COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

Department of Artificial Intelligence & Machine Learning

M.Sc. Artificial Intelligence and Machine Learning

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2019 - 20 and onwards)

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in Engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

MISSION

The Mission of Coimbatore Institute of Technology (CIT) is to impart high quality education and training to its students to make them World-Class Engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

VISION AND MISSION

VISION

Department of Artificial Intelligence and Machine Learning endeavours to make the students, world class software engineers, cutting edge researchers in Artificial Intelligence (AI) and Machine Learning (ML) and data engineers with prudence of pioneering solutions to challengers of the nation and the world.

MISSION

The mission of Department of AI and ML

M1: To impart strong conceptual knowledge along with intensive practical training and real time industry/research project exposure to the students

M2: To provide a learning ambience to enhance innovations, problem solving skills, leadership qualities, team spirit and ethical responsibilities.

M3: To establish Industry Institute Interaction program to provide exposure to a) latest AI, ML tools and technologies used in the IT organizations and enhance the entrepreneurship skills b) domain specific problems that will benefit from AI, ML solutions

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will:

PEO 1: Develop software solutions demonstrating intelligent behaviour, handling uncertainty, constantly learning and effectively using domain knowledge

PEO 2: Promote research in intelligent technology and concepts

PEO 3: Participate in life-long learning for effective professional growth and demonstrate leadership qualities to co-ordinate cooperative team in contributing for the betterment of the society.

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COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

PROGRAMME OUTCOMES (POs)

PROGRAMME OUTCOMES

Graduates of the Programme would be able to:

PO1: Apply skills and concepts of computer science to abstract, design and code computing models and software solutions, from requirements of a problem.

PO2: Ability to analyze real world problems, customer requirements from the perspective of developing software of good quality.

PO3: Analyse, design, develop and implement software solutions that meet requirements and can evolve to meet changes in the requirements.

PO4: Apply mathematical and statistical models to explore and analyze the massive amount of data in various domains.

PO5: Use techniques, skills and tools of both hardware and software including (but not limited to) programming languages, operations research, data storage, decision theory, knowledge representation, visualization,privacy, security to develop scalable techniques for software programming, data analysis, and design.

PO6: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PO7: Recognize the need for, and have the ability to engage in independent and life-long learning.

PO8: Design and develop Artificial Intelligence and Machine Learning (AIML) systems for analysing the varied, voluminous data in fields of medicine, business, geosciences, legal, scientific research and other domains.

PO9: Recognize the importance of innovation and develop a critical and research thinking approach to develop leading innovative intelligent software products.

PO10: Recognize social, professional, cultural, humane and ethical values and issues involved in the use of software technology and consider these adequately in developing and deploying systems.

PO11: Communicate effectively, information both domain and technical with decision makers and team members, to derive software systems of high quality.

PO12: Be self-motivated and enhance self-learning as well as capability to adapt to emerging technologies and create innovative solutions for challenging issues of society, engineering and education as part of an organization or as an entrepreneur.

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VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in engineering along with realised social responsibilities to enable its students to combat the current and impending challenges faced by our country and extend their expertise to the global arena.

MISSION

To impart high quality education and training to its students to make them World-class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF CHEMICAL ENGINEERING

VISION AND MISSON OF THE DEPARTMENT

VISION

Create Chemical Engineers by nurturing innovation, critical thinking, and entrepreneurial spirit to offer solutions to the growing needs of the society.

MISSION

1. To provide academic and research proficiency to pursue a successful career in the field of chemical engineering
2. To nurture critical thinking among students and enable them to offer innovative solutions for a sustainable environment
3. To promote entrepreneurial spirit among the young minds

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF CHEMICAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

1. Students will exhibit professional knowledge in understanding of chemical processes, design and development of chemical equipment's in process & chemical industries.
2. Students will be able to perform industrial solutions for engineering and handle problems of process industries relevance to society.
3. Students can adapt to changes in technologies through continuous education and will be able to contribute to national and global economic growth with socially responsible practices.

PROGRAMME OUTCOME (PO)

1. Apply knowledge of mathematics, physical science and chemical engineering fundamentals to solve complex engineering problems.
2. Identify and analyze chemical engineering problems to improve the efficiency of processes and quality of products in chemical industry.
3. Design innovative process for complex chemical engineering systems and provide solutions to meet specified needs with appropriate consideration for public health & safety, culture, society and the environment.
4. Conduct investigations using research methodology, analysis and interpretation of results to derive scientifically sound conclusions.
5. To apply appropriate techniques and engineering software / tools for design & analysis of the process.
6. Apply contextual knowledge in designing systems, components or processes to meet societal needs in the field of chemical engineering.
7. Demonstrate professional skills and contextual reasoning to assess environmental & societal issues for sustainable development.
8. Apply ethical principles, commit to professional ethics and responsibilities, norms of practices.
9. Work effectively as an individual, as a member / leader in diverse teams and in multidisciplinary environments.
10. Communicate information and able to write technical reports & presentations.
11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment.

12. Recognize the need for, and have the ability to engage in independent and lifelong learning broadest context of technological change.

PROGRAMME SPECIFIC OUTCOME (PSO)

1. Understand and apply working knowledge of chemical engineering principles and applications.
2. Implement the inter-perceptional skills of individuals in technical profession.

COIMBATORE INSTITUTE OF TECHNOLOGY

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B.Tech. CHEMICAL ENGINEERING

Curriculum from the Academic Year - 2019

SUBJECTS OF STUDY

Semester III

Course Code	Course Name	L	T	P	C	CAT
19CEM31	Differential Equations and Boundary Value Problems	2	1	0	3	BS
19CH31	Mechanics of Solids	3	0	0	3	ES
19CH32	Fluid Mechanics	2	1	0	3	PCC
19CH33	Chemical Engineering Thermodynamics	2	1	0	3	PCC
19CH34	Environmental Science	3	0	0	3	PCC
19CH35	Chemical Process Calculations	2	1	0	3	PCC
19HSS01	Science of Creativity and Professional Ethics	1	0	0	1	HS
19CHL36	Computer Laboratory (Programming for problem solving)	0	0	2	1	ES
19CHL37	Electrical and Electronics Engineering Laboratory	0	0	2	1	ES
	One Credit Course	1	0	0	1	
19HOC31	Communication Skills for Engineers - I*	0	0	2	1	EEC
	TOTAL CREDITS				**23**	

Semester IV

Course Code	Course Name	L	T	P	C	CAT
19CH41	Biology for Chemical Engineers	3	0	0	3	ES
19CH42	Mechanical Operations	2	1	0	3	PCC
19CH43	Chemical Reaction Engineering - I	2	1	0	3	PCC
19CH44	Heat Transfer	2	1	0	3	PCC
19CH45	Mass Transfer - I	2	1	0	3	PCC
19CH46	Instrumental Methods of Analysis	3	0	0	3	PCC
19CHL47	Fluid Mechanics Laboratory	0	0	2	1	PCC
19CHL48	Technical Analysis Laboratory	0	0	2	1	PCC
	One Credit Course	1	0	0	1	
19HOC41	Communication Skills for Engineers - II*	0	0	2	1	EEC
	TOTAL CREDITS				**22**	

* Not to be counted for GPA. Pass is required.

Semester V

Course Code	Course Name	L	T	P	C	CAT
19CH51	Numerical Methods in Chemical Engineering	2	1	0	3	PCC
19CH52	Chemical Reaction Engineering- II	2	1	0	3	PCC
19CH53	Mass Transfer-II	2	1	0	3	PCC
	Elective - I	3	0	0	3	PEC
	Elective - II	3	0	0	3	PEC
19CHL56	Entrepreneurship Development	0	0	2	1	HS
19CHL57	Mechanical Operations Laboratory	0	0	2	1	PCC
19CHL58	Heat Transfer Laboratory	0	0	2	1	PCC
	One Credit Course	1	0	0	1	-
19CH68	Mini Project*	0	0	2	No Credit	EEC
19INT51	Internship-I[#]	0	0	2	1	EEC
19HOC51	Employability and Personality Development Skills-I*	0	0	2	1	EEC
	TOTAL CREDITS				**21**	

[#] Internship - I to be completed during 4th semester vacation

* Mini Project will be evaluated in 6th Semester

Semester VI

Course Code	Course Name	L	T	P	C	CAT
19CH61	Process Dynamics and Control	2	1	0	3	PCC
19CH62	Chemical Process Industries	3	0	0	3	PCC
19CH63	Chemical Process Safety	3	0	0	3	PCC
	Elective - III	3	0	0	3	PEC
	Elective - IV	3	0	0	3	PEC
19CHL66	Chemical Reaction Engineering Laboratory	0	0	2	1	PCC
19CHL67	Mass Transfer Laboratory	0	0	2	1	PCC
	One Credit Course	1	0	0	1	-
19CH68	Mini Project	0	0	4	2	EEC
19INT61	Internship-II[#]	0	0	2	1	EEC
19HOC61	Employability and Personality Development Skills-II*	0	0	2	1	EEC
	TOTAL CREDITS				**22**	

[#] Internship-II to be completed during 5th semester vacation

* Not to be counted for GPA. Pass is required.

Semester VII

Course Code	Course Name	L	T	P	C	CAT
19CH71	Transport Phenomena	2	1	0	3	PCC
19CH72	Process Economics and Technology Management	3	0	0	3	PCC
19CH73	Process Modeling and Simulation	2	1	0	3	PCC
19CH74	Electrochemical Engineering	3	0	0	3	PEC
	Elective - V	3	0	0	3	PEC/OEC
19CHL76	Process Equipment Design and Drawing	0	0	4	2	PCC
19CHL77	Process Control and Simulation Laboratory	0	0	2	1	PCC
19CH78	Project Work Phase - I	0	0	6	3	EEC
	TOTAL CREDITS				**21**	

Semester VIII

Course Code	Course Name	L	T	P	C	CAT
	Elective -VI	3	0	0	3	PEC
	Elective-VII	3	0	0	3	PEC
	Elective-VIII	3	0	0	3	PEC/OEC
19CH84	Project Work Phase - II	0	0	10	5	EEC
	TOTAL CREDITS				**14**	

Category : BS - Basic Science, HS - Humanities and Social Science, ES - Engineering Science, PCC - Professional Core Course, PEC - Professional Elective Course, OEC - Open Elective Course, EEC - Employability Enhancement Courses.

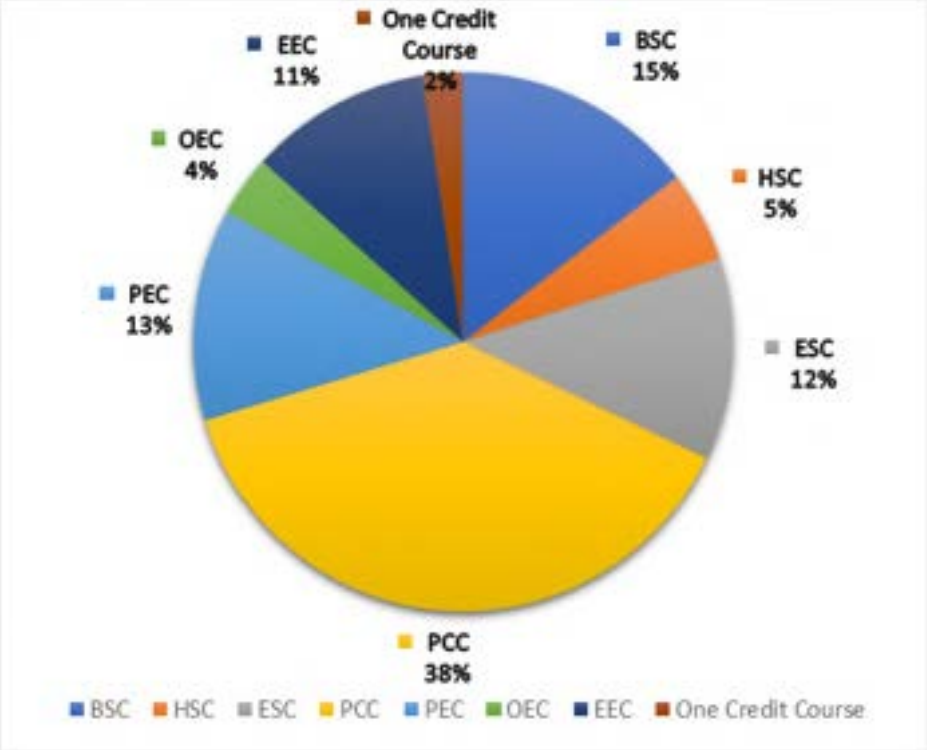
Total Credits

Semester	Credits
I	21
II	21
III	23
IV	22
V	21
VI	22
VII	21
VIII	14
TOTAL	**165**

Category Wise Credit Distribution

Curriculum Components	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Sem-VII	Sem-VIII	Total
BS	12	9	3	-	-	-	-	-	24
HS	2	5	1	-	1	-	-	-	9
ES	6	6	5	3	-	-	-	-	20
PCC	-	-	12	17	11	11	12	-	63
PEC	-	-	-	-	6	6	3	6	21
OEC	-	-	-	-	-	-	3	3	06
EEC	1	1	1	1	2	4	3	5	18
One Credit Course	-	-	1	1	1	1	-	-	4
Total	21	21	23	22	21	22	21	14	165

CATEGORY WISE CREDIT DISTRIBUTON



LIST OF PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Name of Subject	Credits
1.	19CHE01	Water Conservation and Management	3
2.	19CHE02	Sustainability Engineering	3
3.	19CHE03	Nanoscience and Nanotechnology for Chemical Science	3
4.	19CHE04	Polymer Science and Engineering	3
5.	19CHE05	Renewable Energy	3
6.	19CHE06	Advanced Separation Processes	3
7.	19CHE07	Environmental Pollution and Control	3
8.	19CHE08	Colloid and Interfacial Engineering	3
9.	19CHE09	Energy Management in Chemical Industries	3
10.	19CHE10	Biochemical Engineering	3
11.	19CHE11	Process Engineering	3
12.	19CHE12	Petroleum Refinery Engineering	3
13.	19CHE13	Drugs and Pharmaceuticals Technology	3
14.	19CHE14	Food Technology	3
15.	19CHE15	Piping and Instrumentation	3
16.	19CHE16	Process Automation	3
17.	19CHE17	Process Instrumentation	3
18.	19CHE18	Total Quality Management	3
19.	19CHE19	Optimization Methods	3
20.	19CHE20	Integrated Design of Chemical Processes	3
21.	19CHE21	Computer Aided Process Equipment Design	3
22.	19CHE22	Sugar Technology	3
23.	19CHE23	Energy Technology	3
24.	19CHE24	Petrochemicals Technology	3
25.	19CHE25	Fertilizer Technology	3
26.	19CHE26	Mineral Processing Technology	3
27.	19CHE27	Fluidization Engineering	3
28.	19CHE28	Pulp and Paper Technology	3
29.	19CHE29	Surface Coating Technology	3
30.	19CHE30	Heat Power Engineering	3
31.	19CHE31	Carbon Capture	3
32.	19CHE32	Material Science and Technology	3
33.	19CHE33	Bioprocess Technology	3
34.	19CHE34	Pilot Plant and Scale-up Methods	3

LIST OF ONE CREDIT COURSES

S. No.	Course Code	Title of the Course
		GROUP-I
		Personality and Skill Development Courses
1	19CHOC01	Critical Thinking
2	19CHOC02	Creativity & Innovation
3	19CHOC03	Leadership
4	19CHOC04	Emotional Intelligence
5	19CHOC05	Health and Lifestyle
6	19CHOC06	Psychology for Engineers
		GROUP-II
		Social Responsibility & Environment Audit Courses
7	19CHOC07	Fundamentals of Nanoscience
8	19CHOC08	An Introduction to Environmental Ethics
9	19CHOC09	Corporate Social Responsibilities
10	19CHOC10	Composite Material Preparation and Characterization
11	19CHOC11	Environmental Impact Assessment and Audit
		GROUP-III
		Control and Automation Courses
12	19CHOC12	Factory Automation
13	19CHOC13	Controller Tuning
14	19CHOC14	Neural Networks and Fuzzy Systems
15	19CHOC15	Internet of Things
16	19CHOC16	Process Automation and Fault Diagnosis
17	19CHOC17	Process Control in Petrochemical Industries
18	19CHOC18	Power Plant Instrumentation
19	19CHOC19	Industrial Automation
20	19CHOC20	Biomedical Instrumentation
		GROUP-IV
		Energy and Nano Technology Courses
21	19CHOC21	Energy Materials, Devices and Systems
22	19CHOC22	Surface Engineering of Nanomaterials
23	19CHOC23	Nano sensors : Basic components, Characterization and Application
24	19CHOC24	Nanopolymers : Synthesis, Characterization and Applications
25	19CHOC25	An approach to Nanotribology and Nanomechanics
26	19CHOC26	Nanomaterials and Nanofibers
27	19CHOC27	Biomass Conversion to Biofuels and Bioenergy
28	19CHOC28	Biofuel: Fate and Future
29	19CHOC29	Dimensional Analysis and Theory of Models
30	19CHOC30	Pinch Technology
31	19CHOC31	Drug Delivery Systems

S. No.	Course Code	Title of the Course
		GROUP-V
		Waste Treatment and Environment Science Courses
32	19CHOC32	Research Skills
33	19CHOC33	E-Waste Material Flow and Management Practices
34	19CHOC34	Chemicals in the Environment: Fate & Transport
35	19CHOC35	An Integrated approach for wastewater treatment
36	19CHOC36	Textile Effluents : Analysis and Treatment Methods
37	19CHOC37	Advanced Recycling and Recovery Technologies for E-Waste
		GROUP-VI
		Certification Courses
38	19CHOC38	NPTEL / MOOC Certification Courses (Chemical Engineering and Allied Courses)

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LIST OF OPEN ELECTIVES

DEPARTMENT OF CIVIL ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
19CEOE01	Town Planning and Architecture	3	0	0	3	All Branches
19CEOE02	Climate Change and Adaptation	3	0	0	3	All Branches
19CEOE03	Metro Systems and Engineering	3	0	0	3	All Branches
19CEOE04	Renewable Energy Sources	3	0	0	3	All Branches
19CEOE05	Principles of Sustainable Development	3	0	0	3	All Branches
19CEOE06	Disaster Management	3	0	0	3	All Branches

DEPARTMENT OF MECHANICAL ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
19MEOE01	Design of Experiments	3	0	0	3	All branches
19MEOE02	Engineering Optimization	3	0	0	3	All branches
19MEOE03	Engineering Polymers, Composites and Allied Manufacturing Processes	3 3	0 0	0 0	3 3	Mechanical Chemical & Civil
19MEOE04	Industrial Robotics	3	0	0	3	Mechanical EEE and ECE
19MEOE05	Business Process Re-engineering	3	0	0	3	All branches
19MEOE06	Engineering Economics and Financial Management	3	0	0	3	All branches

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
19EEOE01	Energy Auditing	3	0	0	3	ECE, Mech, Chemical, Civil
19EEOE02	Solar and Wind Energy systems	3	0	0	3	ECE, Mech, Chemical
19EEOE03	Electrical Safety Procedures and Management	3	0	0	3	All Branches
19EEOE04	Energy Efficient Illumination Systems	3	0	0	3	All Branches
19EEOE05	Electric Vehicle Technology	3	0	0	3	All Branches except Civil & Chemical
19EEOE06	Energy Efficiency in Thermal and Electrical Utilities	3	0	0	3	EEE & Mechanical

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
19ECEOE01	Signal Processing and its Applications	3	0	0	3	Chemical, Mechanical & Civil
19ECEOE02	Smart Sensors and IoT	3	0	0	3	All Branches
19ECEOE03	Consumer Electronics	3	0	0	3	Mechanical & Civil
19ECEOE04	Robotics	3	0	0	3	Mechanical, CSE & IT
19ECEOE05	Information Theory and Coding Techniques	3	0	0	3	All Branches
19ECEOE06	Wireless Sensor Networks	3	0	0	3	All Branches
19ECEOE07	Automotive Embedded Systems	3	0	0	3	All Branches
19ECEOE08	5G Technologies and Applications	3	0	0	3	All Branches
19ECEOE09	Vehicular Communication	3	0	0	3	All Branches
19ECEOE010	Sensing for Automotive Systems	3	0	0	3	All Branches

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
19CSOE01	Customer Relationship Management	3	0	0	3	All Branches
19CSOE02	Fundamentals of Software Engineering	3	0	0	3	All Branches
19CSOE03	Internet Programming	3	0	0	3	All Branches
19CSOE04	Introduction to Data Warehousing and Data Mining	3	0	0	3	All Branches
19CSOE05	Introduction to Embedded Systems	3	0	0	3	All Branches

DEPARTMENT OF INFORMATION TECHNOLOGY

Course Code	Course Name	L	T	P	C	Eligible Branches
19ITOE01	Digital Computer Basics	3	0	0	3	Civil, Mech, Chem
19ITOE02	Programming in Java	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
19ITOE03	Fundamentals of Database Systems	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
19ITOE04	Cloud Computing Fundamentals	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
19ITOE05	Information Security Fundamentals	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
19ITOE06	Introduction to Human Computer Interaction	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
19ITOE07	Enterprise Resource planning Concepts	3	0	0	3	EEE, ECE, Mech, Civil & Chemical

DEPARTMENT OF CHEMICAL ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
19CHOE01	Industrial Safety Engineering	3	0	0	3	All Branches
19CHOE02	Risk Analysis and Hazop	3	0	0	3	All Branches
19CHOE03	Green Technology	3	0	0	3	All Branches
19CHOE04	Corrosion Science and Engineering	3	0	0	3	All Branches
19CHOE05	Introduction to Chemical Engineering	3	0	0	3	All Branches
19CHOE06	Nanomaterial Synthesis and Characterization Laboratory	0	0	6	3	All Branches
19CHOE07	Multivariate Statistics Laboratory	0	0	6	3	All Branches

DEPARTMENT OF MATHEMATICS

Course Code	Course Name	L	T	P	C	Eligible Branches
19MOE01	Graph Theory & its Applications	3	0	0	3	All Branches
19MOE02	Methods of Applied Mathematics	3	0	0	3	All Branches
19MOE03	Linear and Non - Linear Programming	3	0	0	3	All Branches
19MOE04	Probability and Random Processes	3	0	0	3	All Branches

DEPARTMENT OF PHYSICS

Course Code	Course Name	L	T	P	C	Eligible Branches
19POE01	Introduction to Nanoscience and Nanotechnology	3	0	0	3	All Branches except IT
19POE02	Physics and Technology of Thin Films	3	0	0	3	Mechanical, EEE, Chemical & ECE
19POE03	Solar Cell Fundamentals and Materials	3	0	0	3	EEE, ECE & Chemical
19POE04	Advanced Material Processing Technologies	3	0	0	3	Mechanical & Chemical

DEPARTMENT OF CHEMISTRY

Course Code	Course Name	L	T	P	C	Eligible Branches
19COE01	Medical Nanotechnology	3	0	0	3	Chemical
19COE02	Advanced Drug Delivery Systems	3	0	0	3	Chemical
19COE03	Biosensors	3	0	0	3	Chemical, ECE & EEE
19COE04	Nanocomposites	3	0	0	3	Mechanical, Chemical & Civil
19COE05	Biorefinery	3	0	0	3	Mechanical & Chemical

DEPARTMENT OF HUMANITIES

Course Code	Course Name	L	T	P	C	Eligible Branches
19HOE01	Principles of Management	3	0	0	3	Common to all branches
19HOE02	Current Trends in Indian Economy	3	0	0	3	Common to all branches
19HOE03	Monetary Economics	3	0	0	3	Common to all branches
19HOE04	English for Academic Purposes	3	0	0	3	Common to all branches
19HOE05	English for Competitive Exams	3	0	0	3	Common to all branches
19HOE06	Life and Literature	3	0	0	3	Common to all branches

19CEM31 - DIFFERENTIAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon the completion of the course, the students will be able to

CO1 *: Analyse ordinary differential equations concepts in Modeling and solving physical problems.*

CO2 *: Demonstrate accurate and efficient use of numerical solutions of ordinary differential equations and their role in modern mathematics and applied contexts.*

CO3 *: Formulate concrete problems and finding the solutions of partial differential equations*

CO4 *: Solve the boundary value problems relevant to vibration of strings*

CO5 *: Familiarize finite difference approximation to get numerical solutions of partial differential equation*

ORDINARY DIFFERENTIAL EQUATIONS

Second and Higher order linear differential equations with constant coefficients -Cauchy-Euler equation, Cauchy-Legendre equation- Method of variation of parameters -System of simultaneous linear differential equations with constant coefficients. **(9)**

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Numerical solution of first order ordinary differential equation: Taylor Series Method -Picard's Method - Euler's method -Modified Euler's method- Fourth order Runge- Kutta method-Milne's predictor and corrector method. **(9)**

PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations - Solutions of first order non-linear partial differential equations (standard types) - Lagrange's linear equations -Second and higher order homogeneous linear equations with constant coefficients **(9)**

BOUNDARY VALUE PROBLEMS

Method of separation of variables -Vibration of strings - One dimensional wave equation - One dimensional heat flow equation with steady state and unsteady state solutions. **(9)**

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

Difference Quotients - Graphical Representation of Partial Quotients - Classification - One dimensional Heat equation: Explicit formula (Bender Schmidt recurrence method) -One dimensional wave equation: Explicit formula **(9)**

TOTAL : 45

TEXT BOOKS

1. *B.S. Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers-(2012).*
2. *B.V.Ramana, "Higher Engineering Mathematics", Kindle Edition (2018), Tata McGraw-Hill Publishing Company Limited, New Delhi.*

REFERENCES

1. *Srimanta Pal and Suboth.C.Bhunia, Engineering Mathematics, Oxford University Press, New Delhi, 2015.*
2. *Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.*
3. *S.S.Sastry, "Introductory Methods of Numerical Analysis", 5th Edition (2012), Prentice Hall India Learning Private Limited.*

19CH31 - MECHANICS OF SOLIDS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will able to

CO1 : *Compute stresses due to axial forces, thermal stresses, complex stresses and stresses due to suddenly applied loads and impact loads.*

CO2 : *Illustrate Bending moment and Shear Force diagram for determinate beams.*

CO3 : *Calculate stress related to bending, shear and torsion.*

CO4 : *Have the knowledge of theory of columns.*

CO5 : *Calculate member forces for trusses.*

CONCEPT OF STRESS AND STRAIN

Simple stresses and strains at a point -Normal and shear Stresses - Hook's Law - Young's modulus - Bars subjected to axial Forces - simple problems. Thermal stresses - Simple statically indeterminate problems like compound bars - Elastic constants - modulus of rigidity - Bulk modulus - Relationships. **(9)**

TRANSVERSE LOADING ON BEAMS

Beams - support conditions - types of beams - transverse loading on beams - shear force and bending moment in beams - analysis of cantilevers, simply supported beams and over hanging beams - relationships between loading, S.F and B.M. in beams and their applications -S.F and B.M. diagrams. **(9)**

STRESSES IN BEAMS

Theory of simple bending - assumptions and derivation of bending equation - analysis of stresses in beams - loads carrying capacity of beams - proportioning of beam sections - leaf springs - flitched beams - shear stress distribution in beams - determination of shear stress in rectangular beams. **(9)**

TORSION

Torsion of solid and hollow circular shafts - Power transmitted through shafts - closed coiled helical springs - springs constants - springs in series and springs in parallel. **(9)**

COLUMNS AND PLANE TRUSSES

Axially loaded short columns - columns of unsymmetrical sections - Euler's theory of long columns - critical loads of prismatic columns with different and conditions - Rankine's empirical theory. Analysis of statically determinate plane trusses - Method of Joints and method of sections. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Bansal R.K., Strength of Materials, Fifth Edition, Laxmi Publications Pvt. Ltd, New Delhi, 2012.*
2. *Sadhu Singh, Strength of Materials, Tenth Edition, Khanna Publications, New Delhi, 2012.*

REFERENCES

1. *Khurmi R.S., Strength of Materials, Third Edition Reprint, S.Chand and Company Ltd, 2015.*
2. *Singh J.P., Mechanics of Solids, Fourth Edition, Khanna Publications, New Delhi, 2005.*

19CH32 - FLUID MECHANICS

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of course, students will be able to

CO1 *: Apply the basic concepts of fluid mechanics and to solve dimensional analysis problems.*

CO2 *: Solve problems related to mass, momentum and energy balances in fluid flow.*

CO3 *: Demonstrate the applications of flow statics, fluid flow phenomena.*

CO4 *: Design fluid flow reactors and solve problems on fluid flow measurements.*

CO5 *: Estimate the pump efficiency, head developed and pressure drop.*

BASIC CONCEPTS

Definition of a fluid - Shear stress in a moving fluid - difference between liquids and gases -compressible and incompressible fluids - Newtonian and non- Newtonian fluids - continuum concept of a fluid - properties of fluids - viscosity - compressibility - bulk modulus. Dimensional analysis and its applications in fluid flow. Statics of fluid systems-pressure - variation of pressure vertically in a fluid under gravity -General equation for the variation of pressure due to gravity in a static fluid - manometers: U-tube, differential and inclined manometers. **(9)**

FLUID DYNAMICS

Fluid flow - basic concepts - Reynolds experiment - laminar and turbulent flows - nature of turbulence. Basic concepts of Boundary layer. Equation of continuity and its applications -momentum equations - Euler's equation of motion -Bernoulli's theorem and its applications. **(9)**

INCOMPRESSIBLE FLUID FLOW

Flow in conduits -Shear stress distribution in a cylindrical tube -Friction factor-Fanning's equation - Applications -Laminar flow in pipes -Hagen Poiseuille equation -Velocity distribution for laminar and turbulent flows -Losses due to sudden expansion and sudden contraction -Losses in pipe fittings. **(9)**

FLUIDISED AND PACKED BEDS

Flow through packed beds - Ergun equation and Kozeny - Carman equation. Equation for one dimensional motion - Fluidisation Mechanism of fluidisation - Types of fluidisation-Pressure drop in fluidised beds - Minimum fluidisation velocity. **(9)**

HYDRAULIC PUMPS AND PIPE FITTING

Pipes, Fittings and valves - Pumps, Fans, Compressors and Blowers - Positive displacement pumps - Centrifugal pumps - NPSH and cavitation - Pump calculations - Constant and variable head flow meters. **(9)**

TOTAL : 45

TEXT BOOKS

1. *McCabe. W.L., Smith. J C., Harriot. P., Unit operations of Chemical Engineering, McGraw Hill, Seventh Edition, 2014*
2. *Douglas.J.F.,Gasiorek. J.M., Swaffielf. J.A., FLUID MECHANICS, Sixth Edition, 2011.*
3. *Noel de Nevers, Fluid Mechanics for Chemical engineers, Second Edition, 2013*

REFERENCES

1. *Hughes. F., John A Brighton and Nicholas Winowich, Schaum's Outline of Fluid Dynamics, Third Edition 1999.*
2. *Ranald.V.Giles, Cheng Liu and Jack Evett, Schaum's outline of Fluid Mechanics and Hydraulics, Fourth Edition 2010.*
3. *Sulzer Pumps Ltd, Centrifugal pump Handbook, Third edition, Winterthur, Switzerland, 2010.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	1	1					2	3	2	1
CO2	3	2	2	3	2	3					2	3	2	2
CO3	3	2	3	3		3		1				3	2	3
CO4	3	2	1	3	2	2					1	3	2	1
CO5	3	2	1	3	1	2					1	3	2	1

(1: Slight, 2: Moderate 3: Substantial)

19CH33 - CHEMICAL ENGINEERING THERMODYNAMICS

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will able to

CO1 : *Apply mass and energy balances to closed and open systems and predict the feasibility of process.*

CO2 : *Predict the thermodynamic properties of fluids.*

CO3 : *Formulate phase equilibria problem and explain the concepts of fugacity.*

CO4 : *Construct the phase diagrams for different systems.*

CO5 : *Examine the chemical reaction equilibria problem*

BASIC CONCEPTS AND LAWS OF THERMODYNAMICS:

Preliminary Concepts - The language of Thermodynamics - Measured Thermodynamic Properties - The first law of thermodynamics for closed and open systems -Reversible and Irreversible Process - Thermochemical Data for U and H -PVT behaviour of pure substances - Entropy and The second law of thermodynamics, The second law of thermodynamics for closed and open systems, Calculation of entropy for ideal gases **(9)**

EQUATION OF STATE AND THERMODYNAMICS PROPERTY RELATIONSHIP

Intermolecular forces-Principles of corresponding states - Equation state generalized compressibility charts Determination of parameters for mixtures - Thermodynamic property relations - calculation of change in entropy, internal energy and enthalpy - Departure functions - Joule - Thomson Expansion and Liquefaction **(9)**

PHASE EQUILIBRIA - PROBLEM FORMATION AND FUGACITY

Introduction - Pure Species Phase Equilibrium- - Thermodynamics of Mixtures -Multicomponent Phase Equilibria - The Fugacity - Fugacity in the Vapor Phase - Fugacity in the Liquid Phase - Fugacity in the Solid Phase. **(9)**

PHASE EQUILIBRIA - PHASE DIAGRAMS

Vapor Liquid Equilibrium- Ideal Gas and Ideal Solution- Non-ideal Solution - Azeotropes - Fitting Activity Coefficient Models with VLE data - Liquid-Liquid Equilibrium (LLE)-Vapor- Solid Liquid-Liquid Equilibrium (VLLE)- -Liquid and solid -solid Equilibrium (SLE & SSE)-Colligative Properties. **(9)**

CHEMICAL REACTION EQUILIBRIA

Introduction-Chemical Reaction and Gibbs Energy-Equilibrium for a single reaction-Calculation of K from Thermochemical data and Gibbs Energy of formation - Relationship between the Equilibrium and constant and the concentration of reacting species-Equilibrium constant in Electrochemical Systems-Multiple Reactions - Reaction Equilibria of point Defects in crystalline solids. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Koretsky, Milo D. Engineering and chemical thermodynamics. John Wiley & Sons, 2012.*
2. *J.M. Smith, H.C. Van Ness and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 7th edition, McGraw-Hill International Edition,2005.*
3. *Rao, Y. V. C. Chemical engineering thermodynamics. Universities Press, 1997.*
4. *Narayanan, K. V. "Chemical Engineering Thermodynamics." Prentice Hall India Learning Private Limited; 2nd Revised edition edition (2013).*

REFERENCES

1. *M J Moran, H N Shapiro, D D Boettner and M B Bailey, Principles of Engineering Thermodynamics, 8th Edition, Willey.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	2	1					2	3	
CO2	3	1	1	2	3	2	1					2	3	
CO3	3	1	1	2	1	2	1					2	3	
CO4	3	3	3	3	3	3	1					3	3	
CO5	3	3	3	3	3	3	1					3	3	

(1: Slight, 2: Moderate 3: Substantial)

19CH34 - ENVIRONMENTAL SCIENCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

The students completing the course will have

CO1 *: An insight in to the chemical reactions in water, air and soil environment.*

CO2 *: Ability to apply chemistry principles in analysing pollution of water, air and soil environment.*

CO3 *: An understanding on the fate of chemicals on the environment and suggest relevant interventions*

CO4 *: To understand the importance of green chemistry in the environment.*

CO5 *: An insight into the environmental protection act and the associated rules, knowledge on the institutional setup for environmental management and pollution control.*

NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **(9)**

RENEWABLE ENERGY RESOURCE AND ENVIRONMENTAL POLLUTION

Energy resources-growing energy needs, renewable and non-renewable energy sources uses of alternative energy sources-merits and limitation of solar energy-wind and tidal energy- OTEC-Geothermal energy-Hydel energy.

Sources, causes, effects and management of air pollution and water pollution, soil pollution, noise pollution, marine pollution and radioactive pollution. Solid waste Management. **(9)**

ECOSYSTEM AND BIODIVERSITY

Concept of an ecosystem- structure and functions- ecological succession, food chain, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystem (Ponds, lakes, ocean and rivers). Biodiversity-types, Importance and values of biodiversity, India as a mega diversity nation, Hot spots of biodiversity, Threats to biodiversity, conservation of biodiversity. **(9)**

ENVIRONMENTAL BIOTECHNOLOGY AND GREEN CHEMISTRY

Biotechnology and its applications in environment protection, Bioinformatics, Bioremediation, Bio de-odorization. Green chemistry for clean technology, significance of green chemistry-basic components of green chemistry. Industrial application of green chemistry-green fuels-e-green propellants and bio catalysts. **(9)**

GLOBAL ENVIRONMENTAL ISSUES AND MANAGEMENT

Water conservation, Rain water harvesting, Environmental Ethics, Climate change, Ozone depletion, Acid rain and Greenhouse effect and global warming, Environment (protection) Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection Act and Forest (conservation) Act. Disaster management- Earthquakes, Floods, Landsides and cyclones. **(9)**

TOTAL: 45

TEXTBOOKS

1. *Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.*
2. *Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.*
3. *Dara SS (2005) A Text Book of Environmental Chemistry and Pollution Control, S. Chand & Company, New Delhi.*

REFERENCES

1. *Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.*
2. *ErachBharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.*
3. *G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.*
4. *Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.*
5. *De AK (2003) Environmental Chemistry, 5th edition, New Age International (P) Ltd, New Delhi.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3					3							
CO2			3	2										
CO3						2	3							
CO4										1				
CO5		3	3										3	

(1: Slight, 2: Moderate 3: Substantial)

19CH35 - CHEMICAL PROCESS CALCULATIONS

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will able to

CO1 : *Apply the principles of dimensional homogeneity to convert one form of unit to other equivalent forms in CGS, FPS. MKS and SI unit systems and apply fundamental gas laws to solve ideal gas problems.*

CO2 : *Calculate the composition of a mixture in terms of mole fractions from a given composition expressed in terms of mass fractions or vice versa.*

CO3 : *Compute the concentration, degree of saturation and dew point of vapour -gas mixture at the given temperature and pressure using humidity chart.*

CO4 : *Formulate steady state material balance for the unit operations such as distillation, evaporation, mixing, extraction, drying and crystallization processes with recycle, by-pass and purge.*

CO5 : *Practice the combined steady state material and Energy balance for simple processes like distillation, evaporation and combustion.*

MASS RELATIONS AND IDEAL GASES

Units and dimensions: Basic and derived units - Different ways of expressing units and quantities, Conversion of units. Properties of pure substances, calculations on solid, liquid and gas mixtures using Ideal gas laws. Mole fractions and partial pressures - Application of Dalton's and Amagat's law. **(9)**

HUMIDITY AND SATURATION

Calculations involving change in mass of gas mixture, Concept of Vapour pressure, Raoult's law and its applications, Calculation on Vapor-Liquid mixture, Concepts of gas-vapour mixture, Humidity and Saturation, relative and percentage saturation, Dew point - humid heat, adiabatic saturation curve Humidity Charts. **(9)**

MATERIAL BALANCE - SYSTEM WITHOUT CHEMICAL REACTIONS

Material balance in systems without chemical reactions, Material balance in systems- Distillation, Evaporation, Mixing, Extraction (LLE & Leaching), Absorption, Drying and Crystallization with concept of solubility. Material Balance - Recycle, Byepass and Purge. **(9)**

MATERIAL BALANCE - SYSTEMS INVOLVING CHEMICAL REACTIONS

Combustions Reaction, Concept of ToD, Excess air, Calculations on Orsat Analysis, Flue gas analysis, Calculations on conversion, yield. Concepts of tie elements, Material Balance system involving reactions with recycle, by-pass and purge. **(9)**

ENERGY BALANCE

Definition of Heat capacity and Specific heat, Heat capacity of gases as a function of temperature, Mean heat capacity, heat capacity of mixture of gases. Heat capacities of solids and liquids - Kopp's rule. Standard heat of reaction, formation and combustion, Hess's law of heat summation and its application to determine heat of reaction, heat of neutralization, integral heat of solution, heat of mixing. Effect of pressure and temperature on heat of reaction. Theoretical and actual flame temperature in combustion calculations. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Bhatt, B.I. and Vora, S.M., Stoichiometry, Fourth Edition, Tata-McGraw Hill, New Delhi, 2004.*
2. *Narayanan. K.V. and Lakshmikutty.B., Stoichiometry and Process Calculations, First Edition, Prentice-Hall of India, New Delhi, 2006.*
3. *Richard.M.Felder, Ronald.W.Rousseau, Elementary Principles of Chemical Processes, Third Edition, John Wiley and sons, 2005*
4. *Venkataramani.V, Anantharaman.N, Meera Sheriffa Begum.K.M, Process Calculations, Second Edition, PHI Learning Private Limited, 2011.*

REFERENCES

1. *David M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, Eighth Edition, Prentice -Hall of India, New Delhi, 2012.*
2. *Hougen, O.A., Watson, R.M. and Ragatz, R.A., Chemical Process Principles - Part I, Second Edition, John Wiley (ISE), 1976.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2						2		2	2	
CO2	3													
CO3	3	3	3	3		2							3	
CO4	3	3	3	2		1							2	
CO5	3	3	3	2		1							2	

(1: Slight, 2: Moderate 3: Substantial)

19HSS01 - SCIENCE OF CREATIVITY AND PROFESSIONAL ETHICS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of course, students will be able to

CO1 : *Understand the principles of karma yoga, duty consciousness and evolution of the universe.*

CO2 : *Analyze the benefits of yoga and meditation.*

CO3 : *Understand the benefits of harmony, introspection and examine human values for sustained growth in career and life*

LIFE FORCE, CONCIOUSNESS AND EVOLUTION OF UNIVERSE

Science of Creativity and Personality Development - Principles of Karma Yoga - Duty Consciousness - Law of Nature - Life Force -Potentiality of the Life Force - Consciousness - Pancha Thanmatras - Biomagnetism. Evolution of the Universe: Creation Theory - Evolution Theory - Evolution of Living Beings: Absolute Space and Force - Seven Constituent Layers in the Body. **(6)**

YOGA AND ITS BENEFITS

Simple and Safe yoga - Upa yoga Practices : Yoga for peace, health, joy, love, well-being and success. Physical exercise - Meditation - Seven centers of meditation - benefits - effect of good vibrations - cause and effect system. **(3)**

HARMONY IN LIFE, INTROSPECTION AND HUMAN VALUES

Harmony in Life : Self, family, society and nature - Introspection : Analysis of thought, Moralization of desire, Neutralization of anger, Eradication of worries and Self realization.

Morals, Values and Ethics - Integrity - Work ethics - Service learning - Virtues - Respect for others - Valuing time - Co-operation -Commitment - Empathy - Self confidence - Challenges in work place - impact of cyber space on individual. **(6)**

TOTAL: 15

TEXT BOOKS

1. *Yogiraj Vethathri Maharishi, "Karma Yoga - The Holistic Unity", Vethathri Publications 4th Edition, 2009.*
2. *R.S.Naagarazan, "A Textbook on Professional Ethics and Human Values", New Age International Publishers, New Delhi, 2011.*

REFERENCES

1. *Sadhguru, "Body the Greatest Gadget and Mind is your Business", Diamond Pocket Books Pvt. Ltd, Isha Foundations, 2013.*
2. *Swami Vivekananda and Swami Nikhilananda, "Karma Yoga and Bhakti Yoga", 2nd Edition, Ramakrishna Vivekananda Publications, 2008.*
3. *Mike W. Martin and Roland Schinzinger,"Ethics in Engineering", 4th Edition McGraw Hill, NewYork, 2005.*

19CHL36 - COMPUTERS LABORATROY
(PROGRAMMING FOR PROBLEM SOLVING)

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 *: Describe the basics of C Programming and understand the problem-solving aspect*

CO2 *: To write algorithms and to draw flowcharts for solving problems*

CO3 *: Develop C programs with simple expressions for problem solving*

CO4 *: Use arrays, pointers, strings and structures to formulate algorithms and programs*

CO5 *: Design and develop solutions to real world problems using C.*

LIST OF EXPERIMENTS

Write a C-Program using

1. Operators and expressions
2. Decision Statements
3. Switch operations
4. Basic Loop operations
5. Advanced loops
6. Array
7. Functions
8. Structure

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2		3												1
CO3	3													
CO4														
CO5		3			2									

(1: Slight, 2: Moderate 3: Substantial)

19CHL37 - ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Measure the electrical quantities accurately and analyse the performance of DC and AC machines.*

CO2 : *Implement the proper speed control techniques to DC and AC motors with proper selection of power rating and corresponding drive system using power electronic controller for carios industry process applications.*

CO3 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO4 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

EXPERIMENTS

1. Calibration of Ammeter, Voltmeter and Wattmeter
2. Calibration of Single Phase Energy meter
3. Swinburne's Test
4. No load Speed Control of DC Shunt Motor
5. Open Circuit Characteristics of a separately excited DC generator
6. Critical speed of DC shunt generator
7. Load Test on DC shunt Motor
8. Load Test on DC shunt Generator
9. Open circuit and short circuit test on single phase Transformer
10. Predetermination of efficiency and regulation characteristics of single phase transformer
11. Load test on single phase transformer
12. Load test on three phase squirrel cage induction motor
13. Load test on slip ring induction motor
14. Load test on single phase capacitor start induction motor
15. Load test on single phase Alternator
16. Study of capacitive transducers
17. Study of inductive transducers
18. Speed torque characteristics of single phase Fan motor
19. Simple programs in ARM
20. Interfacing programs in ARM.

19HOC31 - COMMUNICATION SKILLS FOR ENGINEERS - I

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Students will be able to

CO1 : *Gain confidence, enhance Personality and develop positive attitude in their work and life.*

CO2 : *Effectively communicate and present opinions using appropriate functional expressions for a given situation.*

CO3 : *Compose Emails, Reports for a given business scenario using appropriate sentence construction and in the prescribed format.*

CO4 : *Generate ideas and speak on a given topic in a competitive scenario like Debate, Group Discussion, and Public Speaking.*

PERSONALITY DEVELOPMENT

Motivation and Self Confidence, SCOT Analysis - Personality Development - What is Personality, Developing Positive Attitude towards work and life, Building Relationship with others - Personality Development - Paradigms of Human Interaction, Fear Management. **(4)**

VERBAL COMMUNICATION

English Conversation - Asking and Giving Opinions - English Conversation -Thanking People, Asking and Giving Suggestions - English Conversation - Asking for Direction, Agreeing and Disagreeing - Role Play-Business. **(5)**

BUSINESS COMMUNICATION

Email Writing - Format, Etiquettes and Tips - Report Writing -Introduction, elements and tips - Drafting a report - Error Identification - Rules, Common Mistakes and Exercises - Sentence Completion Filler (fill in the blanks using apt words). **(5)**

PUBLIC SPEAKING

How to start and sustain a conversation - Debate - Extempore - Group Discussion - Importance and Process - Public Speaking - Introduction, Tips - Drafting a Public Speech - Interview - Types, Dos and Don'ts - Mock Press. **(6)**

REFERENCES

1. *https://nptel.ac.in/content/storage2/courses/109104030/references/references.pdf (online resource)*
2. *John Seelay, Oxford Guide to Effective Writing and Speaking, 2nd Edition, Kindle Edition by Oxford University Press, 2007.*
3. *Sabina Pillai, Agna Fernandez, Soft Skills and Employability Skills - Published by Cambridge University Press, 2017.*

19CH41 - BIOLOGY FOR CHEMICAL ENGINEERS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 : *Gain insight into the various levels of organization of life, their characteristics and basic needs in the ecosystems.*

CO2 : *Explain the major anabolic & catabolic pathways in carbohydrate, protein & lipid metabolism and understand the significance of high energy compounds.*

CO3 : *Understand the various types of genes, their functions and inheritance, analyze the mechanisms involved in protein synthesis and gene regulation.*

CO4 : *Gain knowledge on the structure and functions of basic cell types and their importance in cellular processes, relate the role of lipid bilayer membrane & proteins to transport of molecules and understand communication of cells through signalling pathways.*

CO5 : *Have knowledge on identification of microorganisms, their physiology, diversity, conservation, growth kinetics & culturing methods, understand microbial interactions and infections and strategies to manage them.*

BASICS

Diversity of life - Genetic diversity, Species diversity & Ecosystem diversity. Prokaryotic and Eukaryotic cells - Constituents and organelles present in prokaryotic and eukaryotic cells. Similarities and differences between prokaryotic and eukaryotic cells. Macromolecules present in cells. **(9)**

BIOCHEMISTRY METABOLISM

(Anabolism and Catabolism) Carbohydrate metabolism - Glycolysis and TCA cycle. Lipid metabolism - Beta oxidation of saturated fatty acids. Synthesis of saturated fatty acids. Protein metabolism - General breakdown of proteins - Deamination, Transamination & Urea cycle. Bioenergetics - Electron transport chain and Oxidative phosphorylation. **(9)**

GENETICS AND MOLECULAR BIOLOGY

Mendelian laws of inheritance. Structure and types of DNA and RNA. Basic features of prokaryotic and eukaryotic genome organization. DNA replication - Basic principles and mechanism of DNA replication - k model of DNA replication. Transcription - Synthesis of RNA and Post-transcriptional modifications. Translation - Genetic code - General features of the genetic code. Mechanism of protein synthesis and Post translational modifications. Regulation of gene expression - Operon concept with specific reference to lac operon. **(9)**

CELL BIOLOGY

Cytoskeleton -functions of microfilaments and microtubules. Membrane systems - Structure and organization of biological membranes. Fluid Mosaic Model. Membrane proteins. Transport of molecules across membranes -Transport of small molecules - Passive transport, Active transport (Sodium-Potassium pump) and Facilitated diffusion. Transport of large molecules - exocytosis and endocytosis. Cell division - Mitosis and Meiosis. Signal transduction - Intracellular and Intercellular signalling. Role of cyclic AMP. **(9)**

MICROBIOLOGY

Basics -Broad classification and Characteristics of microorganisms. Types of culture media. Identification of microbes - Simple staining and Differential staining. Growth kinetics and growth curve. Host-Microbe interaction - Major diseases caused by different microbes in plants, animals and humans. Microbial diversity - Conservation of biodiversity - in-situ and ex-situ conservation. Ecology - Types of Ecosystems. Ecological pyramids. Virology - Structure, mode of spread and clinical manifestations of Human Immunodeficiency virus. **(9)**

TOTAL: 45

REFERENCES

1. *Ananthanarayanan and Paniker's (2017). Textbook of Microbiology, 10th edition, Orient Longman Pvt. Ltd.,Hyderabad.*
2. *Verma, P.S. and Agarwal,V.K.(2008). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. 5thedition, New Age International Publishers, New Delhi.*
3. *Karp, G., Iwasa,J. & Marshall, W. (2015). Cell and Molecular Biology-Concepts and Experiments, 8th edition, John Wiley & Sons Inc., New York.*
4. *Murray,K.R., Bender,D.A., Botham,K.M., Kennelly, P.J., Rodwell.W.V. and Weil, P.A. (2018). Harper's Illustrated Biochemistry, 31st edition, The McGraw Hill Companies.*
5. *Nelson,D.L. and Cox, M.M. (2017). Lehninger Principles of Biochemistry, 17th edition, W.H. Freeman and Company, New York.*
6. *Bery, J.M.,Tymoezko,J.L. and Stryer,L. (2015). Biochemistry, 8th edition, W.H.Freeman and Company, NewYork.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			1	1							3	
CO2	2	3	2		1	2							2	
CO3	3	1				1							1	
CO4	2	2	2		1	1							3	1
CO5	1	2	2		1	1							2	1

(1: Slight, 2: Moderate 3: Substantial)

19CH42 - MECHANICAL OPERATIONS

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to:

CO1 : *Select the appropriate size reduction equipment and analyze the particle size distribution in the feed and product.*

CO2 : *Identify suitable storage, transportation and recovery methods for various types of solids.*

CO3 : *Design the different type of agitators and mixers used in chemical industries and compare the same.*

CO4 : *Apply the basic principles of settling and sedimentation for the separation of different type of solid particles.*

CO5 : *Understand and analyse the working principles of industrial filters, centrifuges and membrane filters.*

PROPERTIES OF PARTICULATE SOLID AND SIZE REDUCTION

Forces employed for size reduction of solids. Types of crushers, grinders and disintegrators for coarse, intermediate, fine and ultrafine grinding. Cutting machines. Size reduction operation - Power requirements - Laws of comminution. Open and closed circuit grinding. Shape factor of particulate solids. Standard sieves and sieve scales. Differential and cumulative analysis - Specific surface determination - Calculation of particle size from sieve analysis data. Size distribution of fine particles. Industrial screening equipments. Screen effectiveness. **(12)**

STORAGE, TRANSPORTATION AND RECOVERY OF FINE PARTICLES

Storage of solids - Angle of repose and angle of internal friction. Pressures in bins - Janssen equation. Mechanical and pneumatic conveying equipments. Gas cleaning methods - Cyclone separators, Bag filters, Scrubbers and electrostatic precipitators. Magnetic separation. Dense Media Separation (DMS), Flotation process. **(9)**

MIXING AND AGITATION

Agitation equipment, classification and types of impellers- applications, power requirement in agitation. Scale up of agitator design. Types of Mixers and mixing equipments for liquids, pastes, rubber and plastic materials and for dry powders. Criteria for mixing of Solids - Mixing Index. **(7)**

SIZE SEPARATION BY SETTLING AND SEDIMENTATION METHODS

Drag on spherical and non-spherical particles, Terminal settling velocity under laminar and turbulent conditions (Stokes' law and Newton's law). Size separation by settling methods - Free settling and Hindered settling. Equipments - Settling chambers, classifiers, jigging and Tabling. Theory of Sedimentation. Types of Thickeners - Batch and Continuous. Applications of batch sedimentation tests for design of continuous thickeners. **(9)**

FILTRATION AND CENTRIFUGAL SEPARATION

Principles and Theory of filtration and washing. Filter media and Filter aids. Compressibility of filter cakes. Batch and continuous filtration equipments. Principles of centrifugal filtration- industrial centrifuges, Membrane filtration. **(8)**

TOTAL : 45

TEXT BOOKS

1. *McCabe. W. L., Smith. J. C., Harriot. P., Unit Operations of Chemical Engineering, Seventh Edition, McGraw-Hill, New York, 2005.*
2. *Badger. W.L., Banchero. J.T., Introduction to Chemical Engineering, McGraw Hill (ISE), 1997.*

REFERENCES

1. *Perry. R. H., Green. D. W., Perry's Chemical Engineer's Handbook, Eighth Edition, McGraw-Hill, New York, 2007.*
2. *Narayanan. C.M., Bhattacharyya. B.C., Mechanical Operation for Chemical Engineers (Incorporating Computer Aided Analysis), Khanna Publisher, Third Edition, 2005.*
3. *Rhodes, M. J., Introduction to Particle Technology, 2nd edition, John Wiley, Chichester ; New York, 2008.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			1	1							3	
CO2	2	3	2		1	2							2	
CO3	3	1				1							1	
CO4	2	2	2		1	1							3	1
CO5	1	2	2		1	1							2	1

(1: Slight, 2: Moderate 3: Substantial)

19CH43 - CHEMICAL REACTION ENGINEERING - I

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 : *Formulate the rate equation from the stoichiometry and reaction mechanism for elementary and non-elementary reactions and determine the effect of temperature on the rate of reaction based on Arrhenius, Collision and Transition State Theories.*

CO2 : *Analyze kinetic data and determine the components of the rate equation (reaction order and specific reaction rate) for homogeneous single or multiple reactions using differential and integral method of analysis.*

CO3 : *Design batch, plug flow and continuous stirred tank reactors and choose the appropriate reactor or reactor combination based on qualitative and quantitative analysis for the specific reaction conditions.*

CO4 : *Predict the effect of pressure and temperature on adiabatic and non-adiabatic operation*

CO5 : *Compute precisely the moments of RTD using pulse tracer test data for the real reactors and estimate extent of non-ideality of real reactors based on the segregation, tank in series and dispersion models using pulse tracer test or conversion data.*

CHEMICAL KINETICS

Classification of reactions, Types of rate expressions, Elementary and Non elementary reactions, Types of intermediates and testing a mechanism in nonelementary reactions, Temperature dependency of the rate constant based on Arrhenius, collision and Transition State Theories. **(9)**

DATA ANALYSIS AND INTERPRETATION

Differential and integral Methods of analysis of rate data, Interpretation of rate data in constant and variable volume systems, Kinetics of irreversible, Parallel and Series reactions in constant volume batch reactor. **(9)**

DESIGN OF IDEAL REACTORS

Development of design expressions for Batch, Plug flow and Continuous Stirred Tank reactors. Comparison, advantages and limitations. Concept of space time and velocity. Size comparison of single reactors. Plug flow reactors in series and parallel, Mixed Flow Reactors of equal and different sizes in series. Reactors of different types in series. Recycle reactor. Qualitative and quantitative treatment of parallel, series reactions. **(9)**

TEMPERATURE AND PRESSURE EFFECTS

Single reactions - Heats of Reaction from Thermodynamics, Equilibrium Constants from Thermodynamics, General Graphical Design Procedure, Optimum Temperature Progression, Adiabatic and non-adiabatic operations, Multiple reactions - Product Distribution and Temperature. **(9)**

NON-IDEAL FLOW

Residence time distribution Function. Relationship among E, F and C curves. Moments of RTD. Models for non-ideal flow - Segregation, Tanks in series and Dispersion models. **(9)**

TEXT BOOKS

1. *Levenspiel O "Chemical Reaction Engineering"(Third Edition) Wiley Eastern, New Delhi,(2000)*
2. *Foggler H.S. " Essentials of Chemical reaction Engineering" PHI Ltd,2010*

REFERENCE

1. *Smith J.M.,"Chemical Engineering Kinetics"(Third Edition),McGraw Hill (ISE)(1981)*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	2	1					2	3	3
CO2	3	3	2	3	2	2	1					2	3	3
CO3	3	3	3	2	2	3	1					3	3	3
CO4	3	3	3	2	2	3	1					2	3	3
CO5	3	3	3	3	2	3	1					3	3	3

(1: Slight, 2: Moderate 3: Substantial)

19CH44 - HEAT TRANSFER

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Solve one-dimensional steady state heat conduction problems for the rectangular, cylindrical and spherical Co-ordinate systems.*

CO2 : *Analyze the convection heat-transfer problems for laminar and turbulent flows in internal and external configurations by understanding the basics of the boundary layer theory.*

CO3 : *Estimate heat exchanger design parameters like heat transfer area and overall heat transfer coefficient using LMTD and effectiveness - NTU method.*

CO4 : *Estimate the heat transfer co-efficient for phase change operations using empirical correlations.*

CO5 : *Apply fundamental laws of radiation to determine the heat transfer rate between surfaces and apply the principles of evaporation to precisely calculate the energy requirement for single and multiple effect evaporators.*

CONDUCTION

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder and sphere - Heat conduction through a series of resistances - effect of temperature on thermal conductivity; Combined Conduction- Convection Heat transfer, Critical radius of insulation, Heat transfer in extended surfaces, Unsteady state heat transfer. **(9)**

CONVECTION

Concepts of heat transfer by convection - Natural and forced convection, Dimensional analysis in heat transfer, Correlations for the calculation of heat transfer coefficients, heat transfer coefficient for flow through a pipe, flow through a non circular conduit, Concepts of thermal boundary layer, Von karmaan Integral & energy Equation for flow past flat plate, Heat transfer by natural convection. **(9)**

HEAT EXCHANGERS

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors - Design of various types of heat exchangers and condensers. **(9)**

CONDENSATION AND BOILING

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, effect of non-condensable gases on rate of condensation. Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling. **(9)**

EVAPORATION AND RADIATION

Theory of evaporation - single effect and multiple effect evaporation -Types of Evaporators -Design calculation for single and multiple effect evaporation. Radiation heat transfer - Emissive power, Black body radiation, Emissivity, Stefen - Boltzman law, Planck's law, radiation between surfaces. **(9)**

TEXT BOOKS

1. *Binay K. Dutta., Heat Transfer: Principles and Applications, Fifth Printing, Prentice Hall of India Private Limited, 2006.*
2. *Holman, J. P., Heat Transfer, Tenth Edition, McGraw Hill, USA, 2010.*
3. *Ghajar A.J., Cengel Y.A., Heat and Mass Transfer: A Practical Approach, 5th edition., McGraw-Hill, USA, 2014.*

REFERENCES

1. *McCabe W.L., Smith J.C., Harriott. P., Unit Operations of Chemical Engineering, Seventh Edition, McGraw Hill International Student Edition, 2005.*
2. *Frank Kreith, Raj M Manglik, Principles of Heat Transfer, 8th edition., Cengage Learning, USA, 2016.*
3. *Kern, D.Q., Process Heat Transfer, McGraw-Hill, 1999.*
4. *Coulson, J.M. and Richardson, J.F., Chemical Engineering, Vol-1, Fourth Edition, Asian Books Private Limited, India, 1998.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		3	3				1	2		3	
CO2	3	3	2	2	3	3				1	1		3	
CO3	3	3	3	1	3	3				1	2		3	
CO4	3	3	3	1	2	3				1	2		3	
CO5	3	3	3	1	2	3				1	2		3	

(1: Slight, 2: Moderate 3: Substantial)

19CH45 - MASS TRANSFER - I

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to:

CO1 : *Estimate the mass transfer flux for molecular diffusion in fluids and measurement of diffusivity.*

CO2 : *Analyze mass transfer theories to predict the mass transfer coefficients, develop the analogy between momentum, heat and mass transfer.*

CO3 : *Compute the height of packing or number of plates required for the given separation by graphical and analytical method for absorption.*

CO4 : *Analyze flash, differential and steam distillation methods and calculate the vapour-liquid equilibria.*

CO5 : *Determine the number of ideal plates using Ponchon-savarit and Mccabe-thiele method and categorize azeotropic and extractive distillation.*

DIFFUSION IN FLUIDS

Molecular diffusion and eddy diffusion. Steady state molecular diffusion in fluids at rest and in laminar flow. Molecular diffusion in gases, Steady state diffusion of gas A through non-diffusing gas B, steady state equimolal counter diffusion. Steady state diffusion in multicomponent mixtures - Effective diffusivity, Molecular diffusion in liquids. Diffusivity prediction in gases and liquids. **(9)**

INTERPHASE MASS TRANSFER

Mass transfer coefficients, F and K type mass transfer coefficients, Relation between mass transfer coefficients, Film theory, Penetration theory, Danckwerts surface renewal theory. Two film theory. Wetted wall towers. Equilibrium stage modelling: equilibrium curve and operating line. Analogy between momentum, heat and mass transfer. **(9)**

ABSORPTION

Equipment for gas-liquid operations: Packed towers and plate columns. Equilibrium solubility of gases in liquids. Choice of solvents for absorption. Single component absorption. Operating and equilibrium lines for absorber and stripper. Minimum liquid - gas ratio for absorption. Counter current multistage operation, absorption of one component in packed tower, overall coefficients, Concept of HETP, NTU and HTU - graphical and analytical methods. **(9)**

DISTILLATION

Vapour - Liquid - Equilibrium (VLE). Ideal solutions and Raoult's law, non ideal solutions and Henry's law, relative volatility, azeotropes - minimum and maximum boiling. Flash distillation, differential distillation - Rayleigh's equation, steam distillation. **(9)**

CONTINUOUS FRACTIONATION

Determination of number of theoretical plates using McCabe - Thiele and Ponchon - Savarit methods. Location of feed plate. Reflux ratio - minimum reflux, optimum reflux, total reflux. Plate efficiency - overall and Murphree efficiencies. Azeotropic and extractive distillations. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Treybal R.E., Mass Transfer Operations, Third Edition, McGraw Hill Education (India) Private Limited., 2012.*
2. *Binay K Dutta, Principles of Mass Transfer and Separation Processes, PHI learning Private Limited, New Delhi, 2013.*
3. *McCabe W.L., Smith J.C., Harriott P., Unit Operations of Chemical Engineering, Seventh Edition, McGraw Hill Education (India) Private Limited., 2014.*
4. *N.Anantharaman, K.M.Meera Sheriffa Begum, Mass Transfer :Theory and Practice, Prentice Hall India Pvt Ltd, 2017.*

REFERENCES

1. *Geankoplis C. J., Transport Processes and Unit Operations, Third Edition, Prentice Hall of India Private Limited, New Delhi, 2003.*
2. *E.L. Cussler, Mass transfer in fluid systems, 2nd edition, Cambridge university press, 1984.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3			1	1							1	
CO2	3	1			1	1							2	1
CO3	3	3	1		2	2							3	2
CO4	1	2	1		1	1							1	1
CO5	3	3	1	1	2	1							3	1

(1: Slight, 2: Moderate 3: Substantial)

19CH46 - INSTRUMENTAL METHODS OF ANALYSIS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Understand the basic principles of spectroscopy and identify the structure of the organic compound from the spectroscopic studies.*

CO2 : *Predict the functional groups and mass of the organic & inorganic compounds from IR & mass spectroscopy.*

CO3 : *Determine the thermal stability from TGA, exothermic & endothermic reactions of the sample from DTA and surface analysis using various advanced techniques.*

CO4 : *Determine the concentration of the solutes in a mixture using solvent extraction and chromatographic methods.*

CO5 : *Understand about the types of precipitants, their advantages and disadvantages; theories of precipitation; general rules for precipitation and role of crucibles.*

UV-VISIBLE SPECTROSCOPY AND NMR SPECTROSCOPY

UV-VISIBLE SPECTROSCOPY

Electromagnetic radiation - Characteristics - Wave length, wave number, frequency, energy. Lambert's and Beer-Lambert's laws - Theory of electronic spectroscopy - Chromophores - Auxochrome - Types of absorption bands - Absorption and intensity shifts -Instrumentation -Applications. **(5)**

NMR SPECTROSCOPY

Theory - Chemical shift - Factors influencing chemical shift - Spin-Spin coupling -Instrumentation. **(4)**

IR SPECTROSCOPY AND MASS SPECTROSCOPY

IR SPECTROSCOPY

Theory of IR spectroscopy, Various molecular vibrations - stretching, bendingand its types -various ranges of IR (Near, Mid, Finger print and Far). Fundamental Vibrational frequency & overtones - Number of vibrational modes for diatomic and triatomic molecules (both linear and nonlinear) - Instrumentation of IR spectroscopy - Applications. **(5)**

MASS SPECTROSCOPY

Basic principles - Theory - Nitrogen rule - Advantages and disadvantages of mass spectra - McLafferty rearrangement - Applications. **(4)**

THERMAL METHODS AND SURFACE CHARACTERIZATIONS

Principles of thermogravimetric analysis (TGA) - Instrumentation - Factors influencing the thermogram - Applications of TGA. Differential thermal analysis (DTA) - Theory - Instrumentation - Thermal analysis of calcium oxalate monohydrate and calcium acetate monohydrate - Applications of DTA. **(6)**

Surface area determination by BET method - Particle size determination by light scattering method- Scanning Electron Microscopy (principles & theory only) and EDAX analysis. **(3)**

SEPARATION METHODS

Principles of solvent extraction - Extraction techniques (Soxhlet extractor) - Analytical applications. **(3)**

Chromatography - Theory - Classification - Principle, Instrumentation and Applications of thin layer, column, paper, gas and high-performance liquid chromatography. **(6)**

PRINCIPLES OF GRAVIMETRIC ANALYSIS

Methods of obtaining the precipitate - Conditions for precipitation - Choice of precipitants - Advantages of using organic precipitants - Disadvantages - Types of organic precipitants - Specific and selective precipitants - Sequestering agents.Theories of precipitation - Co-precipitation - Post-precipitation. Effects of digestion - General rules for precipitation - Precipitation from homogeneous medium - Washing of precipitates - Drying of precipitates - Types, care and use of crucibles. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Sharma B.K., Instrumental methods of chemical analysis, Eighteenth Edition, GOEL publishing House. 2002.*
2. *Ewing G.W., Instrumental methods of Chemical Analysis, Fifth Edition, McGraw Hill, New York, 1992.*
3. *Chatwal, Anand, Instrumental Methods of Chemical Analysis, Seventh Edition, Himalaya Publishing House. 2005.*
4. *Vogel's textbook of Quantitative Chemical Analysis, Fifth Edition. ELBS Publications, 2007.*

REFERENCES

1. *Skoog D.A. - Pinciples of Instrumental Analysis, Sixth Edition, Saunders College Publication, 2007.*
2. *Williard H.H., Meritt L.C and Dean J.H., - Instrumental Methods of Analysis, Sixth Edition, 1990.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2		2	2					1			2	1
CO2		2		2	2					1			2	1
CO3		2		2	2					1			2	1
CO4		2		2	2					1			2	1
CO5	3	2		2	2					1			2	1

(1: Slight, 2: Moderate 3: Substantial)

19CHL47 - FLUID MECHANICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Apply the concepts of fluid mechanics in fluid flow meters to estimate its performance characteristics.*

CO2 : *Calculate the friction losses and loss coefficient of pipe fittings in pipe network.*

CO3 : *Operate fluid transportation equipment and compare the results of analytical models to the actual behaviour of real fluid flows and draw performance curves.*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

LIST OF EXPERIMENTS

1. Determination of discharge / loss coefficient in venturi and orifice Meter
2. Pressure drop studies on helical coil and spiral coil
3. Determination of friction factor and expansion loss coefficient in a pipe
4. Performance studies on reciprocating pump
5. Determination of discharge coefficient for globe Valve and loss coefficient for 90°bend in a pipe
6. Performance studies on centrifugal pump
7. Determination of discharge coefficient for various notch apparatus
8. Pressure drop studies on fluidized bed
9. Pressure drop studies on packed bed
10. Determination of relationship between friction loss and Reynolds number in an annular pipes
11. Verification of Bernoulli's Theorem
12. Study on Reynolds apparatus

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	3					2	1	3	
CO2	2	3	1	1	1	1					2	1	3	
CO3	1	1	1	2	3	2				2	1	2	3	
CO4	3	2	2	2	1	2	1	1	3		2	3	2	3
CO5			2				2	3	3		1	2	1	2

(1: Slight, 2: Moderate 3: Substantial)

19CHL48 - TECHNICAL ANALYSIS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, the students will be able to

CO1 : *Analyse the samples by both quantitative and qualitative methods.*

CO2 : *Attain skills in analysing various samples and handling of instruments.*

CO3 : *Assess practical knowledge to carry out meaningful interpretation of data from analytical chemical measurements.*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

LIST OF EXPERIMENTS

1. Analysis of cement
2. Estimation of available chlorine in bleaching powder
3. Estimation of nitrogen in inorganic fertilizer
4. Determination of total fatty matter in soap
5. Determination of acid value of an oil
6. Determination of saponification value of an oil
7. Evaluation of purity in calcium carbonate
8. Estimation of calcium oxide in quick lime
9. Estimation of magnesium silicate in talcum powder
10. Estimation of Glucose
11. Estimation of manganese dioxide in Pyrolusite
12. Estimation of loss on ignition, silica, iron and aluminum oxides in Bauxite
13. Estimation of tin, lead, copper and zinc in Brass
14. Determination of biochemical oxygen demand (BOD)
15. Determination of acidity or alkalinity of a solution using pH meter
16. Determination of concentration of unknown solution by UV-Vis Spectrophotometer
17. Determination of concentration of unknown solution by Nephelometer
18. Determination of sodium / potassium using Flame Photometer

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1		1		1							1	
CO2	2	2		1		1								
CO3	2		1	1									1	
CO4								1	3	3	2			1
CO5				1				1	2	1	2			1

(1: Slight, 2: Moderate 3: Substantial)

19HOC41 - COMMUNICATION SKILLS FOR ENGINEERS - II

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Students will be able to

CO1 : *Solve objective questions on analogy, Statement and Argument, Statement and Conclusion, Data Sufficiency and Sentence improvement within a given time.*

CO2 : *Construct grammatically correct sentences.*

CO3 : *Speak confidently to describe a process, present information on the specified topic and disseminate information in a professional manner.*

SELF EVALUATION

Self believe and self Esteem - Activities based on Current Events. **(2)**

VERBAL AND LOGICAL RESONING

Analogy - Introduction, Types and Exercises - Statement and Argument - Statement and Conclusion - Data Sufficiency - Sentence Improvement - Critical Reasoning / Theme Detection **(5)**

GRAMMAR

Basic Grammar- Subject Verb Agreement - One word substitute - Preposition- Cause and Effect - Basic level questions and Moderate level questions. **(4)**

PRESENTATION TECHNIQUES

Describing a Process - Presentation Skills - Introduction, Planning and Preparation - Presentation on a Topic - Group Discussion - Dos and Don'ts - Functional Expressions used in Group Discussion - Interview Skills - Ideal Grooming for an interview, Preparing for the Interview **(9)**

REFERENCES

1. *Sanjay Kumar, Pushp Lata, Communication Skills SECOND EDITION, published by Oxford University Press, New Delhi, India, 2015.*
2. *Anthony Manning, Chris Sowton and Craig Thaine, Cambridge Academic English, published by Cambridge University Press, U P, India, 2012.*

19CH51 - NUMERICAL METHODS IN CHEMICAL ENGINEERING

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able

CO1 : *To solve systems of algebraic equation using various numerical schemes and to develop programming code using MATLAB and EXCEL.*

CO2 : *To Solve nonlinear algebraic equation using open and bracketing type numerical methods*

CO3 : *To practice numerical integration using trapezoidal, Simpsons techniques for chemical problems*

CO4 : *To solve single ODE and Simultaneous ODEs using various numerical schemes.*

CO5 : *To formulate and solve PDEs for real time chemical Engineering Problems.*

NUMERICAL METHODS FOR SINGLE ALGEBRAIC EQUATIONS

Introduction, Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, System of Non-linear Equations. Chemical Engineering problems involving solution of non-linear equations **(9)**

NUMERICAL METHODS FOR SIMULTANEOUS ALGEBRAIC EQUATIONS

Methods like Gauss elimination, LU decomposition and matrix inversion, Gauss-Seidel method, Chemical Engineering problems involving solution of linear algebraic equations. **(9)**

INTERPOLATION AND NUMERICAL INTEGRATION

Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, spline interpolation, linear regression, polynomial regression, least square regression, Numerical integration: Trapezoidal rule, Simpson's rule, integration with unequal segments, Chemical engineering problems involving numerical differentiation and integration **(9)**

NUMERICAL METHODS FOR ODES

Ordinary Differential Equations: Euler method, Runge-Kutta method, Adaptive Runge-Kutta method, Initial and boundary value problems, Chemical engineering problems involving single, and a system of ODEs. **(9)**

NUMERICAL METHODS FOR PDES

Introduction to Partial Differential Equations: Characterization of PDEs, Laplace equation, Heat conduction/ diffusion equations, explicit, implicit, Crank-Nicholson method, Introduction to Finite element method. **(9)**

TEXT BOOKS

1. *Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012.*
2. *Pradeep Ahuja, "Intrduction to Numerical Methods in Chemical Engineering", 2nd Edition, PHI Learning Private Limited, 2019.*

REFERENCES

1. *S.C. Chapra & R.P. Canale, "Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, 1985.*
2. *R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.*
3. *Atkinson, K. E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.*
4. *Press, W. H. et al., "Numerical Recipes in C: The Art of Scientific Computing, 3rd Edition, Cambridge University Press, 2007.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3			1	1							1	
CO2	3	1			1	1							2	1
CO3	3	3	1		2	2							3	2
CO4	1	2	1		1	1							1	1
CO5	3	3	1	1	2	1							3	1

(1: Slight, 2: Moderate 3: Substantial)

19CH52 - CHEMICAL REACTION ENGINEERING - II

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 *: Develop rate kinetic for catalytic reaction and catalyst deactivation.*

CO2 *: Analyze external diffusion Effects on heterogeneous reactions.*

CO3 *: Solve the problem based on diffusion and reaction in porous catalysts*

CO4 *: Develop the reaction kinetics for a non-catalytic reaction with chemical reaction and mass transfer controlling regime and design non-catalytic reaction system*

CO5 *: To explain the underlying principles in multiphase reactors kinetics.*

CATALYSIS AND CATALYTIC REACTORS

Catalysts - Steps in a Catalytic Reaction - Synthesizing a Rate Law, Mechanism, and Rate-Limiting Step - Design of Reactors for Gas-Solid Reactions - Heterogeneous Data Analysis for Reactor Design - Chemical Vapor Deposition- Catalyst Deactivation. **(9)**

EXTERNAL DIFFUSION EFFECTS ON HETEROGENEOUS REACTIONS

Mass Transfer Fundamentals - Binary Diffusion - External Resistance to Mass Transfer - Mass Transfer to a Single Particle- Mass Transfer-Limited Reactions in Packed Beds - Mass Transfer-Limited Reaction on Metallic Surfaces - The Shrinking Core Model. **(9)**

DIFFUSION AND REACTION IN POROUS CATALYSTS

Diffusion and Reaction in Spherical Catalyst Pellets - Internal Effectiveness Factor - Falsified Kinetics - Overall Effectiveness Factor - Overall Effectiveness Factor - Estimation of Diffusion- and Reaction-Limited Regimes - Mass Transfer and Reaction in a Packed Bed. **(12)**

HETEROGENEOUS NON-CATALYTIC FLUID-SOLID SYSTEMS

Kinetic models for non-catalytic fluid-solid systems - Progressive conversion and Unreacted core Models. Development of rate expressions for various controlling regimes- Application to design. **(9)**

FLUID-FLUID REACTIONS: KINETICS AND DESIGN

The rate equation- The rate equation for straight mass transfer (absorption) of a - the rate equation for mass transfer and reaction - straight mass transfer - mass transfer plus not very slow reaction - Multiphase Reactors - Slurry Reactors and Trickle bed reactors. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Foggler H. S, Elements of Chemical Reaction Engineering, (Third Edition) Prentice Hall, 2001*
2. *Levenspiel .O, Chemical Reaction Engineering (Third Edition) Wiley Eastern, New Delhi, (2000)*

REFERENCES

1. *Carberry, J. J., Dover, Chemical and Catalytic Reaction Engineering, Mc GrawHill-USA,2001.*
2. *Gilbert F. Froment, Kenneth.B.Bischoff, Juray De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, Incorporated, 2010.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	1					3	3	
CO2	3	2	3	2	2	3	1					3	3	
CO3	3	3	3	2	2	3	1					3	3	
CO4	3	3	3	2	2	3	1					3	3	
CO5	3	2	3	2	2	3	1					3	3	

(1: Slight, 2: Moderate 3: Substantial)

19CH53 - MASS TRANSFER - II

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 : *Determine the number of stages and recovery efficiency for solid-liquid and liquid-liquid extraction processes.*

CO2 : *Calculate the quantity of adsorbent required for stage-wise operations and illustrate the types of adsorption, adsorption isotherms and ion-exchange process.*

CO3 : *Determine the properties of air-water system using psychrometric chart and review the operational features of cooling towers.*

CO4 : *Analyse the applications of dryers and calculate the time of drying from rate of drying curve.*

CO5 : *Compute the yield of crystals and select the crystallizer by revising the working features.*

EXTRACTION

Application of liquid-liquid extraction, Liquid-liquid equilibria, general features of triangular co-ordinate systems, Choice of solvent for extraction, Number of stages, Minimum solvent rate, Solid-liquid extraction, Typical industrial applications, Factors affecting leaching - agitation, particle size, temperature and solvent properties, Leaching by percolation moving bed leaching and shank's system, Operation of stage wise and differential contact extractors. **(9)**

ADSORPTION AND ION EXCHANGE

Types of adsorption, factors influencing adsorption, nature of adsorbents, Industrial adsorbents, Adsorption isotherms, Adsorption operation - single stage and multistage crosscurrent and countercurrent operations, Determination of number of stages. Recovery of solvent vapors, Principles of ion exchange - techniques and applications - equilibria, rate of ion exchange **(9)**

HUMIDIFICATION

Humidification operation, Properties of air-water vapour system, Psychometric chart, Methods of humidification and dehumidification, Lewis relation, Theory and principles of cooling towers, Types of cooling towers. Design of cooling tower. **(9)**

DRYING

Theory and mechanism of drying. Batch drying test, drying rate curve, time of drying. Mechanism of moisture movement, drying rate during constant rate period, unsaturated surface drying, drying with internal diffusion. Methods of drying- Classification of dryers, Continuous drying operations and equipment. Application of dryers in process industries. **(9)**

CRYSTALLIZATION

Theory of crystallization, methods of supersaturation, nucleation and crystal growth, Batch and continuous crystallizers. Performance and applications of industrial crystallizers. **(9)**

TOTAL : 45

TEXT BOOKS

1. *McCabe W. L., Smith J.C., and Harriott P., Unit Operations of chemical Engineering, seventh Edition, McGraw Hill Education (India) Private Limited, 2014.*
2. *Treybal R.E., Mass Transfer Operations, Third Edition, McGraw Education (India) Private Limited, 1980.*
3. *Binay.K.Dutta., Principles of Mass Transfer and Separation Process, PHI Learning Pvt.Ltd, 2013.*
4. *N.Anantharaman, K.M.Meera Sheriffa Begum, Mass Transfer :Theory and Practice, Prentice Hall India Pvt Ltd, 2017.*

REFERENCES

1. *Coulson J.M., Richardson J.F., Backhurst J.R Harker J.M., Coulson and Richardson's., Chemical Engineering, Vol II, 6th Edition,Butter Worth Heinemann, Oxford, 2002.*
2. *Alan S. Foust, Leonard A Wenzel, CurlisW.Clump, Louis Maus, L.Bryce Andersen., Principles of Unit operations, second ed, John Wiley and Sons, 2008.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		2	1							3	1
CO2	3	3	2			1	1						1	
CO3	2	1	1			2							2	
CO4	1	2	1			1							3	3
CO5	1	2	2			1							1	1

(1: Slight, 2: Moderate 3: Substantial)

19CHL56 - ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon successful completion of course, students will be able to

CO1 : *To differentiate between wage employment, self-employment and entrepreneurship*

CO2 : *To appreciate and develop positive thinking and self-confidence for embarking on self-employment / entrepreneurship.*

CO3 : *To appreciate the importance of systematic planning in setting up and managing a business enterprise.*

PART I

MOTIVATION AND CONFIDENCE BUILDING

Positive thinking, shedding negative feelings, Experience Sharing by successful entrepreneurs, Motivational video clips, Scope for Self-employment. **(7)**

PART II

SELF EMPLOYMENT

Advantages over wage employment, Entrepreneurship Development, Need and importance of embarking on self-employment Advantages of self-employment, Assessing self to know entrepreneurial tendencies, Process of Entrepreneurship Development Importance of behavioural changes for entrepreneurship, Difference between Income Generating Activity, Self-Employment and Entrepreneurship, Characteristics of an entrepreneur - Dynamics of Entrepreneurship, Attitude and its impact on Entrepreneurship. **(8)**

TOTAL : 15

TEXT BOOKS

1. *Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Entrepreneurship, Tata McGraw Hill, 10 th Edition.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2	1					
CO2									2					
CO3								3	2					

(1: Slight, 2: Moderate 3: Substantial)

19CHL57 - MECHANICAL OPERATIONS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 *: Apply the concepts of mechanical operations in physical separation processes.*

CO2 *: Perform the sieve analysis using various size reduction equipment's.*

CO3 *: Operate and estimate the performance characteristic parameters for solid fluid and solid-solid separation equipment's.*

CO4 *: Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 *: Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

LIST OF EXPERIMENTS

1. Determination of Critical Speed and Reduction Ratio of Ball Mill
2. Performance Studies on Jaw Crusher
3. Estimation of Separation Efficiency of Froth Floatation Cell
4. Determination of Specific Cake and Filter Medium Resistance of slurry using Plate and Frame Filter Press
5. Performance Studies on Roll Crusher
6. Estimation of area of Thickener for a Batch Sedimentation Unit
7. Determination of Effectiveness of Screen
8. Determination of Specific Cake Resistance of Slurry and Compressibility Factor of Leaf Filter under Constant Pressure Filtration
9. Estimation of Separation Efficiency of Cyclone Separator
10. Performance Studies on Hammer Mill
11. Determination of Specific Cake Resistance of Slurries Using a Continuous Rotary Vacuum drum filter press
12. Estimation of separation efficiency of Air Classifier
13. Study the Wall Effect on the Terminal Settling Velocity of a Sphere
14. Performance studies on mixing apparatus
15. Performance studies on solid transportation equipment

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	3					2	1	3	
CO2	2	3	1	2	1	2					2	1	3	
CO3	3	2	2	2	2	2	1		2	2	1	2	3	
CO4	3	2	2	2	1	2	1	1	3		2	3	2	3
CO5			2				2	3	3		1	2	1	2

(1: Slight, 2: Moderate 3: Substantial)

19CHL58 - HEAT TRANSFER LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *To collect quality raw data from any heat transfer operation and to compare observed with predicted performance.*

CO2 : *To apply the concepts of heat transfer, fluid dynamics and thermodynamics to the design and operation of heat transfer experiments.*

CO3 : *To determine the heat transfer co-efficient and effectiveness of heat exchangers from experimentally observed data.*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

EXPERIMENTS

1. Determination of heat transfer coefficients by Natural Convection
2. Heat transfer in agitated vessel(steady state)
3. Heat transfer studies in fluidized bed dryer
4. Heat transfer studies in packed bed
5. Studies in Cross flow plate fin Heat Exchanger
6. Studies in Plate type Heat Exchanger
7. Studies in on Nucleate Boiling
8. Studies in Shell and Tube Heat exchanger
9. Studies in Stefan Boltzmann apparatus
10. Studies in Film wise and Drop wise Condensation

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	3					2	1	3	
CO2	2	3	1	2	1	2					2	1	3	
CO3	3	2	2	2	2	2	1		2	2	1	2	3	
CO4	3	2	2	2	1	2	1	1	3		2	3	2	3
CO5			2				2	3	3		1	2	1	2

(1: Slight, 2: Moderate 3: Substantial)

19INT51 - INTERNSHIP-I

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, the students are able to

CO1 : *Analyze the basic principles and knowledge of chemical engineering which has been applied in the production of various products in industries.*

CO2 : *Conduct lab scale experiments through the experience gained from the large scale industries.*

CO3 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

- Students are instructed to complete six to eight weeks of internship in any Chemical Process Industry or Nationalized Academic Institution.
- A written report and an oral presentation should be given after successful completion of internship.

19HOC51 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - I

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Students will be able to

CO1 : *Solve objective questions on Syllogisms, Data Interpretation, Critical Reasoning, Theme Detection, Sentence Completion and Business Vocabulary*

CO2 : *Develop appropriate responses for business phone calls and negotiate effectively.*

CO3 : *Speak with appropriate body language for a technical speaking task.*

CO4 : *Project the appropriate grooming and the right etiquettes, for interview and group discussion task.*

VERBAL APTITUDE

Syllogisms-Paragraph Comprehension -Data Interpretation -Critical Reasoning/Theme Detection - Grammar -Sentence Completion Filler - Business Vocabulary- Foreign phrases used in English **(3)**

PROFESSIONAL COMMUNICATION

Telephonic Conversation Skills - Telephonic Interview -Etiquettes - Professional, Dining & Telephone - Employability skills - Importance and Employability level of present Y and Z Generation - Interpersonal Skills - Negotiation Skills - Types, Expressions used in formal and informal negotiations, Stages of Negotiation - Time Management - Pareto principle, Prioritizing tasks, Barriers to time management. **(7)**

THE ART OF SPEAKING

Types of Speaking - Barriers to Speaking - Presentation on a Technical Topic - Speaking on Current Trends in the Industry. **(5)**

NON-VERBAL COMMUNICATION

Interview Skills - Non-Verbal Communication - Smiling, Posture, Handshake, Tone of Voice and Eye Contact - GD tips & techniques and Mock GD- Body Language - Grooming. **(5)**

REFERENCES

1. *Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.*
2. *Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.*
3. *John Hayes. Interpersonal Skills at Work. Second Edition. Routledge publication. 2005*

19CH61 - PROCESS DYNAMICS AND CONTROL

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Apply conservation principles in order to model the dynamics of simple process systems to develop first, second and multi capacity transfer functions.*

CO2 : *Analyse closed loop stability systems by applying transient responses and also to test the stability of the control system by Root Locus, Routh and Bode methods.*

CO3 : *Discuss P, PI, PD, PID controller actions and its transfer functions. Practice block diagram development for closed loop systems by applying transient responses to find the process error.*

CO4 : *Devise control strategies for the control of mass and heat transfer equipment using advanced controllers.*

CO5 : *Discuss digital process controllers and the hardware components of its direct digital controllers and its applications.*

OPEN LOOP SYSTEMS

Laplace Transforms - Standard functions and solution of ODE, Open loop systems, first order systems and their transient response for standard input functions, first order systems in series, Transportation Lag and Dead time, second order systems and their dynamics. **(12)**

CLOSED LOOP SYSTEMS

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, stability analysis using Routh-Huritz and root-locus and its diagrams. **(12)**

FREQUENCY RESPONSE

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, Principle of Nyquist diagram, stability criterion, Controller tuning, Zeigler Nicholas, Cohen-Coon and other methods. **(8)**

ADVANCED CONTROL SYSTEMS

Introduction to advanced control systems, cascade control, feed forward control, feed back controller Model predictive control, Smith Predictor, Ratio controller, IMC and its application. **(8)**

DIGITAL CONTROLLERS

Introduction to Computer control loops, Digital computer, computer process Interface, digital to analog and analog to digital converters, sampling continuous signal, Hardware components of a DDC loop, supervisory controller, DCS and PLC. **(5)**

TOTAL : 45

TEXT BOOKS

1. *Coughanowr D., Steven Leblanc, Process Systems Analysis and Control, Third Edition, McGraw Hill, New York, 2009.*
2. *Vyas R. P, Process Control and Instrumentation, Eighth Edition, Denett & Co, Nagpur, India, 2016.*
3. *Stephanopoulos G., Chemical Process Control: An Introduction to Theory and Practice, Sixth Edition, Prentice Hall of India Pvt.Ltd, New Delhi, 1998.*
4. *Coleman Brosilow, Babu Joseph, Techniques of Model-Based Control, Prentice,Hall International,2002.*
5. *Surekha Bhanot, Process Control: Principles and Applications, Oxford University Press,2007.*

REFERENCES

1. *Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle, III, Process Dynamics and Control, Fourth Edition, John Wiley and sons, New York, 2016.*
2. *Carlos A Smith, Armando B Corripio, Principles and Practice of Automation process control, Third Edition, John Wiley, New York, 2005.*
3. *Harriot P., Process Control, Tata McGraw Hill, New Delhi, 1997.*
4. *Jose.A. Romagnoli, Ahmet Palazoglu, Introduction to Process Control, CRC Press, 2016.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	2	-	-	2	-	-	-	-	-	-	2	2	-
CO3	2	2	-	-	2	-	-	-	-	-	-	2	2	-
CO4	2	3	2	-	2	2	1	-	-	-	-	2	3	-
CO5	2	3	2	-	2	2	1	-	-	-	-	2	3	-

(1: Slight, 2: Moderate 3: Substantial)

19CH62 - CHEMICAL PROCESS INDUSTRIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will able to

CO1 : *Identify the contemporary technologies in water treatment and label the process economics in sal and sulphur based industries.*

CO2 : *Design the production methodology of oil industries and analyse the efficiency of the products.*

CO3 : *Analyze and formulate the chemical processes and economics involved in the carbohydrate industries.*

CO4 : *Describe the flow sheets of manufacture process of pulp based, leather industries and engineering problems faced in the industries.*

CO5 : *Evaluate the surface coating & cement industry processes to justify their appropriate production techniques and their handling processes.*

NITROGEN, PHOSPHOROUS AND SULPHUR BASED INDUSTRIES

Nitrogen, Ammonium nitrate, Ammonium sulphate and Urea. Phosphorus, Phosphoric acid, Ammonium phosphates, Sodium phosphates, Nitrophosphate& Phosphate esters. Mixed fertilizers (NPK Mixtures). Manufacture of Sulphur and Sulphuric acid. Materials for handling, storage and transportation. **(11)**

OIL AND ALLIED INDUSTRIES

Vegetable oil extraction methods.Refining of vegetable oils.Hydrogenation of Oils.Soaps and Candle.Detergents and Glycerine.Materials for handling, storage and transportation. **(7)**

CARBOHYDRATES AND FERMENTATION INDUSTRIES

Manufacture of Starch, Dextrin, Glucose and sucrose and manufacture of Ethyl alcohol, Acetic acid, Citric acid, Oxalic acid and Antibiotics (Penicillin). Materials for handling, storage and transportation. **(9)**

PULP AND LEATHER INDUSTRIES

Production of Pulp.Conversion to paper.Production of Viscose, Cuprammoniumrayons and Cellulose acetate.Production of Dimethyl sulphite and Dimethyl sulphoxide from wood liquor. Manufacture of leather from hides and skins. Manufacture of Glue and Gelatin.Materials for handling, storage and transportation. **(9)**

SURFACE COATING, CEMENT AND GLASS INDUSTRIES

Constituents of paints & varnishes and their functions. Paint mixing process. Manufacture of pigments such as White lead, Zinc oxide and Titanium dioxide. Cements: Introduction, types of cements, properties and applications. Manufacture of Portland cement. Beneficiation & Production of Hydrated lime. Raw materials for Glass Industries.Production of glass by tank furnace - shaping and forming of articles from glass. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gopala Rao, M. & Marshall Sittig.: Dryden's Outlines of Chemical Technology, (3rd Ed.), Affiliated East-West Press, New Delhi, (2004).*
2. *Austin, G.T.: Shreve's Chemical Process Industries, (5th Ed.), McGraw Hill (ISE), (1984).*
3. *Shukla, S.D. Pandey, G.N.: A Text Book of Chemical Technology, Vol. I, Vikas, New Delhi, (1994)*

REFERENCES

1. *Venkateswaralu, D., Upadrashta, K.R. & Chandrasekaran, K.D. (Editors): CHEMTECH - I, S. Chand & Co., New Delhi, (1975).*
2. *CHEMTECH - II, Chemical Engineering Education Development Centre, I.I.T., Madras, (1977).*
3. *Kent, A.J. : Riegel's Handbook of Industrial Chemistry, Van Nostrand - Reinhold, New York, ninth Edition (1974).*
4. *Stephenson, R.M. : Introduction to Chemical Process Industries, Van Nostrand, New Jersy, (1966).*
5. *Furnas, C.C. (Editor): Roger's Manual of Industrial Chemistry, Vol. I, (6th Ed.), Van Nostrand, New Jersy, (1942).*
6. *Lowenheim, F.A. & Moran, M.K. : Faith, Keyes and Clark's INDUSTRIAL CHEMICALS, (4th Ed.), John Wiley, New York, (1975).*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3			1	1							1	
CO2	3	1			1	1							2	1
CO3	3	3	1		2	2							3	2
CO4	1	2	1		1	1							1	1
CO5	3	3	1	1	2	1							3	1

(1: Slight, 2: Moderate 3: Substantial)

19CH63 - CHEMICAL PROCESS SAFETY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students would be able to

CO1 *: judge the importance of safety in chemical process plants*

CO2 *: evaluate the degree of toxicity*

CO3 *: select the extinguishing methods for fire and explosion hazards*

CO4 *: assess temperature hazards and reaction safety.*

CO5 *: analyze risk using qualitative and semi-quantitative methods.*

OVERVIEW OF PROCESS SAFETY

Introduction to safety: Concept and importance of industrial safety-Bhopal disaster. Safety in site selection and lay out, Flares and rupture discs, work permit system, confined space safety practices, Hazards classification - GHS system, accident and loss statistics. **(9)**

TOXICOLOGICAL STUDIES

Toxicology, Dose-response relationship, Hodge-sterner table, Source models-basic, pool boiling, Threshold Limit Value - classification and significance, NFPA diamond, Industrial hygiene. **(9)**

FIRE AND EXPLOSION

Fire hazards, Fire pyramid, Types of fires, Types of fire extinguishers, Sprinklers, Explosion-classification, Fire fighting techniques, Inerting. **(9)**

TEMPERATURE AND REACTION HAZARDS

Extreme temperature hazards - hot and cold, Thermal burns, Reactive chemical hazards- characterisation using calorimeters, Thermal runaway - causes, adiabatic temperature rise, onset temperature, phi factor. **(9)**

RISK ANALYSIS

Hazard identification- Process hazard checklists, Hazard survey, HAZOP, safety review; fault tree analysis, FMEA (failure mode and effect analysis), Layer of Protection Analysis, Bow-tie analysis, domino effect. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Tweeddale, Mark, Managing risk and reliability of process plants, Gulf Professional Publishing, 2003*
2. *Kletz, Trevor, Still going wrong, Case histories of process plant disasters and how they could have been avoided, Gulf Professional Publishing, 2003*
3. *Crowl, Daniel A. and Louvar, Joseph F., Chemical process safety, Fundamentals with applications, 2nd Ed, Prentice Hall, 2002*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2		2			2	3						
CO2	1	1	1										3	
CO3		2				2			2					
CO4			2								2			
CO5	1								2				1	

(1: Slight, 2: Moderate 3: Substantial)

19CHL66 - CHEMICAL REACTION ENGINEERING LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Collect and analyse experimental data for steady state and unsteady state reactors using statistical principles, and compare results to theoretical principles.*

CO2 : *Collect and analyse kinetic data to determine order, activation energy, frequency factor and rate constant in rate equation.*

CO3 : *Collect RTD data from steady state reactors and analyse the deviation of real reactor from ideal reactors*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of Chemical Engineering.*

LIST OF EXPERIMENTS

1. Kinetic Studies in Batch Reactor-I
2. Kinetic Studies in Batch Reactor-II
3. Performance Characteristics of Semi-Batch Reactor-I
4. Performance Characteristics of Semi-Batch Reactor-II
5. Performance Characteristics of Mixed Flow Reactor
6. Performance Characteristics of Plug Flow Reactor
7. Adiabatic Reactor
8. Residence Time Distribution Studies in Plug Flow Reactor
9. Residence Time Distribution Studies in Mixed Flow Reactor
10. Performance Characteristics of Tubular Reactor
11. Performance Studies of Mixed Flow Reactor in Series
12. Determination of Activation Energy

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	0	0	0	0	0	0	**0**	**0**	**0**
CO2	3	3	3	2	0	0	0	1	0	0	0	0	0	0
CO3	3	3	3	2	0	2	0	0	1	0	0	0	0	0
CO4	3	3	3	2	0	0	0	0	0	0	0	0	0	0
CO5	3	3	3	2	0	0	0	0	0	0	0	0	0	0

(1: Slight, 2: Moderate 3: Substantial)

19CHL67 - MASS TRANSFER LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, the students will be able to

CO1 : *Design experiments to obtain mass transfer coefficients like diffusion coefficient in liquids and gases.*

CO2 : *Apply the concepts of mass transfer and thermodynamics to the design and operation of mass transfer experiments*

CO3 : *Calculate drying rates of wet solids and to determine the critical moisture & equilibrium moisture content in the different regimes of drying.*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

LIST OF EXPERIMENTS

1. Determination of HETP for random packing
2. Diffusivity Measurement
3. Drying Characteristics of Solid Materials By Air Blower
4. Generation of Ternary Liquid Equilibrium Data
5. Generation of Vapour Liquid Equilibrium Data
6. Studies in Counter Current Leaching
7. Studies in Cross Current Leaching
8. Studies in Distillation of Immiscible Liquids
9. Verification of Rayleigh's Equation using Simple Distillation

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2		2							3	3
CO2	3	3	3	2		2							3	3
CO3	3	3	3	2		2							3	3
CO4	3	2	2	2		2							3	3
CO5	3	2	2	2		2							3	3

(1: Slight, 2: Moderate 3: Substantial)

19CH68 - MINI PROJECT

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Understand how a project has to be started, their pre-requirements, flowchart preparation, and economic calculation and solution.*

CO2 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO3 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical and allied engineering.*

The students are expected to carry out mini project connected with process development studies which will be assigned by the faculty in charge. Progress of the work will be assessed periodically in which the student will give an oral presentation on the work done. The student should maintain a record of the work done regularly and submit them for assessment periodically. At the end of the semester, the students should submit a report of the work done in standard format which will be evaluated by the faculty and subject experts.

19INT61 - INTERNSHIP-II

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, the students will be able to

CO1 : *Analyze the basic principles and knowledge of chemical engineering which has been applied in the production of various products in industries.*

CO2 : *Conduct lab scale experiments through the experience gained from the large scale industries.*

CO3 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

- Students are instructed to complete six to eight weeks of internship in any Chemical Process Industry or Nationalized Academic Institution.
- A written report and an oral presentation should be given after successful completion of internship.

19HOC61 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - II

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Students will be able to

CO1 *: Exhibit Corporate Etiquettes with assertiveness and personal effectiveness.*

CO2 *: Build teams and solve problems at workplace.*

CO3 *: Manage conflicts in a professional manner*

CO4 *: Simulate an actual Job Interview scenario to prepare a candidate for a real Interview*

CORPORATE ETIQUETTE

Corporate Etiquette: Dos and Don'ts, - Conversational dos and don'ts - Creating elusive first impression- Assertiveness-Personal Effectiveness **(4)**

LEADERSHIP AND TEAM MANAGEMENT

Leadership Skills - Understanding Traits and Styles - Team Building: Bonding, Development and Delegation - Adaptability and Work Ethics - Handling Team Dynamics- Giving and Receiving Feedback- Problem Solving Skills. **(5)**

STRESS AND CONFLICT MANAGEMENT

Emotional Intelligence: Recognition, Understanding and Managing - Stress Management: Techniques and Benefits - Conflict Management: Introduction - Handling Conflicts - Conflicts settlement **(6)**

GROUP DISCUSSION AND INTERVIEW SKILLS

Mock GD - Interview Skills - Answering challenging questions - Common Interview Questions **(5)**

REFERENCES

1. *Barun K Mitra., Personality Development and Soft Skills. Second Edition. Oxford University Press. 2016*
2. *N.Krishnaswamy & Lalitha Krishnaswamy - Mastering Communication Skills and Soft Skills. New Delhi. Bloomsburry. 2015*
3. *Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.*

19CH71 - TRANSPORT PHENOMENA

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Determine the interrelationship between the molecular, microscopic and macroscopic descriptions of transport processes and compare the various coordinate systems to formulate Continuity, Navier-Stokes and Euler equations.*

CO2 : *Apply shell balance technique to formulate the differential equation of change for steady and unsteady-state flows*

CO3 : *Analyse the problems involving steady state and unsteady state heat conduction in simple geometries and obtain numerical solutions for the problems.*

CO4 : *Develop microscopic and macroscopic energy balances for steady and unsteady energy transport processes*

CO5 : *Apply the individual and overall mass transfer coefficient in multi-phase systems for design applications.*

BASIC CONCEPT AND CONSERVATION THEOREM IN MOMENTUM TRANSPORT

Derivation of the basic momentum transport equation - derivation using elementary volume concept and conservation theorems. Equation of continuity and motion - Navier-Stokes and Euler equations of motion in rectangular, cylindrical and spherical co- ordinate systems. Dimensional analysis of equations of change. Analysis of momentum transport using shell balance technique and basic transport equations - types of boundary conditions. **(12)**

APPLICATIONS OF EQUATIONS OF CHANGE IN MOMENTUM TRANSPORT

Flow of fluids in thin films, parallel plates, circular tubes and annulus, adjacent flow of two immiscible fluids, Couetteflow, rotating surface flow and radial flow. Flow near a wall suddenly set in motion. **(12)**

BASIC CONCEPTS AND CONSERVATION THEOREMS IN ENERGY TRANSPORT

Basic energy transport equations - derivations using elementary volume concept and conservation theorems in different co- ordinate systems. Dimensional analysis of equations of change. Analysis of energy transport using shell balance technique and basic transport equations - types of boundary conditions. **(12)**

APPLICATIONS OF EQUATIONS OF CHANGE IN ENERGY TRANSPORT

Conduction with energy sources in fixed bed catalytic reactors and in cooling fins. Forced convection in circular tubes - Natural convection from a heated plate. Unsteady state conduction of finite slab. **(12)**

MASS TRANSPORT

Continuity equation for a binary mixture and its derivation. Dimensional analysis of equations of change. Analysis of mass transport using shell balance technique and types of boundary conditions. Steady and unsteady state one dimensional diffusion, diffusion in porous catalyst with and without chemical reaction and diffusion in falling liquid film. **(12)**

TOTAL = 60

TEXT BOOKS

1. *Byron Bird.R, Warren E Stewart, Edwin N.Lightfoot, Transport Phenomena, Revised Second Edition., John Wiley(ISE), India, 2007.*
2. *Robert S. Brodkey, Harry C.Hershey, Transport Phenomena-A unified approach, McGraw Hill (ISE), 2003.*

REFERENCES

1. *James Welty, Charles E. Wicks, Gregory L. Rorer, Robert E. Wilson, Fundamentals of Momentum, Heat and Mass Transfer, Sixth Edition, John Wiley, (ISE), 2013.*
2. *Carroll O.Bennet, John Earle Meyers, Momentum, Heat and Mass Transfer, Third Edition, Tata-McGraw Hill, New Delhi,1983.*
3. *Christie J. Geankoplis, Transport Processes and Separation Process principles, Fourth Edition, Prentice Hall Professional Technical Reference, 2003.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3		3			2				3	
CO2	3	2	1	3		3			2				3	
CO3	3	2	1	3		3			2				3	
CO4	3	2	1	3		3			2				3	
CO5	3	2	1	3		3			2				3	

(1: Slight, 2: Moderate 3: Substantial)

19CH72 - PROCESS ECONOMICS AND TECHNOLOGY MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Practice various depreciation methods and its uses in industries for the recovery of plant cost*

CO2 : *Assess the various financial ratios by taking the real time data's of the industries and comment the stability of the financial statements*

CO3 : *Practice various Process technology cost calculations and its feasibility analysis.*

CO4 : *Outline the various management principles and organization types practiced in the organizations*

CO5 : *Discuss the production planning control methods in industries and also role of control charts in production for the quality control.*

INTEREST AND PLANT COST

Time value of money-concept of interest, equivalence, Depreciation, Depletion, Capital requirement for complete plant, cost indices, various components of Cost Productions and their Estimation and Project Cost preparations. **(10)**

PROJECT PROFITABILITY AND FINANCIAL RATIOS

Estimation of project profitability, Project Financing, income statement and financial ratios, balance sheet preparation - case studies and problems. **(10)**

PROCESS TECHNOLOGY COST CALCULATION

Description, Raw material and energy sources and Consumption, operating condition, basic block diagram and Simplified Process flow diagram for some of the industrially relevant chemicals like Ammonia, fertilizer, chloro-alkali and Petro chemicals. **(10)**

PRINCIPLES OF MANAGEMENT

Principles of management, planning, organizing, staffing, coordinating, directing, controlling and communicating. Types of organizations, Management information systems (MIS). **(8)**

PRODUCTION PLANNING CONTROL

Work measurement techniques, motion study, principles of time study, elements of production control, forecasting, planning, routing, scheduling, dispatching, inventory methods, role of control charts in production and quality control. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Max Peters, Klaus Timmerhaus, Ronald West, Plant design and economics for chemical Engineers, Fifth Edition, McGraw Hill (ISE), 2013.*
2. *Ahuja K.K, Industrial management, khanna publishsers, New Delhi, 2004.*

3. *H.E. Schwyer, Process Engineering Economics, McGraw Hill Book, New York, 1970.*
4. *Gopala Rao, M. & Marshall Sittig.: Dryden's Outlines of Chemical Technology, (3rd Ed.), Affiliated East-West Press, New Delhi, (2004).*

REFERENCES

1. *FC Jelen, JH Black, Cost and Optimization Engineering, Second Edition, McGraw-Hill., New York, 1990.*
2. *Robin Smith, Chemical Process Design and Integration, Second edition, John Wiley & Sons, United States, 2016.*
3. *Jacob.A.Moulijn, Michiel Makkee, Annelies Van Diepen, Chemical Process Technology, Third Edition, Wiley, 2022.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	1	1	-	-	-	-	3	2	2	2
CO2	2	2	-	1	2	1	-	-	1	-	3	2	2	1
CO3	2	3	2	-	2	2	1	1	1	-	2	2	3	1
CO4	-	1	1	-	1	-	1	2	3	1	3	2	2	2
CO5	2	3	1	-	1	-	-	1	1	-	3	2	2	2

(1: Slight, 2: Moderate 3: Substantial)

19CH73 - PROCESS MODELING AND SIMULATION

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 : *Apply first principles and constitutive laws to develop ordinary or partial differential equations by incorporating valid assumptions for both macroscopic and microscopic systems.*

CO2 : *Derive phenomenological models for simple and variable flow hydraulic tanks, enclosed mixing vessel with reaction, steam jacketed mixing vessel and Continuous flow boiling systems.*

CO3 : *Develop the mathematical model for simple flow systems and Homogeneous and Heterogeneous reaction kinetics.*

CO4 : *Formulate distributed parameter model for various stage operations like binary distillation, multi stage counter current extraction and distributed systems like heat exchanger, tubular reactors and membrane separation unit.*

CO5 : *Apply numerical methods to solve modeled equations using simulation tool Matlab/simulink.*

INTRODUCTION AND FIRST PRINCIPLES

Definition, Uses of Mathematical Models - Principles of formulation, Classification of Process Models, Fundamental laws: Total Continuity equation- Macroscopic and Microscopic Examples, Component Continuity Equation - Macroscopic and Microscopic Examples, Energy equation, Equations of motion, Transport equations, Equations of State, Equilibrium and Chemical Kinetics. Simple Examples. **(10)**

BASIC MODELING

Simple Hydraulic Tank, Variable flow hydraulic tank, Enclosed tank, Adiabatic compression in gas space, Mixing vessel, Mixing with reaction, Reversible reaction, Steam jacketed vessel, Continuous - Flow boiling system. **(9)**

STAGED OPERATIONS AND DISTRIBUTED SYSTEMS

Staged Operations: Counter current extraction, Distillation columns - Binary distillation. Distributed systems: Counter current Heat Exchanger, Membrane Separation Process, tubular Reactor and Evaporators. **(9)**

FITTING DATA TO MODEL

Fitting Data to Linear Model, Multi-Linear Models, Matrix representation of Multi Linear Model, Fitting Data to Quadratic Model, Cubic Model and Polynomial model using Regression, Power Law models. Performance Criteria to check quality model, Co-efficient of Determination (R^2). **(9)**

SIMULATION OF BASIC MODELS

MATLAB/Simulink - Introduction, Basic components, Operational Blocks, Examples - Three CSTR's in series, Gravity flow tank, Numerical Solution of Model using RK4, Euler's explicit and implicit techniques, Introduction ODE 45 Solver, Dynamic Simulation of Simple Tank, Variable Flow Tank, Enclosed Tank with isothermal Compression, Mixing Vessel, Mixing Vessel with Reaction using ODE 45 Solver. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Luyben, W.L.: Process Modeling, Simulation and Control for Chemical Engineers, McGraw Hill, International Student Edition, Second Edition, 1996.*
2. *Franks, R.G.E.: Modeling and Simulation in Chemical Engineering, Wiley-Interscience, New York, 1972.*
3. *Amiya.K.Jana, Chemical Process Modeling and Computer Simulation, Prentice Hall India Pvt. Ltd, Second Edition,2011.*

REFERENCES

1. *Himmelblau, D.M. and Bischoff, K.B,: Process Analysis and Simulation, Wiley, 1968.*
2. *Ramirez,W.F.: Computational methods for Process Simulation, Butterworths, NewYork, 2nd Edition, 1998*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3						3		2	3	
CO2	3													
CO3	3	2	3	2		1							2	
CO4	3	2	2	2		1							2	
CO5	3	3	1	2		1							2	

(1: Slight, 2: Moderate 3: Substantial)

19CH74 - ELECTROCHEMICAL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students would be able to

CO1 : *Determine interfacial tension, charge density and cell potential*

CO2 : *Estimate electrode over potentials and limiting currents*

CO3 : *Design electrochemical reactors using various electrodes*

CO4 : *Explain the principles and working conditions of primary and secondary batteries*

CO5 : *Demonstrate electrode reactions*

REVIEW OF BASICS IN ELECTROCHEMISTRY

Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday's laws, origin of potential, single electrode potential, theories on electrical double layer. Thermodynamics of ideally polarizable and non-polarizable interfaces- Lipman equation- determination of interfacial tension, charge density, surface excess and double layer capacitance by electro capillary & bridge methods- Helmholtz, Gouy-Chapman and stern models of double layer with discussion of potential and charge distribution inside the double layer-contact adsorption and its determination.Electrochemical series, electrochemical cells, Nernst equation and its application, reference electrodes- SHE, Ag/AgCl, Calomel. **(9)**

MASS TRANSFER IN ELECTROCHEMICAL SYSTEMS

Concepts of equilibrium potential, Nernst equation, overpotential and its different types, equilibrium exchange current density-derivation of Butler-Volmer equation -high field and low field approximations - charge transfer resistance and polarizability of the interface - concepts of rate determining step, Stoichiometric number, reaction order - Determination of kinetics parameters by Tafel and linear polarization methods.Current-voltage relationships & estimation of mass transfer co-efficient, plug flow & cstr systems model, thermal behavior of reactors, convective diffusion equation & current distribution, dispersion models & optimization of electrochemical reactor. **(9)**

ELECTRODES AND SEPARATORS

Metals- graphite- lead dioxide- titanium substrate insoluble electrodes, iron oxide- semiconducting type, etc. Metal finishing- cell design, types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, swiss roll cell, plug flow cell, design equation, figures of merit of different types of electrochemical reactors. **(9)**

ELECTROCHEMICAL PROCESSES

Electrodeposition, electrorefining, electroforming, electropolishing, anodizing, selective solar coatings, types of batteries- primary and secondary batteries, fuel cells.Corrosion studies- Introduction to corrosion, corrosion theories, derivation of potential-current relations of activities controlled and diffusion controlled corrosion process. Potential- pH diagram, forms of corrosion- definition, factors and control method of various forms of corrosion- corrosion control measures, industrial boiler water corrosion control, protective coatings, vapor phase inhibitors, cathodic protection, sacrificial anodes, paint removers. **(9)**

ELECTROANALYTICAL TECHNIQUES

Study of electrode reactions: Cyclic voltammetry - reversible, irreversible and quasi reversible processes - study of reaction mechanism, adsorption, quantitative applications - spectroelectrochemistry - scanning electrochemical microscopy. Controlled potential and current techniques: Chronoamperometry -pulse voltammetry - square wave and staircase voltammetry - AC voltammetry - stripping voltammetry - bulk electrolysis - chronopotentiometry - Tafel polarisation - electrogravimetry - flow analysis. Electrochemical impedance spectroscopy: Faradaic impedance - equivalent circuits - AC impedance- Bode and Nyquist plots - applications. Electrochemical instrumentation: Operational amplifiers - current and voltage feedback - potentiostat and galvanostat - troubleshooting in electrochemical systems. **(9)**

TEXT BOOKS

1. *Joseph Wang. Analytical Electrochemistry. Germany, Wiley, 2004.*
2. *Allen Bard and Larry Faulkner. Electrochemical methods: fundamentals and applications. India, Wiley India Limited, 2004.*

REFERENCES

1. *Evgenij Barsoukov and Ross Macdonald.Impedance Spectroscopy: Theory, Experiment and Applications". Wiley, 2005.*
2. *Bagotsky. Fundamentals of Electrochemistry. Wiley, 2006.*

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1			1										
CO2		1											1	
CO3			2											
CO4			1		1									
CO5				1						1				1

(1: Slight, 2: Moderate 3: Substantial)

19CHL76 - PROCESS EQUIPMENT DESIGN AND DRAWING

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Design storage and agitator vessel for the specified requirement as per standard codes.*

CO2 : *Design shell and tube heat exchangers and evaporators for the industrial demand by considering standard codes.*

CO3 : *Compute the design parameters of distillation columns, absorption towers and rotary drier for the given duty according to standards codes.*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

LIST OF EXERCISE

1. Detailed design and drawing of Agitator vessel
2. Detailed design and drawing of Storage vessel
3. Process and mechanical design of Shell and Tube Heat Exchanger (Cooler, Condenser & Reboiler)
4. Process and mechanical design of evaporator
5. Process and mechanical design of Distillation column
6. Process and mechanical design of Absorption column
7. Process and mechanical design of Rotary Drier

TOTAL : 60

TEXT BOOKS

1. *Don W. Green, Robert H. Perry, Perry's Chemical Engineers' Handbook, Eighth Edition, McGraw Hill, 2007.*
2. *Indian Standard Codes:*
   - *(a) IS: 2825 - 1969: Code for Unfired Pressure Vessels.*
   - *(b) IS: 4049 - 1979: Specifications for formed ends for Tanks and Pressure vessels.*
   - *(c) IS: 4179 - 1967: Sizes of Process Vessels and their Leading Dimensions.*
   - *(d) IS: 4864 to 4870 - 1968: Specifications for Shell Flanges for Vessels and Equipment.*
   - *(f) IS: 803 - 1962: Code of practice for Design, Fabrication and Erection of Mild Steel Cylindrical Welded Oil Storage Tanks. (Published by Bureau of Indian Standards, New Delhi).*
   - *(g) ASME Section 8 and 9*
3. *Joshi M.V., Process Equipment Design, Third Edition, MacMillan, India, 2004.*
4. *Bhattacharya.B.C., Introduction to Chemical Equipment Design, CBS Publishers and Distributors,New Delhi, 1985.*

5. *Coulson J.M., Richardson J.F., Sinnott R.K., Chemical Engineering, Vol. VI, Maxwell-Macmillan, New York, 1989.*
6. *Kern, D.Q.: Procss Heat Transfer, McGraw Hill (ISE), (1999).*
7. *Dawande,S.D.: Process Design of Equipments, Central Techno Publications, Nagpur, 1999*

REFERENCES

1. *Brownell, L.E, & Young, E.H.: Process Equipment Design, Wiley Eastern, New Delhi, (1977).*
2. *Smith, B.D.: Design of Equilibrium Stage Processes, McGraw Hill, New York, (1963).*
3. *Ludwig, E.E.: Applied Process Design for Chemical & Petrochemical Plants, Vols. I, II & III, (2nd Ed.), Gulf Publishing Company, Texas, (1977, 1979, 1983).*
4. *Strigle, R.F.: Random Packings & Packed Towers (Design & Application), Gulf Publishing Company, Texas, (1987).*
5. *Fraas, A.P. & Ozisik, M.N.: Heat Exchanger Design, (2nd Ed.), John Wiley, New York, (1989).*
6. *Bednar, H.H.: Pressure Vessel Design Handbook, (2nd Ed.), CBS Publishers & Distributors, New Delhi, (1989).*
7. *Backhurst, J.R. & Harker, J.H.: Process Plant Design, Heinemann Books, London, (1973).*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3						3		2	3	
CO2	3													
CO3	3	2	3	2		1							2	
CO4	3	2	2	2		1							2	
CO5	3	3	1	2		1							2	

(1: Slight, 2: Moderate 3: Substantial)

19CHL77 - PROCESS CONTROL AND SIMULATION LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Evaluate the dynamics of first order system and analyze the behaviour of second order system for step and impulse inputs.*

CO2 : *Estimate the control valve flow coefficient, flow characteristics and examine the response of ON-OFF, P, PI and PID controllers.*

CO3 : *Simulate the unit operations equipment's using Software Packages Such As MATLAB, Fluent Ansys.*

CO4 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO5 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

EXPERIMENTS

- Determination of Control Valve Co-Efficient
- Calibration of Pressure Gauge
- Flow Characteristics of Control Valve
- Dynamic Response of First Order System
- Dynamic Response of Second Order System
- Response of A Non-Interacting System
- Transient Response of Proportional Control
- Transient Response of PI Control
- Transient Response of PD Control
- Transient Response of PID Control
- Simulation of Chemical Process Models using Software Packages Such As MATLAB, FLUENT, Excel and Python

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	0	2	2	0	0	1	0	2	0	0
CO2	3	2	2	1	0	2	2	0	0	2	0	2	0	0
CO3	3	3	3	1	0	3	1	0	0	0	0	2	0	0
CO4	3	3	3	3	0	2	2	0	0	0	0	3	0	0
CO5	2	2	1	0	0	3	2	0	0	0	0	2	0	0

- (1: Slight, 2: Moderate 3: Substantial)

19CH78 - PROJECT WORK PHASE-I

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, the students are able to

CO1 : *Prepare a detailed report on the project work carried out by the students.*

CO2 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO3 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

The students should carry out the project work allotted to them in the stipulated time duration. They should submit a detailed report prior to the final semester examinations. The dates for allocation of the questions and for the submission of the final report will be notified by the department. The following Instructions should be followed by the students regarding the project.

INSTRUCTIONS

1. The answers should be made on preferably 22 x 28.5 cm. size (A-4 Size) papers and the number of pages should be around fifty.
2. The written part should be type written.
3. Drawings must be as blue/ammonia prints or in Indian ink on good quality drawing paper.
4. Detailed flow sheets for the Process, Material and Energy should be given.
5. All symbols used in the flow diagrams should follow the norms prescribed as per IS. Code 3233-1965 (Recommendations on Graphical Symbols for Process Flow Diagrams).
6. All calculations should be made by application of fundamental principles and from available published data.
7. All Physical and Thermodynamic properties required for calculations should be obtained from standard Text books, Handbooks or International Critical Tables. In the absence of such data these properties must be calculated using other known techniques (like group contribution, etc.,). No data should be assumed.
8. Design of equipments should be from first principles as per Indian Standard Codes and other standard text and REFERENCES.
9. A complete drawing of the designed equipment should be furnished.
10. All dimensions, mechanical details and materials of construction should be furnished as per norms prescribed in IS-696: 1972 (Code of Practice for Engineering Drawings). Wherever possible detailed or working drawings should be given.
11. Complete layout diagrams including conveying equipment must be furnished and the floor area should be evaluated for calculating building costs.
12. Cost estimation must be done as per methods followed by text and REFERENCES in Cost Engineering. Current market prices should be obtained from Trade literature or periodicals.
13. References must be given in detail to all sources of published information made use of by the students. The names of the journals/periodicals should be abbreviated as in the Chemical Abstracts (Published by the American Chemical Society).
14. All calculations should be done in SI. Units only.

19CH84 - PROJECT WORK PHASE - II

L	T	P	C
0	0	10	5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, the students are able to

CO1 : *Prepare a detailed report on the project work carried out by the students.*

CO2 : *Conduct experiments to solve complex engineering problems effectively as an individual or team work.*

CO3 : *Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.*

The students should carry out the project work allotted to them in the stipulated time duration. They should submit a detailed report prior to the final semester examinations. The dates for allocation of the questions and for the submission of the final report will be notified by the department. The following Instructions should be followed by the students regarding the project.

INSTRUCTIONS

1. The answers should be made on preferably 22 x 28.5 cm. size (A-4 Size) papers and the number of pages should be around fifty.
2. The written part should be type written.
3. Drawings must be as blue/ammonia prints or in Indian ink on good quality drawing paper.
4. Detailed flow sheets for the Process, Material and Energy should be given.
5. All symbols used in the flow diagrams should follow the norms prescribed as per IS. Code 3233-1965 (Recommendations on Graphical Symbols for Process Flow Diagrams).
6. All calculations should be made by application of fundamental principles and from available published data.
7. All Physical and Thermodynamic properties required for calculations should be obtained from standard Text books, Handbooks or International Critical Tables. In the absence of such data these properties must be calculated using other known techniques (like group contribution, etc.,). No data should be assumed.
8. Design of equipments should be from first principles as per Indian Standard Codes and other standard text and REFERENCES.
9. A complete drawing of the designed equipment should be furnished.
10. All dimensions, mechanical details and materials of construction should be furnished as per norms prescribed in IS-696: 1972 (Code of Practice for Engineering Drawings). Wherever possible detailed or working drawings should be given.
11. Complete layout diagrams including conveying equipment must be furnished and the floor area should be evaluated for calculating building costs.
12. Cost estimation must be done as per methods followed by text and REFERENCES in Cost Engineering. Current market prices should be obtained from Trade literature or periodicals.
13. References must be given in detail to all sources of published information made use of by the students. The names of the journals/periodicals should be abbreviated as in the Chemical Abstracts (Published by the American Chemical Society).
14. All calculations should be done in SI. Units only.

19CHE01- WATER CONSERVATION AND MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After the completion of the course students would be able to

CO1 *: Understand the concepts of Water conservation and management.*

CO2 *: Manage and Conserve quality water for sustainable development*

CO3 *: Gain knowledge on sources of water pollution and environmental standards.*

CO4 *: Knowledge on water conservation and recycling.*

CO5 *: Provide solutions for Water management in industries.*

INTRODUCTION

Concepts of Water Management, Water Cycle, Water Storage, Water Quality, Need for Water conservation - homes, work place and industries. **(9)**

WATER MANAGEMENT

Water Quality- use and controlled use of quality water, water flow measurements, test for salinity, water sanitation, water audits. **(9)**

MANAGEMENT OF WATER QUALITY

Water Pollution, types and sources of pollution, environmental guidelines for water quality. **(10)**

WATER CONSERVATION AND RECYCLING

Perspective on recycle and reuse, Waste water reclamation, Types of Water Conservation - Rain Water harvesting, roof catchment systems. **(9)**

CASE STUDIES

Water conservation and Management in agriculture, process industry, service industry, construction industry. **(8)**

TEXT BOOKS

1. *Rao M N. & Datta, A.K, Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd., 3rd Edition, 2008.*
2. *Glenn O. Schwab, Soil and Water Conservation Engineering, Wiley India Pvt.Ltd., 4th Edition, 2009*

REFERENCES

1. *F.F. Sturm, Goen Ho,Kuruvilla Mathew, Water Auditing and Water Conservation,IWA Publishing*
2. *Mukund Narayan, Satyendra Kumar, Nilesh Biwalkar, Reference Manual Of Soil & Water Conservation Engineering, BioTech Books Publishing.*

Mapping of Course Outcomes with Program Outcomes

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1						3	2						
CO2							3							
CO3	1	1				2	3							
CO4		1												
CO5			1						2				1	

19CHE02 - SUSTAINABILITY ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After the completion of the course the students would be able to

CO1 *: Understand the importance of Sustainable Environment.*

CO2 *: Know about the types of water conservation and its importance*

CO3 *: Acquire knowledge on the Environmental Acts*

CO4 *: Develop an assessment technique for Sustainable development*

CO5 *: Assess and report a real time problem and solutions for the Sustainable development*

SUSTAINABILITY AND ITS RELEVANCE

Introduction to the idea of sustainability and its relevance, Social issues and the environment from unsustainable to sustainable development. **(8)**

WATER CONSERVATION FOR SUSTAINABLE ENVIRONMENT

Water conservation, rainwater harvesting, watershed management, resettlement and rehabilitation of people, its problems and concerns. **(8)**

ENVIRONMENTAL ACTS

Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act. Issues involved in enforcement of environmental legislation- public awareness. **(11)**

SUSTAINABILITY - A CHAIN APPROACH

Tools used to ensure sustainability in engineering activities (environmental management systems and environmental impact assessment); green buildings; green chemistry; sustainable cities; sustainable transportation; sustainable sources of energy; economic and social factors affecting sustainability. **(10)**

CASE STUDIES

Case studies, environmental ethics, issues and possible solutions- climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Wasteland reclamation, consumerism and waste products. **(8)**

TEXT BOOKS

1. *Bhavik.R. Bhakshi, Sustainable Engineering- Priniciple and practice ,Cambridge University Press.*
2. *Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.*

REFERENCES

1. *Dara SS (2005) A Text Book of Environmental Chemistry and Pollution Control, S. Chand & Company, New Delhi.*
2. *Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.*

Mapping of Course Outcome with Program Outcomes

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1						3	2						
CO2							3							
CO3	1	1				2	3							
CO4		1												
CO5			1						2				1	

19CHE03 - NANOSCIENCE AND NANOTECHNOLOGY FOR CHEMICAL SCIENCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Demonstrate a systematic knowledge of the range and breadth of application of nanomaterials*

CO2 : *Review critically the potential impact in all classes of materials of the control of nanostructure*

CO3 : *Describe the methods for the chemical and nano structural characterization of such materials and select appropriate techniques for a range of situations*

CO4 : *Outline the nanotechnology production routes currently available*

CO5 : *Identify possible opportunities for nanomaterials in product development and enhancement*

BULK SYNTHESIS

Synthesis of bulk nano-structured materials -sol gel processing -Mechanical alloying and mechanical milling- Inert gas condensation technique - Nanopolymers - Bulk and nano composite materials. **(9)**

CHEMICAL APPROACHES

Self-assembly, self-assembled monolayers (SAMs). Langmuir-Blodgett (LB) films, clusters, colloids, zeolites, organic block copolymers, emulsion polymerization, templated synthesis, and confined nucleation and/or growth. Biomimetic Approaches: polymer matrix isolation, and surface-templated nucleation and/or crystallization. Electrochemical Approaches: anodic oxidation of alumina films, porous silicon, and pulsed electrochemical deposition. **(9)**

PHYSICAL APPROACHES

Vapor deposition and different types of epitaxial growth techniques- pulsed laser deposition, Magnetron sputtering - Micro lithography (photolithography, soft lithography, micromachining, e-beam writing, and scanning probe patterning). **(9)**

NANOPOROUS MATERIALS

Nanoporous Materials - Silicon - Zeolites, mesoporous materials - nanomembranes and carbon nanotubes - AgX photography, smart sunglasses, and transparent conducting oxides -molecular sieves - nano sponges. **(9)**

APPLICATION OF NANOMATERIALS

Molecular Electronics and Nanoelectronics - Nanobots- Biological Applications - Quantum Devices - Nanomechanics - Carbon Nanotube - Photonics- Nano structures as single electron transistor -principle and design. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Cao G. Nanostructures, Nanomaterials, Synthesis, Properties and Applications, Imperial College Press, 2004.*
2. *Gaddand,W., Brenner,D., Lysherski,S. and Infrate, G.F., Handbook of NanoScience, Engineering and Technology, CRC Press, 2002.*

REFERENCES

1. *Gaponenko,S.P. Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1980.*
2. *Barriham,K., Wedensky,D.D. Low dimensional semiconductor structures, fundamental and device applications, Cambridge University Press, 2001.*
3. *George,J. Preparation of Thin Films, Marcel Dekker, Inc., New York. 2005.*

Mapping of Course Outcome with Program Outcomes

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	2	3		3					2	3	1	
CO2		2	3	3		3					2	3	1	
CO3		2	3	3		3		1				3	1	
CO4		2	3	3		3		1			2	3	1	
CO5		2	3	3		3		1			2	3	1	

1- Slight; 2- Moderate; 3-Substantial

19CHE04 - POLYMER SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After the completion of course, students are able to

CO1 *: Understand the basic concepts of polymer science and identify the polymerization techniques and its kinetics.*

CO2 *: Assess the molecular weight distribution techniques, glass transition, and solution properties like thermodynamics, phase separations.*

CO3 *: Explain the morphology, rheology, mechanical and thermal properties of bulk polymers.*

CO4 *: Compare and analyze the manufacture and properties of commercial polymers.*

CO5 *: Apply the knowledge in assessing the polymeric, fiber and elastomer processing techniques.*

INTRODUCTION TO POLYMERS AND POLYMERIZATIONS

Polymers - Basic concepts - Classification - Natural and synthetic polymers, thermoplasts and thermosets. Polymerization - Addition, condensation, ring opening, copolymerization, ionic and coordination polymerization - Kinetics of polymerization. **(9)**

POLYMER ANALYSIS AND SOLUTION PROPERTIES

Molecular weight and distribution- Number average, weight average, viscosity average and Z-average molecular weight - Determination by light scattering, solution viscosity and gel permeation chromatography. Degree of polymerization.Glass transition temperature - Theory and measurements. Polymer solutions- Solubility and swelling, Thermodynamics of polymer solutions, Phase separation in polymer solutions. **(9)**

STRUCTURE AND PROPERTIES OF BULK POLYMERS

Morphology and order in crystalline polymers -crystal structure of polymers, morphology of polymer single crystals. Rheology and the mechanical properties of polymers - Viscous flow, kinetic theory of rubber elasticity and viscoelasticity, stress-strain behavior, compression vs tensile tests, deformation of solid polymers. Thermal analysis of polymers using TGA and DSC. **(9)**

MANUFACTURE AND PROPERTIES OF COMMERCIAL POLYMERS

Hydrocarbon plastics and elastomers - low density (branched) polyethylene, high density (linear) polyethylene, polypropylene, natural rubber, rubbers derived from butadiene. Other carbon chain polymers - polystyrene, acrylic polymers, poly(vinyl esters) and derived polymers. Heterochain thermoplastics - Polyamides. Thermosetting resins - Phenolic resins and amino resins. **(9)**

POLYMER PROCESSING TECHNIQUES

Plastic molding techniques - Injection, blow, extrusion and compression. Processing agents - Fillers, plasticizers, and other additives. Fiber Technology - Textile and fabric properties, spinning - wet and dry methods - fiber treatments. Elastomer technology - Compounding and elastomer properties, vulcanization and reinforcement. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Billmeyer F.W., Textbook of Polymer Science, Third Edition, Wiley Interscience, 1984.*
2. *Charles E., Carraher Jr., Seymour/carraher's polymer chemistry, Seventh Edition, CRC Press, 2012.*

REFERENCES

1. *Fried J.R., Polymer Science and Technology, Second Edition, Prentice Hall of India Pvt Ltd., 2003.*
2. *Bhatnagar M.S., A Textbook of Polymers, Vol. 2, S.Chand and Company Ltd., 2012.*

CO & PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												1	
CO2		2		2	2					1				1
CO3		2		2	2					1				1
CO4		2		2						1				1
CO5		2		2	2									1

19CHE05 - RENEWABLE ENERGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 *: Understand the Need, importance and scope of non conventional and alternate energy resources.*

CO2 *: Understand significant role of solar energy.*

CO3 *: Know the importance of Wind Energy.*

CO4 *: Analyse the utilization of Biogas plants and geothermal energy*

CO5 *: Understand the concept of energy Conservation.*

INTRODUCTION

Introduction (world energy status, current energy scenario in India, environmental aspects of energy utilization, energy and sustainable development **(9)**

SOLAR ENERGY

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications. **(9)**

WIND ENERGY

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator. **(9)**

BIO-MASS AND GEOTHERMAL ENERGY

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking Geothermal Energy- Resources, types of wells, methods of harnessing the energy, scope in India. **(9)**

ENERGY CONSERVATION TECHNIQUES

Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ristinen RA. Kraushaar JJ. Energy and the Environment, 2nd edition, John Willey & Sons, 2006*
2. *Kishore VVN. Renewable Energy Engineering and Technologies, TERI, 2009*

REFERENCES

1. *Banerjee BP. Handbook of Energy and Environment in India, Oxford University Press, 2005, India.*
2. *J W Twidell & A D Weir, Renewable Energy Resources, ELBS, 2006*
3. *Tiwari GN. Ghoshal MK. Fundamental of Renewable Energy Sources, Narosa, 2007.*

CO & PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3			2	3			2				3
CO2	3		3			2	3			2				3
CO3	3		2			2	3			2				3
CO4	3		2			2	3			2				3
CO5	3		3			2	3			2				3

19CHE06 - ADVANCED SEPARATION PROCESSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to:

CO1 : *Identify and label the recent developments in separation techniques and its properties through the process concepts.*

CO2 : *Recognize the types and choice of membrane reactors and its several separation techniques.*

CO3 : *Apply and analyze the functioning of separation processes and its economics in the industries.*

CO4 : *Conclude the controlling factors; classify the equipment and its applications used in various ionic separations.*

CO5 : *Compare the existing separating techniques with the other techniques like pervaporation to achieve the better processing methods can be used in modern separations of solids, liquids and gases.*

INTRODUCTION

Review of conventional processes, recent advances in separation techniques based on size and surface properties. Process concept - theory and equipment used in cross flow filtration. Surface based solid - liquid separations involving a second liquid. **(9)**

MEMBRANE SEPARATIONS

Types, choice of membrane, plate and frame, tubular, spiral wound and hollow fiber membrane reactors - relative merits. Commercial, pilot plant and laboratory membrane permeators involving dialysis. microfiltration, ultrafiltration, nanofiltration & reverse osmosis - Economics of membrane operations.**(9)**

SEPARATIONS BY ADSORPTION TECHNIQUES

Mechanism, types and choice of adsorbents, foam separation - surface adsorption, nature of foams. Normal adsorption techniques, types of equipment and commercial process, recent advances and process economics. **(9)**

IONIC SEPARATIONS

Controlling factors, applications, types of equipment employed for electrophoresis, dielectrophoresis, electrodialysis and commercial processes. **(9)**

OTHER TECHNIQUES

Pervaporation - basic principles, mass transfer in pervaporation, factors affecting pervaporation and permeation techniques for solids, liquids and gases. Industrial viability and examples, zone melting-equilibrium diagrams, adductive crystallization - fundamental and process techniques. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Kaushik Nath, Membrane separation processes, First Edition, Prentice Hall publishers, 2008.*

REFERENCES

1. *Herbert M.Schoen, New Chemical Engineering Separation Techniques, Interscience publishers, 1962.*
2. *Svarovsky L., Solid-Liquid separation, Fourth Edition, Butterworth and co publishers, 2001.*

CO & PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1			1	1						3	1
CO2	1	2	2	1	1	1	2						1	
CO3	1	3	1			2	2						3	2
CO4	1	2	1			1	1						2	
CO5	1	2				1	1						1	

19CHE07 - ENVIRONMENTAL POLLUTION AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After the completion of the course the students would be able to

CO1 *: Understand the importance on conservation of environment and its rules and regulations.*

CO2 *: Ascertain the standards of Air Pollutants and its effects.*

CO3 *: Analyse the physical and Chemical parameters of water and able to assess the water quality*

CO4 *: Distinguish between different types of Solid waste and disposal techniques.*

CO5 *: Assess the ways to control pollution in industries.*

ENVIRONMENTAL ACTS

Introduction and importance of Environmental Pollution, Types of environments and their pollutants. Classification of pollutants. Legislative aspects including Water act. 1974, Air Act 1981 and Effluent standards. EPA. **(8)**

AIR POLLUTION

Sources and effects of different air pollutants, Sampling and analysis of air pollutants, Air pollution control methods and equipment, Cyclone Separator, Baghouse, ESP, Venturi Scrubber **(8)**

WATER POLLUTION

Sources, sampling and classification of water pollutants, determination of basic parameters and computations associated with: BOD, COD, TS, TDS, SS; Waste water treatment: primary, secondary, tertiary and advanced; aerobic treatment with special reference to activated sludge and trickling filter. **(9)**

SOLID WASTE MANAGEMENT

Sources and classification, public health aspects, Methods of collection and disposal methods: open dumping, landfill, incineration, composting, vermiculture; Solid waste management using bioremediation for specific pollutants like chromium. Mercury, ammonia / urea, phenolic sludges. Management and handling of Bio-medical waste; E-waste - classification and re-use and disposal; Hazardous waste management - Electro-chemical and photo-chemical oxidation - dye waste, chrome slag. **(10)**

POLLUTION CONTROL IN PROCESS INDUSTRIES

Fertilizer industries, Petroleum refineries and petrochemical units, pulp and paper industries, Tanning industries, Sugar industries, Dairy, Alcohol industries, Electroplating and metal finishing industries, Radioactive wastes, ranking of wastewater treatment alternatives- Case Studies. **(10)**

TEXT BOOKS

1. *C S Rao ,Environmental Pollution Control Engineering Third edition , New age International Publishers.*
2. *S.P.Mahajon, Pollution Control in Process Industries, Tata McGraw Hill Education.*

REFERENCES

1. *Wastewater Engg. - Metcalf & Eddy, Tata McGraw Hill Education.*
2. *S.J.Arceivala, Wastewater treatment for pollution control and reuse, Tata McGraw Hill Education.*
3. *Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media*

MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1						3	2						
CO2							3							
CO3	1	1				2	3							
CO4		1												
CO5			1						2				1	

19CHE08 - COLLOID AND INTERFACIAL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to:

CO1 *: Understand the development of the concept of interfacial phenomena in chemical engineering.*

CO2 *: Analyse the different forces involved in interfacial phenomena.*

CO3 *: Understand the concepts of mesoscale thermodynamics and mesoscale phenomena.*

CO4 *: Recognize the stability of nanoparticle dispersions.*

CO5 *: Understand the importance of nanofluidics and advanced and functional Interfaces.*

SURFACE TENSION, ADHESION AND CAPILLARITY

General introduction of colloids, interfaces, surfactants, and micellization. Effects of confinement and finite size; Concepts of surface and interfacial energies and tensions; Apolar (van der Waals) and polar (acid-base) components of interfacial tensions. Young-Laplace equation of capillarity; examples of equilibrium surfaces. **(9)**

INTERMOLECULAR, NANOSCALE AND INTERFACIAL FORCES

Intermolecular, nanoscale and interfacial forces in organic, polymeric, biological and aqueous systems. Van der waals, electrostatic double layer, acid-base interactios including hydrophobic attraction and hydration pressure. **(9)**

MESOSCALE THERMODYNAMICS AND MESOSCALE PHENOMENA

Mesoscale thermodynamics and Mesoscale phenomena in soft matter & applications Gibb's treatment of interfaces, concept of excess concentration, variation of interfacial tension with surface concentration, Adhesion, wetting, nucleation, flotation, patterning of soft material by self organization and other techniques. **(9)**

STABILITY OF NANOPARTICLE DISPERSIONS

Stability of nanoparticle dispersions: DLVO and DLVO like theories and kinetics of coagulation plus general principles of diffusion in a potential field/Brownian movement. **(9)**

NANOFLUIDICS

Nanofluidics and advanced & functional Interfaces: Stability of thin (< 100 nm) film, self-organization in confined systems, mesoscale patterning. Superhydrophobicity, functional coatings, structural colours, nano-adhesives, nanocomposites. **(9)**

TOTAL : 45

TEXT BOOKS

1. *P. C. Hiemenz, and R. Rajagopalan, Principle of colloid and surface chemistry, MercelDekher, 3rd edition,1997.*
2. *Berg, J.C. "An Introduction to Interfaces and Colloids: The Bridge to Nanoscience", World Scientific (2010).*

REFERENCES

1. *Physical Chemistry of Surfaces, Arthur W. Adamson, 5th edition, Wiley, 1990.*
2. *Foundations of Colloid Science, Robert J. Hunter, Clarendons, Oxford, Volume 1, 1989.*

CO & PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1				1							3	
CO2	1	1				1							2	
CO3	1													
CO4	1	1												
CO5	3	1				1							2	1

19CHE09 - ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 *: Plan to optimize energy using systems and procedures to meet energy demand*

CO2 *: Describe the Relationship between Energy & Environment.*

CO3 *: Examine the relationship between energy systems and society*

CO4 *: Use optimization techniques for conservation of energy in chemical industries*

CO5 *: Evaluate the production rate and analyze the cost from economic balance for energy consumption.*

PLANNING FOR ENERGY NEEDS

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modelling and optimal mix of energy sources. **(9)**

ENERGY AND ENVIRONMENT

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environment population and technology. **(9)**

ENERGY AND SOCIETY

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit. **(9)**

MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilisers, cement, pulp and paper, food and chlor-alkali industries; conservation using optimization techniques. **(9)**

ECONOMIC BALANCE IN ENERGY CONSUMPTION

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs **(9)**

TOTAL : 45

TEXT BOOKS

1. *Jerrold H Kertz, Energy Conservation and Utilization, Allyn and Bacur Inc, 1976.*
2. *Gemand M Gramlay, Energy, Macmillion publishing Co, Newyork, 1975.*

REFERENCES

1. *Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc., 1976.*
2. *Gramlay G. M., Energy, Macmillan Publishing Co., New York, 1975.*
3. *Rused C. K., Elements of Energy Conservation, McGraw-Hill Book Co., 1985.*

CO & PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3			2	3			2				3
CO2	3		3			2	3			2				3
CO3	3		2			2	3			2				3
CO4	3		2			2	3			2				3
CO5	3		3			2	3			2				3

19CHE10 - BIOCHEMICAL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Distinguish the chemical and biochemical process and explain the basic terminologies of biochemical engineering.*

CO2 : *Demonstrate the basic concept of enzyme engineering and develop kinetic equation for enzyme catalyzed reactions.*

CO3 : *Analyze the factors affecting the cell growth and develop models for cell growth.*

CO4 : *Apply concepts of mechanical operations, mass transfer and heat transfer in biochemical processes and microbiological systems.*

CO5 : *Design bioreactors for Downstream Processes and Effluent Treatment.*

INTRODUCTION

An overview of industrial biochemical processes with typical examples, comparison of chemical and biochemical processes, development and scope of biochemical engineering as a discipline. Industrially important microbial strains and their classification; structure; cellular genetics; typical examples of microbial synthesis of biologicals. **(9)**

ENZYMES AND ENZYME KINETICS

Enzymes fundamental concepts, classification of enzymes; industrial applications of enzymes; industrially important enzymes; mechanism of enzymatic reactions; Michaelis-Menten and Briggs Haldane equation; Models for complex enzyme kinetics; enzymes inhibition; factors affecting the reaction rates; industrial production, purification and immobilization; enzyme reactors with typical examples. **(9)**

MICROBIAL KINETICS

Typical growth characteristics of microbial cells; factors affecting growth; Monod`s equation; modeling of batch and continuous cell growth; immobilized whole cells and their characteristics. **(9)**

TRANSPORT IN MICROBIAL SYSTEMS

Newtonian and Non-Newtonian behavior of broths; agitation and mixing; power consumption; gas-liquid transport in cells; transfer resistances; mass transfer coefficients and their role in scale-up of equipments; enhancement of O2 transfer; heat transfer correlation; sterilization cycles and typical examples of heat addition during biological production. **(9)**

BIOREACTORS

Batch and continuous types; immobilized whole cell and enzyme reactors; high performance bioreactors; sterile and non-sterile operations; reactors in series with and without recycle; design of reactors and scale-up with typical examples. Downstream Processes and Effluent Treatment Recovery and purification of products; Different unit operations in down streaming with special reference to membrane separations; extractive fermentation; anaerobic treatment of effluents; typical industrial examples for downstream processing and effluent disposal. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Shuler M.L., Kargi F., Bioprocess Engineering Basic Concepts, Second Edition, Prentice Hall of India, 2002.*
2. *Bailey J.E., Ollis D.F., Biochemical Engineering Fundamentals, McGraw-Hill, International Edition, Second Edition, Reprint, New York, 2010.*

REFERENCES

1. *Lee J.M., Biochemical Engineering, First Edition, Prentice Hall, 1992 (Second Edition e-book 2001).*
2. *Blanch H.W., Clark D.S., Biochemical Engineering, Marcel Dekker, 1997.*
3. *Rao D.G., Introduction to Biochemical Engineering, Second Edition, McGraw Hill, 2010.*
4. *Doran P.M., Bioprocess Engineering Principles, Second Edition, Academic press, 1995.*

Mapping of Course Outcome with Program Outcomes

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	2	3		3					2	3	2	
CO2		2	2	3		3					2	3	2	
CO3	2	2	3	3	2	3		1				3	2	
CO4	3	2	2	3		3					2	3	2	
CO5	2	2	2	3	2	3					2	3	2	

Slight; 2- Moderate; 3-Substantial

19CHE11 - PROCESS ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of course, students will be able

CO1 *: Know about the basic concept of equipment in oil and gas industry.*

CO2 *: Know about the project execution, different phases in a project.*

CO3 *: Understand the software used for simulation and flow studies.*

CO4 *: Understand the PFD, P&ID for various processes.*

CO5 *: Understand the works in an EPC company.*

INTRODUCTION TO OIL AND GAS FACILITIES

Introduction to Oil and Gas Industry-Process description- Piping elements- Instruments: field instruments, control valves- Process equipment- Role of Process Engineer. **(9)**

INTRODUCTION TO PROJECT ENGINEERING

Elements in Project Execution, Different Phases of a Project-(Basic Engineering package-BEP, Front End Engineering Design-FEED, Proposal Engineering, EPC-EPCM Contract, LSTK), Elements of Engineering, Process Engineering Deliverables.

Introduction to Piping design engineering, Instrument Design Engineering. **(9)**

PROCESS SIMULATION AND DESIGN

Introduction and purpose- Software used for Simulation, Simulation inputs- Steady state simulation- Typical operation in simulation schemes- Heat and material balance generation, Dynamic Simulation Study and its uses. Introduction to Relief and Blow down Studies, Pipeline Flow assurance Study-Steady State and Transient, software used in Flow assurance Studies, Introduction to AIV/FIV studies, CFD analysis. **(9)**

ENGINEERING DIAGRAMS

Block flow diagram-Process/Utility flow diagram-Symbols for P&ID development: piping elements, control system-Operation & control philosophy-Cause and Effect chart- typical PID development for Glycol Dehydration unit, Process Safety Flow diagrams, SAFE Chart. Introduction to Plot plan, General arrangement drawings. **(9)**

FACILITIES ENGINEERING

Process Design Basis and Design Criteria, Overview of various process equipment and its design principles: Separators, Pumps, Compressors, Heat exchangers, Absorber column, Heaters, Air coolers, Storage Tanks, Line hydraulics (Gas, Liquid and Multiphase lines)- Pump Hydraulics- Control valve hydraulics, software used in Equipment design (Column, Heat Exchanger etc.). Introduction to various Codes and Standards followed in a PROJECT (API, TEMA, ISA etc. **(9)**

TOTAL : 45

REFERENCES

1. *Perry's Chemical Engineers' Handbook, Robert H. Perry, October 2007.*
2. *GPSA Engineering Data Book, Gas Processors Suppliers Association, 13th Edition 2012.*
3. *American Petroleum Institute (API) Standards.*
4. *ISA Standards*
5. *TEMA standards, Tubular Exchanger Manufacturers Association, Inc.*

Mapping of Course Outcomes with Program Outcomes

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3		3	3	3					3	
CO2	3		2	2		3	3	3						2
CO3	3		3	2	2		2	3						
CO4	3		2		2		3	3			1			
CO5	3	2		2			2	2						

(1: Slight, 2: Moderate 3: Substantial)

19CHE12 - PETROLEUM REFINERY ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students would be able to

CO1 : *Assess the quality of refinery products -Liquified Petroleum Gas (LPG), Gasoline, Jet fuel, Diesel, Kerosene and Lube oils using analytical procedures*

CO2 : *Ascertain distillation characteristics of crude and analyze the physical and chemical properties of refinery products*

CO3 : *Illustrate the processes of atmospheric distillation, vacuum distillation, gasoline treatment, kerosene treatment, lube treatment, wax removal from petroleum fractions and sulphur recovery*

CO4 : *Develop flowcharts for thermal and catalytic processes*

CO5 : *Design distillation column, tubestill heaters and evaluate the economics*

FUNDAMENTALS OF PETROLEUM REFINING

Origin, formation, exploration and composition of petroleum, Petroleum reserves in India, Classification of crude, Refinery products and Test methods - Liquefied Petroleum Gas (LPG), Gasoline, Jet fuel, Diesel, Kerosene and Lube oils. **(9)**

PETROLEUM PROCESSING DATA

API gravity, Characterization factor, Correlation Index, Viscosity index, Octane number, Cetane number, Smoke point, Flash and fire points, Pour point, Cloud point, Aniline point, Chemical Analysis Data - Elemental Analysis, Carbon Residue, Detailed Hydrocarbon Analysis, Hydrocarbon Family Analysis, Aromatic Carbon Content, SARA (Saturate Aromatics Resins and Asphaltenes) Analysis, Distillation characteristics - ASTM and TBP (True Boiling Point) interconversion by Riazi- Daubert and Daubert's method **(9)**

PETROLEUM FRACTIONATION AND TREATMENT TECHNIQUES

Crude desalting, Atmospheric and Vacuum distillation, Gasoline treatment - Lead doctoring, Merox Sweetening, Sulphuric acid treatment, Kerosene treatment - Liquid sulphur dioxide extraction, Lube treatment - Clay treatment, Phenol extraction, Furfural extraction, Duo-sol process, Wax and Purification - Dewaxing (without solvent), Ketone dewaxing, Sulphur Recovery by Claus process **(9)**

THERMAL AND CATALYTIC PROCESSES

Visbreaking, Delayed coking, Flexi Coking, Fluid Catalytic Cracking, Catalytic Reforming, Alkylation, Polymerisation, Isomerisation. **(9)**

EQUIPMENT AND DESIGN CALCULATIONS

Design concepts of crude oil distillation column, Tube still heaters - Design, Lobo-Evans method, Refinery Economics - Refining costs, Refining margins, Refinery complexity **(9)**

TOTAL : 45

TEXT BOOKS

1. *Baskara Rao B.K., Modern Petroleum Refining Processes, Fifth Edition, Oxford-IBH, New Delhi, 2008.*
2. *Mohammed A.Fahim, Taher A. Aleahhaf, Amal Sayed Elkilani "Fundamentals of Petroleum Refining".*

REFERENCES

1. *Nelson W.L., Petroleum Refinery Engineering, Fourth Edition, McGraw Hill, Auckland, 1985.*
2. *Bland, W.F., Davidson, R.L., Petroleum Processing Handbook, McGraw Hill, New York, 1973.*
3. *J.H. Gary and G.E. Handwerk "Petroleum Refinery Technologies and Economics"*

19CHE13 - DRUGS AND PHARMACEUTICALS TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students would be able to

CO1 : *Develop nomenclature for upcoming drugs and gain knowledge of therapeutic agents to be used for treatment.*

CO2 : *Estimate the pharmacokinetic parameters and analyze the transformation of drugs in the body.*

CO3 : *Employ standards of hygiene in the manufacturing processes of drugs and pharmaceuticals.*

CO4 : *Examine the constituents present in pharmaceutical and microbiological products.*

CO5 : *Formulate drug delivery systems to transport pharmaceutical agents in the body to achieve therapeutic effect.*

INTRODUCTION

Development, sources, and characteristics of drugs; Important terms used in chemistry of drugs- Medicinal Chemistry, Pharmacology, Pharmacophore, Gram positive and negative bacteria, virus, fungi ; Classification and nomenclature of drugs; **(6)**

PHARMACOKINETICS AND PHARMACODYNAMICS

Physico - chemical principles; Pharmacokinetics - Absorption Distribution, Metabolism and Excretion of Drugs; Bioavailability measurement - Plasma level-time and Urinary excretion studies; Basic Pharmacodynamics. **(9)**

MANUFACTURING PRINCIPLES

Compressed tablets and coating, Wet granulation, Dry granulation or Slugging, Capsules, Parenteral solutions, Oral liquids, Ointments, Good Manufacturing Practice as per Drugs and Cosmetics Act. **(9)**

PHARMACEUTICALS, MICROBIOLOGICAL PRODUCTS

Laxatives, Radiopharmaceuticals, Cardiovascular agents, Central Nervous System stimulants, External Antiseptics, Analgesics, Antacids, Antibiotics, Antineoplastic drugs, Antidiabetic drugs, Hormones, Vitamins. **(12)**

DRUG DELIVERY

Transdermal drug delivery, Polymers in drug delivery, Liposomal drug delivery, Nano drug delivery, Opthalmic drug delivery, Design of Controlled Drug Delivery Systems. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Chatwal G.R., Synthetic Drugs, Himalaya Publishing House, Delhi, 2009.*
2. *Brahmankar D.M. and Jaiswal S.B. Biopharmaceutics and Pharmacokinetics - A Treatise, Vallabh Prakashan, New Delhi, 2015.*
3. *Felton, Linda A., Remington : Essentials of Pharmaceutics, College of Pharmacy, Philadelphia, 2013.*

REFERENCES

1. *Juergen Siepmann, Ronald A. Siegel, Michael J. Rathbone, Fundamentals and Applications of Controlled Release Drug Delivery, Springer, 2011.*
2. *Tyagi O.D., Yadav M. A., Text Book of Synthetic Drugs, Anmol Publications, New Delhi, 2011.*
3. *Lachman L. Lieberman H.A. and Kanig J.L., The Theory and Practice of Industrial Pharmacy, Indian Edition, Varghese Publishing House, Mumbai, 2013.*

19CHE14 - FOOD TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students would able to

CO1 *: Understand the principles of Food Science and aware of the effects of Food Additives*

CO2 *: Apply the Preservation techniques in the practical and real world situations and problems.*

CO3 *: Gain Knowledge on various Food Packaging Technology.*

CO4 *: Incorporate the principles of food processing indifferent food sectors.*

CO5 *: Identify the government regulations for the Hygienic manufacture of foods.*

GENERAL ASPECTS OF FOOD INDUSTRY

Introduction, World food demand and Indian scenario, Control of food quality by regulatory mechanism in India, Constituents of food, Quality and nutritive aspects, Food additives, Standards, Deteriorative factors and their control, preliminary processing methods, conversion and preservation operation. **(8)**

FOOD PRESERVATION TECHNIQUES

Processing systems, Microbial survivor curves, Influence of external agents, Thermal death time, Spoilage probability. General methods of preservation by heat and cold dehydration, concentration, frying, irradiation, microwave heating, sterilization and pasteurization, fermentation and pickling, packing methods. **(10)**

PACKAGING TECHNOLOGY

Packaging - Introduction, Food protection, Product containment, Product communication, Product convenience, Innovations in food packaging, Food packaging and product shelf-life, Food canning technology. Heat sterilization of canned food, containers - metal, glass and flexible packaging. Canning procedures for Fruits, Vegetables, Meats, Poultry Marine products. **(10)**

PRODUCTION AND UTILIZATION OF FOOD PRODUCTS

Bakery, confectionery and chocolate products; Soft and alcoholic beverages; Dairy products; Meat; poultry and fish products, treatment and disposal of food processing wastes. **(8)**

FOOD PLANT SANITATION

Sanitation, Sanitation Laws , Regulations and guidelines, Establishment of Sanitary practices, Waste product handling, Role of HACCP in Sanitation, Good Manufacturing practices, Standard operating procedures. **(9)**

TOTAL : 45

TEXT BOOKS

1. *R. Paul Singh, Dennis R. Heldman., "Introduction to Food Engineering", Academic Press, 2014*
2. *Potter N.N., "Food Science", The AVI publishing Co., Fourth Edition, USA, 2013*
3. *Michael.M. Cramer, "Food Plant Sanitation : Design, Maintanance and Good Manufacturing Practices", CRC Press 2013.*

REFERENCES

1. *Ernest R.V., Elementary Food Science, Fourth Edition, Springer, 2001*
2. *Considine D.M., Considine G.D., Considine P.E., Foods and Food production Encyclopedia, Vol. 8, Van Nostrand - Reinhold, 1982*
3. *Heldman D.R., "Food Process Engineering", The AVI publishing Co., USA, 1975.*

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3				2						1			
CO2		1						2						
CO3				2						2				
CO4		2			1			2						2
CO5			2			2							1	

19CHE15 - PIPING AND INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Determine the process flow sheets to identify the various process alternatives and to develop the piping and instrumentation diagrams.*

CO2 : *Design and formulate piping drawings for the various manufacturing chemical equipment pressure vessels, Process vessels and absorber.*

CO3 : *Generate the process flow sheet and control strategies for the heat and mass transfer equipment Heat exchanger, reactors, dryers, Distillation column and Evaporators.*

CO4 : *Outline and design the safety systems to the processes for control variables temperature, pressure and flow by employing DCS and SIS.*

CO5 : *Identify the P&I diagrams design and HAZOPS and Risk analysis for the application of process industries.*

INTRODUCTION

Types of flow sheets, flow sheet presentation, flow sheet symbols, process flow diagram - Synthesis of steady state flow sheet - Flow sheeting software. **(9)**

BASICS OF PIPING DRAWINGS

P&ID objectives, guide rules, symbols, line numbering, line schedule, P&ID development, typical stages of P&ID, P&ID for rotating equipment and static pressure vessels, process vessels, absorber. **(9)**

CHEMICAL EQUIPMENTS DESIGN AND CONTROL

Control System for heater, heat exchangers, reactors, dryers, distillation column and evaporators. **(9)**

INSTRUMENTATION DESIGN

Distributed Control Systems (DCS), Safety Instrument System (SIS), instrument symbols, instrument signal lines, temperature instruments, flow instruments. **(9)**

APPLICATIONS

Applications of P and ID in design stage - Construction stage - Commissioning stage - Operating stage - Revamping stage - Applications of P and ID in HAZOPS and risk analysis. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ernest E. Ludwig, Applied Process Design for Chemical and Petrochemical Plants, Vol.1, Gulf Publishing Company, Houston, 1989.*
2. *Max. S. Peters, Timmerhaus K.D., Plant Design and Economics for Chemical Engineers, McGraw Hill, Inc., New York, 1991.*

REFERENCES

1. *Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill Publishing Company Limited, New Delhi 1981.*
2. *Westerberg A.N., Process Flow sheeting, Cambridge University Press, 1979*

Mapping of COs with Pos

Mapping of COs with Pos														
COs	**Program Outcomes Pos**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**		**3**						**3**		**2**	**3**	
CO2	**3**													
CO3	**3**	**2**	**3**	**2**		**1**							**2**	
CO4	**3**	**2**	**2**	**2**		**1**							**2**	
CO5	**3**	**3**	**1**	**2**		**1**							**2**	

19CHE16 - PROCESS AUTOMATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

PREREQUESTIE : Process Dynamics and Control

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Demonstrate the concepts of instrumentation for the measurement, control and classification of systems by utilizing the analog / digital control devices.*

CO2 : *Develop the skills required for automation, control and monitoring of industrial processes in high level with automation and control systems.*

CO3 : *Employ high-level PLC control systems in the computer integration of manufacturing processes.*

CO4 : *Integrate the industrial processes, control of sequences for automation and monitoring through distributed control systems.*

CO5 : *Practice the manufacturing and inventory management systems currently used in the process industries.*

INTRODUCTION

Principles of measurement and classification of process control instruments, temperature, pressure fluid flow, liquid level, velocity, fluid density, viscosity etc., instrument scaling, sensors, transmitters and control valves, instrumentation symbols and labels. **(9)**

PROCESS AUTOMATION

Structure &components of Industrial Automation systems. Architectural levels of Industrial controls, Single loop and Multi loop controllers and their tuning. **(9)**

PROGRAMMABLE LOGIC CONTROLLER

Introduction, architecture, definition of PLC, PLC vs PC, PLC vs DCS, Relay diagram, Ladder diagram examples, timers/counters, PLC design **(9)**

DISTRIBUTED CONTROL SYSTEM

Introduction, functions, advantages, and limitations DCS as automation tool for resource planning and support enterprise, DCS architecture of different makes, specification, Configuration and programming **(9)**

PROCESS OPERATION MANAGEMENT SYSTEMS

Overview of process operation management systems, order, inventory management, process scheduling, quality management. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Nakara B.C., Choudary K.K., Instrumentation and Analysis, Second Edition, Tata McGraw Hill, New Delhi, Seventh Reprint, 2006.*
2. *Stephanopoulos G., Chemical Process Control, Tata McGraw Hill, New Delhi, 1993.*

REFERENCES

1. *Karl J.Astrom, Bjorn Willermans., Computer Controlled Systems, Prentice Hall of India Pvt. Ltd., 1994.*
2. *Chemical Engineering Refresher Series on Process Automation, McGraw-Hill Publications, New York, 1991.*

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	3							2	2
CO2	3	3	3	2	3	3							2	2
CO3	3	3	3	2	3	3							2	2
CO4	3	3	3	2	3	3							2	2
CO5	2	2	3	2	3	3							2	2

19CHE17 - PROCESS INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After comletion of the course, students are able to,

CO1 : *Explain the basic principles of various measuring instruments and its static, dynamic response. Errors in the measurements.*

CO2 : *Demonstrate the various instruments utilized to measure the temperature and calculate the temperture using thermometer, thermistor, radiation pyrometer.*

CO3 : *Calculate the pressure using manometer and demonstrate the basic fundamentals of pressure measuring devices.*

CO4 : *Demonstrate the fundamentals of variable head meter, area flow meter, direct, inertial type level meter and density measurement devices.*

CO5 : *Select suitable measuring device for gas mixture analysis, thermal, electrical conductivity, viscosity and construct piping and instrumentation diagram.*

PRINCIPES OF MEASUREMENT

Analysis: Measurement of Force, Strain and Torque- Use of strain gauges. Transducers - Resistive, capacitive, Inductive and piezoelectric pickups.Static and Dynamic response of Instruments. Errors in measurements. **(9)**

TEMPERATURE MEASUREMENT

Liquid filled, Gas filled and Vapour pressure Thermometers. Bimetallic and Resistance thermometers.Thermocouples and Thermistors. Optical and Radiation pyrometers. **(9)**

PRESSURE MEASUREMENT

Manometers, Bourdon gauge and Bellow gauge. Measurement of pressure and Vacuum.Use of Transducers. **(9)**

FLOW, DENSITY AND LEVEL MEASUREMENTS

Variable head flow meters. Area flow meters. Positive displacement meters. Pressure Probes.Level measurements - Direct and Inertial types.Measurement of density and specific gravity. Instruments for weighing and feeding. **(9)**

MISCELLANEOUS MEASUREMENTS

Analysis of gas mixtures.Thermal conductivity, Viscosity and Electrical conductivity.Supporting instrumentation - Standard cells, Balancing circuits and Terminating devices.Principles of Telemetering. P and I diagrams. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Eckman, D.P, Automatic Process Control, Wiley Eastern, New Delhi, 2006.*
2. *Jain, R.K, Mechanical and Industrial Measurements, Twelfth Edition Khanna Publishers, New Delhi 2015.*

REFERENCES

1. *Perry, R.H., Green, D.W., Perry's Chemical Engineer's Handbook, Eighth Edition, McGraw Hill (ISE), 2007.*
2. *Considine, D.N., Process Instruments and Controls Handbook, Fifth Edition, McGraw Hill. New York, 1999.*
3. *Benedict, R.P, Fundamentals of temperature, Pressure and Flow measurements, Third Edition, John Wiley, New York. 1984.*
4. *Notlingk. B.E., Jones' Instrument Technology, Vol. I and II, Fourth Edition, ELBS, 1987.*
5. *Patranabis. D., Principles of Instrumentation, Second Edition, Tata-McGraw Hill, New Delhi, 2007.*

Mapping of Course Outcomes with Programme Outcomes

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2		1			1			1		1		
CO2	3	3	2	2			2			1		1		
CO3	3	3	2	2			2			1		2		
CO4	3	3	3	2			2			1		2		
CO5	3	3	2	2		2	2			1		2		

19CHE18 - TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to

CO1 *: Describe the basic concepts of Total Quality Management.*

CO2 *: Identify the Principles of Total Quality Management.*

CO3 *: Apply and acquire knowledge on quality tools & Techniques.*

CO4 *: Formulate the Quality Management System for use in any process industries.*

CO5 *: Justify and Gain confidence in implementing Quality system Management in process industries.*

INTRODUCTION

Definition of TQM, basic approach, gurus of TQM,TQM frame work, defining quality, obstacles, benefits of TQM, leadership - Concepts, The deming philosophy, The role of TQM leaders, implementation, quality council, quality statements, strategic planning. **(9)**

TQM PRINICIPLES

Customer satisfaction - Customer perception of quality, using customer complaints, service quality, customer retention; employee involvement - Motivation, empowerment, teams, recognition and reward, performance appraisal, benefits; Continuous process improvement - The juran trilogy, The PDSA cycle, kaizen, six sigma; supplier partnership - Partnering, sourcing, supplier selection, supplier rating, relationship development; performance measures - Basic concepts, strategy, presentation, quality costs analysis techniques. **(9)**

STATISTICAL PROCESS CONTROL

The seven tools of quality, statistical fundamentals, process capability, control charts for variable and attributes, new seven management tools. **(9)**

TQM TOOLS

Benchmarking - Reasons to benchmark, process, pitfalls and criticisms; Quality function deployment - Benefits, house of quality, QFD process; Taguchi's quality loss function; Total Productive Maintenance (TPM) - Concept, improvement needs; FMEA - Stages of FMEA. **(9)**

QUALITY SYSTEMS

Benefits of ISO registration, ISO 9000 series of standards, sector-specific standards, ISO requirements, implementation, documentation, internal audits, registration; environmental management system-ISO 14000 series standards, concepts of ISO 14001, requirements of ISO 14001, benefits of EMS. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Besterfield, Dale H., Carol Besterfield-Michna, Glen Besterfield and Mary Besterfield-Sacre,:Total Quality Management, Third Edition, Second Impression, Pearson Education Inc, Delhi, 2007.*
2. *Subburaj Ramasamy, : Total Quality Management, Second reprint, Tata McGraw Hill publishing Company Ltd, New Delhi, 2006.*

REFERENCES

1. *Kumar S, Total Quality Management, 1st Ed., Reprint, Laxmi Publications (P) Ltd., Delhi, 2007.*
2. *Naagarazan R.S and Arivalagar A.A, :Total Quality Management, First Edition, Reprint, New Age International (P) Ltd., New Delhi, 2005.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								3	3		3			3
CO2								3	3		3			3
CO3								3	3		3			3
CO4								3	3		3			3
CO5								3	3		3			3

(1: Slight, 2: Moderate 3: Substantial)

19CHE19 - OPTIMIZATION METHODS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Formulate a chemical engineering real world problem as a mathematical programming model by developing objective functions and the relevant environmental-economic constraints.*

CO2 : *Solve linear programming problems using the simplex method, Big-M method, two-phase method and duality theory.*

CO3 : *Estimate the optimum conditions for single and multivariable, unconstrained and constrained non-linear optimization problems using quadratic, geometric and dynamic programming techniques.*

CO4 : *Solve unconstrained and constrained non-linear optimization problems using numerical techniques such as Newton's, quasi Newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques*

CO5 : *Apply the concepts of both linear and nonlinear optimization techniques to determine optimum number of effects, optimum reflux ratio and optimum pipe diameter in multiple effect evaporation, binary distillation and fluid flow problems.*

PROBLEM FORMULATION & CLASSIFCATION

Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions; analytical methods. **(9)**

LINEAR PROGRAMMING

Review on basic concepts of LP formulations; Simplex methods; Big-M method, two phase method and Duality in linear programming. **(9)**

NON-LINEAR PROGRAMMING

The Lagrange multiplier method,Integer,quadratic,geometric and dynamic programming. **(9)**

NUMERICAL METHODS

Unimodal functions; Newton's quasi Newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; Powell's technique; indirect methods; gradient and conjugate gradient methods; secant methods. **(9)**

APPLICATIONS

Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Edgar T.F., Himmelblau D.M., Lasdon,L.S., Optimization of Chemical Processes, Second Edition, McGraw-Hill Book Co., New York, 2001.*
2. *Reklaitis G.V., Ravindran A., Ragsdell, K.M., Engineering Optimization, John Wiley, New York, 1980.*

REFERENCES

1. *Biles W.E., Swain J.J., Optimization and Industrial Experimentation, Inter Science, New York, 1980.*
2. *Seinfeld J.H., Lapidus L., Process Modeling, Estimation and Identification, Prentice Hall, Englewood Cliffs, New Jersey, 1974.*

19CHE20 - INTEGRATED DESIGN OF CHEMICAL PROCESSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Compute the design calculations for the various reactor configurations of reactors used for homogenous and heterogeneous reactions.*

CO2 : *Solve the design problems related to Settling and Sedimentation, Centrifugal filtration and drying unit.*

CO3 : *Solve the design problems for distillation, absorption, stripping, and Liquid-Liquid Extraction and Evaporation units.*

CO4 : *Formulate steady state material balance for the unit operations such as distillation, evaporation, mixing, extraction, drying and crystallization processes with recycle by-pass and purge.*

CO5 : *Apply the combined material and energy integration to select the optimal process conditions for the design equipments used for separation and transport processes.*

REACTOR CONDITIONS AND CONFIGURATION

Hierarchy and approaches of Chemical process Design and Integration. Role of process economics, optimization Reactor Performance - Idealized reactor models and their choice. Reactor conditions - Reactor temperature, pressure and concentration. Reactor Configuration - temperature control, reactors for homogeneous and hetero reactions **(9)**

HOMOGENEOUS SEPARATORS

Separators for Heterogeneous mixtures.Settling and Sedimentation, Inertial and Centrifugal separation, Filtration, Scrubbing, Flotation and Drying. **(9)**

HETEROGENEOUS SEPARATORS

Separator for Homogeneous fluid mixtures, Distillation, Absorption, stripping and Liquid-Liquid extraction, Adsorption, Membranes, Crystallization, Evaporation, Sequencing. **(9)**

NETWORKING

Reaction, separation and Recycle systems for continuous processes and for batch processes. Heat exchanger networks - Heat transfer equipments, Energy capital and total cost targets, network Design. **(9)**

PROCESS INTEGRATION

Heat Integration of reactions, Distillation columns, Evaporators, Dryers. Steam systems and Cogeneration, Cooling water networking design. **(9)**

TOTAL : 45

TEXT BOOK

1. *Robin Smith, Chemical Process Design and Integration, Second Edition, Willey India Pvt Ltd, New Delhi, 2009.*

REFERENCES

1. *Alexandre C. Dimian, CostinSorinBildea, Chemical Process Design: Computer-Aided Case Studies, WIELY-VCH VerlagGmbh and Co KGaA, Weinheim, 2008.*
2. *Anil Kumar, Chemical Process Synthesis and Engineering Design, McGraw Hill, 1982.*

19CHE21 - COMPUTER AIDED PROCESS EQUIPMENT DESIGN

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 *: Apply the phase equilibrium concepts to estimate vapour or liquid phase composition, bubble point or dew point of ideal and non-ideal mixtures with the aid of ASPEN PLUS/ MATLAB /C Programming.*

CO2 *: Analyse a complete chemical process plant and assess alternative process flow sheets by decomposing the process flow sheets with the help of tearing- precedence ordering techniques.*

CO3 *: Develop MATLAB/C Programming codes to calculate performance indices like batch time, equilibrium conversion of ideal batch and continuous flow reactors.*

CO4 *: Generate MATLAB or C Programming codes to compute the design parameters for tubular exchanger, surface condenser, evaporator, crystallizer and storage tank.*

CO5 *: Apply the process simulation software like ASPEN PLUS/ MATLAB /C Programming in the design of single and multiple effect evaporators.*

PHYSICAL PROPERTIES EVALUATION

Review on Programming languages, Physical properties evaluation, Thermodynamic properties of gases, binary mixtures, methods of calculating vapor liquid equilibrium, data for ideal and non-ideal mixture. Bubble point and dew point. Flash and distillation calculation. **(12)**

FLOWSHEETING

Conceptual design- hierarchical approach- General Structure of computer aided design programme - hierarchical design procedure for chemical processes- Importance of Flow sheeting of Flow sheet - Flow sheet structure. **(12)**

DEVELOPMENT OF SOFTWARES

Development of Software for rectors- batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions. **(12)**

SIMULATION SOFTWARE

Introduction to simulation software Design II, Design of process equipment using Design II - tubular exchanger, surface condenser, evaporator, crystallizer, storage tank. **(12)**

APPLICATIONS OF DESIGN SOFTWARES

Linear Programming, Dynamic Programming in Chemical Engineering, Formulation and solution through PC based programs. Introduction to simulation software Aspen Plus, Simulation of chemical processes using Aspen Plus. Introduction to EVAP software. Design of multiple effect evaporator using EVAP. **(12)**

TOTAL : 60

TEXT BOOKS

1. *Douglas J.M., Conceptual Design of Chemical Processes, McGraw Hill, New York, 1988*
2. *Sinnott R.K., Coulson and Richardson's Chemical Engineering Vol.6, Fourth Edition, Chemical Engineering Design, Butterworth-Heinemann, 2005.*
3. *Hanna O.T., Scandell, O.C., Computational Methods in Chemical Engineering, Prentice Hall, 1995.*
4. *Leasley M.E., Computer Aided Process Plant Design, Gulf Publishing, 1982.*

REFERENCES

1. *Jerry O.P., Breneman G.L., Spreadsheet Chemistry, Prentice Hall, Englewood Cliffs, 1991.*
2. *Myers A.L., Seider W.D., Introduction to Chemical engineering and Computer Calculations, Prentice-Hall,1976*

19CHE22 - SUGAR TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Determine the raw materials required for the manufacture of sugar and the analytical methods to be followed for high grade product.*

CO2 : *To produce a clear juice that is light in color and free of suspended matter*

CO3 : *Employ evaporation process to improve the concentration of syrup from clear juice.*

CO4 : *Determine the optimum temperature to control the size of sugar crystals and study the kinetics on growth rate*

CO5 : *Separate the sugar crystals based on the size and colour and utilise spent molasses to extract sucrose.*

INTRODUCTION

Sugar industry in India. Chemical and Physical properties of Sucrose and reducing sugars. Source for Sucrose. Formation of sucrose plants. Non sugar compounds of sugar cane. Inorganic constituents of sugar cane juices and sugars. Analytical methods used in Sugar Industry. **(9)**

PURIFICATION

Chemical technology of the purification processes. Fundamental reactions and physical chemistry aspects of clarification. Liming, sulphitation and carbonation processes. Filtration of sugar juice. **(9)**

EVAPORATION

Evaporation of sugar juice. Heat transfer in evaporators. Evaporation equipment and its auxiliaries. Methods of obtaining steam and quality of steam. Steam economy. Chemistry of the evaporation process. Scale formation and cleaning of evaporators. **(9)**

CRYSTALLIZATION

Solubility of sucrose. Solubility of sucrose - nucleation in super saturated solutions - kinetics and growth of crystallization. Chemistry of crystallization. Control methods and equipment used in sugar crystallization; Technology of sugar crystallization. Evaporation and circulation in vacuum pans. **(9)**

CENTRIFUGATION

Theory of the centrifugal processes. Centrifugal operation. Engineering principles of sugar centrifugals and the centrifugal process. Centrifugal equipment and its auxiliaries. Production of final molasses and its utilizations. Grading of sugar. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Honig P., Principles of Sugar Technology, Vol.1,2 and 3, Elsevier Publishing Company, 1953.*
2. *Van der Poel P.W., Schwartz T.K., Schiweck H.M., Sugar Technology [Beet and Cane Sugar Manufacture], Beet Sugar Development Foundation (Fort Collins, Colo.), Fourth Edition, Verlag Dr Albert Bartens KG, 1998.*

REFERENCES

1. *Payne J.H., Sugarcane factory Analytical control, Fifth Edition, Elsevier Publisher, London, 1968.*
2. *Jenkins G.H., Introduction to Sugarcane technology, Elsevier Publisher, London, 1966*
3. *Hoing P., Principle of Sugar Cane Technology, Elsevier Publisher, London.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	0	0	3	2	2	0	0	0	2	0	0
CO2	2	3	3	0	0	2	1	0	0	0	0	2	0	0
CO3	2	3	3	0	0	3	1	0	0	0	0	2	0	0
CO4	3	3	3	0	0	3	2	0	0	0	0	2	0	0
CO5	2	3	3	0	0	2	1	0	0	0	0	2	0	0

(1: Slight, 2: Moderate 3: Substantial)

19CHE23 - ENERGY TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *To understand the formation of coal and its classification, ranking, analysis, testing, carbonization, gasification, liquefication and manufacture of coke.*

CO2 : *To create the knowledge about occurrence of crude oil, its composition, classification and production of petroleum products, properties and testing, handling and storage of petroleum, refining and other conversion processes.*

CO3 : *To state the occurrence, properties, production and storage of gaseous fuels, combustion, furnaces for different gaseous fuels and waste heat recovery.*

CO4 : *To understand the concept of nuclear reactions and to infer the fuel materials, moderators and structural materials for construction of various types of nuclear reactors for contribution to the energy needs.*

CO5 : *To analyze the utilization of solar energy for room and water heating, to derive energy from biomass using different biogas plants and to study application of other energy resources such as wind energy, tidal and ocean energy.*

SOLID FUELS

Principal solid fuels, coal - preparation, storage, carbonization, biofuels, briquetting. **(9)**

LIQUID FUELS

Liquid fuels from crude oil, synthetic and other liquid fuels. Storage and handling of liquid fuels. **(9)**

GASEOUS FUELS

Natural gas, manufacture of gaseous fuels. Gas purification. Combustion. Furnaces. Waste heat recovery. **(9)**

NUCLEAR ENERGY SOURCES

Nuclear energy - Nuclear reactions. Fuel materials, moderators and structural materials. Nuclear reactors. Reprocessing of spent nuclear fuel. **(9)**

RENEWABLE ENERGY SOURCES

Solar energy - utilization for room and water heating. Silicon cells in storage of solar energy. Energy from biomasses - biogas plant. Wind energy, tidal and ocean thermal sources. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gupta O.P., Elements of Fuels, Furnaces and Refractories, Khanna Publishers, New Delhi,1990.*
2. *Rao S, Parulekar B. B Energy Technology, Non Convectional, Renewable and Convectional Khanna publication, New Delhi 1997.*
3. *Himus G.W., The Elements of Fuel Technology, second Edition, Leonard Hill, London,1958.*

REFERENCE

1. Considine D.M., Energy Technology Handbook, McGraw Hill, New York,1977.

CO & PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3				3		1				2	
CO2		2	3				3		1					
CO3			3				3		1				2	
CO4		2	3				3		1					
CO5		2	3				3		1				2	
		2	**3**				**3**		**1**				**2**	

19CHE24 - PETROCHEMICALS TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Identify the feed stock selection for the distillation of crude oil in to petrochemicals.*

CO2 : *Classify the production & purification techniques involved in separation of polymeric compounds.*

CO3 : *Discover the possible aromatic polymers from the crude oil separations.*

CO4 : *Distinguish the modern methods available for the production and separation of petrochemicals.*

CO5 : *Plan the production techniques for the production of synthesis gas, paraffines and aromatics.*

PETROCHEMICAL INDUSTRY-FEEDSTOCKS

Feed stock selection for Petrochemicals. Production and purification of raw materials like gaseous hydrocarbons, liquid hydrocarbons, Separation of impurities and precise fractionation, etc. **(9)**

OLEFINIC POLYMERS

Production of mono-olefines from gaseous and liquid petroleum fractions. Purification and polymerization for products like polyethylene, polypropylene, polyisobutylene and copolymers of olefins **(9)**

AROMATIC POLYMERS

Production and purification of aromatics, Synthetic rubbers, Synthetic fibres and Synthetic detergents. **(9)**

ALKYLATION, ISOMERIZATION

Alkylation, Isomerization, Oxosynthesis, Udex process and Fischer-Tropsch reactions. Modern methods of production of acetylene and its compounds. **(9)**

SYNTHESIS GAS AND CHEMICALS

Hydrogen and Synthesis gas production. Petroleum carbon and petroleum coke. Oxidation products of paraffines and aromatics **(9)**

TOTAL : 45

TEXT BOOKS

1. *Bhaskara Rao B.K., Textbook on Petrochemicals, Fourth Edition, Khanna Publishers Delhi, 2007.*
2. *Waddams A.L., Chemicals from Petroleum, Fourth Edition, John Murray Publishers Ltd., ELBS, 1980.*
3. *Belov P.S., Fundamentals of Petroleum Chemicals Technology, Mir Publishers, Moscow, 1970.*

REFERENCES

1. *Kobe K.A., McKetta J.J.(Jr.), Advances in Petroleum Chemistry and Refining, Vol. 2,3 and 4, Interscience, New York, 1958 - 1962.*
2. *Hengstebeck R.J., Petroleum Processing, McGraw Hill, New York, 1959.*
3. *Chauvel A., Lefebvre G., Petrochemical Processes, Vol.1 and 2, Second Edition, Paris, 1989.*
4. *Tonohue D., Lang K., A First Course in Petroleum Technology, Prentice Hall, New Jersy, 1989.*
5. *Wiseman P., Petrochemicals, Ellis Horwood, 1986.*

19CHE25 - FERTILIZER TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Illustrate chemical, organic fertilizers and nutrients*

CO2 : *Develop the flow chart for manufacture of nitrogenous fertilizers*

CO3 : *Analyze the various processes and develop the flow chart for the manufacture of phosphatic fertilizers.*

CO4 : *Develop the flow chart for the manufacture of potassic fertilizer and analyze the unit operations involved in the process.*

CO5 : *Illustrate the quality and pollution standards permissible in fertilizer industry.*

INTRODUCTION

Chemical Fertilizers and Organic Manures - Types of chemical Fertilizers. Secondary nutrients, micro nutrients. **(9)**

NITROGEN FERTILIZERS

Nitrogenous Fertilizers - Methods of production of Ammonia and Urea. Nitric acid, Ammonium sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Ammonium Chloride - Their methods of production, characteristics, storage and handling specifications. **(9)**

PHOSPHATIC FERTILIZERS

Raw materials, phosphate rock, Sulphur pyrites -Process for the production of Sulphuric and Phosphoric acids. Ground phosphate rock, bone meal. Single Super Phosphate, Triple Super phosphate -Methods of production, characteristics and specifications. **(9)**

POTASSIC FERTILIZERS

Potassium chloride, Potassium sulphate, Potassium schoenite - Methods of production, specification, characteristics. Complex Fertilizers, NPK Fertilizers, Mono ammonium phosphate, Diammonium phosphate, Nitro phosphate Methods of production. **(9)**

FERTILIZERS IMPACTS AND STANDARDS

Fluid fertilizers. Controlled Release of fertilizers. Solid, Liquid and Gaseous pollution from ammonia urea and NPK fertilizer industries and standards laid down for them. Fertilizer production in India. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gopala Rao M., Marshall Sittig, Dryden's Outlines of Chemical Technology, Third Edition, WEP East-West Press, New Delhi, 2010.*
2. *George T. Austin., Shreve's Chemical Process Industries, Fifth Edition, McGraw Hill Professional, 2012*
3. *Vincent Sauchelli., The Chemistry and Technology of Fertilizers, Reinhold Pub. Corp., 1960*

REFERENCES

1. *Editorial Committee - FAI Seminar on Fertilizer in India in the Seventies (Proceedings), The Fertilizer Association of India, New Delhi, 1973.*
2. *Editorial Committee - Seminar on Recent Advances in Fertilizer Technology, The Fertilizer Association of India, New Delhi, 1972.*
3. *Sauchelli V., Manual on Fertilizer Manufacture, Industry Publication Inc, New Jersy, 1963.*
4. *CHEMTECH - II - (Chapter on Fertilizers by Chari, K.S.), Chemical Engineering Education Development Centre, I.I.T., Madras, 1977.*
5. *Menon M.G., Fertilizer Industry - Introductory Survey, Higginbothams, Madras, 1973.*

CO & PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2	3				3		1				2	
CO2		2	3				3		1					
CO3			3				3		1				2	
CO4		2	3				3		1					
CO5		2	3				3		1				2	
		2	**3**				**3**		**1**				**2**	

19CHE26 - MINERAL PROCESSING TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Recall the size reduction and size separation equipment's used in the mechanical operations processes.*

CO2 : *Understand the specific gravity separation of minerals would be exposed to the practices of beneficiation ores which is important for value upgradation for main product and for byproduct recovery.*

CO3 : *Understand the various commonly used methods to beneficiate (separate) minerals from less valuable gangue material, including density, electrostatic and magnetic, based approaches.*

CO4 : *Design the flotation circuits and identify the chemicals used for concentrating minerals in flotation process.*

CO5 : *Identify the suitable disposal and treatments methods for mineral wastes and flowsheet for various mineral processes.*

COMMUNITION

Testing sieve analysis. Principles of size reduction, size separation. Different types of crushers, grinding mills, screens and classifiers. Closed and open circuit operations in size reduction. **(9)**

CONCENTRATING OPERATIONS

Principles of specific gravity separation. Launders, vibrating tables, spiral concentrators, cone concentrators, vanners, cordouries, pans and other types of specific gravity separators. **(9)**

SEPARATION PROCESSES

Electrical separation and magnetic separation of minerals. Different types of electrical and magnetic separators. **(9)**

FROTH FLOTATION

Interfacial phenomenon for mineral particles in water. Collection, frothing, activation, depression, regulation and conditioning. Froth flotation machines. Design of froth flotation circuits. **(9)**

WASTE DISPOSAL

Dewatering and drying operations. Disposal and treatment of mineral sludges. Mineral processing flow sheets for copper, lead, zinc and gold only. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gaudin A.M., Principles of Mineral Dressing, First Edition, Tata McGraw Hill, New Delhi, 2002.*
2. *Wills B.A., Mineral Processing Technology, Seventh Edition, Maxwell Macmillan, 2006.*
3. *Pryor E.J., Mineral Processing, Third Edition, Elsevier, New York, 1965*

REFERENCES

1. *Richards R.H., Locke C.E., Text Book of Ore Dressing, Third Edition, McGraw Hill, New York, 1940.*
2. *Taggart A.F., Hand Book of Mineral Dressing, John Wiley, New York, 1954.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	2	2	1	0	0	3	0	0	1	1	2	0	0
CO2	0	3	3	2	0	0	2	0	0	2	1	2	0	0
CO3	0	3	3	2	0	0	3	0	0	2	1	2	0	0
CO4	0	3	3	2	0	0	3	0	0	1	1	2	0	0
CO5	0	3	3	2	0	0	3	0	0	2	1	2	0	0

(1: Slight, 2: Moderate 3: Substantial)

19CHE27 - FLUIDIZATION ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Analyze the various fluidization behavior, operating conditions and its industrial application*

CO2 : *Develop the various flow models and test their empirical correlations*

CO3 : *Develop a heat and mass transfer fluidization correlations for the industrial chemical equipment*

CO4 : *Evaluate the two and three phase inverse fluidized bed correlation and their application*

CO5 : *Solve the solid- liquid mixing problems for the fluidization operations by applying various temperature and other conditions*

INTRODUCTION

Fluidized state - nature of Hydrodynamic Suspension, Regimization of the fluidized state, Operating models for fluidization systems and its industrial applications. **(9)**

HYDRODYNAMICS OF FLUIDIZATION SYSTEM

General bed behavior, pressure drop, empirical correlations for solid holdup, flow Models **(9)**

SOLIDS MIXING AND SEGREGATION

Degree of segregation, Operation shifts, reversal points, mixing - segregation Equilibrium generalized fluidization of poly systems, Liquid phase mixing and gas phase mixing. **(9)**

HEAT AND MASS TRANSFER IN FLUIDIZATION SYSTEMS

Mass Transfer - Gas- Liquid Mass Transfer, Liquid-Solid mass Transfer and wall to bed Mass Transfer. Heat Transfer - Column wall to bed Heat transfer. **(9)**

MISCELLANEOUS SYSTEM

Moving bed, slurry bubble column, two phase and three phase inverse fluidized bed, typical applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Kunii D., Levenspiel O., Fluidization Engineering, Second Edition, Butterworth-Heinemann, 2013.*
2. *Leva M, Fluidization, McGraw Hill, New York, 1959.*
3. *J.F. Davidson, R. Clift and D. Harrison, Fluidization. Second Edition, 1985, Academic Press, New York.*

REFERENCES

1. *Zenz F.A., Othmer D.F., Fluidization and Fluid Particle Systems, Sixth Edition, Reinhold, New York, 1960.*
2. *Geldart D., Gas Fluidization Technology, John Wiley, New York, 1986.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3		2					2		2	
CO2	2	2	2	3		2					2		2	
CO3	2	2	2	3		2		1					2	
CO4	2	2	2	3		2					2		2	
CO5	2	2	2	3		2					2		2	

(1: Slight, 2: Moderate 3: Substantial)

19CHE28 - PULP AND PAPER TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Identify the available sources and preparation of pulp.*

CO2 : *Explain the steps involved in mechanical and chemical pulping process and determine the kappa number and H- factor for bleached pulp*

CO3 : *Analyze the significance of recycling of chemicals in paper manufacturing process*

CO4 : *Analyze the importance of additives in paper machine operation and control measures involved in paper and pulp industry*

CO5 : *Illustrate the quality parameters of paper and usage of alternate raw material for the scope of paper industry*

INTRODUCTION TO SOURCE OF PULP AND PROPERTIES

Source of Pulp wood. Structure and properties of pulp wood. Preparation of pulp wood:Debarking, chipping, depithing. Softwoods. Hardwoods. Comparison of different raw materials. **(9)**

PULPING PROCESS AND TREATMENT

Manufacture of pulp - Mechanical, Sulphite, Kraft and alkaline process. Treatment of pulp :Washing, screening, cleaning and Bleaching of pulp. H-factor.control parameters: Effect of raw material on pulp quality; kappa number. **(9)**

CHEMICAL RECOVERY

Kraft and soda recovery cycles.black liquor characterization, oxidation and causticization.lime mud reburning. **(9)**

PAPER MAKING EQUIPMENT AND PROCESSES

Manufacture of paper and boards.Additive preparation.Special papers.Auxiliary paper mill equipment.Pollution control and effluent treatment in paper and pulp industries. **(9)**

PAPER TESTING AND SCOPE OF PAPER INDUSTRY

Specification for paper and boards.Testing of paper and paper products. Future and scope of paper industry in India. Use of alternate raw materials. **(9)**

TOTAL : 45

TEXT BOOKS

1. *John B. Calkin, Modern Pulp and paper Making, Third Edition, Reinhold Pub.Corp, 1960.*
2. *Stephenson N., Pulp and Paper manufacture, Vol.1, 2, 3 and , McGraw Hill, New York, 1950.*
3. *Halpern M.G, Pulp Mill Processes, Park Ridge, N.J: Noyce Data Corporation, 1975.*

REFERENCES

1. *Britt.K.W., Handbook of Pulp and Paper Technology, Second Edition, CBS Publishers Delhi,1984.*
2. *Smook, G.A., Handbook for pulp and paper technologist, Third Edition, Angus Wilde Publications, Inc., 2003.*
3. *Casey J.P., Pulp and Paper: Chemistry and Chemical technology, Third Edition, Vol. 4, Wiley Interscience, 1983.*
4. *The complete Technology Book on Pulp and Paper Industries, NIIR Board of Consultants & Engineers, 2003.*
5. *Pratima Bojpai., Biermann's Handbook of Pulp & paper, Raw Material and Pulp maing, Third Edition, Vol. 1.*
6. *Pratima Bajpai. Pulp and Paper Industry : Chemical Recovery Elsevior science, 2016.*
7. *Christopher J. Biermann, Handbook of Pulping and Paper making, Second Edition, Elgevier Science, 1996.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3		2					2		2	-
CO2	2	2	2	3		2					2		2	-
CO3	2	2	3	3		2		1					2	-
CO4	2	2	2	3		2					2		2	-
CO5	2	2	2	3		2					2		2	-

(1: Slight, 2: Moderate 3: Substantial)

19CHE29 - SURFACE COATING TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Analyze and improve the surface properties of materials for protection in demanding contact conditions or aggressive environments.*

CO2 : *Calculate the composition and properties of various resins and manufacturing procedures.*

CO3 : *Evaluate the amount of solvents and additives required for surface coating with its appropriate properties to meet out the quality standards.*

CO4 : *Design and develop the modern technologies involved in the synthetic pigments and choose the suitable pigments for better surface coatings.*

CO5 : *Differentiate the interior and exterior decorative coatings to be appropriately used for commercial purposes.*

FILM FORMATION AND DRYING OILS

Film formation - Film forming compositions - Properties - Types of polymerization in film forming compounds. Drying oils - Composition - Manufacturing procedure. **(9)**

RESINS

Resins - Types - Natural resins and its extraction - Alkyl resin - Manufacturing procedure - Compositions - Properties - Various synthetic resins - Chemical constitution - Manufacturing procedure. **(9)**

SOLVENTS AND ADDITIVES

Diluents - Thinners - Plasticizers - Driers - Additives - Anti settling agents in sur face coating. **(9)**

PIGMENTS

Pigments - Properties - Types - White pigments - Properties - Red pigments - Green pigments - Blue pigments - Black pigments - Properties and manufacturing procedure. **(9)**

COATINGS TYPES

Formulation of exterior coating - Interior - Decorative - Industrial - Special purpose - Marine - Bituminous - Powder coatings. Manufacture of Various paints. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Payne H., Organic Coating Technology, Vol. I, John Wiley and Sons Inc., New York, 1954.*
2. *Payne, H., Organic coating technology, Pigments and Pigmented Coatings, Vol.2, John Wiley and Sons Inc., New York, 1961.*

REFERENCES

1. *Oil and Colour chemists Association, Australia: Surface coatings, Vol. 1, Raw materials and their usage, Third Edition, Tafe educational books, Chapman and Hall, London, 1993.*
2. *Oil and Colour chemists Association, Australia: Surface coatings, Vol.2, Paints and their applications, Second Edition, Tafe educational books, Chapman and Hall, London, 1984.*
3. *Oil and Colour chemists Association, Australia: NON- convertible coatings, Part 1, Eleventh Edition, Tafe educational books, Chapman and Hall, London, 1987. (H.W. Keenan, chairman, Technical education committee.)*
4. *Parkar P.K., Technology of Resins.*
5. *Noel Heaton, Introduction to Paint Technology, Second Edition, Charles Griffin and Co. Ltd., London, 1940.*
6. *Noel Heaton, Outlines to Paint Technology, Third Edition, Charles Griffin and Co. Ltd., London, 1947.*
7. *Keenan H.W., Convertible Coatings, Vol. 1 and 2, Oil and Colour chemists Association, Australia, Chapman and Hall, London, 1961.*
8. *Wood H.R, Morrel R.S, The Chemistry and Technology of Drying Oils, Ernest Benn ltd., Seventh Edition, 1984.*

Mapping of Course Outcomes with Program Outcomes

COs	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2		1		1					1		2	
CO2	1	1			1		1							
CO3			1					1				1		
CO4			1		2				2					
CO5	2					1		1						

19CHE30 - HEAT POWER ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 *: Understand the principle and applications of refrigeration and air-conditioning processes.*

CO2 *: Understand the working principle of IC engines and to analyze port-timing and valve timing diagram for four stroke engines.*

CO3 *: Analyze various process cycles and to solve problems for various cycles.*

CO4 *: Understand the working principles of steam Boilers steam and gas Turbines.*

INTERNAL COMBUSTION (IC) ENGINE

Classification - working of four stroke and two stroke engines - Petrol and Diesel engines - Ignition systems - working of simple carburetor - cooling and lubrication systems - Testing of IC Engines - various efficiencies - Heat balance test. **(12)**

AIR POWER CYCLES AND JET PROPULSION

Otto cycles, Diesel cycle, Dual cycle, comparison. Mean Effective Pressure (MEP) - Brayton cycle - Simple problems, Turbo jet - thrust - thrust power - propulsion efficiency - Rocket propulsion. **(9)**

GAS AND STEAM TURBINES

Open and closed cycle gas turbine system - practical gas turbines - Regeneration - Intercooling and Reheating - Simple Problems, Principle of impulse and reaction turbines - compounding of turbines - Simple problems. **(10)**

STEAM POWER CYCLE AND BOILERS

Ranking cycle, Properties of steam - steam tables and charts, Study of boilers - fire tube, water tube boilers- Mounting - Accessories. **(8)**

REFRIGERATION AND AIR CONDITIONING

Vapour compression refrigeration cycle on p-h diagram - COP - heat pump, Psychrometry - Air-Conditioning processes - application. **(6)**

TOTAL : 45

TEXT BOOKS

1. *Rudramoorthy. R, Thermal Engineering, Fifteenth Edition, Tata McGraw Hill, New Delhi, 2012.*
2. *Kothandaraman C.P., Domkundwar S., Engineering Thermodynamics , Second Edition, Dhanpath Rai and Sons, New Delhi, 2003.*

REFERENCES

1. *Rajput.R .K., Thermal Engineering, Ninenth Edition, Laxmi Publication Pvt. Ltd, New Delhi ,2013.*
2. *Ballaney.P.L., Thermal Engineering, Fifth Edition, Khanna publishers, New Delhi, 2010.*

19CHE31 - CARBON CAPTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 : *Discuss the impacts of climate change and the measures that can be taken to reduce emissions.*

CO2 : *Discuss carbon capture and carbon storage and Explain the fundamentals of power generation.*

CO3 : *Explain methods of carbon capture from power generation and industrial processes.*

CO4 : *Explain different carbon storage methods: storage in coal seams, depleted gas reservoirs and saline formations.*

CO5 : *Explain Carbon dioxide compression and pipeline transport.*

INTRODUCTION

The Carbon Cycle, Mitigating Growth of The Atmospheric Carbon Inventory, The Process of Technology Innovation. Carbon Capture, Carbon Storage. **(9)**

FUNDAMENTALS OF POWER GENERATION

Physical and Chemical Fundamentals, Fossil-Fuelled Power Plant, Combined Cycle Power Generation, Future Developments in Power-Generation Technology. **(9)**

CARBON CAPTURE FROM POWER GENERATION

Introduction, Pre-combustion Capture, Post-combustion Capture, Oxy- fuel Combustion Capture, Chemical Looping Capture Systems, Capture-Ready and Retrofit Power Plant, Approaches to Zero-Emission Power Generation. **(9)**

MEMBRANE SEPARATION SYSTEMS

Physical and Chemical Fundamentals, Membrane Configuration and Preparation and Module Construction, Membrane Technology RD&D Status, Membrane Applications in Pre-combustion Capture, Membrane and Molecular Sieve Applications in Oxy-fuel Combustion, Membrane Applications in Post-combustion CO2 Separation, Membrane Applications in Natural Gas Processing **(9)**

CRYOGENIC AND DISTILLATION SYSTEMS

Physical Fundamentals, Distillation column configuration and operation, Cryogenic oxygen production for oxy-fuel combustion, Ryan-Holmes process for CO2 - CH4 separation, R&D in cryogenic and distillation technologies. **(9)**

TEXT BOOK

1. *Carbon Capture and Storage Stephen A. Rackley Elsevier 2010.*

19CHE32 - MATERIAL SCIENCE AND TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 *: Demonstrate selection criteria of materials based on their relevant applications in process industries.*

CO2 *: Explain various mechanical properties of material with their end use*

CO3 *: Construct Phase diagrams for various unary and binary situations and to interpret properties from Iron-Carbide diagrams.*

CO4 *: Explain properties of ferrous and non-ferrous metals and its composites.*

CO5 *: Explain nanomaterials and their applications.*

INTRODUCTION

Structure - Property relationship - Selection criteria and processes: General criteria of selection of materials in process industries. Properties: Mechanical, Thermal, Physical, Chemical, Electrical, Magnetic and Technological properties. Processing of Metals and Alloys- Casting, Hot and cold rolling, Forging, Extrusion, Deep drawing. **(9)**

MECHANICAL BEHAVIOUR

Elastic, Anelastic and Viscoelastic Behaviour - Introduction to Slip, Slip planes, Plastic Deformation by Slip: Critical resolved shear stress, Mechanism of Creep, Creep Resistant Materials - Fracture: Ductile and Brittle, Fatigue fracture, Griffith's theory, S-N curves, Fracture toughness. **(9)**

PHASE DIAGRAMS AND PHASE TRANSFORMATIONS

Gibb's Phase rule : Uniary and Binary phase diagrams , Al2CO3 - Cr2O3 , Pb-Sn, Ag-Pt and Iron- Iron Carbide Phase Diagram - Lever rule - Invariant reactions- TTT diagrams - Micro structural changes - Nucleation and growth - Martensitic transformations - Solidification and Crystallization - Glass transition - Recrystallization and Grain growth **(9)**

FERROUS, NON-FERROUS METALS AND COMPOSITES

Pig iron, Cast iron, Mild Steel-Manufacturing process, properties &, Applications Stainless steels, Special Alloy steels-properties and uses; Heat treatment of plain-carbon steels Manufacturing methods of Lead, Tin and Magnesium. Properties and applications in process industries. FRP-Fiber Reinforced Plastics (FRP), manufacturing methods; Asphalt and Asphalt mixtures; Wood. **(9)**

NANOMATERIALS

Introduction to Nanotechnology- Zero Dimensional Nano Structures - Nano particles - One .Dimensional Nano Structures- Nano wires and Nano rods - Two Dimensional Nano Structures, Films - Special Nano Materials - Nano Structures fabricated by Physical Techniques - Characterisation and Properties of Nano Materials - Applications of Nano Structures. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Khanna O P, "Material Science and metallurgy" Dhanpat Rai Publications (1995)*
2. *Raghavan V, "Materials and Engineering" Prentice Hall of India, Newdelhi (2006)*
3. *Brenner D, "Hand book of Nanoscience and technology" (2002)*
4. *Material Science & Engineering, Callister*

REFERENCES

1. *Henry R Clauster, "Industrial and Engineering Materials" McGraw Hill Book Co. (1975)*
2. *Kingery W D and Bowen H K and Unimann D R, "Introduction to Ceramics" John Wiley and Sons, Second edition (1991)*
3. *Fahrner W R, "Nanotechnology and Nanoeletronics" Springer International edition(2005)*
4. *Budinsky K G and Budinsky K M "Engineering Materials- Properties and Selection" Prentice Hall of India (2002)*
5. *Arumugam M, "Material Science" Anuradha Technical Book Publishers (1997)*

19CHE33 - BIOPROCESS TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of course, students will be able to

CO1 : *Explain the mechanism of fermentation process*

CO2 : *List and differentiate different inoculum for bacterial and fungal process*

CO3 : *Explain the various microbial kinetics used in bioprocess technology*

CO4 : *Design bioreactor for given duty'*

CO5 : *Design bio reactor with various configurations.*

BIOPROCESS DEVELOPMENT

An interdisciplinary challenge, Biotechnology & Bioprocess Engineering, steps in bioprocess development, Microbial culture, Screening and selection for fermentation processes; Preservation and improvement of industrially important microorganisms, Strain development. **(9)**

MEDIA FOR INDUSTRIAL FERMENTATIONS

Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Ingredients for mammalian cell culture and plant cell culture. Inoculum production for bacterial and fungal processes. Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media. **(9)**

INOCULUM DEVELOPMENT FOR INDUSTRIAL FERMENTATION & MICROBIAL KINETICS

Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples. **(9)**

DESIGN OF BIOREACTORS

Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases; Automation (processes computerization). Validation of Fermentor. **(9)**

BIOREACTOR CONFIGURATIONS AND TYPES

Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors. Heat and Mass transfer in Bioprocess, Relationship in between heat transfer, cell concentrations and stirring conditions, Measurement of KLa, Rheological properties of fermentation broths, Factors affecting broth viscosity, Mixing in Fermenters. **(9)**

TEXT BOOKS

1. *Comprehensive biotechnology, vol 1, 2, 3 and 4 Murray moo young, Pergamon press2004.*
2. *Principles of fermentation technology P.F. Stanburry& Whitaker Pergamon Press, II Ed, Butterworth Heinemann-Elsevier, 2005.*
3. *Bioprocess Engineering, Basic Concepts, II Ed. Michael L Shuler, FikretKargi, Prentice Hall of India pvt. Ltd. 2002.*
4. *Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.*
5. *Coulson & Richardson's Chemical Engineering, R.K. Sinnotl, III Ed. Vol 6 ButterworthHeinemann-Elsevier Pub, 1999.*

REFERENCES

6. *Coulson & Richardson's Chemical Engineering, J F Richardson & J H Harker, 5th Ed, Vol 2, Butterworth- Heinemann-Elsevier Pub, 2003.*
7. *Manual of Industrial Microbiology & biotechnology, Arnold Demain& Julian E. Davis, II Ed, ASM Press. Washington DC, 1999.*
8. *Current developments in Solid Substrate fermentation, Ashok Pandey, Carlos Ricardo Soccol, Christian Larroche - 2008.*
9. *Industrial Biotechnology by Rita Singh, S. Ghosh, Global Vision Publishing Ho, 2004*
10. *Industrial Biotechnology: Sustainable Growth and Economic success by WimSoetaert, Erick J. Vandamme.*

19CHE34 - PILOT PLANT AND SCALE-UP METHODS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 *: Understand the techniques to solve problems relevant to the general practice of chemical engineering and engineering design.*

CO2 *: Experience in the process of original chemical engineering design in the three areas of equipment design, process design, and plant design through the process of formulating a design solution to a perceived need and then executing the design and evaluating its performance including economic considerations and societal impacts.*

CO3 *: Understand the effects of scale on the relative rates of mass, heat and momentum transfer, mixing effects, utility of various reactor operating modes and the acquisition of reliable kinetic, thermodynamic and transport data.*

CO4 *: Ability to use different approaches for process scale - up and perform a power analysis and understand flow regimes basic to scale up.*

PRINCIPLES OF SIMILARITY, PILOT PLANTS AND MODELS

Introduction to scale up methods, pilot plants and models and principles of similarity. **(9)**

DIMENSIONAL ANALYSIS AND SCALE - UP CRITERION

Dimensional Analysis, Regime concept, similarity criterion and scale up methods used in chemical engineering. **(10)**

SCALE - UP OF MIXING AND HEAT TRANSFER EQUIPMENT

Typical problems in scale - up of mixing equipment and heat transfer equipment. **(9)**

SCALE - UP OF CHEMICAL REACTORS

Kinetics, Reactor Development and scale - up techniques for chemical reactors. **(9)**

SCALE - UP OF DISTILLATION COLUMN AND PACKED TOWERS

Scale - up of distillation columns and packed towers for continuous and batch process. **(8)**

TOTAL : 45

TEXT BOOKS

1. *John stone,Thring, Pilot plants models and scale - up methods in chemical Engineering, McGraw - Hill, New York, 1962.*
2. *Marko Zlokarnik, Dimensional Analysis and scale - up in Chemical Engineering, Springer - Verlag, Berlin, Germany, 1986.*

REFERENCE

1. *Donald. G. Jordan. Chemical Process Development (Part 1 and 2), Interscience Publishers, 1988.*

19CHOC01 - CRITICAL THINKING

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Demonstrate the logical connection between the ideas.*

CO2 *: Distinguish relevant from non-relevant data, fact from opinion.*

CO3 *: Solve problems by accessing information and presenting arguments in a logical way*

CRITICAL THINKING PROCESS

Critical Thinking - Characteristics of Critical Thinker - Critical Thinking Process -Critical Thinking Styles - Logical Fallacies - Inductive and Deductive Reasoning. **(9)**

CRITICAL THINKING SKILLS

Critical Thinking Skills set - Solving Problems - Critical argumentation **(6)**

TOTAL: 15

Pedagogy

Lecture, Exercises

Evaluation and Grading

Exercises … 50%

Case Action Plan … 50%

REFERENCES

1. *De Bono, Edward (2015) Lateral Thinking : Creativity Step by Step, (International Edition), Harper Perennial Publishers*
2. *Tidd, Joe, and Bessant, R. John (2015). Managing Innovation : Integrating Technological, Market and Organizational Change, 5/e, New Delhi : Wiley India.*
3. *Christensen, M. Clayton and Raynor, E. Micheael (2013). The Innovators Solution, Boston : Harvard Business School Press.*
4. *Khandwalla, N. Pradip (2009). Life long Creativity - An Unending Quest, New Delhi : McGraw Hill Education.*

PO-CO Mapping

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	2	-	2	2	3	-	-	-	3	2	2	2
CO2	-	2	2	-	2	2	3	-	-	-	3	2	2	2
CO3	-	2	2	-	2	2	3	-	-	-	3	2	2	2

3 - High Correlation, 2 - Medium Correlation, 1 - Low Correlation

19CHOC02 - CREATIVITY & INNOVATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

The course is intended to kindle the spirit of creativity and innovation among students. The student mind is largely conditioned to approach issues in logical and sequential order. This course will provide opportunities for students to be spontaneous and creative and think out of the box.

CO1 *: Apply the techniques of creativity in decision making and problem solving under various scenarios*

CO2 *: Analyze various methods that enhance creative ability*

CO3 *: Design solutions to problems through the systematic process of innovation*

THE CREATIVITY PHENOMENON

The Realm of Creativity - Creativity Process - Components of Creativity - Enhancing Creative Intelligence - Mastering Creative Problem Solving - Existential, Entrepreneurial and Empowerment Creativity - Acquiring a Creative Persona - Techniques of Creative Problem Solving **(8)**

THE PRACTICE OF INNOVATION

Purposeful Innovation - Impetus to innovate - Sources of Innovation Opportunity - Types and Patterns of Innovation - Designing and Implementing Innovation Strategies **(7)**

TOTAL : 15

Pedagogy

Lecture, Journaling, Exercises

Evaluation and Grading

Article Review	…	20%
Presentation	…	30%
Exercises	…	50%

REFERENCES

1. *De Bono, Edward (2015). Lateral Thinking: Creativity Step by Step, (International Edition), Harper Perennial Publishers*
2. *Tidd, Joe, and Bessant, R. John (2015). Managing Innovation: Integrating Technological, Market and Organizational Change, 5/e; New Delhi: Wiley India*
3. *Christensen, M. Clayton, and Raynor, E. Michael (2013). The Innovators Solution, Boston: Harvard Business School Press*
4. *Khandwalla, N. Pradip (2009). Lifelong Creativity - An Unending Quest, New Delhi: McGraw Hill Education*

PO-CO Mapping

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	2	-	-	-	3	2	2	2
CO2	-	-	3	-	-	-	-	-	-	-	3	2	2	2
CO3	-	-	3	-	3	-	3	-	-	-	3	2	2	2

3 - High Correlation, 2 - Medium Correlation, 1 - Low Correlation,

19CHOC03 - LEADERSHIP

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

This course introduces the students to the foundations of leadership, the role of a leader in the changing business environment and the stories of remarkable leaders from various walks of life. The leaders are those who have left their mark and made a difference in whatever area they chose to influence - political, social, business, environmental etc. It is important to understand their contributions towards the development of societies and economies.

CO1 *: Explain the impact of changes in the business environment on business (K2)*

CO2 *: Apply theories of leadership to create an effective team environment (K3)*

CO3 *: List the characteristics of effective leadership (K4)*

Unit I

Leadership Theories, Characteristics of a Leader, Leadership in Teams **(7)**

Unit II

Leadership and Motivation, Leadership and Values, Vision **(8)**

TOTAL: 15

Pedagogy

Discussion, Seminar, Role Play

Evaluation and Grading

Presentation	…	50%
Assignment	…	50%

REFERENCES

1. *Hurley, Kathleen and Priscilla, Shumway (2015). Real Women, Real Leaders: Surviving and Succeeding in the Business World, New Jersey: WileyIndia*
2. *Yukl, Garry (2013). Leadership in Organizations, 8/e; New Jersey: Pearson Education*
3. *Sandberg, Sheryl (2013). Lean In: Women, Work, and the Will to Lead, New York: Knopf Doubleday PublishingGroup*
4. *HBR (2011). HBR's 10 Must Reads - On Leadership, USA: Harvard Business Publishing*
5. *Barsh, Joanna, Susie, Cranston and Geoffrey, Lewis (2011). How Remarkable Women Lead - The Breakthrough Model for Work and Life, New York: McKinsey & Company, Inc*

PO-CO Mapping

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	3	-	3	2	2	2
CO2	-	-	-	-	-	-	3	-	3	-	3	2	2	2
CO3	-	-	-	-	-	-	2	-	2	-	3	2	2	2

3 - High Correlation, 2 - Medium Correlation, 1 - Low Correlation

19CHOC04 - EMOTIONAL INTELLIGENCE

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

UNIT 1

Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence. **(5)**

UNIT 2

Components of Emotional Intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills. Emotional Intelligence Competencies, Elements of Emotional Intelligence, Models of Emotional Intelligence: The Ability-based Model, The Trait Model of Emotional Intelligence, Mixed Models of Emotional Intelligence. **(5)**

UNIT 3

Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place, Cost -savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence. **(5)**

TOTAL : 15

REFERENCES

1. *Daniel Goleman (1996). Emotional Intelligence - Why it can Matter More than IQ. Bantam Doubleday Dell Publishing Group*
2. *Daniel Goleman (2000). Working with Emotional Intelligence.Bantam Doubleday Dell Publishing Group*
3. *Liz Wilson, Stephen Neale & Lisa Spencer-Arnell (2012). Emotional Intelligence Coaching. Kogan Page India Private Limited*

19CHOC05 - HEALTH AND LIFESTYLE

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

UNIT 1

Introduction to Health Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits - eating disorders, skipping breakfast, junk food consumption. **(5)**

UNIT 2

Food and Nutritional Requirements during Adolescence Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits - alcoholism, and other tobacco products, electronic addiction etc. **(5)**

UNIT 3

Need for a Positive Life Style Change Peer pressure & procrastination, Stress, depression, suicidal tendency. **(5)**

TOTAL : 15

TEXTBOOKS

1. *B.Srilakshmi, "Dietetics", New age international (P) ltd, publishers, 2010.*
2. *"Nutrient requirement and Recommended Dietary Allowances for Indians", published by Indian Council of Medical Research, ICMR, 2010.*

REFERENCE BOOK

1. *K Park "Textbook of preventive and social medicine", 2010. WHO Report on Adolescent Health: 2010.*

19CHOC06 - PSYCHOLOGY FOR ENGINEERS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

UNIT 1

Psychology of Adolescents: Adolescence and its characteristics.

UNIT 2

Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills, Mnemonics.

UNIT 3

Attention & Perception: Definition, types of attention, perception.

TOTAL : 15

TEXTBOOKS

1. *S. K. Mangal, "General Psychology", Sterling Publishers Pvt. Ltd.2007*
2. *Baron A. Robert, "Psychology", Prentice Hall of India. New Delhi 2001*

REFERENCES

1. *Elizabeth B.Hurlock, Developmental Psychology-A life span approach, 6th edition.*
2. *Feldman, Understanding Psychology, McGraw Hill, 2000.*
3. *Clifford Morgan, Richard King,John Scholper,"Introduction to Psychology", Tata Mcgraw Hill, Pvt Ltd 2004.*

19CHOC07 - FUNDAMENTALS OF NANOSCIENE

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OVERVIEW

The general goal of the course is to provide an introduction to and an overview over nanotechnology. This course introduces the fundamentals of nano-scale engineering and manufacturing. Current and future applications of nanostructured materials will be reviewed with respect to their impact in commercial products and technologies.

INTRODUCTION

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films-multilayered materials. **(5)**

PREPARATION METHODS

Bottom-up Synthesis-Top-down Approach. **(5)**

CHARECTERISATION TECHNIQUES:

X-ray diffraction technique, Scanning Electron Microscopy, Transmission Electron Microscopy, Surface Analysis techniques. **(5)**

TOTAL : 15

PEDAGOGY

Lecture, Exercises

EVOLUTIONAL GRADING

Tests / Quiz	:	50%
Assignments / Seminar Presentations	:	50%

TEXT BOOKS

1. *A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.*
2. *N John Dinardo, "Nanoscale characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000*

REFERENCES

1. *G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.*
2. *AkhleshLakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.*

19CHOC08 - AN INTRODUCTION TO ENVIRONMENTAL ETHICS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to:

CO1 *: Understand the philosophical and ethical views as they relate to the environment.*

CO2 *: Identify the ethical issues, analyse environmental laws and justice.*

CO3 *: Examine applications of ethics in environmental issues.*

ETHICS AND THE ENVIRONMENT

Introduction, Ethics and the Environment, Environmental ethics approach and world views - Foundations for an Environmental Ethics, History and Its Pioneers, types of environmental ethics. **(5)**

ENVIRONMENTAL JUSTICE

Ethical Issues and Environmental Justice, Principles of Environmental Justice, Environmental Laws and Regulations. **(5)**

APPLICATION OF ETHICS IN ENVIRONMENTAL ISSUES

Ethical contributions to contemporary environmental issues, Environmental standard establishment and maintenance. **(5)**

TOTAL : 15

REFERENCES

1. *Environmental Ethics, Andrew Light and Holmes Rolston III, eds. Blackwell Publishing, 2003.*
2. *The Economy of the Earth: Philosophy, Law, and the Environment, 2nd edition, Mark Sagoff. Cambridge University Press, 2008.*

MAPPING

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1							1	2						
2								3						1
3								2						1

Strong – 3, Medium – 2, Weak – 1

19CHOC09 - CORPORATE SOCIAL RESPONSIBILITIES

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students will be able to :

CO1 : *Understand the key characteristics of Corporate Social Responsibility (CSR) in the context of present-day management*

CO2 : *Apprise regarding business decision-making by ethical values and respect for people communities and the environment*

CO3 : *Become aware of creating a strategic plan that enables an organization to reach out its internal and external stakeholders with consistent messages*

UNIT I

Corporate Social Responsibility- Definition, concept, linkages to development Growth of CSR-historical & contemporary perspectives, National & International scenario Factors influencing growth of CSR in societies- ideological, socio-economic, legal & environmental perspectives Government initiatives for promoting CSR Impact of globalization & liberalization on CSR initiatives **(6)**

UNIT II

CSR & Development: -CSR activities-nature, types, impact on development programmes- CSR& development organisations-relationships, functioning & impact on organisational functioning Stakeholders' participation & perspectives about CSR **(9)**

TOTAL : 15

Pedagogy

Lecture, Exercises

Evaluation and Grading

Exercises … 50%

Case Studies … 50%

REFERENCES

1. *Grayson D., Hodges A. (2004). Corporate Social Responsibility- Seven Steps to Make Corporate Social Responsibility Work for Your Business. UK: Greenleaf Publishing Limited*
2. *Narang R.K. (2009). Corporate Social Responsibility-Replicable Models on Sustainable Development. New Delhi: The Energy & Resources Institute.*
3. *William B Werther, Jr, David Chandler, 2010 Strategic Corporate Social Responsibility, Stakeholders in a Global Environment, Second Edition, SAGE Publications, New Delhi*

MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							2	1	3		3	3		3
CO2							2	2	3		2	3		3
CO3							2	1	3		3	3		3

Strong – 3, Medium – 2, Weak – 1

19CHOC10 - COMPOSITE MATERIAL PREPARATION AND CHARACTERIZATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *To acquire basic knowledge in material science.*

CO2 : *To understand the basic familiarity in manufacturing process.*

CO3 : *To analyze the various novelty about the strength of materials.*

INTRODUCTION TO COMPOSITES AND FIBERS

Definition - Need - General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic, Aramid fibers and Natural fibers. **(8)**

MATRIX MATERIALS

Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Processing of PMC Hand layup process-Compression Moulding process. Processing of MMC-stir casting method. **(7)**

TOTAL : 15

Pedagogy

Lecture, Presentation, Assessment

Evaluation and Grading

Literature review … 20%

Presentation … 30%

Assessment … 50%

References

1. *Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc, 1993*
2. *Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, 2006.*

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1				3										
CO2		2												
CO3		2	2			1								

19CHOC11 - ENVIRONMENTAL IMPACT ASSESSMENT AND AUDIT

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Gain knowledge to handle the complex industrial environment.*

CO2 *: Explain about Industrial safety and the risk assessment and management.*

CO3 *: Acquire knowledge on environmental audit trails and audit scheduling*

UNIT I

Introduction - Safety, Health and Environment - Principles & Practices - Role of Management Accident Prevention - Incident - accident injury - unsafe acts - Theories/Models of accident - Principles of Prevention - Financial Implication - Reports. **(8)**

UNIT II

Personal Protective Equipment - Needs - Respiratory protective devices - Non respiratory protective devices - Fire Extinguishers & its operations Environmental Audit - ISO regulations - Qualities of Environmental Auditor - Contents of EA reports. **(7)**

TOTAL : 15

PEDAGOGY

Lecture, Exercises

EVALUATION AND GRADING

Case Studies … 50%

Report submission and Seminar … 30%

Test … 20%

REFERENCES

1. *The Factories Act 1948, Madras Bok Agency, Chennai,2000*
2. *National seminar on hazardous waste management organized by National Safety council, Ministry of environment and forests, Government of India, UnitedStates- Asia environmental partnership, Tamilnadu pollution control board and Indian chemical manufacturers association, April 2001.*
3. *W. Kurge: ISO 14001 Certification - Environmental ManagementSystem, PrenticeHall,199*

MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2			2	3	3		3
CO2						2	2			2	2	3		3
CO3						2	2			2	3	3		3

(Strong – 3, Medium – 2, Weak – 1)

19CHOC12 - FACTORY AUTOMATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PREREQUISITES

- Basic knowledge in hydraulics and pneumatics
- Basic knowledge in Analog/Digital circuits and electrical drives
- Principles and operations of sensors and transducers
- Basic knowledge in microprocessor based systems

COURSE OUTCOME

At the end of the course students will be able to

CO1 *: Understand the basics of hydraulics, electro hydraulics and its circuits*

CO2 *: Understand the basics of pneumatics, electro pneumatics and its circuits*

CO3 *: Develop an automation system with suitable sensors*

UNIT I HYDRAULICS

Basics of Hydraulics - Components of hydraulics - Types of valves - DCVs - operations - hydraulic Circuits - Electro hydraulics - Solenoids - Relays - Electrical logic circuits - Applications of electro hydraulics - Practices on different types of electro hydraulic circuits. **(9)**

UNIT II AUTOMATION SYSTEM

Introduction to Mechatronics system - over view of Automation System - Types of Automation - role of sensors in automation system. Introduction to PLC H/W - Architectural evolution - Role of PLC in Automation - Ladder Logic - Basics of digital logic - Latching - Timers - counters - Selections of PLC - Practices on Ladder logic using PLC. **(6)**

TOTAL : 15

Evaluation and Grading

S. No	Description	Max. Marks
1.	Continuous Assessment I (Quiz/Practicals/Test)	30
2.	Continuous Assessment II (Quiz/Practicals/Test)	30
3.	Final Assessment (Practicals/Test)	40

REFERENCES

1. *Bosch Rexroth User Manuals*
2. *Esposito Anthony, "Fluid Power with Applications", Pearson Education Inc., New York, 2003.*
3. *W. Bolton "Mechatronics" Pearson education, second edition, fifth Indian Reprint, 2010*
4. *Devadas Shetty and Richard A.Kolk, "Mechatronics systems design", PWS Publishing company 2007*

19CHOC13 - CONTROLLER TUNING

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PRE-REQUISITE :

Process Control

COURSE OUTCOMES

Students will be able to

CO1 *: Understand various methods of tuning PID controller*

CO2 *: Design of PID controller for SISO and MIMO systems*

CO3 *: Choose optimal controller for chemical processes*

UNIT I

Introduction to tuning of controllers - classification of controllers - open loop and closed loop methods for SISO and MIMO systems - Fractional order control - Relay tuning of PID controllers - Auto tuning of decentralized PID controller. **(8)**

UNIT II

Exercises using Matlab-Simulink. **(7)**

TOTAL : 15

Pedagogy

Lecture, Practical

Evaluation and Grading

Practical session - 75%

Internal exam - 25%

TEXT BOOKS

1. *M. Chidambaram, Nikita Saxena, Relay Tuning of PID Controllers: For Unstable MIMO Processes, Springer, 2018.*
2. *Cheng-Ching Yu, Autotuning of PID controllers: Relay feedback approach, 2nd edition, Springer, 2006.*
3. *Seborg, D. E., Edgar, T. F., Millechamp, D. A., Doyle III, F. J., Process Dynamics and Control, 3rd Edition, Wiley, 2014.*

CO - PO Mapping :

	Programme Outcomes												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	1		3	1			2		2		2	
CO2	2	3	3		3	2			2		2		2	
CO3	1	2	1		2	1			2		2		3	

19CHOC14 - NEURAL NETWORKS AND FUZZY SYSTEMS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Understanding the principles of neural networks and fuzzy logic fundamentals; Design the required and related systems.*

CO2 : *Acquire understanding and knowledge of soft computing models and algorithms and so they will be able to design program systems using these techniques to solve various real-world problems.*

CO3 : *Appreciate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent systems.*

INTRODUCTION TO NEURAL NETWORKS

Artificial Neural Networks: Basic properties of Neurons, Neuron Models, Feed forward networks - Perceptrons, Multilayer networks - Exact and approximate representation, Back propagation algorithm, Competitive learning and self-organizing networks, Hybrid Learning; Computational complexity of ANNs. **(5)**

INTRODUCTION TO FUZZY LOGIC

Fuzzy Controllers: Preliminaries - Fuzzy sets and Basic notions - Fuzzy relation calculations - Fuzzy members - Indices of Fuzziness - comparison of Fuzzy quantities - Methods of determination of membership functions. **(5)**

ANN & FUZZY BASED CONTROL

ANN based control: Introduction: Representation and identification, modeling the plant, control structures - supervised control, Model reference control, Internal model control, Predictive control, Fuzzy Controllers: Preliminaries - Fuzzy sets in commercial products - basic construction of fuzzy controller, case studies. **(5)**

TOTAL : 15

REFERENCES

1. *Laurene V. Fausett, "Fundamentals of Neural Networks, Algorithms and Applications", Prentice Hall, 1994*
2. *Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley International, 3rd Edition, 2010.*
3. *Kosco B, "Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence", Prentice Hall of India, New Delhi, 1992.*
4. *George J. Klir and Folger T.A, "Fuzzy sets, Uncertainty and Information", Prentice Hall of India, New Delhi, 2000.*

19CHOC15 - INTERNET OF THINGS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Ability to design fully connected products by integrating Internet services and physical objects.*

CO2 *: Ability to analyze, design and develop prototypes of Internet-connected products using appropriate tools.*

CO3 *: Identifying, classifying and describing different kinds of Internet-connected product and its concepts.*

INTRODUCTION

Smart Objects - Challenges for Smart Objects - IP for Smart Objects: motivation and main challenges - Security for Smart objects - Web services for Smart Objects - Connectivity models for Smart Object Networks - Introduction to the Internet of Things: application scenarios, current solutions. **(4)**

SMART OBJECTS & ROUTING

Communication for Smart Objects : IEEE 802.15.4: main features, topologies, addressing and MAC frame format - Low Power and Lossy Networks (LLN): Introduction to 6LoWPAN - 6LoWPAN architecture - 6LoWPAN adaptation layer - IPv6 addressing in 6LoWPAN-Mesh-under and route-over solutions - Routing Requirements - Routing metrics - DODAG formation - RPL Messages - CoAP. **(7)**

APPLICATIONS

Case Study -Smart Cities and Urban automation - Home Automation - Building Automation - Structural Health Monitoring - Chemical Industries. **(4)**

TOTAL : 15

TEXT BOOK

1. *RajKamal, "Internet of Things - Architecture and Design Principles", 2017.*

REFERENCES

1. *J.P. Vasseur, A. Dunkels, "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kaufmann, 2010.*
2. *Z. Shelby, C, "Bormann. 6LoWPAN: The Wireless Embedded Internet", Wiley, 2009*
3. *Z. Shelby, K. Hartke, K. Hartke, "The Constrained Application Protocol (CoAP)", RFC 7252, 2014.*

19CHOC16 - PROCESS AUTOMATION AND FAULT DIAGNOSIS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PREREQUESTIE : PROCESS CONTROL

COURSE OUTCOMES

CO1 : *Ability to explain different approaches to Fault Detection and Diagnosis to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach*

CO2 : *Ability to detect faults in sensor and actuators using Parameter Estimation*

CO3 : *Ability to explain various types of fault tolerant control schemes*

INTRODUCTION

Introduction, Functional architecture of Process Monitoring and Diagnostic Systems, Normal and Faulty Systems and Signal Models, Residual Generation for Linear and Nonlinear Dynamic Systems, State Estimation: Observers, Kalman Filters, Fault Detection and Diagnosis using Parameter Estimation **(5)**

FAILURE DIAGNOSIS

Failure Diagnosis using DES Models: Formulation and Concept of Diagnosis. Diagnosers and Diagnosability. Introduction to Failure Diagnosis using Hybrid Systems models. **(5)**

CASE STUDIES

Case Studies and Examples from Automotive, Aerospace and Industrial Systems, Application of PMFD : Fault tolerant Control of Aerospace Systems, Adaptive Supervisory Control of Industrial Processes. **(5)**

TOTAL : 15

REFERENCES

1. *S. X. Ding, "Model -based Fault Diagnosis Techniques: Design Schemes, Algorithms and Tools", Springer, 2008, ISBN : 978-3-540-76304-8*
2. *Janos J. Gertler, "Fault Detection and Diagnosis in Engineering Systems", ISBN: 0-8247-9427-3.*
3. *T. Söderström and Petre Stoica " System Identification", Prentice-Hall , 1989, ISBN : 978-0-138-81236-2.*
4. *C. K Chui and G. Chen, "Kalman Filtering with real -Time Applications", Springer, 1999, ISBN : 978-3-540-87848-3.*
5. *M. Basseville and A. Benvesisle, "Detection of Abrupt changes in Dynamic Systems", ISBN: 0-387-16043-4.*
6. *Ron Patton, Paul Frank and Robert Clark, "Fault Diagnosis in Dynamic Systems Theory and Applicat ions", Prentice Hal l , 1989, ISBN: 0-L3-308263-6.*

19CHOC17 - PROCESS CONTROL IN PETROCHEMICAL INDUSTRIES

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PREREQUESTIE : PROCESS CONTROL

COURSE OUTCOMES

CO1 *: To understand the principle of petroleum exploration process.*

CO2 *: To identify the measurement problems involved in petroleum exploration process.*

CO3 *: To analyse the control mechanisms involved in the process.*

PETROLEUM EXPLORATION

Petroleum Exploration - Petroleum recovery techniques -oil-gas separation-Processing of wet gases - refining of crude oil. **(5)**

MEASUREMENTS IN PETROCHEMICAL INDUSTRIES

Measurements in refineries and petrochemical industries - selection and maintenance of measuring instruments - special measurement problems. **(5)**

CONTROL IN PETROCHEMICAL INDUSTRIES

Process control in refineries and petrochemical industries - Control of distillation column - control of Catalytic crackers and pyrolysis unit - Automatic control of polyethylene production - Control of Vinyl chloride and PVC production. **(5)**

TOTAL : 15

REFERENCES

1. *Waddams A.L, "Chemicals from Petroleum",Butter and Tanner Ltd., 1968.*
2. *Balcen J.G. and Mumme K.I., "Process Control Structures and Applications", New York. 1968.*
3. *Austin G.T. Shreves, "Chemical Process industries", McGraw Hill international student edition Singapore. 1985.*

19CHOC18 - POWER PLANT INSTRUMENTATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: To understand the basics of piping and instrumentation diagram.*

CO2 *: A Brief outline of the Boiler control.*

CO3 *: To identify the sensors and actuators used in a nuclear power plant.*

INTRODUCTION

Piping and instrumentation diagram of a thermal power plant, basic process on a boiler, Fuel measurement-review of pressure and temperature measurement steam and water flow measurement - instrument applications in power stations: review of indicating and recording instrument applications in power stations: review of indicating and recording instruments, water level gauge for boiler drums, closed circuit television instrument, gas analysis meters, smoke instruments, dust monitor-measurement of impurities in feed water and steam generator coolant controls and instruments instrument maintenance aspects. **(5)**

BOILER CONTROL

Boiler control objectives-combustion of fuels (gaseous liquid, and solid), excess air, combustion chemistry and products of combustion, requirement for excess combustion, air-circulation of efficiency of boiler: input/output method-stream temperature control systems super heaters and de-super heaters. **(5)**

NUCLEAR POWER PLANT INSTRUMENTATION

Piping and instrumentation diagram of different types of nuclear power plants-radiation detection instruments process sensors for nuclear power plants-spectrum analyzers-nuclear reactor control systems and allied instrumentation. **(5)**

TOTAL : 15

TEXT BOOK

1. *B.G.Liptak, Instrumentation in process industries, Vol. I and II, Chilton books co, 1973.*
2. *Sam G. Dukelow. The control of boilers, Instrument Society of America press.*

REFERENCE BOOK

1. *A.Sherryet. Al. (Editors), Modern power station practice, Vol.6 (Instrumentation controls and testing), Pergamon Press, 1971.*

19CHOC19 - INDUSTRIAL AUTOMATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PREREQUESTIE : PROCESS CONTROL

COURSE OUTCOMES

CO1 *: To understand the use of Industrial Automation*

CO2 *: To Analyze the use of Programmable logic controllers in an industry.*

CO3 *: To provide a brief overview on Distributed Control Systems.*

COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS

Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, and Computer based data acquisition system, Internet of things (IoT) for plant automation **(5)**

PROGRAMMABLE LOGIC CONTROLLERS

Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries. **(5)**

DISTRIBUTED CONTROL SYSTEM

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS. **(5)**

TOTAL : 15

REFERENCES

1. *Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies*
2. *Process Control Instrumentation Technology By. C.D. Johnson, PHI*
3. *Industrial control handbook, Parr, Newnem*
4. *Programmable logic controller, Dunning, Delmar*

19CHOC20 - BIOMEDICAL INSTRUMENTATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PREREQUESTIE : PROCESS CONTROL

COURSE OUTCOMES

CO1 : *To understand the fundamentals of Biomedical Engineering.*

CO2 : *To identify the Non electrical parameter measurement and diagnostic procedures.*

CO3 : *To analyze the Electrical parameters and the instruments used in Biomedical field.*

FUNDAMENTALS OF BIOMEDICAL ENGINEERING

Cell and its structure - Resting and Action Potential - Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems - Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers - selection criteria - Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors. **(5)**

NON-ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements - spirometer - Photo Plethysmography, Body Plethysmography - Blood Gas analysers, pH of blood -measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements. **(5)**

ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS

Electrodes - Limb electrodes -floating electrodes - pregelled disposable electrodes - Micro, needle and surface electrodes - Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers - Isolation amplifier - ECG - EEG - EMG - ERG - Lead systems and recording methods - Typical waveforms - Electrical safety in medical environment, shock hazards - leakage current-Instruments for checking safety parameters of biomedical equipments. **(5)**

TOTAL : 15

TEXT BOOKS

1. *Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.*
2. *Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.*
3. *Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2 nd Edition, 2003.*

REFERENCES

1. *John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.*
2. *Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.*
3. *Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.*
4. *Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.*
5. *M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.*

19CHOC21 - ENERGY MATERIALS, DEVICES AND SYSTEMS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OBJECTIVE

To understand the concepts of energy storage materials, their characterization and applications in energy storage devices. To analyze the design of solar photovoltaic device and fuel cells for developing innovative ideas towards energy materials and devices.

COURSE OUTCOMES

After the course completion, students will be able to

CO1 *: Understand the recent technologies in energy storage*

CO2 *: Analyze various devices and mechanism for energy conversion from renewable sources*

CO3 *: Develop novel materials for energy conversion and storage application*

NANOMATERIALS FOR ENERGY CONVERSION AND STORAGE

Advanced materials and devices for energy storage: Carbon Nano-Tubes (CNT), fabrication of CNTs, CNTs for hydrogen storage, CNT-polymer composites, ultra capacitor, Polymer membranes for fuel cells, PEM fuel cell, Acid/alkaline fuel cells, Batteries. **(8)**

ENERGY CONVERSION AND STORAGE DEVICES

Device fabrication technologies, fundamentals of solar cells, recent advances in photovoltaics, spectral response and IV characterization. **(7)**

TOTAL : 15

Pedagogy

Lecture, Presentation, Assessment

Evaluation and Grading

Literature review	…	20%
Presentation	…	30%
Assessment	…	50%

REFERENCES

1. *Robert F. P. Advanced Semiconductor Fundamentals, 2nd Edition, Pearson,2002*
2. *Duncan W. B., Dermot O., and Richard I. W. Energy Materials, 1st Edition, Wiley,2011.*
3. *Christoph B. Ullrich S. and Vladimir D. Organic Photovoltaics: Materials, Device Physics, and Manufacturing Technologies, 2nd Edition, Wiley?VCH,2014.*
4. *San P. J. and Pei K. S.Nanostructured and Advanced Materials for Fuel Cells, 1st Edition, CRC Press,2013*
5. *Daniel C. and Besenhard J. O. Handbook of Battery Materials, 1st Edition Wiley? VCH,2011*

MAPPING OF COURSE OUTCOMES WITH PROBRAM OUTCOMES

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	3													
CO2		2												
CO3		2	2			1								

19CHOC22 - SURFACE ENGINEERING OF NANOMATERIALS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OBJECTIVES

To impart knowledge in surface modification of nanomaterials to improve its thermal, electrical properties and to enhance the compatibility of nanomaterials with some matrix as reinforcing fillers in composites for high performance applications.

COURSE OUTCOMES

After the course completion, students will be able to

CO1 *: Understand the fundamentals of surface engineering*

CO2 *: Analyze the performance enhancement of the surface engineered materials*

CO3 *: Identify appropriate technique for modification of nanomaterial to improve its properties*

SURFACE ENGINEERING - FUNDAMENTALS

Fundamentals of surface engineering, physical modifications, chemical modifications, Application of surface engineering to nanomaterials. **(7)**

SURFACE ENGINEERING - METHODS

Deposition and surface modification methods, Advanced coating practices, characterization of nano coatings, thin films for surface engineering, microencapsulation, applications and current trends in surface engineering of nanomaterials. **(8)**

TOTAL : 15

Pedagogy

Lecture, Presentation, Assessment

Evaluation and Grading

Literature review	…	20%
Presentation	…	30%
Assessment	…	50%

REFERENCES

1. *Gabor A. Somorjai, Yimin Li, Introduction to Surface Chemistry and Catalysis, John Wiley & Sons, New Jersey, 2010.*
2. *HaraldIbach, Physics of Surfaces and Interfaces, Springer-Verlag, Berlin, 2006.*
3. *Pankaj Vadgama, Surfaces and interfaces for biomaterials, First Edition, CRC Press, Boca Raton, 2005.*
4. *Peter J. Blau, Friction Scienceand Technology- From concepts to applications, Second Edition, CRC Press, Boca Raton, 2009*
5. *B. Bhusan, Modern Tribology Handbook, CRC Press, Boca Raton, 2005.*

Mapping of COs with POs

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	2													
CO2		2												
CO3			1	2		1								

19CHOC23 - NANO SENSORS: BASIC COMPONENTS, CHARACTERIZATION AND APPLICATION.

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

- *To acquire the basic knowledge and skills needed in this course and to provide a basis for more advanced nano techniques to solve complex problems.*
- *Analyze the importance of nanoscale materials for sensing applications and various approached used for characterizing sensors-based nanomaterials.*
- *Develop tailoring nanomaterials for a specific sensing application.*

UNIT I

Definition of nano materials, Nanostructures 0-D, 1-D, 2-D, 3-D structures. **(6)**

UNIT II

Human senses, component and classification of sensors, parameters for sensor characterization, sensors based on nanoparticles for detection of DNA and bio molecules. **(6)**

UNIT III

Chemi-Resistors based on nanoparticles, medical and biological applications of gold nanoparticles. **(3)**

TOTAL : 15

Pedagogy

Lecture, Presentation, Assessment

Evaluation and Grading

Literature review … 20%

Presentation … 30%

Assessment … 50%

REFERENCES

1. *Vinod Kumar Khanna, Nano sensors: Physical, Chemical, and Biological (2012),CRC press, Taylor and Fransis group.*
2. *Kevin C, Honeychurch, Nanoensors for chemical and biological applications: sensing with nano tubes, nano wires and nano particles (2014), Wood head Publishing*

MAPPING OF Cos with POs

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	1	2		2									2	
CO2		2												
CO3		2	2			1							2	

19CHOC24 - NANOPOLYMERS - SYNTHESIS, CHARACTERIZATION AND APPLICATIONS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

Students will be able to

CO1 *: Explain the significance of nanopolymers and its environmental impacts*

CO2 *: Investigate about the synthesis and various characterization techniques of nanopolymers*

CO3 *: Analyse the influence of nanopolymers on water treatment technologies*

INTRODUCTION TO NANOPOLYEMRS

Introduction; Classification of polymers; physical and chemical properties; application of polymers in various fields - an overall view; advantages and disadvantages during exploitation; hazards, health impacts and safety measures **(5)**

SYNTHESIS AND CHARACTERIZATIONS

Classification of methodologies for the synthesis of nanopolymers - polymerization techniques, size reduction processes, materials handling and storage; different forms of nanopolymers - powder, hydrogels, membranes; characterization - mass spectroscopy, nuclear magnetic resonance, x-ray diffraction, scanning electron microscopy, transmission electron microscopy, gel permeation chromatography, Fourier transform infrared spectroscopy, UV - visible spectroscopy **(5)**

APPLICATIONS IN WASTEWATER TREATMENT

Hydrogels in fluidized bed reactors - advantages and disadvantages; membranes in reverse osmosis processes in wastewater treatment plants - advantages and disadvantages; recycling and reuse of nanopolymers. **(5)**

TOTAL : 15

TEXT BOOK

1. *Oleg V. Stoyanov, A. K. Haghi, Gennady Efremovich Zaikov, Nanopolymers and Modern Materials: Preparation, Properties, and Applications, 1st Edition, Apple Academic Press, 2013*

REFERENCES

1. *Mostafa Rajabi, Fahimeh Najafi, Omid Moradi, Behrooz Mirza, Nanopolymers, Chapter 8: Nanopolymers: Graphene and Functionalization, Elsevier publications, 2018*
2. *Stoyko Fakirov, Nano-size Polymers, Springer International Publishing, 2016*

CO/PO

CO/PO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1	3	1	1	1								2	2	
CO2	3	1	2	3	1							3	2	
CO3	3	1	3	3	1							3	2	

19CHOC25 - AN APPROACH TO NANOTRIBOLOGY AND NANOMECHANICS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Focuses on the latest scientific developments and discoveries in the field of nano mechanics.*

CO2 : *Ability to understand the various characterization techniques such as Atomic Force Microscope, Scanning Probe Microscope.*

CO3 : *To analyze and understand the industrial importance of nanotribology and nano medicine.*

UNIT I

Introduction : Measurement techniques and application, Scanning Probe Microscopy-Principle of operation, Instrumentation and probes, Biomedical sensing with the Atomic Force Microscope **(6)**

UNIT II

Nano mechanics : Depth-sensing nano-indentation Techniques for Nano mechanical characterization, Nano mechanical properties of nanostructures and scale effects. **(6)**

UNIT III

Industrial Applications: micro/nanotribology and micro/nano mechanics of magnetic storage devices, nanotribology and nano mechanics of MEMS/NEMS and BioMEMS/BioNEMS materials and devices. **(3)**

TOTAL : 15

Pedagogy :

Lectures, Exercise

Evaluating and Grading :

Article Review - 20%

Assignments - 30%

Exercise - 50%

REFERENCES

1. *Bharat Bhushan, Nanotribology and Nano mechanics An Introduction (2017 fourth edition), Springer Publications, Germany.*

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

COURSE OUTCOME	PROGRAMME OUTCOMES										PSO'S			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1		2		2			3							1
CO2		2		2			3							1
CO3		2		2		1	3							1

19CHOC26 - NANOMATERIALS AND NANOFIBERS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Synthesis and fabricate of nanofiber membranes by electrospinning method.*

CO2 : *To study the basic concepts of polymer blend with nanoparticles*

CO3 : *Characterize the nanoparticles and nanofiber composites*

CO4 : *To study the mechanical properties of nanofiber membrane*

CO5 : *Implantable therapeutic system*

ELECTROSPINNING

Basic principle and introduction of electrospinning process and parameters. **(3)**

PREPARATION OF POLYMER BLENDS AND NANOPARTICLES

Definition of polymer blends and nanoparticles - effect of Metal nanoparticles on properties of polymers, determination morphology. Advantage and disadvantage of blended and embedded nanoparticles with nanofiber membranes. **(3)**

CHARACTERIZATION TECHNIQUES

FTIR, XRD, DLS, TGA, TEM, SEM and contact angle. **(3)**

MECHANICAL PROPERTIES OF THE NANOFIBER MEMBRANES

Mechanical properties of stress - strain behaviour, tensile strength and young's modulus. **(3)**

BIOLOGICAL INTERACTION WITH NANOFIBER MEMBRANES

Biocompatibility, toxicity, cytotoxicity, interaction of the materials. **(3)**

TOTAL : 15

TEXT BOOKS

1. *BlOMATERIALS SCIENCE, An Introduction to Materials in Medicine, Edited by Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons,*
2. *Biomaterials and Nanotechnology for Tissue Engineering by S Sethuraman, U M Krishnan, A Subramanian, 2016, CRC Press*

REFERENCES

1. *P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).*
2. *W.N.Chang, Nanofibers Fabrication, Performance and Applications, Nova Science Publishers Inc., (2009).*

19CHOC27 - BIOMASS CONVERSION TO BIOFUELS AND BIOENERGY

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Understanding various renewable feedstock of importance, their availability and attributes for biofuel production*

CO2 : *Understanding of the broad concept of second and third generation biofuel production from biomass and other low-cost agro-residues and other wastes.*

CO3 : *Perform and interpret life cycle analysis and environmental impact assessment for biofuel from any feedstock*

INTRODUCTION

Fundamental concepts in understanding biofuel and biotechnology production - Various biofuels and bioenergy from biomass - Feedstock - types, availability, characterisation and attributes for bioenergy - Biofuel production - Biomass pre-processing - Drying, densification and size reduction. **(5)**

CONVERSION OF BIOMASS TO ENERGY

Biomass conversion to heat and power - thermal gasification of biomass, anaerobic digestion - Biomass conversion to biofuel - thermo chemical conversion, syngas fermentation - Biochemical conversion to ethanol - biomass pre-treatment - Different enzymes, enzyme hydrolysis, and their applications in ethanol production - Biodiesel production from oil seeds, waste oils and algae. **(5)**

ENVIRONMENTAL SIGNIFICANCE OF BIOFUEL PRODUCTION

Environmental impacts of biofuel production - Energy balance and life-cycle analysis of biofuel production - Value-added processing of biofuel residues and co-products. **(5)**

TOTAL : 15

TEXT BOOK

1. *Biorenewable Resources: Engineering New Products from Agriculture. Robert C. Brown. Wiley-Blackwell Publishing (2003).*

REFERENCES

1. *Anaerobic Biotechnology for Bioenergy Production: Principles and Applications. Samir K. Khanal. Wiley-Blackwell Publishing (2008).*

19CHOC28 - BIOFUEL : FATE AND FUTURE

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Understanding the concept of release of biofuel and its impact on the environment*

CO2 : *Understanding the interaction of biofuel with petroleum fuel and the environment*

CO3 : *Understanding and planning long term release response strategies and closures.*

INTRODUCTION - BIOFUEL RELEASE

Definition of key terms - Biofuel summary - Current and projected volumes of biofuel - Biofuel toxicity - Biofuel release scenarios and causes - Release prevention. **(5)**

FATE AND TRANSPORT OF BIOFUELS IN THE ENVIRONMENT

Physical and chemical properties of biofuel - Biodegradation - Biofuel interaction with petroleum fuels - Physical transport. **(5)**

LONG TERM RESPONSE STRATEGIES FOR BIOFUEL RELEASE

Regulatory thresholds and / or potential hazards - Risk assessment and management - Active remedy evaluation and selection - Closure requirements - Timing and duration of long-term response. **(5)**

TOTAL : 15

REFERENCES

1. *Biofuels: Release Prevention, Environmental Behaviour, and Remediation; The Interstate Technology & Regulatory council, Biofuels team, 2011.*

19CHOC29 - DIMENSIONAL ANALYSIS AND THEORY OF MODELS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PREREQUISITES

Chemical Process Calculations, Fluid Mechanics

COURSE OUTCOMES

Students will be able to

CO1 *: Apply principles of dimensional homogeneity to check consistency of empirical equations used in science and Engineering*

CO2 *: Develop empirical relationship from first principles or from specific experimental observations*

CO3 *: Validate dimensional consistency of any equations used in current research conclusions*

Unit - I

Principles of dimensional homogenity, Geometric similarity - Singular dimensional matrix - Dimensional homogeneity - Buckingham's theorem - reduction of dimensionless form.

Introduction to models and testing - dynamic, geometric and kinematic similarity. **(7)**

UNIT - II

Applications of dimensional analysis in fluid mechanics - velocity distribution in conduit - Pumps and compressors

Application of dimensional analysis in real world physical problems - Transient convective heat transmission to a body in a fluid - Condensation in a vertical pipe. **(8)**

ASSESSMENT

Assignment and internal examination - 50%

External examination - 50%

TEXT BOOKS

1. *Henry L Langhaar, Dimensional Analysis and Theory of Models, John Wiley & sons, 1951*
2. *Jonathan Worstell, Dimensional analysis: Practical Guides in Chemical Engineering, Elsevier, 2014.*

CO - PO Mapping

	Programme Outcomes												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3											1	1
CO2	3	3											1	1
CO3			2	2									1	1

19CHOC30 - PINCH TECHNOLOGY

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

PRE-REQUISITE

Heat Transfer

COURSE OUTCOMES

Students will be able to

CO1 *: Identify the locations of energy minimization in heat exchanger networks*

CO2 *: Obtain energy targets by constructing composite curves*

CO3 *: Arrange the heat transfer equipment in most efficient manner*

INTRODUCTION

Pinch analysis - process synthesis - pinch point - composite curves - energy targeting: problem table algorithm - shifted composite curve - capital cost - total cost targeting - process modification. **(8)**

PINCH ANALYSIS

Identification of streams - temperature-enthalpy diagram - minimum temperature difference - construction of composite curves - Energy cost target - optimum target - design of heat exchanger network. **(7)**

TOTAL : 15

Pedagogy

Lecture

Evaluation and Grading

Test - 50%

Internal exam - 50%

TEXT BOOKS

1. *Ian C. Kemp, Pinch Analysis and Process Integration, Second edition, Elsevier, 2007.*
2. *Rokni Masoud (2016), Introduction to Pinch Technology, Technical University of Denmark.*
3. *V. UdayShenoy, Heat Exchanger network synthesis, Gulf Publishing Co, USA, 1995.*
4. *D.W. Linnhoff et al., User Guide on Process Integration for the efficient use of Energy, Institution of Chemical Engineers, U.K., 1994.*

CO - PO Mapping

	Programme Outcomes												PSO's	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	1	1	3	1				1		3	
CO2	2	3	3		2	2					1		2	
CO3	1	2	1		1	2					1	1	2	

19CHOC31 - DRUG DELIVERY SYSTEMS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Understand the basic properties of nanomaterials*

CO2 : *Nanomaterials and its biological applications*

CO3 : *To study the toxicity of material with cells*

CO4 : *Learn nanoparticles as drugs to targeted sites with controlled release of drugs*

CO5 : *To study drug release from the nanomaterials*

TRANSDERMAL DRUG DELIVERY SYSTEMS

Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches. **(5)**

NASOPULMONARY DRUG DELIVERY SYSTEMS

Nasal and Pulmonary routes of drug delivery, formulation of Inhalers (dry powder and meterd dose).**(5)**

TARGETED DRUG DELIVERY

Concepts and approaches, introduction to liposomes, niosomes, monoclonal antibodies and their applications. **(5)**

TOTAL : 15

TEXT BOOKS

1. *B. Wang, Drug Delivery: Principles and Applications, Wiley Intersceince, 2005.*
2. *M.Salzman, Drug Delivery: Engineering Principles for Drug Therapy.*

REFERENCES

1. *A.M.Hillery, Drug Delivery and Targetting, CRC Press, 2002.*
2. *Bio-Applications of Nanoparticles Warren C.W. Chan.*

19CHOC32 - RESEARCH SKILLS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : *Understand the concept of performing research, literature survey procedure and skills for pursuing research.*

CO2 : *Identify the research topic, advisor, time span, benefits of research and admission procedure.*

CO3 : *Write a research article and publishing it in a suitable journal and making presentations.*

UNIT I

What is Research and What makes a Good Research Question? - What is Literature Review and Why Do We Need to Do One? - Why are Planning and Management Skills Important for Research? **(5)**

UNIT II

When should I begin research? - How much time is required? - How do I select a research advisor? - How do I select a research topic? - What are the benefits of research? - How do I register for research programme? **(5)**

UNIT III

How to write a research / review article? - How to write abstract, introduction, methodology, results and discussion - How to format tables and figures? - Ethical issues in scientific publishing - How to avoid plagiarism? - Determining authorship - Submission of Manuscript - Monitoring Peer Review - Acceptance and post publication process. **(5)**

TOTAL : 15

Evaluation and Grading

Literature Survey (Assignment) - 30%

Presentation - 40%

Review Article Writing - 30%

TEXT BOOKS

1. *J.W. Creswell, Research Design: Qualitative, Quantitative and Mixed Methods Approaches, SAGE Publications, Inc., 4th Ed., 2014.*
2. *N. William, Research Methods, Routledge; 2nd Ed., 2017.*
3. *C.R. Kothari, Research Methodology Methods and Techniques, New Age Publications, New Delhi, 2009.*

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				2						3				1
CO2				3				2		3				1
CO3				3				2		3				1

19CHOC33 - E-WASTE MATERIAL FLOW AND MANAGEMENT PRACTICES

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: To enhance the student understands the concept of e-waste issues and challenges.*

CO2 *: Identify the flow of e-waste from manufacture to recycler.*

CO3 *: To impart ability to identify the methodology to recycle e-waste.*

UNIT I

Introduction - Definition -E-waste components and composition - Material Flow - Source of e-waste generation - Selection of methodology for Inventory - Limitations in e-waste inventory Mechanism of WEEE trade - E-waste life cycle - Material flow model - components of e-waste management - National and Social Policies: Laws and Regulations - Institutional roles in Developed and Developing countries. **(9)**

UNIT II

Collection systems - E-waste Treatment Systems - First Level and Second Level Treatment - Unit Operations in E-waste Management - other advanced recycling methods. **(6)**

TOTAL : 15

Pedagogy

Lecture, Exercises

Evaluation and Grading

Case Studies … 50%

Report submission and Seminar … 50%

REFERENCES

1. *Rakesh Jhori, E-waste: Implications, regulations, and management in India and current global best practices, TERI, 2008.*
2. *E-waste Volume I - Inventory Assessment Manual by United Nations Environmental Programme.*
3. *E-waste Volume II - E-waste Management Manual by United Nations Environmental Programme.*

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2			2	3	3		3
CO2						2	2			2	2	3		3
CO3						2	2			2	3	3		3

19CHOC34 - CHEMICALS IN THE ENVIRONMENT : FATE AND TRANSPORT

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *To analyze the behavior of chemicals in the environment.*

CO2 : *To understand the process that govern the behavior of both hazardous and naturally-occurring substances in the environment.*

CO3 : *To acquire basic knowledge about waste water treatment methodologies.*

UNIT I

Control volumes, Mass balance, and advective/dispersive transport, Chemical equilibria, Mass action, Electro neutrality, and Mass conservation, ecosystem characteristics and redox chemistry. **(6)**

UNIT II

River transport, lakes and wetlands and estuaries, Sediment transport, bottom, sediments, Paleolimnology, air-water exchange, major ion chemistry of natural waters. **(6)**

UNIT III

BOD/DO modeling and microbial kinetics, Photochemistry and hydrolysis. **(3)**

Pedagogy

Lecture, Presentation, Assessment

Evaluation and Grading

Literature review … 20%

Presentation … 30%

Assessment … 50%

REFERENCES

1. *Robert L. Swann and Alan Eschenroeder (Eds.), Fate of chemicals in the environment, Compartmental and multimeia mode for predictions, 1983, American Chemical Society.*

MAPPING OF COs with POs

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1		3		2			3						3	
CO2		3					3							
CO3		3	2			1	3						3	

19CHOC35 - AN INTEGRATED APPROACH FOR WASTEWATER TREATMENT

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *To present the basic principles of disinfection, drinking water quality, natural treatment systems.*

CO2 : *To integrate theoretical principles of disinfection with practical aspects of evaluation of disinfection systems.*

CO3 : *To acquire basic knowledge about adsorption process and its methodologies.*

UNIT I

Drinking water quality, Water collection and storage, disinfection, Natural treatment systems.

Quality and analysis of Water: characteristics of water - physical, chemical and biological, kinds of microorganisms, pathogenic microbes, indicator microbes, enumeration of microbes, Coliform bacteria as indicator organisms, Tests for the coliform group (MPN Method) **(9)**

UNIT II

Adsorption: biological materials, nano materials and composites, Case study. **(6)**

TOTAL : 15

Pedagogy

Lectures, Exercise

Evaluating and Grading

Presentation - 20%

Assignments - 30%

Exercise - 50%

REFERENCES

1. A D Patwardhan, Industrial waste water Treatment, 2008, PHI publishers.

Mapping of Course Outcomes with Program Outcomes

COURSE OUTCOME	PROGRAMME OUTCOMES												PSO'S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CO1		2		3			3						3	
CO2		2		3			3							
CO3		2		3		1	3						3	

19CHOC36 - TEXTILE EFFLUENTS : ANALYSIS AND TREATMENT METHODS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *To learn the operation of textile industries and its influence on depleting the ecosystem*

CO2 : *To analyse the constituents of textile effluents for a safer discharge*

CO3 : *To study the operation of various stages of effleunt treatment plant and to emphasize the standards on effluent discharge*

INTRODUCTION

Introduction to textile industries - a general study; chemicals used for the manufacture of textiles introduction to natural and synthetic dyes - classification and chemical properties; manufacture of textiles; hazardous impacts of the untreated effluents on discharge to ecosystem **(5)**

EFFLUENT ANALYSIS

General testing of organic and inorganic compounds - conductivity, salinity, total dissolved solids, total suspended solids, total toxic organics, turbidity, biochemical oxygen demand and chemical oxygen demand, pH, hardness. **(5)**

EFFLUENT TREATMENT PROCESS

Primary treatment - screening, homogenizing, neutralization and cooling; secondary treatment - aerobic and anaerobic stages, sedimentation, sludge management, disinfection, tertiary Treatment effleunts - pressure sand filter and activated carbon filter, ultrafiltration, softener, reverse osmosis adsorption and degradation - basic studies; standards for discharge - government policies, norms and legislations **(5)**

TOTAL : 15

TEXT BOOKS

1. *Mohd Yusuf, Handbook of Textile Effluent Remediation, 1st Edition, Jenny Stanford Publishing, 2018.*

REFERENCES

1. *S. Kathleen, M. Christopher, L. Lynn. Bergeson, Nanotechnology and the Environment, CRC press 2009.*
2. *Darcy J. Gentleman, Nano and the Environment: Boon or Bane?" Environmental Science and Technology, ACS Publication, Vol. 43, 2009.*

19CHOC37 - ADVANCED RECYCLING AND RECOVERY TECHNOLOGIES FOR E-WASTE

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: To develop the student, understands the methodology to recycle and recover e-waste.*

CO2 *: To understand the recent research practices involved in metal recovery from e-waste.*

CO3 *: Ability to apply knowledge of various unit operations involved in e-waste management.*

UNIT I

Sorting, Disassembly - Crushing, Diminution -Emerging Technologies -Automated Disassembly, Comminution -Separation - Printed Circuit Boards - Solder removal using IR heater. **(6)**

UNIT II

Need for recycling and recovery -Advanced methods - Plasma Arc Method - Cryo-milling technique, Bioleaching using Micro-organisms - Hydrometallurgical treatments - Pyrometallurgy and Pyrolysis. Characteristics study - Determination of metals using Atomic Absorption Spectroscopy -Proximate and Ultimate analysis **(9)**

TOTAL : 15

Pedagogy

Lecture, Exercises

Evaluation and Grading

Case Studies … 50%

Report submission and Seminar … 50%

REFERENCES

1. *Vidyadhar Ari (June 29th 2016). A Review of Technology of Metal Recovery from Electronic Waste, E-Waste in Transition - From Pollution to Resource, Florin-Constantin Mihai, Intech Open.*
2. *R. E. Hester, R. M. Harrison, Electronic Waste Management, RSC publishing, 2009.*

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2			2	3	3		3
CO2						2	2			2	2	3		3
CO3						2	2			2	3	3		3

19CHOC38 - NPTEL / MOOC CERTIFICATION COURSE

(Chemical Engineering and Allied Courses)

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

INSTRUCTIONS :

- *A Student can select any NPTEL / MOOC Course that is offered by Chemical and Allied Engineering Branches.*
- *Evaluation pattern will be based on performance in Assignments/ Tutorials and Final Exams conducted by the mentor of the respective NPTEL / MOOC Courses.*
- *Student should submit certificate of NPTEL / MOOC Course for successful completion at end.*

OPEN ELECTIVES

19CEOE01 - TOWN PLANNING AND ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : interpret the geometric forms and aesthetic qualities of Architecture

CO2 : integrate the various elements of architecture and orientation of buildings

CO3 : describe the development plans and planning regulations

CO4 : incorporate the development control rules in town and country planning

PRINCIPLES OF TOWN PLANNING

Evaluation of planning - Objects of town planning - principles of town planning- origin of towns - growth of towns - origin - direction - various forms of planning **(9)**

ELEMENTS OF ARCHITECTURE

Introduction of architecture - definition - Evaluation of geometric forms - function and history - Sphere, Cube, Pyramid, Cylinder and Cone - aesthetic qualities of Architecture - Proportion, Scale, Balance, Symmetry, Rhythm and axis - Contrast in Form - Harmony. **(9)**

PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS

Factors affecting orientation - Sun-Wind-Rain - Orientation criteria for Indian conditions - Principles governing the theory of planning - Planning of residential buildings. **(7)**

DEVELOPMENT PLAN

Principles of city planning - levels of planning- scope and contents of regional plan, master plan, detailed development plan and structure plan - preparation and implementation - planning of new towns - slum clearance and urban renewal. **(9)**

PLANNING LEGISLATION AND DEVELOPMENT CONTROL RULES

Planning legislation and administration - Tamil Nadu Town and Country Planning Act, Tamil Nadu Housing Board Act, Tamil Nadu slum clearance and Improvement Act. Zoning regulations - sub division regulations - building regulations - Floor Space Index - minimum plot sizes - open spaces - minimum standard dimensions **(11)**

TOTAL : 45

TEXT BOOKS

1. *RangwalaS.C., "Town Planning", Charotar Publishing House, Anand, 2013.*
2. *Francis D.K., Ching, "Architecture Form, Space and Order", Oxford University Press, 2014.*

ONLINE RESOURCE

1. *https://nptel.ac.in*

19CEOE02 - CLIMATE CHANGE AND ADAPTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Outline the earth's system which influences the climatic factors of the earth.

CO2 : Infer the evidences and observed changes in the climate and environment on a global scale and in India.

CO3 : Analyse the impacts of climate change on various sectors and the uncertainties over the projected impacts of climate change.

CO4 : Investigate the various adaptation and mitigation options in various sectors and examine the mitigation efforts made in India.

CO5 : Correlate future clean technology and alternate energy options inferred in clean development mechanism.

EARTH'S CLIMATE SYSTEM

Introduction-Climate in the spotlight-The Earth's Climate Machine - Climate Classification - Global wind systems - Trade Wind Systems - Trade Winds and the Hadley Cell - The Weserlies - Cloud formation and Monsoon Rains - Storms and Hurricanes - The Hydrological Cycle - Global Ocean Circulation - EI Nino and its Effect - Green House Gases and Global Warming - Carbon Cycle. **(9)**

OBSERVED CLIMATE CHANGE AND ITS CAUSES

Observation of Climate Change - Changes in pattern of temperature, precipitation and sea level rise - Observed effects of Climate Changes - Patterns of Large Scale Variability - Drivers of Climate Change - Feedbacks - The Montreal Protocol - UNFCCC - IPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India. **(9)**

IMPACTS OF CLIMATE CHANGE

Impacts of Climate Change on various sectors - Agriculture, Forestry and Ecosystem - Water resources - Human Health - Industry, Settlement and Society - Methods and Scenarios - Projected Impacts for different regions - Uncertainties in the Projected Impacts of Climate Change. **(9)**

CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES

Adaptation Strategy/options in various sectors - Water - Agriculture - Infrastructure and Settlement including coastal zones - Human Health - Tourism - Transport - Energy - Key Mitigation Technologies and practices - Energy supply - Transport - Buildings - Industry - Agriculture - Forestry - Carbon sequestration - Carbon Capture and Storage (CCS) - Mitigation Efforts in India and Adaptation funding. **(9)**

CLEAN TECHNOLOGY AND ENERGY

Clean Development Mechanism - Carbon Trading - Examples of future Clean Technology - Biodiesel - Natural Compost - Eco-friendly Plastic - Alternate Energy - Hydrogen - Bio-fuels - Solar Energy - Wind - Hydroelectric Power. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Dash Sushil Kumar, "Climate Change - An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.*
2. *UNIPCC Fifth Assessment Report, 2014.*
3. *Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.*

REFERENCES

1. *Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.*
2. *Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998.*
3. *Jepma, C.J., and Munasinghe, M., Climate Change Policy - Facts, Issues and Analysis, Cambridge University Press, 1998.*
4. *Dash Sushil Kumar, "Climate Change - An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.*

ONLINE RESOURCES

1. *"An Inconvenient truth (2006)"- video*
2. *https://climate.nasa.gov*
3. *https://unfccc.int*
4. *https://environment .gov.au*

19CEOEO3 - METRO SYSTEMS AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Integrate the basic elements of MRTS, BRTS, LRTS and other transportation systems

CO2 : Illustrate the components of metro rail systems

CO3 : Apply the concepts of ITS in the field of Transportation Engineering

PRINCIPLES OF TRANSPORTATION SYSTEMS

Transportation systems in India - various modes of transport - public transport - Intermediate public transport - types - characteristics - other urban transportation modes - drawbacks- various transit systems **(9)**

MRTS

Definition - Mass Rapid Transit System - History of MRTS - Need for MRTS - connectivity in Indian conditions - cities having MRTS - infrastructure - operations - fares and ticketing - case study. **(8)**

BRTS and LRTS

Bus Rapid Transit System - terminology - history -features - performance - cost - drawbacks - Light Rail Transit System - necessity - types - gauge- capacity integration with cycles - comparison to other rail modes **(9)**

METRO RAIL SYSTEMS

History of Metro trains - Need for Metro rail - connectivity in Indian conditions - cities having Metro - construction techniques adopted in Metro Rail stations - Case study - Delhi Metro (DMRC) - Chennai Metro (CMRL) **(10)**

ITS

Definition - Intelligent Transport System - Principles - Application of ITS technologies in various countries - smart transportation - case studies **(9)**

TOTAL : 45

TEXT BOOKS

1. *Pradip Kumar Sarkar, Vinay Maitri, G. J. Joshi ·"Transportation Planning Principles, Practices and Policies", Prentice Hall India Pvt., Limited 2017*
2. *D. Johnson Victor, S. Ponnuswamy, "Urban Transportation Planning, Operation and Management" Tata McGraw-Hill Education, 2012*
3. *Mashrur A. Chowdhury, Adel Wadid Sadek "Fundamentals of Intelligent Transportation Systems Planning" Artech House · 2003*
4. *Sumit Ghosh, Tony S. Lee, "Intelligent Transportation Systems Smart and Green Infrastructure Design, Second Edition" CRC Press · 2010*

ONLINE RESOURCES

1. *https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_48.pdf*

19CEOE04 - RENEWABLE ENERGY RESOURCES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Infer the current energy scenario and future energy usage in India.

CO2 : Interpret the concepts of solar energy, wind energy, tidal energy and biomass energy.

CO3 : Compare the energy utilization from wind energy, solar energy, biomass energy and tidal energy.

CO4 : Correlate the challenges and problems associated with the use of energy sources.

ENERGY PERSPECTIVES

Conventional and non conventional energies - Energy and sustainable development - Global energy scenario - Energy scenario in India - Energy consumption pattern in rural and urban regions in India - Energy efficiency and economy - Energy losses and its control - Renewable energy potential mapping - Plant load factor **(9)**

SOLAR ENERGY PERSPECTIVES

Concept of solar energy - Solar energy to light and to thermal conversions - Total energy and necessary infrastructure - Units and measurement of solar radiation - Temperature dependent collecting devices and their efficacies - Design aspects - Typical applications: heating, cooling, lighting, power generation and cooking. **(9)**

WIND ENERGY PERSPECTIVES

Wind potential in India - Wind turbines and their types - Merits and demerits - Wind power and appropriate coefficient - Efficiency and performance of wind machines -Energy conversion and storage - Synchronous invertors - Various storage aspects: battery, fly wheel, hydrogen and compressed air. **(9)**

BIOMASS ENERGY PERSPECTIVES

Biomass potential in India - Gobar gas and producer gas - Characteristics of biomass - Operation and design of biogas plants - Objectives, principles and operational aspect of biogassifiers - Pyrolysis and incineration - Power generation from municipal solid waste and industrial Sludges - Application of biodiesel plants - Fuel cells. **(9)**

TIDAL ENERGY PERSPECTIVES

Tidal aspects in coastal India - Tidal energy conversion system: mechanical to electrical and thermal to electrical - Tidal force calculation and power generation - conceptualization and potential of geothermal energy - Geothermal vents. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Sukathme, S.P, Nayak J.K., "Solar Energy", Tata McGraw-Hill Book Co., New Delhi, 2017.*
2. *Rai, G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2010.*
3. *P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.*
4. *Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.*

REFERENCES

1. *Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.*
2. *Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.*
3. *Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.*

ONLINE RESOURCES

1. *https://swayam.gov.in/nd1_noc20_ge06/preview*
2. *https://swayam.gov.in/nd2_nou20_cs09/preview*

19CEOE05 - PRINCIPLES OF SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Identify the components, factors and environmental issues affecting Sustainable development.

CO2 : Assess the role of International summits, conventions and Environmental aspects on Sustainable development.

CO3 : Interpret the necessity and importance of Indian and International Socio -economical and legal aspects in Sustainability.

CO4 : Illustrate the different strategies to achieve Sustainable development.

CO5 : Assess the role of Life cycle Assessment, Cleaner Production and Sustainable Chemistry to achieve sustainable development.

CONCEPTS OF SUSTAINABLE DEVELOPMENT

Sustainable development- Evolution of Environmental awareness and Sustainable development, global Sustainable development goals -components and factors affecting Sustainable development-Demographic dynamics and sustainability- Environmental issues and crisis- ozone layer depletion, global warming and climate change **(9)**

ENVIRONMENTAL ASPECTS

International Environmental summits, conventions and agreements-Tiwari committee recommendation - Role of Pollution Control Board - Transboundary issues - Ecological indicators- Ecological foot print- Carbon foot print - Basic concept of Environmental impact assessment **(9)**

SOCIO ECONOMIC AND JUDICIAL ASPECTS

UN Sustainable development policies through trade- World Trade Organization-International monetary fund and World bank - Circular Economy and Sustainable Development - Socio economic policies for sustainable Development- Role of Judiciary in Sustainable Development - Major Environmental Cases in India - Development of Environmental Policies in India - Environment Protection Act, 1986 - EIA notification 2006 - National Conservation Strategy and Policy Statement on Environment and Development, 1992 - Policy Statement for the Abatement of Pollution, 1992 - National Environment Policy, 2006. SDG India Index - Baseline Report 2018 **(9)**

STRATEGIES FOR SUSTAINABLE DEVELOPMENT

Economic growth and Sustainable Development - Resource depletion and resource protection- - Internet of things and Sustainable Development - Sustainable Management of Forest, Land, water- Natural Disaster management- case studies. **(9)**

CLEANER PRODUCTION, LIFE CYCLE ASSESSMENT - GREEN/SUSTAINABLE CHEMISTRY

Cleaner Production, definition, aim, application-Generic process of Cleaner Production Assessment- Life cycle Assessment - definition, necessity and elements- ISO Environmental standards- Environmental Audit -Green Chemistry - twelve Principles of Green Chemistry - case studies. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ramakrishnan, P. S., "Ecology and Sustainable Development", National Book Trust, New Delhi, 2001*
2. *Paul Robbins, John Hintz, and Sarah A. Moore, "Environment and Society: A Critical Introduction", Wiley-Blackwell, 2014*
3. *Bimal N. Patel and Ranita Nagar, "Sustainable Development and India", Oxford University Press, 2018.*

REFERENCES

1. *Nick Hanley, Jason F. Shogren and Ben White, "Environmental Economics in Theory and Practice", Macmillan Publishers, UK, 1997*
2. *Tietenberg T. and Lynne Lewis, "Environmental and Natural Resource Economics", Harper Collins, Routledge, 2016*
3. *Kirkby, J.O., Keefe, P., and Timberlake, "Sustainable Development", Earthsean Pub., London, 2001*

ONLINE RESOURCES

1. *https://nptel.ac.in*

19CEOE06 - DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Identify natural and manmade disasters

CO2 : Explain in detail about causes and effects of natural and manmade disasters.

CO3 : Apply geospatial techniques (including GIS) that can enhance vulnerability assessments

CO4 : Identify and analyse the factors that give rise to differential vulnerabilities and levels of community resilience and suggest necessary mitigation plans

CO5 : Assess and manage these vulnerabilities through disaster planning and policy-making.

NATURAL DISASTERS

Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche. **(9)**

MAN MADE DISASTERS

Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster- Forest Fire- Oil fire -accident in Mines. **(9)**

GEOSPATIAL TECHNOLOGY

Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping. **(9)**

RISK ASSESSMENT AND MITIGATION

Hazards, Risks and Vulnerabilities - Disasters in India, Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans. **(9)**

DISASTER MANAGEMENT

Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism - Role of Engineers in Disaster Management. **(9)**

TOTAL : 45

TEXT BOOKS

1. *R. Subramanian, "Disaster Management" Vikas Publishing House Pvt. Ltd, New Delhi, 2018.*
2. *Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2017.*

REFERENCES

1. *Disaster Management in India-A Status Report- Published by the National Disaster Management Institute, Ministry of Home Affairs, Govt. of India, 2004.*
2. *Murthy D. B. N., "Disaster Management : Text and Case Studies", Deep and Deep Publications (P) Ltd., New Delhi, 2007.*
3. *Sundar I. and Sezhiyan T., "Disaster Management", Sarup and Sons, New Delhi, 2007.*
4. *Singhal J.P. "Disaster Management", Laxmi Publications, 2010.*

5. *Khanna BK, "All You Wanted To Know About Disasters", New India Publishing Agency, New Delhi, 2005.*
6. *Ramana Murthy, "Disaster Management", Dominant, New Delhi, 2004.*
7. *Rajdeep Dasgupta, "Disaster Management and Rehabilitation", Mittal Publishers, New Delhi, 2007.*

19MEOE01 - DESIGN OF EXPERIMENTS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Demonstrate the fundamental concepts applied with mathematical knowledge, methodologies to bring knowledge of characterize, analyse and solve a wide range of problems between the purpose of a model and the appropriate level of complexity and accuracy.

CO2 : Plan, design and conduct experimental investigations efficiently and effectively; choose an appropriate experiment to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results.

CO3 : Analyse the nature of variables, statistical inference, influence parameter selection, factorial concepts, Conduct Design of experiments; interpret the direct and interaction effects using RSM.

INTRODUCTION

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. **(7)**

BASIC STATISTICAL CONCEPTS

Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples. **(9)**

EXPERIMENTAL DESIGN

Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples. **(11)**

ANALYSIS AND INTERPRETATION METHODS

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples. **(9)**

EXPERIMENT DESIGN USING TAGUCHI'S ORTHOGONAL ARRAYS

Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples. **(9)**

TOTAL :45

TEXT BOOKS

1. *C.F. Jeff Wu & Michael Hamada, "Experiments-Panning, Analysis, and Optimization", 3rd Edition, John Wiley & Sons. Inc., 2021.*
2. *D.C. Montgomery, "Design and Analysis of Experiments", 10th Edition, John Wiley & Sons. Inc. 2019.*

REFERENCES

1. *T.B. Barker, Andrew Milivojevich, "Quality by Experimental Design", 4th Edition, CRC Press, 2021*
2. *https://nptel.ac.in/courses/110/105/110105087/*
3. *https://nptel.ac.in/courses/111/104/111104075/*

19MEOE02 - ENGINEERING OPTIMIZATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Formulate single or multi-variable engineering optimization problems and comply with the appropriate objective functions.

CO2 : Select the appropriate optimization technique for the specified engineering problems based on number of variables and constraints.

CO3 : Derive, develop and utilize the possible randomness or any other associated factors that would possibly occur during constrained and unconstrained optimization situations.

INTRODUCTION

Problem formulation - design variables, constraints, constraint surfaces, objective functions, objective function surfaces. Classification of optimization - based on existence of constraints, nature of design variables, structure of the problem, nature of equation involved, permissible value of the design variables, deterministic nature of the variables, separability of the functions and the number of objective functions. Example of engineering optimization problems. **(11)**

SINGLE VARIABLE OPTIMIZATION

Optimal criteria - bracketing method - exhaustive search method, region elimination method - interval halving, Fibonacci, golden search method, point estimation method - successive quadratic approximation, gradient search method - Newton Raphson's method. **(10)**

MULTIVARIABLE OPTIMIZATION WITH CONSTRAINTS

Multivariable optimization - semi definite case - saddle point. Multivariable optimization with equality constraints - solution by direct substitution - solution by the method of constrained variation - solution by the method of Lagrange multipliers. Multivariable optimization with inequality constraints - Kuhn-Tucker conditions, constraint qualification. **(12)**

UNCONSTRAINED OPTIMIZATION

Introduction - classification of unconstrained minimization methods - general approach - rate of convergence - scaling of design variables. Direct Search Methods - random search methods - random walk method with direction exploitation - advantages of random search methods. Indirect Search Methods - gradient of a function - evaluation of the gradient - rate of change of function along a direction - steepest descent (Cauchy) method. **(12)**

TOTAL : 45

TEXT BOOKS

1. *S. S. Rao, "Engineering Optimization: Theory and Practice", 5th Edition, John Wiley & Sons, 2019.*
2. *K. Deb, "Optimization for Engineering Design - Algorithms and Examples", 2nd Edition, Prentice Hall India, 2013.*

REFERENCES

1. *J. S. Arora, "Introduction to Optimum Design", 4th Edition, Academic Press, 2016.*
2. *Ashok D. Belegundu &Tirupathi R. Chandrupatla, "Optimization Concepts and Applications in Engineering", 3rd Edition, Kindle Edition, Cambridge University Press, 2019.*

3. *A. Ravindran, K. M. Ragsdell, Reklaitis G.V., "Engineering Optimization: Methods and Applications", John Wiley & Sons, Inc., 2006.*
4. *https://nptel.ac.in/courses/112/105/112105235/*
5. *https://nptel.ac.in/courses/105/108/105108127/*
6. *https://nptel.ac.in/courses/112/101/112101298/*

19MEOE03 - ENGINEERING POLYMERS, COMPOSITES AND ALLIED MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Choose manufacturing processes for polymers and PMC materials to obtain required shapes by applying product design considerations

CO2 : Find the processes to develop new ceramic and cermet materials for manufacturing of high temperature cutting tools by applying design considerations

CO3 : Develop and characterize the Nano-composites, MMCs, CMCs and PMCs for the engineering applications using secondary processing methods

CO4 : Synthesize, characterize, compaction and sintering of metal powders for application of P/M parts using powder metallurgy techniques

CO5 : Synthesize and characterize the nanostructured materials for fabricating electronic devices, MEMS, magnetic, electronic and optical sensors and fabricating carbon nano structured materials for fuel cell and energy storage applications

SHAPING PROCESSES FOR PLASTICS

Properties of polymer melts - extrusion - production of sheet and film - fibre and filament production (spinning) - coating processes - injection moulding - compression and transfer moulding - blow moulding and rotational moulding - thermoforming. Casting - polymer foam processing and forming - product design considerations. **(8)**

RUBBER-PROCESSING TECHNOLOGY

Rubber processing and shaping - manufacture of tyres and other rubber products - product design considerations. **(5)**

SHAPING PROCESSES FOR POLYMER MATRIX COMPOSITES

Materials for PMC - open mold processes - closed mold processes - filament winding -pultrusion process - other PMC shaping processes. **(4)**

PROCESSING OF CERAMICS AND CERMETS

Processing of traditional ceramics - processing of new ceramics - processing of cermets - product design considerations. **(4)**

APPLICATION OF COMPOSITES

Composites including Nano-composites for electrical, superconducting and device applications, fabrication of Nano-composites, secondary processing and joining of various composite materials for structural applications and their fracture behavior and safety. **(9)**

POWDERS

Production and characterization of powders, compaction of metal powders - die compaction, isostatic pressing, powder forging, powder rolling and extrusion, pressure less compaction techniques, hot pressing and hot isostatic pressing, sintering of powder compacts, liquid phase sintering, sintering furnaces, post sintering operations, applications of P/M parts. **(7)**

INTRODUCTION TO NANOMATERIALS

Nano structured materials, low-dimensional structures: quantum wells, quantum wires, and quantum dots, Nano clusters & Nanocrystals, electronic and optical properties of Nano crystallites, metallic and semiconducting superlattices, synthesis of nanostructured materials, fabrication and characterization of Nano electronic devices and MEMS, basics of synthesis and

characterization of Nano-multi-component systems for sensors (magnetic, electronic and optical) and electrodes, synthesis and fabrication of carbon Nano structures for fuel cell and energy storage applications. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Mikell P. Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", 4th Edition, John Wiley & sons, Inc. 2015.*
2. *Ajayan P. M., Schadler L. S., & Braun P. V, "Nano composite Science and Technology", John Wiley & Sons, Inc., 2014.*

REFERENCES

1. *Charles A. Harper, "Modern Plastics Handbook", McGraw-Hill, 2010.*
2. *Sperling L.H., "Introduction to Physical Polymer Science", 3rd Edition, John Wiley & Sons, 2011.*
3. *Chawla K.K., "Ceramic matrix composites", 1st Edition, Chapman & Hall, 2013.*
4. *Randall M German, "A-Z of Powder Metallurgy (Metal Powders Technology)", Elsevier Science, 2007.*
5. *Upadhyaya G. S., "Powder Metallurgy Technology", Cambridge International Science Publishing, 2002.*

19MEOE04 - INDUSTRIAL ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Examine the configuration of a robot and suggest a robot for a particular operation (pick and place, welding, vision, climbing etc.).

CO2 : Calculate the position, velocity and acceleration for a robot manipulator and solve the forward and inverse kinematics.

CO3 : Calculate mass and inertia for the links of a robot manipulator and also find its forward and inverse dynamics.

CO4 : Choose an appropriate vision system for the robot and then extract these images to get the desired output.

CO5 : Write a program to determine path for obstacle avoidance for a specific task and can solve using matrix laboratory software.

INTRODUCTION

Brief history of robots, robot definitions, today's practical importance of robot applications, challenges faced by robots in industrial situations, future scope of robotics. **(3)**

GENERAL CONSIDERATION OF ROBOTIC MANIPULATORS

Introduction - Brief history of robotics- Robot geometrical configurations - wrist and gripper subassemblies - robot drive systems - robot software. **(5)**

KINEMATICS OF ROBOT MANIPULATORS

Homogeneous representation of objects, robot manipulator joint coordinate system, Euler angles and Euler transformations, Denavit- Hartenburg (D-H) representations, direct kinematics in robotics, inverse kinematic solutions, geometrical approach in inverse Kinematics, Jacobian of transformation in robotic manipulation. **(12)**

ROBOT WORKSPACE AND MOTION TRAJECTORY DESIGN

General Structure of robotic workspaces, robotic workspace performance index, extreme reach of robotic hands, robotic task description, robotic motion, trajectory design, general design considerations on trajectories, 4-3-4 trajectory, 3-5-3 trajectory, simulation of robotic workspaces. **(8)**

MOTION CONTROL OF ROBOTIC MANIPULATORS

General arm control system - open and closed loop control systems error controlled robotic dynamics - control structure of amplifier- control of a single axis robotic arm, common control systems for industrial robots, force control of robotic manipulators. **(9)**

ROBOT SENSING AND ROBOT VISION SYSTEM

Desirable features of sensor- range sensors - proximity sensors - tactile sensors-force sensors, torque sensing detectors - TV cameras - illumination techniques - fundamentals of image processing visual data acquisition - image enhancement - image segmentation - image extraction and recognition- object and model matching - image extraction. Typical vision systems, robot programming languages - characteristics of robot- level languages - characteristics of task level languages, simulation languages. **(8)**

TOTAL : 45

TEXT BOOK

1. *Fu.K S, Gonzales .R.C., & Lee.C.S.G., "Robotic Control, Sensing, Vision and Intelligence", McGraw Hill International, 2006.*
2. *Ashitava Ghushal "Robotics : Fundamental Concepts and Analysis", Oxford, 2006.*

REFERENCES

1. *Mikell.P.Groover, Mitchell Weiss, Tooger. N. Nager, & Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill International, 2004.*
2. *Richard. D. Klafter, Thomas. A. Chmielewski, & Michaelnegin, "Robotic Engineering - An Integral Approach", Prentice Hall of India, 2002.*
3. *https://nptel.ac.in/courses/112/105/112105249/*

19MEOE05 - BUSINESS PROCESS REENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Gain knowledge about BPR, Factors affecting BPR operations and design BPR techniques.

CO2 : Use BPR tools, utilize concepts of BPR, analyse cost / Benefit and appreciate the need of IT in BPR.

CO3 : Incorporate changes in the business operation based on market demand and implement the same in the manufacturing system.

CO4 : Select an appropriate practice of the business re-engineering project by taking the practical situations into consideration.

CO5 : Provide the most feasible practical solution to the problem keeping in mind the considerations of business automation, value, processes and risks in launching the business reengineering project.

INTRODUCTION TO BPR

Definition; the paradigm shifts in production; the need for BPR, advantages and benefits of BPR, constraining factors, challenges, the positioning concept; the re-engineering visions; The BPR Life Cycle Methodology, Guidelines for BPR steps, Role of Information Technology in BPR; process Improvement and Process Redesign; BPR Experience in Indian Industry. **(9)**

METHODOLOGIES AND TOOLS FOR BPR

Process management; dynamic business re-engineering change framework; steps to reengineer the process. Tools used in Modelling the Business: flow-charting, business activity maps, relational diagrams, benefit/cost analysis. The enabling role of information technology in business re-engineering. Conceptual Foundation of Business Process Re-engineering; Process Identification and Mapping; Role/Activity Diagrams. **(9)**

CHANGE MANAGEMENT

Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering. Process Visioning and Benchmarking. Business process Improvement, Business Process Redesign; Man Management for BPR implementation; Re-organizing People and Managing Change. **(9)**

GOVERNANCE & BPR

Total Quality Management, Risk Management, Organizational Structures, BPR Project Management, The Power of Habit in organizations. The role of eLearning environments. Applications, gaming, BPR facilitation, BPR in Software Development, Basic principles, Relation to BPR. **(9)**

BEST PRACTICES IN BPR

Research & Practice, Perspectives in BPR, Discussion on research challenges, and practice challenges for industry and governments Case studies: Nissan, Chrysler, Hewlett Packard etc. Workflow systems, Imaging technology, Floware, Business design facility tools, Risk and impact measurement. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Davenport, "Process Innovation: Reengineering work through information technology". Harvard Business School Press, 1993.*
2. *Hammer & Champy, "Reengineering the Corporation: A Manifesto for Business Revolution" Harper Business Books, 1993.*

3. *Hammer & Stanton, "The Reengineering Revolution" Harper Collins. London, 1995.*
4. *Henry J Johansson, Patrick McHugh, John Pendlebury & William A. Wheeler, "Business Process Reengineering: Break Point Strategies for Market Dominance", Wiley, New Delhi, 1993.*

REFERENCES

1. *Harmon, P, "Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals", Elsevier/ Morgan Kaufmann Publishers, 2007.*
2. *R. Anupindi et al., "Managing Business Process Flows: Principles of Operations Management", Pearson Education Inc, 2006.*
3. *Kock, N.F., "Process Improvement and Organizational Learning: The Role of Collaboration Technologies", Idea Group, 1999.*
5. *Walford, R.B., "Business Process Implementation for IT Professionals and Managers" Artech Business Process Reengineering" Prentice Hall, New Delhi, 1993.*

19MEOE06 - ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Analyze the demand and supply and sketch a demand and supply curve.

CO2 : Determine the Breakeven point and find out the strength and weakness of the Market Structure.

CO3 : Sketch the curve for cost behavior for the short run concept.

CO4 : Analyze and specify the causes and provide the solution to each cause.

CO5 : Formulate the steps involved in a recruitment process as a chart and interpret it.

INTRODUCTION

Definition -Nature and Scope-Significance of Economics for Engineers. **(5)**

BASICS OF MICRO ECONOMICS

Demand Analysis and Supply Analysis - Elasticity of Demand and Supply - Case Study in Demand Forecasting - Cost concepts - Classifications - Short run and Long run cost curves - Break-even Analysis. **(8)**

MARKET STRUCTURE

Classification of Market - Perfect Competition-Characteristics -Monopoly - Monopolistic Competition - Oligopoly and Duopoly - Price Discrimination under different markets - Price and output determination in short run and long run. **(8)**

MONEY AND BANKING

Money - Quantity theory of Money -Supply of Money - RBI Measures of Money Supply - Banking - Functions of Commercial Banks and Central Banks- Balance of Payments - Meaning and methods of Exchange control Methods of Foreign Payments - IMF, IBRD, WTO- Agreements of WTO and its Impact on Indian Economy. **(9)**

NATIONAL INCOME

Meaning - National Income - Concepts -Methods of Calculating and Problems in calculating National Income - Inflation - Causes - Measures -Deflation - Stagflation - Phillips Curve - Unemployment New Environment Policy- Liberalisation -Privatisation - Globalisation. **(8)**

HUMAN RESOURCE MANAGEMENT

Principles of Management, Evolution of Management, Development of Managerial Skills- Human Resource Management- Importance- Objectives- Job Analysis- Recruitment- Selection and Placement and Training Development. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Dewett. K. K., & Navalur M.H., "Modern Economic Theory", S. Chand and Company Ltd, New Delhi, 2014*
2. *Lipsey & Chrystal, "Economics", Oxford University Press, 2010*
3. *V. S. Bagad, "Principles of Management", Technical Publication, Pune*

REFERENCES

1. *Paul A Samuelson & William, "Economics", Tata McGraw Hill, New Delhi, 2012.*
2. *Francis Cheriunullem, "International Economics", McGraw Hill Education, 2011.*
3. *William A McEachern & Smrit Kaur, "Micro Economics", Cengage Learning, 2013.*
4. *William A McEachern & Indira A., "Macro Economics", Cengage Learning, 2014.*
5. *Lipsey & Chrystal, "Economics", Oxford University Press, 2010.*
6. *https://nptel.ac.in/courses/112/107/112107209/*

19EEOE01 - ENERGY AUDITING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Exhibit Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing

CO2 : Compute the thermal efficiency of various thermal utilities and use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.

CO3 : Analyse the cost- benefit of various investment alternatives for meeting the energy needs of productive processes through energy conservation study.

CO4 : Illustrate the energy saving techniques to reduce power consumption of the non- productive loads

CO5 : Advocacy of strategic and policy recommendations on energy conservation and energy auditing.

ENERGY AUDIT

Global energy scenario - Heat and Electrical energy - Role of energy managers in industries - Energy auditing -Types of energy audit- Data to be collected in auditing - Needs, methodology and types of energy audits - Simple payback period - Net present value of saving- Energy audit report **(9)**

ELECTRICAL ENERGY CONSERVATION

Basic Industrial electrical distribution- energy saving and energy efficiency with Transformers, reactive power correction and cable loss reduction- Energy saving in lighting systems -Specific Energy Consumption (SEC) - Load management - Demand Side Management (DSM). **(9)**

HEAT ENERGY CONSERVATION

Energy Audit - Losses in Boiler - Waste heat recovery - Sources of waste heat - High temperature heat recovery - Medium temperature heat recovery - Waste heat recovery applications- Cogeneration- Heating, ventilation and air conditioning systems (HVAC) :Types - energy conservation in cooling towers and Spray ponds. **(9)**

BUILDING, TRANSPORT AND UTILITY ENERGY CONSERVATION

Real buildings systems: Consumption - Cost versus lifecycle cost - Building design - Water supply systems Real Transportation Systems: Energy conservation in transportation - New technologies - Progress in clean diesel technology. Energy conservation inpumps, and fan and blowers - Energy efficient motors. **(9)**

ENERGY AUDIT PLANNING AND MONITORING

Energy Action Planning: Energy management system - Management commitment and Energy conservation policy - Energy performance assessment - Data collection and management - Analysis of data, baseline and benchmarking - Estimation of energy savings potential - Action planning and Training planning.

Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & targeting - Data and information, various techniques - Energy consumption, Production and Cumulative sum of differences (CUSUM). **(9)**

TOTAL : 45

TEXT BOOKS

1. *D. P. Sen Gupta, K. R. Padiyar, IndranilSen, M.A, "Recent Advances in Control and Management of Energy Systems", Interline Publishers, Bangalore, 1993.*

2. *AmlanChakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2012.*
3. *YP.Abbi and Shashank Jain, "Handbook on Energy Audit and Environment Management", TERI, 2006.*
4. *Frank Krieth and D Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, 2007.*
5. *C.B. Smith, "Energy Management Principles", Pergamon Press, New York, 1981.*

REFERENCES

1. *"General Aspects of Energy Management and Energy Audit-Unit- 1,2,3,4", BEE Guide book, 2010.*
2. *Hamies, "Energy Auditing and Conservation: Methods, Measurements, Management & case study", Hemisphere, Washington, 1980.*
3. *Diamant R.M, "Total Energy", Pergamon Press, Oxford Press, 1970.*
4. *Albert Thumann, "Fundamentals of Energy Engineering", Prentice Hall, May 1984*
5. *Larry C Whit et.al, "Industrial Energy Management & Utilization", 1st Edition, Springer, 1988.*

19EEOE02 - SOLAR AND WIND ENERGY SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Summarize the solar radiation, measurements and characteristics of solar PV cell.

CO2 : Develop the model of a PV system and its applications.

CO3 : Illustrate the basic types, mechanical characteristics and model of wind turbine.

CO4 : Analyse the electrical characteristics and operation of various wind-driven electrical generators.

CO5 : Utilize various power electronic converters used for hybrid system.

SOLAR RADIATION AND SOLAR CELL FUNDAMENTALS

Basic characteristics of sunlight - solar spectrum - insolation specifics- irradiance and irradiation pyranometer - solar energy statistics- Solar PV cell - I-V characteristics -P-V characteristics- fill factor. Modeling of solar cell- maximum power point tracking. **(9)**

SPV SYSTEM PERFORMANCE AND APPLICATIONS

PV module - blocking diode and by -pass diodes- composite characteristics of PV module - PV array - solar cell array design concepts - Peak power operation-System components. PV- powered fan-PV fan with battery backup - PV-powered pumping system - PV powered lighting systems - grid - connected PV systems. **(9)**

WIND ENERGY FUNDAMENTALS AND COMPONENTS

Wind source-wind statistics-energy in the wind- Basic principle of wind energy conversion - nature of wind - power in the wind -turbine power characteristics- parts of wind turbines- braking systems-tower-Maximum power operation. **(9)**

WIND TURBINE TYPES AND CONTROL

Classification of WECS - Generating Systems - DC generator, Synchronous generator, Induction -generator, Doubly fed Induction generator, Direct -driven generator- generator control - load control. **(9)**

SYSETM INTEGRATION

Energy storage-Power electronic converters for interfacing wind electric generators - power quality issues- Hybrid system: wind - diesel systems, wind-solar systems. **(9)**

TOTAL : 45

TEXT BOOKS

1. *S N Bhadra, S Banerjee and D Kastha, "Wind Electrical Systems", Oxford University Press, 1st Edition, 2005.*
2. *Chetan Singh Solanki, "Solar Photovoltaic's: Fundamentals,Technologies and Applications" PHI Learning Publications, 3rd Edition, 2015.*

REFERENCES

1. *Roger A. Messenger and Jerry Ventre, "Photovoltaic systems engineering", Taylor and Francis Group Publications, 2020.*

2. *M.Godoy Simoes and Felix A. Farret, "Alternative Energy Systems: Design and Analysis with Induction Generators", CRC press, 2nd Edition, 2008.*
3. *Ion Boldea, "The electric generators hand book - Variable speed generators", CRC press, 2015.*

19EEOE03 - ELECTRICAL SAFETY PROCEDURES AND MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Identify and analyze the precautions and protection of electrical hazards

CO2 : Select and use the suitable personal protective equipment according to the working environment

CO3 : Interpret the safety procedures for the specific work place

CO4 : Analyze and apply the various grounding techniques

CO5 : Infer the electrical safety against low voltage and high voltage and to manage the medical equipments

INTRODUCTION AND HAZARDS OF ELECTRICITY

Electrical Safety introduction : Hazard Analysis: Primary and secondary hazards - Arc, blast, shocks - Causes and effects - Summary of causes- Protection and precaution - Injury and death protective strategies - IE Rules 1956 - Basic rules for new installations: power system, Domestic and Industry (Qualitative treatment only) **(9)**

ELECTRICAL SAFETY EQUIPMENT

General inspection and testing procedure for electrical safety equipment - Electrical safety equipment for external protection: Flash and thermal protection - Head and eye protection - Insulation protection. Electrical safety equipment for internal protection: Over voltage, Short circuit, Earth Fault, Leakage current, High/ Low frequency - Single Line diagram of industrial power system with safety control - Electrician's Safety kit and materials. **(9)**

SAFETY PROCEDURES

Introduction - Six step safety method - Job briefings - Energized or De - energized - Safe switching of power systems - General energy control programs - Lockout - Tagout - Voltage measurement techniques - Placement of safety grounds - Flash hazard calculations and approach distances - Calculating the required level of arc protection (flash hazard calculations) - Barriers and warning signs - Tools and test equipment - Field marking of potential hazards - Shock avoidance techniques - One minute safety audit. **(9)**

GROUNDING AND ELECTRICAL MAINTENANCE

Need for electrical equipment grounding - System grounding - Equipment grounding - Types of Earthing - Earth testing for electrical equipment in Power house and Industry - Eight step maintenance program - Maintenance requirements for specific equipment and location - IEC and UL standard. **(9)**

VOLTAGE SAFETY SYNOPSIS AND MEDICAL SAFETY MANAGEMENT

Safety equipment and safety procedures for low voltage and high voltage system - Electrical safety around electronic circuits- Electrical safety for medical equipment like over current safety, Isolation, EMI and harmonics - Battery maintenance procedure- Stationary battery safety - Accident prevention - Accident investigation - First aid - Rescue techniques - Electrical safety program structure and development - Safety meetings - Safety audits. **(9)**

TOTAL : 45

TEXT BOOK

1. *John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel and Al Winfield, "Electrical Safety Handbook", 4th edition, Mc Grew Hill, 2012*

REFERENCE S

1 *Mohamed A El - Sharkawi, "Electric safety: Practice and Standards", CRC press, New York, 2013*

2. *Martha J. Boss and Gayle Nicoll, "Electrical Safety: systems, sustainability and stewardship", CRC press, New York, 2014*

3. *Ray A. Jones and Jane g. Jones, "The Electrical Safety Program Guide", National fire protection association, Quincy, 2011*

4. *Electrical Safety booklets issued by Government bodies*

19EEOE04 - ENERGY EFFICIENT ILLUMINATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Understand the properties of light, importance of lighting in various fields, types of light sources and methods of lighting.

CO2 : Perform the calculation of luminance parameters in various applications.

CO3 : Identify the criteria for selection of lighting equipment's and control systems in various applications.

CO4 : Impart design and technology for Interior lighting and Exterior lighting applications

CO5 : Review the various technologies used in Smart lighting systems.

INTRODUCTION : BASICS OF LIGHTING

Lighting Physics - Optical Radiation - Concept of Color - Biological Factors : Human eye and brain response - Different entities of illuminating systems. Properties of Lighting - Natural and Artificial lighting - Good and Bad Lighting - Challenges in Lighting - Good Practices in Lighting - Types of Lighting. **(7)**

LIGHTING CALCULATIONS AND LIGHT SOURCES

Basic Terms in Lighting System - Luminance measurement - Laws of Illumination - Polar Curves - Rousseau's construction - Concept of Photometry - Introduction of lighting software.

Lamps: Incandescent Lamps: Halogen lamps - Discharge Lamps: MV and SV Lamps, Fluorescent Lamps: FTL, CFL - Arc lamps - Special Lamps: LED: Surface Mounted Devices (SMD-LEDs), Chip on Board (COB-LEDs) - Neon lamps - Lasers - Comparison of Lamps - Life Cycle Cost (LCC) Analysis - Efficacy. **(12)**

LIGHTING EQUIPMENTS AND STANDARDS

Luminaries, Wiring, Control gears, Switching boards, Reflectors and Control circuits - Heating, Harmonics and EMI Suppression techniques from lighting equipment - Switching and Dimming control algorithm - Recommendation of Illumination Levels for Various Tasks / Activities / Locations - Role of 3D printing technology for designing luminaries - International Standards and codes of lighting system. **(9)**

LIGHTING APPLICATIONS

Interior lighting: Industrial, Residential, Indoor stadium and Hospitals. Exterior lighting: Flood, Street, Aviation and Transport lighting - Sign and display Board Lighting - Lighting in Agriculture - Lighting in Automobiles. **(8)**

SMART LIGHTING SYSTEMS

Intelligent lighting system - Smart LED lighting systems - LED Smart Projector system - Solar Street Lighting Systems - Role of IoT in lighting system - Concept of Light Fidelity (Li-Fi) - Significance of UV-C lighting in medical - Concept of Artificial Moon for street lighting. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to the Laser", Visions Communications, Washington DC, USA, 2nd Edition, 1994.*
2. *Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, New Delhi, 3rd Edition, 2008*

3. *Leon Gaster, John Stewart Dow, "Modern Illuminants and Illuminating Engineering", Nabu Press, Washington DC, 1st Edition, 2010.*
4. *Philip Gordon., "Principles and Practices of Lighting Design: The Art of Lighting Composition", Blue Matrix Productions, 2011.*

REFERENCES

1. *Lighting Engineering: Practical Hand Book, INDALUX 2002*
2. *IES Lighting Handbook, 10th Edition, 2011.*
3. *NPTEL Course: Illumination Engineering*
4. *Lighting - Research paper reference from Philips - Lighting Academy and Signify Lighting University.*

19EEOE05 - ELECTRIC VEHICLE TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Apprehend the fundamentals and importance of electric vehicles and its components

CO2 : Select the suitable drive scheme based on the motor and topology for the given specification and applications

CO3 : Design and categorize the battery system for electric vehicles and hybrid electric vehicles

CO4 : Recognize the suitable battery charging scheme for different environments and applications.

CO5 : Describe the significance of E-mobility and its various business opportunities

ELECTRIC VEHICLES

An Overview of Conventional, Battery, Hybrid and Fuel Cell Electric Systems - Conventional IC Engine Vehicle - BEVs - HEVs - Series HEV - Parallel HEV - Series-Parallel HEV - FCEV - EV subsystems - Vehicle Dynamics: Vehicle Load Forces - Basic Power, Energy, and Speed Relationships - Aerodynamic Drag - Aerodynamic Drag and Fuel Consumption - Rolling Resistance - Gradability **(9)**

ELECTRIC PROPULSION

Electric Motors in EVs - Configuration and control of DC motor drives - Induction motor drives- Permanent Magnet motor drives - Switched reluctance motor drives - Transmission configuration, Components - gears, differential, clutch, brakes - regenerative braking - types - Motor sizing.- Matching the electric machine and the internal - combustion engine (ICE), Sizing the propulsion motor, sizing the power - electronics, selecting the energy storage technology, Communications- supporting subsystems **(9)**

BATTERIES

Introduction to Batteries - Energy Storage Requirements in Electric Vehicles: Batteries Types: Lead-Acid Battery - Nickel-Metal Hydride - Lithium-Ion - Battery Operation - Battery Parameters and Comparisons - Battery Packs - Battery Sizing - Battery based energy storage and its analysis - Fuel Cells - Fuel Cell based energy storage and its analysis - Super capacitors- Hybridization of different energy storage devices **(9)**

BATTERY CHARGING

Charging methods for battery- Fast charging - Battery Charging, Protection, and Management System - Termination methods - Charging from grid - Isolated and Non-isolated DC - DC Converters - Bidirectional DC-DC converter - High-frequency transformer based isolatedcharger topology - Transformer less topologies. **(9)**

E-MOBILITY

Energy Management Strategies - Automotive networking and communication, EV and EV charging standards, V2G, G2V, V2B, V2H - E-mobility business - Electrification challenges - Connected Mobility and Autonomous Mobility- Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). **(9)**

TOTAL : 45

TEXT BOOKS

1. *Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 2nd Edition CRC Press, 2018.*
2. *Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021*

REFERENCES

1. *James Larminie, John Lowry, Electric Vehicle Technology Explained, 2nd edition, Wiley, 2012*
2. *Soylu "Electric Vehicles - The Benefits and Barriers", InTech Publishers, Croatia, 2011.*
3. *J.M. Miller, "Propulsion Systems for Hybrid Vehicles", Institution of Electrical Engineers (IEE), 2nd edition, London, UK, 2010.*
4. *R. Stone and J.K. Bell, "Automotive Engineering Fundamentals", SAE International, Warrendale, PA, 2004.*
5. *Viswanathan B. and Scibioh Aulice M, "Fuel cells: Principles and Applications", University Press, 2008.*

19EEOE06 - ENERGY EFFICIENCY IN THERMAL AND ELECTRICAL UTILITIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Preaudit the energy

CO2 : Analyse the possibility of energy savings

CO3 : Analyze the methods of energy savings

CO4 : Design the solutions

CO5 : Identify and perform appropriate energy management

ENERGY EFFICIENCY IN THERMAL UTILITIES - I

- Fuels and Combustion: Introduction to fuels, properties of fuel oil, coal and gas, storage, handling and preparation of fuels, principles of combustion, combustion of oil, coal, and gas.
- Boilers: Types, combustion in boilers, performance evaluation, analysis of losses, feedwater treatment, blowdown, energy conservation opportunities..
- Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.
- Insulation and Refractories: Insulation-types and application, the economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss.
- FBC boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, Retrofitting FBC system to conventional boilers, saving potential. **(9)**

ENERGY EFFICIENCY IN THERMAL UTILITIES - II

- Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate, and flash steam recovery system, identifying opportunities for energy savings
- Cogeneration: Definition, need, application, advantages, classification and saving potentials.
- Waste Heat Recovery: Classification, advantages, and applications, commercially viable waste heat recovery devices, saving potential.
- Energy Management & Audit: Definition, need and types of an energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to the requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.
- Material and Energy balance: Facility as an energy system, methods for preparing process flow, material, and energy balance diagrams. **(9)**

ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

- Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.
- Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy-saving opportunities with energy- efficient motors.

- Energy-Efficient Technologies in Electrical Systems: Maximum demand controllers, automatic power factor controllers, energy-efficient motors, soft starters with energy savers, variable speed drives, energy-efficient transformers, electronic ballasts, occupancy sensors, energy-efficient lighting controls. **(9)**

ENERGY EFFICIENCY IN THERMO ELECTRIC UTILITIES - I

- Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities
- HVAC and Refrigeration System: Vapor compression refrigeration cycle, refrigerants, the coefficient of performance, capacity, and factors affecting Refrigeration and Air conditioning system performance and savings opportunities.
- Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system, saving potentially
- Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.
- Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. **(9)**

ENERGY EFFICIENCY IN THERMO ELECTRIC UTILITIES - II

- Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy-saving opportunities assessment of cooling towers.
- Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues.
- Diesel Generating system: Factors affecting the selection, energy performance assessment of diesel conservation avenues **(9)**

TOTAL : 45

ENERGY PERFORMANCE ASSESSMENT FOR EQUIPMENT AND UTILITY SYSTEMS

Open Book examination on the following energy performance assessments for equipment and utility systems:

- Boilers, Furnaces
- Cogeneration, Turbines (gas, steam)
- Heat Exchangers
- Electric Motors, Variable Speed Drives
- Fans and Blowers, Water Pumps, Compressors
- HVAC systems
- Lighting Systems
- Performing Financial Analysis.
- Applications of Non-conventional & Renewable Energy Sources (NRES)
- Waste minimization and resource conservation

TEXT BOOKS

1. *Mehmet Kanolu, Yunus A. Çengel, "Energy efficiency and management for engineers", McGraw- Hill Education, 2020*
2. *Stephen A. Roosa, Steve Doty, Wayne C. Turner, "Energy Management Handbook", 9th edition, River Publishers, Taylore and Francis Group, 2020*
3. *Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency (BEE), Guide books*
4. *Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency (BEE), Guide books*

REFERENCES

1. *Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2017*
2. *Wayne C. Turner," Energy Management Handbook", Eighth Edition, 2012*
3. *Stephen A. Roosa, Steve Doty, "Energy Management Handbook", 2018*
4. *General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency (BEE), Guide books*
5. *Energy Performance Assistance for Equipment and Utility Systems, Bureau of Energy Efficiency (BEE), Guide books*

19ECEOE01 - SIGNAL PROCESSING AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Compute the Discrete Fourier Transform (DFT) of a given discrete time sequence using Radix-2 Fast Fourier Transform algorithms and design FIR/IIR Filters

CO2 : Apply source coding procedure to calculate coding efficiency based on entropy & mutual information and outline different pulse analog modulation techniques

CO3 : Analyze various equalization techniques and compare its performance

CO4 : Calculate channel capacity using Shannon's channel capacity theorem and develop channel error control codes

CO5 : Analyze speech processing methods in time and frequency domain and design codec methods for speech compression techniques

ORTHOGONAL TRANSFORMS AND DIGITAL FILTER STRUCTURES

DFT-DCT-Properties of DFT- Computation of DFT, FFT and structures-Decimation in time-Decimation in frequency - Linear convolution using DFT

Basic FIR/IIR filter structures-FIR/IIR Cascaded lattice structures-Parallel allpass realization of IIR transfer functions- Sine cosine generator - Computational complexity of filter structures **(10)**

DATA COMPRESSION

Information entropy-Source coding-Huffman algorithm-Delta Modulation-Adaptive Delta Modulation- Continuously Variable Slope Delta Modulation-Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation. **(8)**

SIGNAL PROCESSING IN COMMUNICATION RECEIVER

Temporal Equalization-Space Time Equalization-Frequency Domain Equalization-Symbol Timing Recovery- Channel Quality Estimation- Automatic Frequency Control-Overall Receiver Block. **(9)**

ERROR CORRECTING CODES & CHANNEL CODING

Error Correcting codes-Error Correction-Linear Blocks Codes-Cyclic Codes- Bose, Chaudhari and Hocquenghem Codes-Convolution Codes-Viterbi Decoding-Interleaving Codes-Concatenated Codes- Turbo Codes. **(9)**

SPEECH CODING

Speech Coding-Adaptive Predictive Coding-Sub Band Coding,-Vocoders-Liner Predictive Coding- Image Coding-Joint Photo Graphic Expert Group (JPEG)-Moving Pictures Expert Group (MPEG), the layer-3 of MPEG-1 Algorithms(MP3),Lempel- ZIV Algorithms - Recognition techniques:Speech Recognition and Image recognition. **(9)**

TOTAL : 45

TEXT BOOKS

1. *V. Oppenheim, R. W. Shafer and J.R.Buck, "Discrete-Time Signal Processing", Pearson Education, 3rd Edition, 2011.*
2. *Simon Haykin, "Digital Communications Systems", 1st Edition, Wiley, 2013.*

REFERENCES

1. *Sanjit. K. Mitra and Sanjit Kumar Mitra, "Digital Signal Processing - A computer based approach", Tata McGraw Hill, 4th Edition, 2011.*
2. *Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 2005.*
3. *Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003*
4. *L.R.Rabiner and R.W.Schaffer "Digital Processing of Speech signals" Prentice Hall 1978*
5. *Nirmal K. Bose, Calyampudi Radhakrishna Rao, "Signal Processing and Its Applications" North-Holland, 1993*

19ECEOE02 - SMART SENSORS AND IoT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the classification ,types,packaging and testing of smart sensors

CO2 : Interpret the construction and working principles of Electronic sensors

CO3 : Exemplify the working of different types of light radiation sensors .

CO4 : Illustrate the key concepts of temperature ,gas and airquality sensors used to measure the parameters.

CO5 : Interpret the characteristics, functional blocks and architecture of IoT to develop an IoT based applications.

SMART SENSORS BASICS

Sensor Classification, Performance and Types, Error Analysis characteristics- Semiconductor Packaging- Hybrid Packaging- Packaging for Monolithic Sensors- Reliability Implications-Testing Smart Sensors- HVAC Sensor Chip- Amplification and Signal Conditioning- Integrated Signal Conditioning- Digital conversion- MCU Control-MCUs for Sensor Interface- Techniques and System Considerations- Sensor Integration. **(9)**

ELECTRONIC SENSORS

Resistance strain gauge - piezoelectric pressure gauge - characteristics- load cells-torque sensor- Piezo-resistive and capacitive pressure sensor- optoelectronic pressure sensors- vacuum sensors- Capacitor plate sensor, Inductive sensors, LVDT- Hall effect- Doppler detectors- liquid level detectors, flow sensors - ultrasonic sensor- flow sensors. **(9)**

GHT RADIATION SENSORS

Electronic and Optical properties of semiconductor as sensors - LED - Semiconductor lasers- Fiber optic sensors- Thermal detectors - Photo multipliers- photoconductive detectors- Photo diodes- Avalanche photodiodes - CCDs - Intensity sensor - Interferometers-Phase sensor: Phase detection, Polarization maintaining fibers. **(9)**

TEMPERATURE, GAS AND AIR QUALITY SENSORS

Bimetallic strip- Bourdon temperature gauge- thermocouples- Resistance thermometers- thermistors- bolometer- Pyroelectric detector-Engine combustion process- Catalytic exhaust after treatment, Emission limits- Exhaust sensors and Engine control - Exhaust sensors for OBD- Hydro-Carbon Sensors- NOx-Sensors-Oxygen Sensors- Measurement of oxides of sulphur,oxides of nitrogen unburnt hydrocarbons, carbonmonoxide, dust mist and fog- smoke sensors. **(9)**

IoT AND ITS APPLICATIONS

IoT Definition - Characteristics - IoT Functional Blocks -IoT Architecture -Physical design of IoT - Logical design of IoT- Sensing & Actuation -Basics of Networking - Communication Protocols- Machine-to-Machine - Communication models & APIs.

Domain specific applications of IoT: Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture, Smart Traffic Control and Smart water management. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Jacob Fraden," Handbook of modern sensors: physics, designs, and applications", 5th Edition, Springer, 2016.*
2. *Randy Frank, "Understanding Smart Sensors", Artech House, 2nd Edition, Boston, 2011.*

REFERENCES

1. *Arshdeep Bahga, Vijay Madisetti, "Internet of Things - A hands-on approach", Universities Press, 2015.*
2. *Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier, 1st Edition, Netherland, 2011.*
3. *John G Webster, "Measurement, Instrumentation and sensor Handbook", CRC Press, 2nd Edition, Florida, 2017.*
4. *John P. Bentley," Principles of Measurement systems", 3rd Edition, Pearson Education Asia Pvt. Ltd, 2009.*
5. *D. Patranabis," Sensors and Transducers", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2006.*
6. *Ernest O Doebelin, Dhanesh N Manik, "Measurement Systems, Application and Design", McGraw Hill, 6th Edition, 2007.*

19ECEOE03 - CONSUMER ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Understand the various types of microphones and loudspeaker.

CO2 : Explain the principle and working of Monochrome TV.

CO3 : Describe the Colour TV scanning process and camera tube.

CO4 : Illustrate LCD, LED TV, working of cable TV and DTH.

CO5 : Interpret the significant technical considerations using a broad systems perspective.

AUDIO SYSTEMS

Microphones Carbon, moving coil, wireless microphone; Loudspeakers - Direct radiating Electrostatic and horn loudspeaker; Multi-speaker system; Sound Recording - Magnetic Recording, Digital Recording, Optical Recording (CD system and DVD). **(9)**

MONOCHROME TV

Elements of TV communication system, Scanning process, Scanning methods and Aspect Ratio, Need of synchronizing and blanking pulses, Composite Video Signal, Camera Tube: Vidicon. **(9)**

COLOUR TELEVISION

Primary, secondary colours, Concept of Mixing, Colour Triangle, Camera tube, PAL TV Receiver, Concept of Compatibility with Monochrome Receiver, NTSC, PAL, SECAM. **(9)**

LCD AND LED TELEVISION

Basic principle and working of LCD & LED TV, Cable Television: Working of Cable TV, DTH **(9)**

DOMESTIC & CONSUMER APPLIANCES

Operation of Microwave Oven, Automatic Washing Machine, Photostat Machine, Digital Camera, Vacuum cleaner, Food Processors, Scanner. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Bali S.P., "Consumer Electronics" Pearson Education, 2017.*
2. *Bali R and Bali S.P. "Audio video systems: principle practices & troubleshooting", Khanna Book Publishing Co. (P) Ltd., 2010.*

REFERENCES

1. *Gulati R.R., "Modern Television practices" New Age International Publication (P) Ltd.2011.*
2. *Gupta R.G, "Audio video systems" Tata Mc graw Hill, 2nd Edition, 2010.*
3. *Whitaker Jerry & Benson Blair, "Standard Handbook of Audio engineering" McGraw-Hill Professional, 3rd Edition, 2010.*
4. *Amit Dhir, "The Digital Consumer Technology Handbook", Elsevier Science, 2004.*

19ECEOE04 - ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

Upon completion of this course, students will be able to demonstrate an ability to

CO1 : Describe the concepts of robotics, safety measures and homogeneous transformation.

CO2 : Formulate the concepts of mechanical drives and sensors in robotics.

CO3 : Describe the types of sensors and Robotic Vision

CO4 : Develop robotics programming, classifications and its applications.

CO5 : Exemplify the concepts of artificial intelligence.

ROBOT KINEMATICS

Introduction - Robotics and programmable automation - Historical background - Laws of Robotics - Robot definitions - Robotics system and Robot anatomy - Specifications of Robots - Safety measures in Robotics. **(10)**

ROBOTIC DRIVERS AND CONTROLS

Robot drives, actuators and control - Functions of drive systems - General types of fluids - Pump classification - Pneumatic systems - Electrical drives - DC motors - Stepper motors - Drive mechanism. **(9)**

SENSORS AND MACHINE VISION

Need for sensing systems- Principles and Applications of the following types of sensors- Position and displacement sensors - Potentiometers, Encoders, Linear Variable Differential Transformer, Force and Torque sensors- Wrist sensor, Joint sensor, Tactile array sensor, Slip sensors- Proximity sensors- Range finders- Imaging sensors- Inductive Proximity switch- Acoustic sensors- Opto-electronic sensors- Lighting Techniques, Robot Vision- Sensing and Digitizing, Image Processing and analysis- Preprocessing, Segmentation, Description, Recognition, Interpretation and Applications of robot vision system **(9)**

ROBOTIC LANGUAGE AND PROGRAMMING

Robot language and programming. Robot language - Classification of Robot languages - Computer control and robot software - VAL system and language. Applications of Robots: Capabilities of Robots - Robotics applications - Obstacle avoidance. **(8)**

ARTIFICIAL INTELLIGENCE IN ROBOTICS

The history of Artificial Intelligence- Artificial and Natural Intelligence- Artificial Intelligence and Automated manufacturing- The application domains of Artificial Algorithms- Risks and Benefits of AI- Agents and Environments- Knowledge representation.

(9)

TOTAL : 45

TEXT BOOKS

1. *Satya Ranjan Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 2nd Edition, 2012.*
2. *Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2014.*

REFERENCES

1. *Robin.R.Murphy, "Introduction to AI Robotics", The MIT Press, Canbridge, Massachusetts, London, England, Second Edition, 2019.*
2. *Jadran Lenarcic, Jean-Pierre Merlet, "Advances in Robot Kinematics 2016", Springer International Publishing AG, 2018.*

3. *Peter McKinnon, "Robotics", CreateSpace Independent Publishing Platform, 2016.*
4. *Ritu Tiwari, Anupam Shukla, Rahul Kala, "Intelligent Planning for Mobile Robotics: Algorithmic Approaches", Information science reference, United states of America, 2013.*
5. *David. L. Pool and Alan. K. Mackworth, "Artificial Intelligence: Foundations of Computational agents", Cambridge University, 2011.*

19ECEOE05 - INFORMATION THEORY AND CODING TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the information content in a discrete memoryless source through parameters such as entropy and mutual information.

CO2 : Estimate a channel's capacity based on Shannon's channel capacity theorem

CO3 : Analyze various channel encoding and decoding methods

CO4 : Design and develop an error control coding methods for random error and burst error detection and correction techniques

CO5 : Understand different applications in coding techniques

INFORMATION THEORY AND SCHEMES FOR SOURCE CODING

Uncertainty Information and Entropy - Basic Properties of entropy - Information rate - Conditional entropy - Joint Entropy - Mutual Information - Channel capacity of a Gaussian channel

SOURCE CODING : Prefix codes - Necessary conditions for source coding - Kraft Mcmillan Inequality- Huffman Coding- Shannon Fano Coding Efficiency calculations. **(9)**

MEMORYLESS FINITE SCHEMES FOR CHANNEL CODING

Discrete Memoryless Channel - Channel models - BSC and BEC channels - Cascaded channels - Channel capacity of discrete and analog channels - Channel capacity of a Gaussian channel-Bandwidth-S/N trade-off-Channel coding theorem - Information capacity theorem - Code rate and redundancy-Parity check codes - Rate Distortion Theory. **(9)**

LINEAR BLOCK CODES AND CYCLIC CODES

Rationale for coding - Types of codes - Matrix description of linear block codes - Syndrome decoding - Minimum distance considerations -Repetition codes - Dual codes- Cyclic codes :Generator polynomial - Parity check polynomial - Encoder of cyclic codes - Calculation of syndrome - Cyclic codes for error correction. **(10)**

CONVOLUTIONAL CODES

Convolutional codes : Tree codes- Trellis codes- Viterbi decoding of convolutional codes - Catastrophic Error Propagation in Convolutional Codes -Performance Bounds for Convolutional Codes - Coding Gain - Convolutional Code Trade off - Soft Decision Viterbi Decoding -Feedback Decoding - Sequential Decoding **(9)**

CODING TECHNIQUES IN DATA COMPRESSION

Static and Dynamic Huffman coding - Arithmetic coding - Run length encoding- Lempel-Ziv coding -Image compression techniques -JPEG standard for Lossy and Lossless compression- Video compression standards. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003.*
2. *Ranjan Bose, "Information Theory Coding and Cryptography", Tata McGraw Hill, 3rd Edition 2016.*

REFERENCES

1. *Richard B.Wells, "Applied Coding and Information Theory for Engineers", Pearson Education, 1st Edition Indian reprint, 2009.*
2. *Khalid Sayood, "Introduction to Data Compression", 4th Edition, Elsevier, 2012.*
3. *Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2nd Edition, 2009.*
4. *Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons, 2nd Edition, 2006.*
5. *Reza F M, "An Introduction to Information theory", McGraw Hill, 2000.*
6. *Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 1st Edition, 2021.*

19ECEOE06 - WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Outline the challenges & issues in the wireless sensor network and its subsystems and interpret network architecture and its components

CO2 : Describe the essential principles of the MAC protocols for Wireless Sensor Networks

CO3 : Elucidate the Routing & localization tracking inWireless Sensor Networks

CO4 : Discuss the features of WSN Operating systems

CO5 : Illustrate the methodologies to provide WSN based solution for various critical issues.

SENSOR NETWORKS - INTRODUCTION & ARCHITECTURES

Challenges for Wireless Sensor Networks-Enabling Technologies for Wireless Sensor Networks- Characteristic requirements for WSN - WSN architecture - Commercially available sensor nodes -Imote, IRIS, Sunspot -Physical layer and transceiver design considerations in WSNs-Single Node Architecture -Energy Consumption of Sensor Nodes- Sensor Network Scenarios- Optimization Goals and Figures of Merit. **(9)**

DATA LINK LAYER

Fundamentals of MAC protocols- Issues in designing a MAC Protocol for WSN - Low duty cycle protocols and wakeup concepts - Contention based protocols:PAMAS - Schedule-based protocols:LEACH - Sensor MAC - Berkeley MAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4- Link Layer protocols - fundamentals task and requirements, error control, framing, link management, Address and Name Management, Assignment of MAC Addresses, Unique,Content-based and geographical addressing. **(10)**

ROUTING AND TRACKING

Routing Challenges and Design Issues in Wireless Sensor Networks- Taxonomy :Data-centric routing SPIN - Energy aware routing, Gradient-based routing -Hierarchical Routing LEACH -Location Based Routing GAF, Data aggregation - Various aggregation techniques

A Tracking Scenario - Problem formulation - Distributed representation and inference of states- Tracking multiple objects - Sensor models - Topology control - Clustering - Time synchronization - Localization and Localization Services **(10)**

EMBEDDED OPERATING SYSTEMS FOR WSNs

Embedded Operating Systems: Operating Systems for WSNs - Introduction - Operating System Design Issues- Introduction to Tiny OS - NesC - Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM. **(7)**

APPLICATIONS OF WSN

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications - Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling **(9)**

TOTAL : 45

TEXT BOOKS

1. *Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, First Edition, 2007.*
2. *Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.*

REFERENCES

1. *Anna Hac, "Wireless Sensor Network Design", John Wiley & Sons, First Edition, 2003.*
2. *C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "Wireless Sensor Networks", Springer Publication, 2004.*
3. *Paolo Santi, "Topology Control in Wireless Adhoc and Sensor Networks", John Wiley & Sons, 2005.*
4. *Philip Levis, David Gay,"TinyOS Programming", Cambridge University Press, 2009 Contiki - Open Source Operating System for IoT - http://www.contiki-os.org/*

19ECEOE07 - AUTOMOTIVE EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Design modules for hybrid vehicle using automotive system components.

CO2 : Design control system in automotives by appropriate choice of Microcontrollers, Sensors and actuators.

CO3 : Examine the communication protocols for real time applications

CO4 : Understand the safety and comfort in Automobiles as per the government test procedures.

CO5 : Understand the communication and diagnostic protocols

AUTOMOTIVE SYSTEMS

Overview of Automotive industry - Tools and Processes - Introduction to modern automotive systems -Spark and Compression Ignition Engines - Automotive Transmissions - Vehicle braking fundamentals -Steering Control - Overview of Hybrid Vehicles - Analog and Digital Systems - Basic measurements systems. **(9)**

SENSORS AND ACTUATORS

Sensors: Characteristics, response and modeling - Actuators - Microcontroller and Digital Signal Processors used for automotive applications. **(9)**

EMBEDDED COMMUNICATION

Embedded Automotive Protocols: CAN, LIN, FLEXRAY, MOST **(9)**

SAFETY SYSTEMS

Active Safety Systems: ABS, TCS, ESP, brake assist - Passive Safety Systems: Airbag systems, Advance Driver Assistance system (ADAS) -Computer vision techniques - Connected cars technology - Trends towards Autonomous vehicles. **(9)**

FUNDAMENTALS OF DIAGNOSTICS

Basic wiring system and Multiplex wiring system, Self-Diagnostic system - various On board and off board diagnostics in Automobiles - Diagnostics tools - Diagnostics Protocols: KWP20000 and UDS. **(9)**

TOTAL : 45

TEXT BOOK

Ronald K Jurgen, "Automotive Electronics Hand Book", McGraw- Hill, 2nd Edition 1999.

REFERENCES

1. *William B. Ribbens, Ph.D, "Understanding Automotive Electronics", Elsevier Publications, 7th Edition, 2012.*
2. *Tom Denton, "Advance Automotive Diagnosis", 2nd Edition, Elsevier 2006.*
3. *BOSCH Automotive Handbook, 8th Edition.*
4. *Denton. T, "Automobile Electrical and Electronics Systems", SAE (Society for Automobile Engineers) International, 3rd Edition, 2004.*
5. *Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009.*

19ECEOE08 - 5G TECHNOLOGIES AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : describe the evolution of cellular systems from 2G to 4G

CO2 : explain the motivation, targets of 5G technology and its standardization

CO3 : elaborate the 3GPP releases and 5G radio access network architecture

CO4 : discuss the services offered by 5G deployment and its design approaches

CO5 : understand the role between 5G and emerging next generation wireless technologies

EVOLUTION OF CELLULAR SYSTEMS

Evolution from 2G to 3G and 3G to 4G - Circuit Switch to Packet Switch - ITU Standardization Process- - Evolution of LTE and releases. **(9)**

INTRODUCTION TO 5G

Motivation for 5G - 5G targets - Technology components - Spectrum - capabilities - The role of 3GPP in standardization - use cases - 5GPPP (Public-Private Partnership) **(9)**

5G RADIO ACCESS NETWORK

Radio access - 3GPP Releases - 5G New Radio (NR) - Requirements - 3GPP phases for IMT-2020 - NR air interface - 5G RAN architecture **(9)**

5G SERVICES

Enhanced Mobile Broadband (eMBB) systems - Massive Machine Type Communication (MMTC) system - Ultra Reliable and Low Latency Communication (URLLC) systems - Design approaches **(9)**

EMERGING TECHNOLOGIES IN 5G

Massive MIMO - Network Function Virtualization - Software Defined Networking - Cognitive radio -Millimetre Wave - Heterogeneous network - Internet of Things **(9)**

TOTAL : 45

TEXT BOOKS

1. *Saad Asif, "5G mobile Communications Concepts and Technologies", CRC Press,2018*
2. *Biljana Badic, Christian Drewes, Ingolf karls, Markus Mueck, "Rolling out 5G Use cases, Applications and Technology Solutions", Apress, 2016*

REFERENCES

1. *Antti Toskala, Harri Holma, Takehiro Nakamura, "5G Technology 3GPP New Radio", Wiley & Sons Ltd. 2020.*
2. *Devaki Chandramouli, Juho Pirskanen, Rainer Liebhart, "5G for the Connected World", Wiley,2019*
3. *Haesik Kim, "Design and Optimization for 5G Wireless Communications", Wiley, 2020*
4. *Ramjee Prasad, "5G Outlook Innovations and Applications", River Publications, 2016*
5. *Anwer Al-Dulaimi, "5G Networks Fundamental Requirements, Enabling Technologies, and Operations Management", Wiley, 2018*
6. *Mauro Boldi, Olav Queseth, Patrick Marsch, Ömer Bulakci, "5G System Design Architectural and Functional Considerations and Long Term Research", Wiley,2018*

19ECEOE09 - VEHICULAR COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Understand basic principles, technologies, and system architecture of vehicular ad-hoc networks (VANET)

CO2 : Analyze Physical Layer and MAC Layer for signal propagation for vehicular communication

CO3 : Describe the various routing mechanisms and protocols to fulfill vehicular networking requirements.

CO4 : Explain the challenges and issues in establishing cellular V2X connection and mobility management.

CO5 : outline vehicular communication platforms for various emerging applications

INTRODUCTION TO VEHICULAR RADIO NETWORKS

Basic principles and challenges-Mobile Wireless Communications and Networks-Need for Vehicular Communications-VANET activities- Network Architecture for Vehicular Communications. **(9)**

PHYSICAL LAYER AND MAC LAYER

Signal Propagation-Doppler spread and its impact on OFDM Systems-Proposed MAC approaches and standards, Intelligent Transportation Systems: IEEE 802.11p-ITS-IVC **(10)**

VANET ROUTING PROTOCOLS

Opportunistic packet forwarding-topology based routing- geographic routing **(8)**

VEHICULAR MOBILITY MANAGEMENT

Connected Vehicles& Connected Autonomous Vehicles- Dedicated Short Range Communication-flow and traffic models-Standards and Regulations- DSRC Protocol Stack, Cellular V2X **(9)**

EMERGING VANET APPLICATIONS

Vehicle to Infrastructure Safety Applications-communication paradigms-message coding and composition-data aggregation-Security and Privacy **(9)**

TOTAL : 45

TEXT BOOKS

1. *H. Hartenstein and K. P. Laberteaux, VANET: Vehicular Applications and Inter-Networking Technologies, John Wiley & Sons Ltd., 1st Edition 2010.*
2. *Luca Delgrossi, Tao Zhang, "Vehicle Safety Communications: Protocols, Security, and Privacy", John Wiley & Sons Ltd 1st Edition 2012.*

REFERENCES

1. *P. H.-J. Chong, I. W.-H. Ho, Vehicular Networks: Applications, Performance Analysis and Challenges, Nova Science Publishers, 2019.*
2. *C. Sommer, F. Dressler, Vehicular Networking, Cambridge University Press, 2015.*
3. *Popescu-Zeletin R, Radusch I and Rigani M.A, "Vehicular-2-X Communication",Springer,2010.*
4. *M. Watfa, Advances in Vehicular Ad-Hoc Networks: Development and Challenges, Information Science Reference, 2010.*
5. *H. Moustafa, Y. Zhang, Vehicular Networks: Techniques, Standards, and Applications, CRC Press, 2009.*
6. *Xiang W, "Wireless Access in Vehicular Environments Technology", Springer, 2015*

19ECEOE10 - SENSING FOR AUTOMOTIVE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Acquaint with the basic automotive system components and need for automotive sensors.

CO2 : Discuss the fundamentals of various Power train sensors in automotive systems.

CO3 : Comprehend various sensors for chassis management.

CO4 : Understand the sensors for vehicle management & security systems in Automobiles.

CO5 : Examine the vehicle communication protocols standards in automotive applications.

AUTOMOTIVE SYSTEMS

Introduction to Modern Automotive Systems- Electronics in Automobiles - Combustion Engines- Power-train- braking systems - Transmission- Applications and Challenges in the automotive. **(9)**

POWERTRAIN AUTOMOTIVE SENSORS

Exhaust temperature sensor - λ sensors - PM sensor - NOx sensor - fuel quality sensor- level sensor- torque sensor-speed sensor- manifold pressure sensor - mass flow sensor. **(9)**

CHASSSIS SENSORS

Wheel speed sensors/direction sensors- steering position sensor (multi turn)- acceleration sensor (inertia measurement)- brake pneumatic pressure sensor- ABS sensor- electronic stability sensor. **(9)**

SENSORS FOR VEHICLE MANAGEMENT & SECURITY SYSTEMS

Gas sensors (CO2)- Temperature/humidity sensor- air bag sensor- key less entering sensor- radar sensors. Tire pressure monitoring systems- Two wheeler and Four wheeler security systems. **(9)**

VEHICLE COMMUNICATION STANDARDS

Automotive Protocols : CAN, LIN, FLEXRAY, MOST **(9)**

TOTAL : 45

TEXT BOOK

John Turner, Automotive Sensors, 2010, Momentum Press, 1st Edition, New York.

REFERENCES

1. *Automotive Electrics, Automotive Electronics: Systems & Components, 2014, 5th Edition, BOSCH.*
2. *Ronald K Jurgen, "Automotive Electronics Hand Book", McGraw- Hill, 2nd Edition 1999.*
3. *Automotive Sensors Handbook, 8th Edition, 2011, BOSCH*
4. *Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, Iwao Yokomori, "Sensors for Automotive Technology", 4th Edition, Wiley, New York, 2010.*
5. *Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009.*

19CSOE01 - CUSTOMER RELATIONSHIP MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : State the evolution of marketing and define CRM architecture explaining customer acquisition, retention and segmentation.

CO2 : Describe the business value, its costs and deploying data mining for CRM.

CO3 : Understand the type of collecting and connecting the customer data with proper guidelines for privacy.

CO4 : Demonstrate the scoring process and apply the various CRM optimization techniques to optimize the CRM process in order to improve customer profitability.

CO5 : Evaluate CRM tools using tool assessment and methodology to choose the appropriate tool for real time applications.

INTRODUCTION

Most profitable Customer - CRM: Custom centered database, Managing campaigns, Evolution of marketing, Closed loop marketing, CRM architecture - Customer profitability - Customer acquisition - Cross selling - Customer retention - Customer segmentation. **(9)**

BUILDING THE BUSINESS CASE

Introduction - Uncovering the needs for data mining - Defining the business value - The costs - Deploying Data mining for CRM: Introduction - Define the problem - Define the user - Define the data - Scope the project - Trial - Quality assurance - Education Launch - Continuation. **(10)**

COLLECTING CUSTOMER DATA

Introduction - Three types of customer data - Collecting customer data - Connecting customer - Customer data and privacy - Privacy and data mining - Guidelines for privacy - Legal issues associated with data mining. **(8)**

SCORING YOUR CUSTOMER

Introduction - Process - Scoring architectures and configurations - Preparing the data - Integrating scoring with other applications- Optimizing the CRM process: Introduction - Improved customer profitability through optimization - Optimized CRM - Complete loop - Optimal CRM process - Optimization techniques. **(8)**

OVERVIEW OF DATA MINING AND CRM TOOL MARKETS

Introduction - Data mining market place - Taxonomy of data mining tools - Tool assessment attributes and methodology - Tool evaluation -Data mining tool: WEKA -CRM tools - Next generation for CRM. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Alex Berson, Stephen Smith, Kurt Thearling, "Building Data mining Applications for CRM", Tata McGraw Hill, Fifteenth Reprint, 2008.*
2. *Ian H.Witten ,Eibe Frank, Mark A.Hall, "Data Mining Practical Machine Learning Tools and Techniques", Morgan Kaufmann, Fourth Edition, 2016*

REFERENCES

1. *Francis Buttle, Stan Maklan "Customer Relationship Management: Concepts and Technologies", Routledge, Fourth Edition, 2019.*
2. *Roger J. Baran, Robert J. Galka, "CRM: The Foundation of Contemporary Marketing Strategy", S.Chand (G/L) & Company Ltd, Second Edition, 2017.*

19CSOE02 - FUNDAMENTALS OF SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the various software life cycle models and choose an appropriate model for a given application.

CO2 : Identify the functional requirements, prepare data flow, ER diagrams and Software Requirement Specifications.

CO3 : Employ suitable architectural styles, software design methodologies, coding standards and practices in developing practical applications

CO4 : Discuss various testing techniques and their application in defect removal.

INTRODUCTION

The Software Engineering Discipline - Software Development Projects - Software Life Cycle Models: Use of Life Cycle Models - Classical Waterfall Model-Iterative Waterfall Model-Prototype model-Evolutionary Model-Spiral Model **(9)**

SOFTWARE REQUIREMENTS AND ANALYSIS

Requirements Analysis and Specification - Requirements Gathering and Analysis- Value of good SRS - Requirement process- Requirement Specification - desirable characteristics, components and Structure of requirements document - Functional Specification with use cases - basics - developing Use Cases -DFDs - Data Dictionary - ER Diagrams. **(8)**

SOFTWARE DESIGN

Design concepts - Cohesion and Coupling- The Open-Closed Principle - Function Oriented Software Design : Structured charts - Structured design methodology - Detailed Design: Logic / Algorithm design - State Modeling of Classes. **(10)**

CODING

Programming principles and guidelines - Structured programming - Information hiding - Some programming practices - Coding standards - Code inspection - Planning- Self review - Group review meeting. **(7)**

TESTING

Testing Fundamentals -Black Box Testing: Equivalence Class Partitioning - Boundary Value Analysis - White box Testing: Control Flow based criteria - Data Flow based Testing - Levels of Testing: Unit Testing - Integration Testing - System Testing - Acceptance Testing. **(11)**

TOTAL : 45

TEXT BOOKS

1. *Pankaj Jalote, "Software Engineering A Precise Approach", Wiley India, Third edition 2012.*
2. *Rajib Mall, "Fundamentals of Software Engineering", PHI Learning Private Limited, Third Edition 2013.*
   (Introduction only)

REFERENCES

1. *Roger.S.Pressman "Software Engineering A Practitioner's Approach", McGraw Hill International Edition, Seventh Edition, 2014.*
2. *Ian Sommerville, "Software Engineering", Dorling Kindersley (India) Private Ltd., Eighth Edition, 2008*

19CSOE03 - INTERNET PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Gain knowledge in overview of www and web based applications.

CO2 : Design and develop dynamic and Interactive web page using DHTML.

CO3 : Design and develop web applications using servlets.

CO4 : Gain knowledge on E-business models and E-marketing.

BASIC WEB CONCEPTS

Basic Web Concepts - Web based Client/Server model -Web Protocols- Working of web browser - Browser & Server Communication - Review of HTML: Markup Languages, Introduction to HTML- forms - frames - tables. **(9)**

CLIENT SIDE PROGRAMMING

Client-side Programming (Review of JavaScript): Introduction, Writing Comments, Variables, Operators, Statements, Alert, Confirm, and Prompt Boxes, Functions, Event and Error Handling, Introduction to Built-in Classes, Form Validation, Cookies. **(9)**

DYNAMIC HTML

Dynamic HTML :Introduction - cascading style sheets-object model and collections - event model - filters and transition - data binding - data control - ActiveX control - handling of multimedia data. **(9)**

SERVER SIDE PROGRAMMING

Servlets - Deployment of simple servlets - Web server (Java web server / Tomcat / Web logic) - HTTP GET and POST requests - Session tracking - Cookies - JDBC - Simple web applications - Multi-tier applications. **(9)**

WEB BASED APPLICATIONS AND ITS TECHNOLOGIES

Rails: Overview of Rails-Ajax: Overview of Ajax Rails with Ajax- e-Business Models-e-Marketing-online payments-Security. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Deital & Deital, "Internet and World Wide Web-How to Program", Pearson Education Fifth Edition, 2011.*
2. *Robert W.Sebesta, "Programming with World Wide Web", Pearson Education, Eighth Edition, 2015.*

REFERENCES

1. *Scot Johnson, Keith Ballinger, Davis Howard Chapman, "Special Edition Using Active Server Pages", Prentice Hall of India, paperback 1999.*
2. *Ravi Kalakota and Andrew B Whinston, "Frontiers of e-commerce", Addison Wesley, paperback 1999.*
3. *Jeffrey C. Jackson," Web Technologies: A Computer Science Perspective", Pearson Education, Reprint 2011.*
4. *Elliotte Rusty Harold, "Java Network Programming", O'Reilly Publishers, Fourth Edition 2013.*

19CSOE04 - INTRODUCTION TO DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the basic concepts, architecture, data models of database management systems and data warehouse.

CO2 : Demonstrate the multidisciplinary fields of data mining and illustrate the techniques for data preprocessing.

CO3 : Find frequent item set and generate association rules for the given transactions.

CO4 : Analyze different types of data using classification and clustering techniques.

BASIC CONCEPTS OF DATABASE SYSTEM

Purpose of DBMS - Applications - Views of data - Data Abstraction - Instances and Schemas - Data Models - Database Languages - Relational Databases - Database Architecture - Database users and administrators - History of Database systems. **(8)**

DATA MINING

Data Mining - On What Kind of Data-Data Mining Functionalities - Classification of Data Mining Systems - Data Mining Task Primitives - Integration of a Data Mining System with a Database or Data Warehouse System-Major Issues in Data Mining. **(9)**

DATA WAREHOUSING

Data Warehouse - Introduction-Multidimensional Data Model-Data Warehouse Architecture -Data Warehouse Implementation from Data Warehousing to Data Mining. **(8)**

DATA PREPROCESSING AND ASSOCIATION RULES

Data Preprocessing: Needs Preprocessing the Data - Data Cleaning- Data Integration and Transformation-Data Reduction-Discretization and Concept Hierarchy Generation. Association Rules: Basic concepts - Apriori Algorithm - Generation of association rules from frequent item sets - FP Tree Algorithm - Pattern evaluation methods **(10)**

CLUSTERING AND CLASSIFICATION

Cluster analysis - Partitioning Methods - K-Means and K-Medoid algorithm - CLARA - CLARANS - Hierarchical clustering - BIRCH - Density based clustering - DBSCAN - Decision tree induction. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Tata McGraw Hill, Sixth Edition, 2013. (Basic Concepts of Database System only)*
2. *Jiawei Han & Micheline kamber, "Data Mining-Concepts and Techniques" Morgan Kaufmann Publishers, Third Edition, 2012.*

REFERENCES

1. *Arun K Pujari, "Data Mining Techniques" Universities Press India Ltd., Third Edition, 2012.*
2. *Dunham, "Data Mining- Introductory and Advanced Topics", Pearson Education, New Delhi, First Edition, 2006.*
3. *Sam Anahory, Dennis Murray, "Data Warehousing in the Real World ", Pearson Education, Seventh Indian Reprint New Delhi,2003.*
4. *George M. Marakas, "Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, First Edition, 2003*
5. *Paulraj Ponnaiah, "Data Warehousing Fundamentals", Wiley Publishers, Singapore, First Edition, 2001.*

19CSOE05 - INTRODUCTION TO EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Examine the characteristics and challenges in embedded system development

CO2 : Identify the parameters affecting CPU performance and develop optimized code

CO3 : Demonstrate the scheduling of given set of real-time tasks using the appropriate scheduling algorithm

CO4 : Design embedded system for simple applications

INTRODUCTION

Characteristics of embedded computing applications- Challenges in embedded computing design - Performance in embedded computing. Embedded System Design Process - Computer Architecture Taxonomy - ARM Processor -Assembly Language Programming. **(10)**

CPU PERFORMANCE

I/O Primitives - Busy -Wait I/O - Interrupts - Memory System Mechanisms: Cache, Memory Management Unit and Address Translation - Pipelining - CPU Power Consumption **(8)**

DEVELOPMENT AND DEBUGGING

Development environments - Debugging Techniques - Debugging challenges - System Level Performance analysis - Program Level Performance analysis - Program Optimization **(9)**

SCHEDULING

Scheduling states of a Process-Running Periodic Processes - Preemption - Priorities- Rate Monotonic Scheduling - Earliest Deadline First Scheduling - Priority Inversion - Data dependency. **(10)**

NETWORKS

Bus Standards: I2C, CAN Bus, Field Bus. CASE STUDY: Alarm Clock, Elevator Controller. **(8)**

TOTAL : 45

TEXT BOOK

1. *Marilyn Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman, Third Edition, 2012*

REFERENCES

1. *Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education, First Edition, 2009. (For Scheduling)*
2. *David. E. Simon, "An Embedded Software Primer", Pearson Education, First Edition, 2012*
3. *Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill, Third Edition, 2014.*

19ITOE01 - DIGITAL COMPUTER BASICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Explain various schemes of number system representations, code conversions and perform arithmetic operations.

CO2 : Describe Boolean Algebra, formulate and simplify Boolean expressions using K-Maps and illustrate the logic gates realization.

CO3 : Describe the working of basic combinational circuits and sequential circuits.

CO4 : Describe the structure and functioning of various memory schemes.

NUMBER SYSTEMS

Binary Numbers, Number Base Conversions, Octal and Hexadecimal Numbers.

Complements of Numbers - Signed Binary Numbers. Binary Codes : Binary-Coded Decimal (BCD) Code, Gray Code, ASCII Character Code, Error Detecting Code. BCD Addition - Decimal Arithmetic. Binary Storage and Registers. **(9)**

BINARY LOGIC AND BOOLEAN ALGEBRA

Definition of Binary logic. Boolean Algebra - Basic Definitions - Theorems and Properties of Boolean Algebra - Canonical and Standard Forms. Digital Logic Gates : Integrated Circuits. Gate-Level Minimization: Map Method - Four Variable K-Map - Product of Sums Simplification. Realization of Boolean functions using Gates **(9)**

COMBINATIONAL CIRCUITS

Adder : Half Adder - Full Adder - Binary Parallel Adder - BCD Adder. Subtractor : Half Subtractor - Full Subtractor. Code Conversion. Decoders - De-Multiplexer - Encoders - Multiplexers. **(10)**

SEQUENTIAL CIRCUITS

Storage Elements - Latches, Flip Flops - RS, D, JK and T flip -flops- Triggering of flip -flops - Characteristic Tables - Characteristic Equations. Registers - Shift Registers. Counters: Binary ripple counter - Up down binary counter. **(9)**

MEMORY AND PROGRAMMABLE LOGIC

Random Access Memory - Memory Decoding - Read Only Memory - Types of ROMs, Programmable Logic Array, Programmable Array Logic **(8)**

TOTAL : 45

TEXT BOOK

1. *M. Morris Mano and Michael D. Cieti,"Digital Design with an Introduction to the Verilog HDL, Pearson Education, Fifth Edition, 2013.*

REFERENCES

1. *M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, First Edition, 2008.*
2. *Thomas L.Floyd, "Digital Fundamentals", Pearson Education, Tenth Edition, 2011.*

19ITOE02 - PROGRAMMING IN JAVA

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the fundamental aspects of object oriented programming paradigm.

CO2 : Develop java programs using features like methods, classes, constructors, overloading and string handling.

CO3 : Write exception handling routines for practical applications.

CO4 : Describe multithreading, synchronization and networking features of Java.

CO5 : Demonstrate use of applets and database connectivity in developing practical Applications.

OBJECT ORIENTED PROGRAMMING

Introduction to object oriented languages - Evolution of object oriented languages - Object oriented programming paradigm - Basic concepts of object oriented programming - Procedural Vs object oriented programming. **(6)**

INTRODUCTION TO JAVA

Java and Internet - Byte Code - Features of Java - Java Development Environment- Java Programming: Methods and Classes- Constructor - Garbage Collection - Overloading - Inheritance - Overriding - Packages and Interfaces - Java IO systems - String Handling : String and String Buffer. **(12)**

EXCEPTION HANDLING

Exception Handling: Fundamentals of Exception handling and types - Built in Exceptions - User defined Exceptions. **(5)**

MULTI THREADS

Multithreaded Programming: Thread Model -Thread properties -Thread priorities - Synchronization- Inter thread communication- Networking :Inet address- Datagrams - Sockets - URL connections. **(11)**

APPLET AND DATABASE CONNECTIVITY

Introduction to Abstract Window Tool kit - Applet class - HTML applet tags - Parameter passing - Audio clip interface - Event class: Keyboard and Mouse events handling. **(11)**

TOTAL : 45

TEXT BOOK

1. *Herbert Schilt :"Java 2 - Complete references ", Tata McGraw Hill, ftinth Edition, McGraw Hill Education, 2014.*

REFERENCE

1. *Deitel H.M and Deitel P.J, "Java - How to Program", Prentice Hall of India, Ninth Edition, 2012.*

19ITOE03 - FUNDAMENTALS OF DATABASE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the database system concepts and explain the key features of Relational data models.

CO2 : Describe the features of Entity Relationship diagram and draw Entity Relationship diagram for the given real world application

CO3 : Design a normalized database system and carry out data retrieval using SQL.

CO4 : Demonstrate various transaction concepts and various concurrency control mechanisms

DATABASE SYSTEMS

Data Vs Information-Introducing the database and DBMS- Importance of Database Design- Files and File systems-Problems with File System Data Management, Database Systems. Relational Database Model: Logical view of Data- Keys- Integrity Rules- Relational Set Operators- Data Dictionary and the system catalog -Codd's relational database rules. **(10)**

RELATIONAL MODEL

Entity Relationship Model: Entities-Attributes-Relationship-Connectivity and cardinality- Existence Dependence-Relationship Strength-Weak Entities-Relationship participation- Relationship Degree-Recursive Relationship-Developing an ER Diagram. **(8)**

STRUCTURED QUERY LANGUAGE

Introduction to SQL- Data Definition Commands- Data Manipulation Commands-Advanced Data Definition and SELECT Commands - Virtual Tables -Creating Views- Joining Database Tables. **(8)**

DATABASE DESIGN

Database Tables and Normalization- Need for Normalization- Normalization Process- Improving the Design-Surrogate Key Considerations, High level Normal Forms, Normalization and Database Design-Denormalization. **(10)**

TRANSACTION MANAGEMENT

Transaction Concepts: Transaction Properties- Transaction Concurrent Executions. Concurrency control with Locking Methods: Lock Granularity-Lock Types-Two-Phase Locking to Ensure Serializablity-Deadlocks-Database Recovery Management-RAID. **(9)**

TOTAL : 45

TEXT BOOK

1. *Peter Rob, Coras M.Colonel, "Database Systems: Design, Implementation and Management", Thompson Learning Course Technology, Tenth Edition, 2012.*

REFERENCES

1. *Abraham Silberschatz, Henry F.Korth,S.Sudharshan,"Database System Concepts", McGraw-Hill, Sixth Edition, 2013.*
2. *Ramez Elmasri, Shamkant B. tJavathe, "Fundamentals ofDatabase Systems", Pearson Education, Sixth Edition, 2013.*
3. *Raghu Ramakrishnan, Johannes Gehrke, "Database ManagementSystems", McGraw Hill Education, Third Edition, 2014.*
4. *Thomas M.Connolly and Carolyn E.Begg, "A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2004.*

19ITOE04 - CLOUD COMPUTING FUNDAMENTALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Understanding the client- server, distributed collaborative and cloud computing architecture along with cloud storage and services.

CO2 : Classify the different virtualization environments and techniques.

CO3 : Illustrate various services deployed from a cloud architecture supported by different providers.

CO4 : Analyze the major security challenges and privacy problems in the cloud and virtual environment.

INTRODUCTION

Understanding Cloud Computing- history of cloud computing: Client/Server computing, Peer to peer computing, Distributed computing and Collaborative computing.- Understanding cloud architecture, cloud storage and services-Pros and cons of cloud computing. **(9)**

VIRTUALIZATION

Introduction-Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Technology Examples **(9)**

CLOUD COMPUTING ARCHITECTURE

Cloud reference model: Architecture, Infrastructure / Hardware as a service, Platform as a service-Software as a service, Types of cloud: Public clouds, Private clouds, Hybrid Cloud, Community Clouds. **(9)**

CLOUD SERVICES

Discovering Cloud services Development services and tools: Amazon, Google App Engine, IBM, Salesforce.com, Other Cloud Services development tool **(9)**

CLOUD SECURITY

Security Overview - Cloud SecurityChallenges - Software as a Service Security - Security Governance - Risk Management - Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Michael Miller "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online",1st Edition, Pearson Education, New Delhi, 2009.*
2. *Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013. (Virtualization, Cloud Computing Architecture)*
3. *John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010. (Cloud Security)*

REFERENCES

1. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.*
2. *Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2002.*
3. *Kai Hwang, Geoffrey C Fox,Jack GDongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2002.*

19ITOE05 - INFORMATION SECURITY FUNDAMENTALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Identify and analyze the security threats and attacks and applydevice suitable security policies and standards.

CO2 : Assess the risks and apply suitable risk control strategies.

CO3 : Employ appropriate intrusion detection and prevention systems to ensure information security.

CO4 : Discuss various national and international laws of information security and its framework.

INTRODUCTION, NEED FOR SECURITY

Introduction to Information Security - The History of Information Security- Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing Components - Balancing Information Security and Access - The Systems Development Life Cycle - The Security Systems Development Life Cycle. The Need for Security: Introduction Business Needs First -Threats -Attacks. **(9)**

RISK MANAGEMENT AND INFORMATION SECURITY

Introduction - An Overview of Risk Management - Risk Identification -Risk Assessment - Risk Control Strategies - Selecting a Risk Control Strategy - Risk Management Discussion Points - Recommended Practices in Controlling Risk. **(9)**

POLICIES, STANDARDS, PRACTICES AND BUSINESS CONTINUITY

Introduction - Information Security Policy, Standards and Practices -The Information Security Blueprint: ISO 17799/BS 7799, ISO 27001and itscontrols, NIST SecurityModels, Design of Security Architecture - Security Education, Training and Awareness Program - Continuity Strategies. **(6)**

SECURITY TECHNOLOGY

Introduction - Intrusion Detection and Prevention Systems: IDPS Terminology, Use of IDPS, Strengths and Limitations of IDPS - Honey Pots, Honey Nets, and Padded Cell Systems - Scanning and Analysis Tools, Access Control Devices **(6)**

BIOMETRIC CONTROLS

Biometrics - Nature of Biometrics Identification/Authentication Techniques - Biometric Techniques - Matching and Enrollment Process in Biometrics - Benefits Over Traditional Authentication Methods. **(6)**

SECURITY OF WIRELESS NETWORKS

Attacks on Wireless Networks: Other Security Risks in Wireless Networks, Management and Mitigations for Wireless Networks Attacks. **(7)**

LAWS AND LEGAL FRAMEWORK

Introduction - Information Security and the Law: The Rising Need -Understanding the Laws for Information Security:A Conceptual Framework - The Indian ITAct - Laws for Intellectual Property Rights (IPR) -Health Insurance Portability and Accountability Act (HIPAA) - Building Security into Software/System Development Life Cycle. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Course Technology, New Delhi, Fourth Edition, 2012 Reprint.*

2. *Nina Godbole, "Information Systems Security-Security Management, Metrics, Frameworks and Best Practices", Wiley India Pvt. Ltd., New Delhi, First Edition, 2009.(Biometric Controls, Security of Wireless Networks, Laws and Legal Framework)*

REFERENCES

1. *Thomas R.Pettier, "Information Security Fundamentals", Auerbach Publications, Second Edition, 2013.*
2. *Vicki Krause and Harold F.Tipton, "information Security Management Handbook", Auerbach Publications, Sixth Edition,2008.*
3. *Mark Merkow and Jim Breithaupt,"Information Security - Principles & Practices", Second Edition, Pearson Education, 2014.*

19ITOE06 - INTRODUCTION TO HUMAN COMPUTER INTERACTION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the importance and need for effective user friendly Graphical User Interfaces (GUI).

CO2 : Choose suitable interactions devices/tools to meet application specific requirements.

CO3 : Design Graphical User Interfaces(GUI) using apt components and apply the design guidelines for user-friendly navigation and presentation.

CO4 : Asses graphical user interfaces for compliance against the screen design guidelines.

INTRODUCTION

Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design **(9)**

THE GRAPHICAL USER INTERFACE & DESIGN PROCESS

GUI: Popularity of graphics - The concept of direct manipulation - Graphical system - Characteristics - Web user - Interface Popularity - Characteristics and Principles of User Interface.

Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration - Human Interaction Speeds and Understanding Business Junctions. **(9)**

SCREEN DESIGNING

Design Goals - Screen Planning and Purpose - Organizing Screen Elements - Ordering of Screen Data and Content - Screen Navigation and Flow - Visually Pleasing Composition - Amount of Information - Focus and Emphasis - Presenting Information Simply and Meaningfully - Information retrieval on web - Statistical Analysis - Technological considerations in Interface Design. **(9)**

WINDOWS & COMPONENTS

Windows: New Navigation Schemes - Selection of Window - Selection of DevicesBased on Screen Based Controls. Components: Text and Messages - Icons and Increases - Multimedia - Colors - Uses -Problems - Choosing colors. **(11)**

SOFTWARE TOOLS AND INTERACTION DEVICES

Specification Methods - Interface Building Tools - Keyboard and Function Keys - Pointing Devices Speech Recognition. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.*
2. *Ben Shneidermann, "Designing the User Interface", Fifth edition, Pearson Education Asia, 2013. (Software Tools and Interaction Devices)*

REFERENCE

1. *Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition*

19ITOE07 - ENTERPRISE RESOURCE PLANNING CONCEPTS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the operational aspects of ERP system and its related technologies.

CO2 : Demonstrate the steps required for ERP Project management and implementation process by choosing the right vendors/consultants, employee training and monitoring.

CO3 : Categorize the business modules of an ERP package in order to define the functionality of various departments in a company.

CO4 : Analyze the ERP market place and its vendors, and assess how Enterprise Application Integration (EAI), e-business help the company use ERP to its utmost benefit.

INTRODUCTION

Enterprise - An Overview - Introduction to ERP - Benefits Of ERP - ERP and Related Technologies - Business Process Reengineering (BPR) - Data Warehousing - Data Mining - OLAP--SCM. **(9)**

ERP IMPLEMENTATION

ERP Implementation Lifecycle - Implementation Methodologies - ERP deployment methods - Package Selection - Process Definition - Vendors and Consultants - Contract with Vendors, Consultants and Employees - Training and education- Project Management and Monitoring. **(10)**

THE ERP BUSINESS MODULES

Business modules of an ERP Package - Finance - Manufacturing - Human Resources - Plant Maintenance - Materials Management - Quality Management - Sales and Distribution. **(9)**

THE ERP MARKET & ERP - PRESENT AND FUTURE

ERP Marketplace and Marketplace Dynamics - ERP Vendors - SAP AG, Oracle Corporation, Microsoft Dynamics, EPICOR, QAD, RAMCO Systems - Enterprise Application Integration (EAI)- ERP and E-Business- Future Directions and Trends in ERP. **(9)**

SAP

Gateway to SAP: Architecture of SAP R/3 -SAP Integrated-Three Tier Architecture - SAP Easy Access - Understanding ABAP Workbench **(8)**

TOTAL : 45

TEXT BOOKS

1. *Alexis Leon, "ERP Demystified", Tata McGraw Hill, New Delhi, Third Edition, 2014.*
2. *Dreamtech Press, "SAP R/3, Black Book", Dreamtech Software Team, 2006. (SAP)*

REFERENCES

1. *Ellen F.Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Course Technology Ptr, Fourth Edition, 2011.*
2. *Vinod Kumar Garg and Venkitakrishnan N.K., "Enterprise Resource Planning - Concepts and Practice", Prentice Hall of India, New Delhi, Second Edition, 2012.*

19CHOE01 - INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Practice the safety norms and inspect turning machines, boring machines, milling machine, planning machine, grinding machines, CNC machines and wood working machinery to create risk free working environment.

CO2 : Assess the adequacy of machinery guarding to eliminate or reduce the hazards from the point operation, flying chips and sparks and moving parts.

CO3 : Apply the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes, etc.,

CO4 : Predict, identify and evaluate, hazardous conditions and practices safety rules in in cold forming and hot working of metals

CO5 : Employ the safety rules in inspection and testing process and take plan the preventive measures in health and welfare of workers' aspects in engineering industry.

SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards. **(9)**

PRINCIPLES OF MACHINE GUARDING

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS - guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe - drilling - boring - milling - grinding - shaping - sawing- shearing presses - forge hammer - flywheels - shafts - couplings -gears - sprockets wheels and chains pulleys and belts - authorized entry to hazardous installations-benefits of good guarding systems **(9)**

SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing - explosive welding, selection, care and maintenance of the associated equipment and instruments - safety in generation, distribution and handling of industrial gases-colour coding - flashback arrestor - leak detection-pipeline safety-storage and handling of gas cylinders. **(9)**

SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills - hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes. **(9)**

SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, electro plating, paint shops, sand and shotblasting, safety in inspection and testing, dynamic balancing, hydrotesting, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal

monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal **(9)**

TOTAL : 45

TEXT BOOKS

1. *Wells G.L.,R.M.C. Seagrave-Flow sheeting for safety, Indian Institute of Chemical Engineering, London U.K,1977.*
2. *TrevurKletz Butterworth, Learning from accidents, - London, 1988.*
3. *John Barton and Richard Rogers, Chemical reaction Hazards - A guide to safety, Institution of Chemical Engineering London, 1997.*
4. *Philip Hagan "Accident Prevention Manual for Business and Industry", N.S.C.Chicago, 13th edition 2009.*

REFERENCES

1. *Rohatgi A.K, Safety handling of Hazardous Chemicals Enterprises, Bombay, 1986.*
2. *Shukla S.K., Envirohazards and Techno Legal aspects, Shashi Publications, Jaipur India, 1993.*
3. *John V.Grimaldi and Rollin H.Simonds," Safety Management", Richard D Irwin, 1994.*
4. *Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.*
5. *"The Indian boilers act 1923 with amendments", Law Publishers (India) Pvt. Ltd., Allahabad.*
6. *"Health and Safety in welding and Allied processes", Welding Institute, UK, High Tech. Publishing Ltd., London, 1989.*
7. *"Safe use of wood working machinery", HSE,UK,2005.*

19CHOE02 - RISK ANALYSIS AND HAZOP

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Identify individual hazards in a process and deduce the associated risks.

CO2 : Identify radiation intensity and effects of explosion

CO3 : Perform risk analysis of various types of problems

CO4 : Evaluate effect about key hazard identification techniques

CO5 : Apply risk analysis techniques and Hazop study

INTRODUCTION AND DISPERSION MODELS

Risk analysis introduction, quantitative risk assessment, rapid risk analysis - Comprehensive risk analysis - Emission and dispersion - Leak rate calculation. Single and two-phase flow - Dispersion model for dense gas - Flash fire - Plume dispersion - Toxic dispersion model - Ealuation of risk. **(9)**

RADIATION INTENSITY

Radiation - Tank on fire - Flame length - Radiation intensity calculation and its effect on plant, people and property radiation VCVCE - Explosion due to over pressure - Effects of explosion, risk contour -Effects, explosion, BLEVE - Jet fire - Fire ball.**(9)**

RISK ANALYSIS

Overall risk analysis - Generation of meteorological data - Ignition data - Population data - Consequences analysis and total risk analysis - Overall risk contours for different failure scenarios - Disaster management plan - Emergency planning - On site and off site emergency planning, risk management ISO 14000, EMS models case studies - Marketing terminal, gas processing complex, refinery. **(9)**

HAZARD ANALYSIS

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough - Mexico - Madras - Vizag - Bopal analysis **(9)**

CASE STUDIES

Hazop - Guide words, parameters, derivation - Causes - Consequences - Recommendation - Coarse Hazop study - Case studies - Pumping system - Reactor - Mass transfer system. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ragavan K.V., Khan A.A., Methodologies in Hazard identification and assessment -Manual, CLRI publication, 1990.*
2. *Marcel.V.C., Major Chemical Hazard, Ellis Hawood Ltd., Chi Chester, UK, 1987.*
3. *Skeleton B., Process Safety Analysis, Institution of chemical Engineers, U.K., 1997.*

REFERENCE

1. *Daniel A Crowl., Louvar J.F., Chemical Process Safety: Fundamentals with Applications, Prentice Hall, New Jersey, 2002.*

19CHOE03 - GREEN TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Outline the green technology concepts and relevance in twenty first century requirements.

CO2 : Defend the environmental and sustainability issues, role of CSR and CER and Indian corporate structure and environment.

CO3 : Recall the indicators of sustainability and their use and can also find the alternate theories.

CO4 : Criticize the environmental reporting, ISO 14001, ISO 14064, financial initative by UNEP, etc.

CO5 : Analyse the green tax incentives and rebates, business redesign and its models.

INTRODUCTION

The concept of green technology; evolution; nature, scope, importance and types; developing a theory; green technology in India; relevance in twenty first century. **(9)**

SUSTAINABILITY & ENVIRONMENT

Organizational environment; internal and external environment; Indian corporate structure and environment; how to go green; spreading the concept in organization; environmental and sustainability issues for the production of high-tech components and materials, life cycle analysis of materials, sustainable production and its role in corporate social responsibility (CSR) and corporate environmental responsibility (CER). **(9)**

ECOSYSTEM APPROACHES

Approaches from ecological economics; indicators of sustainability; ecosystem services and their sustainable use; bio-diversity; Indian perspective; alternate theories **(9)**

ACTS OF GREEN TECHNOLOGY

Environmental reporting and ISO 14001; climate change business and ISO 14064; green financing; financial initiative by UNEP; green energy technology; green product technology. **(9)**

GREEN ECONOMICS

Definition; green techniques and methods; green tax incentives and rebates (to green projects and companies); green project technology in action; business redesign; eco-commerce models. **(9)**

TOTAL : 45

REFERENCES

1. *Green Technology and Green Technologies: Exploring the Causal Relationship by Jazmin Seijas Nogarida, 2008.*
2. *Green Marketing and Technology: A global Perspective by John F. Whaik, 2005.*
3. *The Green Energy Technology Book by Leo A. Meyer.*
4. *Green Project Technology by Richard Maltzman and David Shiden.*
5. *Green Marketing by JacquelinOttman.*
6. *Green and World by Andrew S. Winston.*

19CHOE04 - CORROSION SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Classify the types of corrosion and theories and also relate the various controlled corrosion process.

CO2 : Examine the factors involved in the corrosion and control methods of various corrosion.

CO3 : Analyse the mechanism of corrosion and evaluate the effects like pH, temperature, flow rate on corrosion.

CO4 : Design and develop the corrosion control methods like cathodic protection, sacrificial anode and impressed current anodes and anodic protection.

CO5 : Predict the different corrosion testing, monitoring and inspection tests by surface analytical studies.

INTRODUCTION

Introduction, classification, economics and cost of corrosion. emf series, galvanic series, corrosion theories derivation of potential Current relations of activities controlled and diffusion controlled corrosion process. Potential - pH diagram, Fe-H2O system, application and limitation. Passivation - Definition, anodic passivation theory of passivation, oxidation laws, effects of oxygen and alloying on oxidation rates. **(9)**

CORROSION CONTROL METHODS

Forms of corrosion - Definition, factors and control methods of various forms of corrosion such as pitting, inter granular, crevice, dezincification, stress corrosion, corrosion fatigue, fretting corrosion, hydrogen embitterment, corrosion processes and control methods in fertilizers, petrochemical, chemical building industries **(9)**

MECHANISM OF CORROSION

Environmental aspects, atmospheric corrosion - Classification, factors influencing atmospheric corrosion, temporary corrosion preventive methods, corrosion in immersed condition, effect of dissolved gases, salts, pH, temperature, and flows rates on corrosion, marine corrosion, underground corrosion. Biological corrosion, definition, mechanism of corrosion, control of bio-corrosion. **(9)**

CORROSION PREVENTION

Corrosion control aspects, electrochemical methods of protection-theory of cathodic protection design of cathodic protection, sacrificial anodes, impressed current anodes, anodic protection. Corrosion inhibitors for acidic, neutral and alkaline media, cooling water system - Boiler water system. Organic coating, surface preparation, natural, synthetic resin, paint, formulation and application. Design aspects in corrosion prevention, corrosion resistant materials. **(9)**

CORROSION TEST

Corrosion testing, monitoring and inspection, laboratory corrosion tests, accelerated chemical tests for studying different forms of corrosion. Electrochemical methods of corrosion rate measurements by DC and AC methods, corrosion monitoring methods, chemical and electrochemical removal of corrosion products, newer techniques to study corrosion processes, inspection methods by NDT. Surface analytical techniques such as AES, ESCA, SEM. Evaluation of paints by conventional and electrochemical methods. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Roberge P. R., Corrosion Engineering, McGraw Hill, New York, 2008.*
2. *Fontana M.G., Greene N.D., Corrosion Engineering, Third Edition, McGraw Hill, NewYork, 2005.*
3. *Uhling H. H., Revie R.W., Corrosion and Corrosion Control, John Wiley and Sons, Inc, 1985.*

REFERENCE

1. *Banarjee.S.N., An introduction to corrosion and corrosion inhibitors, Oxonian Press Ltd., New Delhi, 1985.*

19CHOE05 - INTRODUCTION TO CHEMICAL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Express the fundamentals of chemical engineering and to solve problems.

CO2 : Ability to develop basic fluid concepts, transfer and separation operations.

CO3 : Design equipment for transport and separation processes.

CO4 : Apply material and Energy balance to precisely calculate material required for a process.

CO5 : Apply steady state balances to develop process flow sheets.

OVERVIEW OF CHEMICAL ENGINEERING

Concepts of unit operations and unit processes, and more recent developments, The Chemical Industry-scope, features & characteristics. Flow sheets, and symbols for various operations. **(9)**

MATERIAL AND ENERGY BALANCE CALCULATIONS

Material balances in simple systems involving physical changes and chemical reactions; systems involving recycle, purge, and bypass, combustion reactions, Forms of energy, optimum utilization of energy, Energy balance calculations in simple systems. Introduction to Computer aided calculations-steady state material and energy balances, combustion reactions. **(9)**

BASIC FLUID CONCEPTS

Dimensions and Units, Velocity and Stress Fields, Viscosity and surface tension, Non Newtonian viscosity, Dimensional Analysis (Buckingham PI theorem), Types of flows, Methods of Analysis, Fluid Statics. pipe flow, Pumps, Agitation and Mixing, Compressors. **(9)**

HEAT TRANSFER OPERATIONS

Review of conduction, resistance concept, extended surfaces, lumped capacitance; Introduction to Convection, natural and forced convection, correlations; Radiation; Heat exchangers- Fundamental principles and classification of heat exchangers, Evaporators. **(9)**

MASS TRANSFER OPERATIONS

Fundamental principles and classification of Distillations, Adsorption, Absorption, Drying, Extraction, Membrane Process. Energy and Mass Conservation in process systems and industries. Introduction to chemical reactors. **(9)**

TOTAL : 45

REFERENCES

1. *G.T. Austin, R.N. Shreve, Chemical Process Industries, 5th Ed., McGraw Hill, 1984.*
2. *W.L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 6th Edition, McGraw Hill, 2001.*
3. *R. M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd Ed., John Wiley, New York,2004.*
4. *L.B. Anderson and L.A. Wenzel, Introduction to Chemical Engineering, McGraw Hill, 1961.*
5. *H.S. Fogler, Elements of Chemical Reaction Engineering, 4th Ed., Prentice-Hall, 2006.*

19CHOE06 - NANOMATERIAL SYNTHESIS AND CHARACTERIZATION LABORATORY

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : To synthesize several nanomaterials in different methods in lab scale.

CO2 : To understand and operate the instruments for material characterization.

CO3 : To interpret the properties of synthesized nanomaterials by analyzing the results

EXPERIMENTS

1. Chemical synthesis of Ag nanoparticles; UV-Visible absorption of the colloidal sol.
2. Chemical synthesis of CdS nanoparticles; Optical absorption spectra; Band gap estimation from the band edge.
3. Synthesis of ceria nanofibres by Solvothermal method.
4. Synthesis of silica nanoparticles using Stober method.
5. Synthesis of Au nanoparticles by simple chemical method.
6. Synthesis of Fe_3O_4 nanoparticles by simple reduction method.
7. Effect of reducing agent on the synthesis of metal nanoparticles.
8. Aqueous to organic phase transfer of Ag and CdS nanoparticles; Confirmation by UV-Visible absorption.
9. Effect of concentration on the synthesis of silver nanoparticles.
10. Effect of reducing agent on gold nanoparticles.
11. Fabrication of silver nanofilms.
12. Synthesis of polyvinyl alcohol fibres by electrospinning method.
13. Synthesis of Au and Ag nanoparticles at aqueous-organic liquid interface; UV-visible spectroscopy of the colloidal film; comparison with the corresponding colloidal sol.
14. Sol gel synthesis of $ZnO/TiO_2/CdO$ nanoparticles.
15. A bioroute to Au nanoparticles.
16. Sol-gel spin coating route to SnO_2 nanothin films: surface roughness measurement by AFM.
17. Hydrothermal synthesis of ZnS Nanorods: Nanorods formation by SEM analysis.
18. Fabrication and wettability characterization of nanostructured soft polymer surfaces.
19. Preparation of nanofluids.
20. Determination of viscosity of nanofluids.
21. Evaporation studies of nanofluids.
22. Measurement of stability of nanofluids.
23. Optical properties of nanofluids.
24. Measurement of onset of natural convection in nanofluids.
25. Thermal conductivity measurement of nanofluids.

TOTAL : 60

REFERENCES

1. *Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, Nanofluids: Science and Technology, Wiley, 2007.*
2. *Vincenzo Bianco, Oronzio Manca, Sergio Nardini, Kambiz Vafai, Heat Transfer Enhancement with Nanofluids, CRC Press, 2017.*
3. *Amy S., Thermal Energy Storage Using Phase Change Materials: Fundamentals and Applications Fleischer, Springer, 2015.*
4. *Mohsen Sheikholeslami and Davood Domairry Ganji, Applications of Nanofluid for Heat Transfer Enhancement, Elsevier, 2017.*
5. *S.M. Sohel Murshed, Carlos Nieto de Castro, Nanofluids: Synthesis, Properties and Applications, Nova Science Publishers, 2014.*
6. *T. Pradeep, A Textbook of Nanoscience and Nanotechnology. Tata McGraw-Hill Education, 2003.*
7. *P.R. Chandran, M. Naseer, N. Udupa, N. Sandhyarani. Size controlled synthesis of biocompatible gold nanoparticles and their activity in the oxidation of NADH. Nanotechnology. 8, 23(1), 2011.*
8. *I.A. Ibrahim, A.A. Zikry, M.A. Sharaf. Preparation of spherical silica nanoparticles: Stober silica. J. Am. Sci. 6(11), 985-9, 2010.*
9. *X. Chen, S.S. Mao. Titanium dioxide nanomaterials: synthesis, properties, modifications, and applications. Chemical reviews. 11, 107(7), 2891-959, 2007.*
10. *Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, Nanofluids: Science and Technology, Wiley, 2007.*

19CHOE07 - MULTIVARIATE STATISTICS LABORATORY

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Design experiments to obtain statistical principles of Univariate examples.

CO2 : Apply the concepts of statistics to draw conclusions from data

CO3 : Assess practical knowledge to carry out meaningful interpretation of data from real life

CO4 : Conduct experiments to solve complex engineering problems effectively as an individual or team work.

CO5 : Perform as a leader with good ethical principles to meet societal needs in the field of chemical engineering.

LIST OF EXPERIMENTS

1. Point and Interval Estimation for Normal and Chi-Square Distribution using Excel and R.
2. Point and Interval Estimation for T-Distribution and F-Distribution using Excel and R.
3. K-means Clustering.
4. One-way ANOVA Model in Excel and R.
5. Linear Regression
6. Logistic Regression
7. Naive Bayesian Classifier
8. Decision Trees
9. Simulation of Principal component analysis using Excel and R.
10. Simulation of Fischer Discriminant Analysis using Excel and R.
11. Modeling the Change by Differential Equations using R and Excel.
12. Modeling the Change by Difference Equations using R and Excel.
13. Multivariate Normal & Hoteling's T2 Distribution.
14. Multivariate Analysis of Variance (MANOVA).
15. Correspondence Analysis using R.

TOTAL : 60

REFERENCES

1. *Apostol T.M. (1985) Mathematical Analysis, Narosa,Indian Ed.*
2. *Courant R. And John F. (1965) Introduction to Calculas and Analysis, Wiley.*
3. *Miller K.S. (1957) Advanced Real Calculas, Harper, New York.*
4. *Rudin, Walter (1976) Principles of Mathematical Analysis,McGraw Hill.*
5. *Malik S.C. (2005) Principles of Real Analysis, New Age International (p)Ltd.*
6. *Bartle R.G. (1976) Elements of Real Analysis*

19MOE01 - GRAPH THEORY AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the idea of graph theory and to solve the real time problem.

CO2 : To relate the Graph theory Algorithms' in their field of engineering and apply the same in the irrespective mainstream.

CO3 : To become familiar with Special graphs for modeling the networks.

CO4 : Able to design and solve Coloring concepts for defined problems.

CO5 : Model the networks using graph theory.

GRAPHS ANDSUB GRAPHS

Graph-Standard Concepts in Graphs - Sub graphs - Complete Graph - Bipartite Graph - Isomorphism - Adjacency Matrix and Incidence Matrix-Walk, Trail and Path - Bipartite Graph - Connectedness - The Shortest Path Problem - Dijkstra's Algorithm **(9)**

TREES

Trees- Characterization - Blocks - Block Graphs - Cayley's Formula - Spanning Trees - Spanning Tree Algorithms - Kruskal's and Prim's Algorithm **(9)**

EULERIAN AND HAMILTONIAN GRAPHS

Eulerian graphs - Euler's theorem - Hamiltonian graphs - Dirac's and Ore's theorems - Closure of a graph - Bondy -Chvatal theorem - Traveling salesman problem - The Chinese Postman Problem - Fleury's Algorithm. **(9)**

COVERING AND COLORING

Covering - Independent Sets - Matching - Perfect Matching- Applications - The Personal Assignment Problem - Coloring - Chromatic Number - Four Color Problem - Chromatic Polynomials - Application. **(9)**

DIRECTED GRAPHS

Digraph - orientation - strongly, weakly and unilaterally connected digraphs - directed acyclic graph - adjacency matrix and incidence matrix of graph - Network Flows - Transport Networks - Max - Flow Min-Cut Theorem - Activity Network **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gary Chatrand and Ping Zhang, Introduction to Graph Theory, Mc Graw Hill Education (India), 2017.*
2. *Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India Private Limited, 2004.*

REFERENCES

1. *Douglas B.West, "Introduction to Graph Theory" Second Edition, Prentice Hall of India Private Limited, 2001.*
2. *Balakrishnan. R, Ranganathan. K , "A Text book of GraphTheory", Second Edition, Springer Newyork, 2012.*
3. *Clark. J. and Holton. D.A, "A First Look at GraphTheory", Allied Publishers,1995.*
4. *Frank Harary, Graph Theory, 10th Edition, Narosa Publishing House, 2001.*

19MOE02 - METHODS OF APPLIED MATHEMATICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the idea of integral equations and to solve the real time problems.

CO2 : To familiarize the students with basic concept of ordinary differential equations, special functions and solve problems associated with engineering applications.

CO3 : To achieve an understanding of the basic concepts of boundary value problems and characteristic function representations and method of solving them.

CO4 : Able to construct and solve a mathematical model for heat flow problems in real life situation

CO5 : Able to use the concepts of Calculus of variations and basic concepts for solving equations involving functional

INTEGRAL EQUATIONS

Relation between integral and differential equations - Green's function. Fredholum's equation with separable Kernals Hilbert Schmidt theory, interactive methods for solving equations of second kind. **(9)**

SECOND ORDER ORDINARY DIFFERENTITAL EQUATIONS AND SPECIAL FUNCTIONS

Singular points, Series solutions and the methods of Frobenius, Bessel Equation, Bessel Functions, modified Bessel functions and their properties, Ber and Bei functions. **(9)**

BOUNDARY PROBLEMS AND CHARACTERISTIC FUNCTION REPRESENTATIONS

Sturm - Liouviller problems. Orthogonal functions and expansions in series of Orthogonal functions. Stodola and Vianello method for Sturm - Liouviller problems, Fourier - Bessel and Legendre Series **(9)**

PARTIAL DIFFERENTITAL EQUATIONS

Linear and quasi - linear equations of the first and second order. Characteristics of first and second order linear equations. Heat flow equations. Problems in one, two and three dimensions - Fourier method. **(9)**

INTEGRAL TRANSFORM METHODS

Calculus of variations - Variational notation, Constraints and Lagarangian multipliers, variable and points, Rayleigh - Ritz method. **(9)**

TOTAL : 45

TEXT BOOKS

1. *M.K. Venkatraman, Higher Mathematics for Engineering and Science, Third Edition, The National Publishing Company, 2014.*
2. *F.B. Hildebrand: Advanced Calculus for applications second Edition (EEE).Prentice Hall of India P.Ltd., 2014.*

REFERENCES

1. *F.B. Hildebrand - Methods of Applied Mathematics, Second Edition. Prentice Hall of India P.Ltd., 2012.*
2. *David Borthwick : An introduction to partial differential equation Springer International Publishing 2017.*
3. *Mattias Blennow: Mathematical methods in Physics and Engineering, CRC Press, 2018.*

19MOE03 - LINEAR AND NON - LINEAR PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the idea of linear Programming problems and to solve the real time problems.

CO2 : To familiarize the students with basic concept of Transportation models and solve problems associated with engineering applications.

CO3 : To achieve an understanding of the basic concepts of Assignment problems and method of solving them.

CO4 : Able to construct and solve a Game theory models in real life situation

CO5 : Able to use the concepts of Non-linear Programming problems for solving Constrained and unconstrained equations.

LINEAR PROGRAMMING

Formulation of LPP - Graphical methods for two variables - The Simplex method - Artificial Variables Techniques - Big M - method - The Two Phase method - Dual Simplex Method **(9)**

TRANSPORTATION MODEL

Mathematical formulation of a Transportation problem - Methods for finding initial basic feasible solution - North West corner rule - Least cost method - Vogel's Approximation method - Modified distribution method - Degeneracy in Transportation problems. **(9)**

ASSIGNMENT PROBLEM

Mathematical formulation of an Assignment problem - Hungarian Method - Unbalanced Assignment Models -Maximization case in Assignment Problems - Restrictions in Assignments - Travelling Sales man Problem. **(9)**

GAME THEORY

Two person zero - sum Games - The Maxmini - Minimax Principle - Saddle Point and value of the game -Games without saddle points, Mixed Strategies - Matrix Oddment method for n×n games - Dominance Property - Graphical Method of 2×n or m×2 games. **(9)**

NON - LINEAR PROGRAMMING

Non - linear Programming Algorithm - Unconstrained Non - linear Algorithms - Constrained Non -linear Lagrange multipliers, Kuhn - Tucker optimality conditions. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Operations Research An Introduction, Eight Edition, Hamdy A .TAHA, Pearson Prentice Hall 2016, New Delhi.*
2. *Resource management techniques by V.Sundaresan, Tenth Edition, 2016, A.R Publications, Chennai.*

REFERENCES

1. *Kanti Swarup, P.K. Gupta and Man Mohan, " Operations Research", Sultan Chand & Sons, Educational publishers, New Delhi. 20th Edition, 2019.*
2. *Frederick S. Hillier, Gerald J. Lieberman, "Introduction to Operations Research", Mc Graw Hill, (India) Private Limited, India, 11th Edition, 2021.*

19MOE04 - PROBABILITY AND RANDOM PROCESSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the basic probability problems and to solve the real time problems.

CO2 : To familiarize the students with basic concept of probability distributions and solve problems associated with engineering applications.

CO3 : To achieve an understanding of the basic concepts of Correlation and regression and method of solving them.

CO4 : Able to solve a signal processing problems by using random process concepts.

CO5 : Able to use the concepts of Correlation functions and Power spectral densities for solving Electrical and electronics problem.

THEORY OF PROBABILITY

Sample Space, Events, Axioms of probability, Conditional probability, Independent events, Theorem of total probability, Baye's Theorem. **(9)**

PROBABILITY DISTRIBUTIONS

Definition of Discrete and Continuous random Variables

Discrete distributions : Binomial, Poisson and Geometric - Properties and Simple problems

Continuous distributions : Normal, Uniform Exponential - Properties and Simple problems. **(9)**

CORRELATION AND REGRESSION

Correlation -Meaning and scope of Correlation - Scatter diagram, Karl Pearson's co-efficient of Correlation, Spearman's Rank Correlation, Multiple Correlation and partial correlation - simple problems.

Regression Analysis - Meaning and Scope of regression - Regression in two variables - Uses of Regression. **(9)**

RANDOM PROCESSES

Classification - Stationary process - Markov process - Poisson process - Random telegraph process. **(9)**

CORRELATION FUNCTIONS AND POWER SPECTRAL DENSITIES

Auto Correlation functions - Cross Correlation functions - Properties - Power spectral density - Cross spectral density - Properties. **(9)**

TOTAL : 45

TEXT BOOKS

1. *S.C. Gupta and V.K. Kapoor, Fundamental of Mathematical Statistics, Tenth Revised Edition, 2020.*
2. *T. Veerarajan, Probability, Statistics and Random Processes, Second Edition, Tata Mc Graw - Hill 2017.*

REFERENCS

1. *Robert Hogg & Joseph McKean: Introduction to Mathematical Statistics, Pearson 8th Edition 2018.*
2. *Bhat, B. R.: Modern Probability Theory - An Introductory Text Book, Third Edition, New Age International 2015.*

3. *Cochran,W.G: Sampling Techniques, Wiley Eastern Private Limited, 2007.*
4. *Sukhatme, P.V. and Sukhatme, B.V.(1977) : Sampling Theory of Survey with Applications, Asia publishing House.*
5. *Rakesh Dube, "Higher mathematics for Engineering and Science" Manakin Press, 2018.*
6. *Ibe,O.C.,"Fundamentals of Applied Probability and Random processes", 2nd Edition, Elsevier, 2019.*
7. *Peyton Peebles, "Probability Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, NewDelhi, 2017.*

19POE01 - INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology.

CO2 : Understand the different classes of nanomaterials.

CO3 : Identify the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

CO4 : Outline the applications of nanotechnology and develop an ability to critically evaluate the promise of a nanotechnology device.

BASICS OF NANOTECHNOLOGY

Introduction - Time and length scale in structures - Definition of a nanosystem - Dimensionality and size dependent phenomena - Surface to volume ratio - Fraction of surface atoms - Surface energy and surface stress- surface defects - Effect of nanoscale on various properties - Structual, thermal, mechanical, magnetic, optical and electronic properties. **(9)**

DIFFERENT CLASSES OF NANOMATERIALS

Classification based on dimensionality - Quantum Dots, Wells and Wires - Carbon based nano materials (buckyballs, nanotubes, graphene) - Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites - Nanopolymers - Nano ceramics - Biological nanomaterials. **(9)**

SYNTHESIS OF NANOMATERIALS

Chemical Methods: Metal Nanocrystals by Reduction - Sol - gel processing - Solvothermal Synthesis - Photochemical Synthesis - Chemical Vapor Deposition (CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE). **(9)**

CHARACTERIZATION OF NANOSTRUCTURES

Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX) - Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM) - Atomic force microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman spectroscopy - X-ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy(AES). **(9)**

APPLICATIONS

Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics - Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices - Nanomaterials for data storage - Photonics, Plasmonics - Chemical and biosensors - Nanomedicine and Nanobiotechnology. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Nano technology: Basic Science and Emerging technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)*
2. *A Text book of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw Hill Education Pvt. Ltd., 2012.*
3. *Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, 2002.*
4. *Introduction to Nanotechnology, Charles P.Poole,Frank J.Owens, Wiley Interscience (2003)*

5. *Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, Springer Science & Business Media, 2013.*

REFERENCES

1. *Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)*
2. *Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994*
3. *Dupas C., Houdy P., Lahmani M.,Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg, 2007*

19POE02 - PHYSICS AND TECHNOLOGY OF THIN FILMS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Recognize the fundamental growth and material parameters of thin films.

CO2 : Evaluate and use models for nucleation and growth of thin films.

CO3 : Asses the relation between deposition technique, film structure and film properties.

CO4 : Identify modern techniques for the characterization of thin films

CO5 : Demonstrate the applications of thin films

Preparation of thin films : Preparation methods: electrolytic deposition, cathodic and anodic films, thermal evaporation, cathodic sputtering, chemical vapour deposition. Molecular beam epitaxy and laser abalation methods. Thickness measurement and monitoring: electrical, mechanical, optical interference, microbalance, quartz crystal methods. **(9)**

Growth Kinetics of Thin Films : General features.- nucleation theories - energy formation of a nucleus - critical nucleation parameters; spherical and non spherical (cap, disc and cubic shaped) Effect of electron bombardment on film structure. Post-nucleation growth, epitaxial films and growth. **(9)**

Analytical techniques of characterization : X-ray diffraction - Photoluminescence - UV-Vis-IR spectrophotometer - Atomic Force Microscope - Scanning Electron Microscope - Hall effect - Vibrational Sample Magnetometer - Secondary Ion Mass Spectrometry - X-ray Photoemission Spectroscopy - Auger emission spectroscopy. **(9)**

Properties of Thin films : Dielectric properties - experimental technique for the determination of dielectric properties - optical properties - experimental technique for the determination of optical constants - mechanical properties - experimental technique for the determination of mechanical properties of thin films - magnetic and superconducting properties. **(9)**

Applications : Optoelectronic devices : LED, LASER and Solar cell - Micro Electromechanical Systems (MEMS) - Fabrication of thin film capacitor - application of ferromagnetic thin films; data storage, Giant Magnetoresistance (GMR) - sensors - fabrication and characterization of thin film transistor and FET. **(9)**

TOTAL : 45

TEXT BOOKS

1. *A. Goswami, Thin Film Fundamentals, New Age international (P) Ltd. Publishers, New Delhi, 2006.*
2. *L.I. Maissel and Glang (Eds.), Handbook of Thin film Technology, McGraw-Hill, 1970.*
3. *K.L. Chopra, Thin Film Phenomena, McGraw-Hill (1983)*

REFERENCES

1. *Thin-Film Deposition : Principles and Practice, Smith Donald Donald L Smith Smith, McGraw-Hill Professional Pub, 1995*
2. *J.C. Anderson, The Use of Thin Films in Physical Investigation, Academic Press 1966.*
3. *J.J. Coutts, Active and Passive Thin Film Devices, Academic Press 1978.*
4. *George Hass, Physics of Thin Films: Volumes 1.:12, Academic Press 1963.*
5. *Kiyotaka Wasa, Makoto Kitabatake, Hideaki Adachi, Thin Films Material Technology, Springer-Verlag Berlin Heidelberg, 2004.*

19POE03 - SOLAR CELL FUNDAMENTALS AND MATERIALS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Demonstrate the knowledge about photovoltaics.

CO2 : Gain knowledge about principle of operation of solar cells

CO3 : Realization about semiconducting materials used in the manufacture of PV cells

CO4 : Outline the various advanced solar cell technologies, their current status and future technological challenges

EVOLUTION OF SOLAR CELLS

Historical development; present and future global issues- commercialization/economic factors- basic components of PV systems - The solar spectrum - terrestrial and space spectra; air mass (AM0, AM1.5) - Introduction to 1st, 2nd and 3rd generation photovoltaics. **(9)**

SOLAR CELL FUNDAMENTALS

Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell - light absorption- creating charge carriers forming the electric field - driving the charge carriers - solar cell parameters- electrical characteristics - the ideal solar cell, solar cell in practice, the quantum efficiency and spectral response, optical properties - basics of solar cell device design. **(9)**

SEMICONDUCTOR PROPERTIES

Overview of semiconductor properties relevant to solar cell operations- semiconductor band structure, carrier statistics in semiconductors, the transport equations, carrier mobility, carrier generation by optical absorption - band to band transitions, free-carrier absorption, recombination- bulk recombination processes, surface recombination, minority carrier life time. **(9)**

SILICON AND THIN FILM SOLAR CELLS

Si photovoltaics - single crystal silicon cells - semicrystalline and polycrystalline silicon cells - overview of various thin film solar cells: gallium arsenide solar cells - fabrication techniques, InP & cadmium telluride based solar cells - copper indium diselenide solar cells - multijunction cells - environmental and health aspects. **(9)**

ADVANCED SOLAR CELLS

Advanced solar cell concepts - organic (polymer) photovoltaics - new concepts - quantum dots, wires, intermediate band, multiple exciton generation - Dye sensitized solar cells - perovskite solar cells - challenges in materials and device design - current and future research trends in PV. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Fonash S. J., "Solar Cell Device Physics", Academic, 2010.*
2. *Goetzberger, J. Knobloch, and B. Voss "Crystalline Silicon Solar Cells" Wiley, 1998.*
3. *Green M. A. "Third Generation Photovoltaics: Advanced Solar Energy Conversion" Springer, 2006 .*

REFERENCES

1. *Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", PHI Learning Pvt. Ltd., 2009.*
2. *Jha A.R., "Solar Cell Technology and Applications", CRC Press, 2010.*

19POE04 - ADVANCED MATERIAL PROCESSING TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Recognize the criteria for material selection based on properties of materials and to choose the required material for a specified application.

CO2 : Understand various metallurgical forming processes such as casting, rolling extrusion, drawing, development of grain structure and processing of different composite types.

CO3 : Demonstrate knowledge about powder metallurgy, ceramic and polymer processing methods.

CO4 : Identify and choose the required surface treatment technique for coating formation on account of enhancing the surface properties of the mechanical components for engineering applications.

CO5 : Understand the applicable joining and machining techniques and their limitations

INTRODUCTION AND SELECTION OF MATERIALS

Motivation for selection - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability, corrosion and wear resistance - Relationship between materials selection and processing - Case studies - aero, auto, marine, machinery and nuclear applications. High and low temperature materials, superconductors, supramagnetic materials, high entropy alloys, nanomaterials and biomaterials. **(9)**

METALLURGICAL FORMING AND PROCESSING OF COMPOSITES

Metallurgical forming: Casting, rolling extrusion, drawing, development of grain structure for specific properties. Processing of composites: lay up methods, press/ autoclave / resin transfer moulding, Reinforced Reaction Injection Molding (RRIM), obtrusion and filament winding. **(9)**

POWDER METALLURGY, CERAMIC AND POLYMER PROCESSING

Powder metallurgy and ceramic processing: green fabrication methods, sintering, hot pressing, Hot Isostatic Pressing (HIP), spark plasma sintering, development of microstructure in powder processed materials. Polymer processing: extrusion, injection moulding, blow moulding, rotational moulding, vacuum forming and related processes processing of cellular polymers. **(9)**

COATING METHODS

Introduction to surface Engineering, Differences between surface and bulk properties, Properties of surfaces-wear, wettability. Chemical vapour deposition, physical vapour deposition, electro deposition, electroless deposition, thermal spray processes. Principle of various coating processes, process parameters, controlling the yield of coating and various surface properties of the coating. Criteria for selection of a surface coating technology. Product oriented surface coating technology. **(10)**

JOINING AND MACHINING

Joining: fusion welding, solid state welding, adhesive bonding, mechanical joining and recent advancements in welding. machining: Electromachining (electrochemical and electro-discharge), mechanical machining and recent advancements. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Charles J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials", 3rd Edition, Butterworth-Heinemann, 1977.*
2. *Betzalel Avitzu, "Metal Forming- Processes and Analysis", Tata McGraw Hill, 1977.*

3. *William F Hasford, Robert M Caddell "Metal Forming: Mechanics and Metallurgy" Cambridge University Press P. ltd, 2007.*
4. *Angelo P C and Subramanian R" Powder Metallurgy Science, Technology and Applications", Prentice Hall of India, New Delhi, 2012.*

REFERENCES

1. *Michael Barsoum, "Fundamentals of Ceramics", Mc Graw Hill Publishing Co., INC, 1997*
2. *Gowariker V R, Viswanathan N V, Jayadev Sreedhar, "Polymer Science", New Age International P Ltd., 2005.*
3. *David S. Rickerby, Allan Matthews "Advanced surface coatings: a handbook of surface engineering", Blackie, 1991.*
4. *Parmar, R.S, "Welding Engineering and Technology", Khanna Publishers, 2003.*

19COE01 - MEDICAL NANO TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

The students will be able to

CO1 : Understand the essential features of nanomedicine

CO2 : Identify the medical based nanotools

CO3 : Assess health effects due to nanoparticle exposure

ASSESSING NANOTECHNOLOGY HEALTH

Nanomaterials : The Current State of Nanotechnology Application - Nanotechnology Risks - Risk Analysis - Hazard Identification - Exposure Assessment for Nanomaterials - Risk Characterization - Risk Management - Best Practices for Nanomaterials in the Workplace - Safety Research - Needs for Engineered Nanoscale Materials **(9)**

RISK ASSESSMENT AND ENVIRONMENTAL PROTECTION

Context for Technological Risk - Need for Risk Assessment for Nanotechnology - Adaptive Risk Assessment for Nanomaterials - Origins and Development of Risk Assessment - Risk Assessment Used in Environmental Decision Making - Issues in Applying the Four Steps of Risk Assessment to Nanotechnology - Hazard Assessment - Exposure Assessment - Dose - Response Evaluation **(9)**

SUSTAINABLE NANOTECHNOLOGY DEVELOPMENT

Necessity of Risk Assessment in Nanotechnology - The Pace of Nanotechnology Development and the Paucity of Information - Potential for Wide Dispersion in the Environment Amid Uncertainty - Few Standards or Guidelines - Environmental Risk Issues - Carbon Nanotubes - Defining the Toxic Dose - Environmentally Friendly Nanotechnology - Life Cycle Analysis for Sustainable Nanotechnology **(9)**

HUMAN HEALTH, TOXICOLOGY, AND NANOTECHNOLOGY RISK

Mechanisms of Toxicity - Types of Toxicological Studies - Pulmonary Toxicity Studies - Gastro intestinal Toxicity - In Vitro Studies - Dermal - In Vitro Toxicity Studies **(4)**

ENVIRONMENTAL RISKS

Antimicrobial Properties of Nanoscale Silver - Buckyballs, Titanium Dioxide - Short-term Toxicity Tests - Daphnia LC50 Assays - Studies of Nanomaterial Toxicity to Fish - Buckyballs and Bass-TiO_2 in Arsenic - Field Studies - Environmental Exposures - Nanoscale Zerovalent Iron **(9)**

NANOELECTRONIC DEVICES

Resonant tunneling diodes - Field effect transistors - Single electron transfer devices - Potential effect transistors - Light emitting diodes and lasers - Nanoelectromechanical system devices - Quantum dot cellular automata **(5)**

TOTAL : 45

TEXT BOOKS

1. *George W. Hanson, "Fundamentals of Nanoelectronics", Prentice Hall, 2007*
2. *Vladimir V. Mithin et.al, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications" Cambridge University Press, 2012*

REFERENCES

1. *Mithin.V, Kochelap.V and Stroscio.M, "Introduction to Nanoelectronics", Cambridge University Press, 2008*
2. *Karl Gosar et.al, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices", Springer, 2005.*

19COE02 - ADVANCED DRUG DELIVERY SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to know the fundamentals of Nanoscience and their applications in pharamacological industries

CO2 : The students will able to describe polymeric drug delivery systems and their encapsulation methodology to study targeted drug delivery with different polymeric systems

CO3 : The students will able to identify lipids-nanocarriers and their application in biological system

CO4 : The students will able to study site specific drug delivery for gene therapy

THEORY OF ADVANCED DRUG DELIVERY

Fundamentals of Nanocarriers - Size, Surface, Magnetic and Optical Properties, Pharmacokinetics and Pharmacodynamics of Nano drug carriers. Critical Factors in drug delivery. Transport of Nanoparticles - In Vitro and Ex Vivo Models. **(10)**

POLYMERS Dendrimers- Synthesis -Nanoscale containers- Dendritic Nanoscafold systems Biocompatibility of Dendrimers, Gene transfection. pH based targeted delivery- chitosan and alginate. Copolymers in targeted drug delivery- PCL,PLA, PLGA. **(8)**

LIPID BASED NANOCARRIERS

Liposomes, niosomes and solid lipid nanoparticles. Ligand based delivery by liposomes. Cubosomes. **(9)**

MICROBES AND ANTIBODY BASED NANOCARRIERS

Bacterial dependent delivery of vaccines. Drug delivery and subcellular targeting by virus, Drug packaging and drug loading. Delivery of therapeutics by antibodies and antibodybioconjugates. **(9)**

SITE SPECIFIC DRUG DELIVERY

Concepts and mechanism of Site specific drug delivery- Microneedles, Micropumps, microvalves. Implantable microchips. **(9)**

TOTAL : 45

REFERENCES

1. *Drug Delivery: Engineering Principles for Drug Therapy, M. Salzman, Oxford University Press, 2001.*
2. *Drug Delivery and Targeting, A.M. Hillery, CRC Press, 2002.*
3. *Drug Delivery: Principles and Applications, B. Wang, Wiley Intersceince, 2005.*
4. *Nanoparticle Technology for Drug Delivery, Ram B. Gupta, Uday B. Kompella Taylor & Francis, 2006.*

19COE03 - BIOSENSORS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing

CO2 : The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products

CO3 : The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors

CO4 : The students will able to study about the fabrication of biosensors and its application as nanochip analyzer

PROTEIN BASED BIOSENSORS

Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporous silica - Protein based nano crystalline Diamond thin film for processing **(9)**

DNA BASED BIOSENSOR

Heavy metal complexing with DNA and its determination, water and food samples - DNA zymo biosensors **(9)**

ELECTRO CHEMICAL APPLICATION

Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors **(9)**

FABRICATION OF BIOSENSORS

Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis **(9)**

BIOSENSORS IN RESEARCH

Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design - Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors **(9)**

TOTAL : 45

REFERENCES

1. *Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004*
2. *Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007*
3. *Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.*

19COE04 - NANOCOMPOSITES

L	T	P	C
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ASSESSMENT : THEORY

COURSE OUTCOME

The students will be able to

CO1 : Study the different synthesis techniques of metal ceramic nanocomposites and their functionality

CO2 : Describe the processing techniques for heterometallic nanocomposites and to study their electromagnetical property

CO3 : Understand the design of super hard nanocomposites with improved mechanical properties

CO4 : Study the polymer based carbon nanotube composites, to study their mechanical properties and their industrial applications

NANO CERAMICS

Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. **(9)**

METAL BASED NANOCOMPOSITES

Metal-metal nanocomposites, some simple preparation techniques and their new electrical and magnetic properties. **(9)**

DESIGN OF SUPER HARD MATERIALS

Super hard nanocomposites, its designing and improvements of mechanical properties. **(9)**

NEW KIND OF NANOCOMPOSITES

Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Electrical property of fractal based nanocomposites. Core-Shell structured nanocomposites. **(9)**

POLYMER BASED NANOCOMPOSITES

Preparation and characterization of diblock Copolymer based nanocomposites; Polymercarbon nanotubes based composites, their mechanical properties, and industrial possibilities. **(9)**

TOTAL : 45

REFERENCES

1. *Nanocomposites Science and Technology - P. M. Ajayan, L.S. Schadler, P. V. Braun 2006.*
2. *Physical Properties of Carbon Nanotubes- R. Saito 1998.*
3. *Carbon Nanotubes (Carbon, Vol 33) - M. Endo, S. Iijima, M.S. Dresselhaus 1997.*
4. *The search for novel, superhard materials- Stan Veprek (Review Article) JVST A, 1999*
5. *Electromagnetic and magnetic properties of multi component metal oxides, hetero*
6. *Nanometer versus micrometer-sized particles-Christian Brosseau,Jamal Ben, Youssef, Philippe Talbot, Anne-Marie Konn, (Review Article) J. Appl. Phys, Vol 93, 2003*
7. *Diblock Copolymer, - Aviram (Review Article), Nature, 2002*

19COE05 - BIOREFINERY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

The students will be able to

CO1 : Understand various renewable feedstocks for biofuels production

CO2 : Understand the broad concept of second and third generation biofuel products from biomass and other low-cost agri-residues and biowastes.

CO3 : Analyze the design processes for biofuel production

CHEMISTRY & BIOCHEMISTRY OF BIOMASS

Types of biomass (e.g. wood waste, forestry residues, agricultural residues, perennial annual crops, organic municipal solid waste). Composition of lignocellulose (lignin, hemicellulose, cellulose); energy crops; chemical pretreatment; enzymatic pretreatment; degradation of cellulose; trichoderma cellulases; bacterial cellulases; and comparison with degradation of high starch. **(9)**

BIODIESEL

Sources and processing of biodiesel, nature of lipids, fatty acids and triglycerides.Sources and characteristics of lipids for use as biodiesel feedstock; and conversion of feedstock into biodiesel, (transesterification). Use of vegetable oil (SVO) and waste vegetable oil (WVO). Environmental issues of biodiesel; major policies and regulations pertaining to the production, distribution, and use of biodiesel. **(9)**

BIOMETHANE OR BIOGAS

Hydrolysis; anaerobic digestion; methanogenesis (acetoclastic, hydrogenotrophic), rates of methane formation; and one and two stage fermentation.Thermal depolymerization.Use of exhaust gases (e.g. CO_2, H_2S and H_2) from geothermal power plants and industrial operations (e.g. coal and oil refineries) as an energy sources (methane and hydrogen) **(9)**

GASIFICATION & PYROLYSIS TECHNOLOGIES

Gasification processes and the main types of gasifier designs; production of electricity by combining a gasifier with a gas turbine or fuel cell.Combined- cycle electricity generation with gas and steam turbines, and generation of heat and steam for district heating systems or CHP, including kalina Cycle. Production of synthesis gas (i.e. CO, H_2, H_2O, CO_2) tar vapor and ash particles) for subsequent conversion to hydrogen and transport fuels; advanced gas cleaning technologies for biomass. Biological conversion of syngas into liquid biofuels. Fast pyrolysis technology to produce a range of fuels, chemicals, and fertilizers; biorefineries, and new uses for glycerine in biorefineries. **(9)**

POLICIES AND FUTURE R&D OF BIOFUELS & BIOENERGY

Analysis of both current and future EU regulations and directives on biofuels and bioenergy.Tax regulations. Evaluation of different production alternatives to produce bioenergy; competitiveness of bioenergy alternatives in agriculture compared to other energy sources. Evaluation of current and future R&D needs; legal framework to support sustainable development and increased use of biofuels; government policies and programs with regard to biofuels and investment opportunities worldwide. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Robert C.Brown, "Biorenewable Resourses: Engineering", New Products from Agriculture, Wiley- Blackwell Publishing, 2003.*
2. *Samir K.Khanal, "Anaerobic Biotechnology for Bioenergy Production: Principles and Application", Wiley- Blackwell Publishing 2008.*

REFERENCES

1. *Martin Kaltschmitt; Hermann Hofbauer. "Biomass Conversion and Biorefinery", Springer Publishing, 2008.*

19HOE01 - PRINCIPLES OF MANAGEMENT

COURSE OUTCOMES

CO1 : Design the Management function for a given organization

CO2 : Design and develop a strategic approach for the completion of the project

CO3 : Analyze the behavior of individuals and groups in organizations in terms of the key factors

CO4 : Formulate the procedure for recruitment, selection, training of staff to establish an organization

Unit I - Introduction to Management: Meaning, Definition and Significance of Management-Basic functions of Management-Development of Management Thought **(9)**

Unit II - Management Concepts: Planning, Organizing, Staffing, Directing and Controlling- MBO-Six sigma **(9)**

Unit III - Organizational Behavior: Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and Perceptions at work **(9)**

Unit IV - Business Process Reengineering: Need for BPR, Various phases of BPR, Production and Productivity-Factors influencing Productivity **(8)**

Unit V - Human Resource Management: Evolution of Management- Development of Managerial skills-Human Resource Management - Objectives -Job analysis -Recruitment -Selection and Placement and Training Development **(10)**

TOTAL : 45

TEXT BOOKS

1. *Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management" Tata Mcgraw Hill, New Delhi, 2013.*
2. *Mamoria, CB, "Personnel Management", Sultan Chand and Sons, New Delhi, 2013.*

REFERENCES

1. *Robbin Finchanm and Peter Rhodes, "Principles of Organizational Behavior" Oxford University Press, 2010.*
2. *CB Gupta "Management Theory and Practice" Sultan Chand and Sons, New Delhi, 2009.*
3. *VSP Rao "Management Text and Cases" Excel Books, New Delhi, 2009.*
4. *Fred Luthans "Organizational Behavior" Mc-Graw hill, New York, 2005.*
5. *Knanna OP "Industrial Engineering and Management", Dhanpat Rai publications, New Delhi, 2003.*

19HOE02 : CURRENT TRENDS IN INDIAN ECONOMY

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COURSE OUTCOMES

CO1 : Outline the structure of our Indian Economic System

CO2 : Access the role of industrial sector in Indian economy

CO3 : Interpret the demographic trends for the current scenario

CO4 : Analyze the role of two tier for the achievement of common national goals

Unit - 1 National Income and Agriculture Sector: Economics Development-Meaning-National Income and Per capita Income in India- Indian Planning-Agricultural Development of India: Major crops- Production-Productivity-Contribution to GDP and Exports **(8)**

Unit - II Industrial Sector: India's industrial development-Industrial policies of 1948, 1956 and 1991-Liberalisation-Public sector-Privatization-Disinvestment policy-Role and importance of large scale industries and small scale industries-Special economic zones-Contribution to GDP-Growth rate **(8)**

Unit - III Population: Growth and policy issues-Demographic trends-Vital statistics-India's population: size and growth rate-Demographic dividend-HDI-Population policy-Issues of Unemployment, Poverty and inequality in India **(10)**

Unit - IV Service sector: Service sector in India-Banking-Insurance-Telecommunication-IT sector-Software exports-BPO-Contribution to GDP **(9)**

Unit - V Federal System and Foreign Trade: Federal setup in India-Taxes: Direct and Indirect Tax-Value added Tax-Foreign direct investment-Merits and Demerits-India's imports and exports: Composition and direction-Foreign exchange reserve position-MNC's in India **(10)**

TOTAL : 45

TEXT BOOKS

1. *Ruddar Datt and Sundaram, KPM, Indian Economy, S.Chand and company, New Delhi-2015*
2. *Ramesh Singh Indian Economy, McGraw hill Education 7th edition, 2015*

References: www.jagranjosh.com

19H0E03 - MONETARY ECONOMICS

L	T	P	C
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COURSE OUTCOMES

CO1 : Evaluate the monetary measures formulated through static and dynamic role of money

CO2 : Design the driving force of circular flow of money

CO3 : Analyse how quantity theory of money fluctuate the price level

CO4 : Estimate the demand and supply of money based on the Interest rate

Unit I Nature and significance of Money: Definition of Money-Functions of Money-Static and Dynamic role of Money-Circular flow of Money-Monetary standards-Gold standard-Paper currency standard-Principles of Note issue-Measures of Money supply **(9)**

Unit II Quantity Theory of Money: Fisher's quantity theory of Money-Assumptions-Cash Balance Approach (Cambridge Equations)- Equation of Marshall, Pigou and Keynes-Similarities and dissimilarities of cash balance and cash transaction approaches-Income and expenditure theory-Superiority of Income and expenditure theory-Demand for Money: Classical and Keynesian liquidity preference theory approach **(9)**

Unit III Inflation and Deflation: Meaning-Types-Causes of Inflation-Demand Pull and Cost push inflation -Inflationary Gap-Phillips Curve-Effects of Inflation-Deflation-Causes-Measures to control Inflation and Deflation-Stagflation **(9)**

Unit IV Commercial Banking and Financial Markets: Functions of Commercial Banks-Credit Creation-Meaning and constitute of Money Markets-Capital Market-Institutional structure of Capital Market-Primary Market-Secondary Market-Indian capital Market-Non-Banking financial intermediaries **(9)**

Unit V Central Banking and Monetary Policy: Central Banking-Functions-Organization-Instruments of Credit control-Monetary Policy: Meaning, Objectives, and Recent policy changes in RBI-Monetary Policy in a developing economy **(9)**

TOTAL : 45

TEXT BOOK

1. *Jhinghan ML "Monetary Economics:" Vrinda Publications, New Delhi, 2013.*

REFERENCES

1. *Sethi TT, "Monetary Economic Theory", S Chand & Co, New Delhi, 1996.*
2. *Mithani DN, "Money Banking and International Trade", Himalaya, Mumbai, 2013.*

19HOE04 - ENGLISH FOR ACADEMIC PURPOSE

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Write a description and apply grammatical rules.

CO2 : Analyse a passage and enhance vocabulary.

CO3 : Formulate a research paper

CO4 : Listen to a lecture and prepare a summary.

CO5 : Construct dialogues using appropriate expressions.

FOCUS ON LANGUAGE

Sentence construction- types of clauses- sequence- co ordination- subordination- paragraphing information - describing a system & procedure **(9)**

READING

Understand a writer's purpose - Use strategies to ascertain meaning from unfamiliar vocabulary encountered in context - Recall and use vocabulary regarding urbanization and megacities - To identify and outline main ideas in a passage - Skim a reading passage for main ideas - Summarize texts and images - Using a dictionary to obtain lexical, phonological and orthographical information - Identify and use target vocabulary words - Highlight important parts and texts. **(13)**

WRITING

Achieving appropriate tone and style in academic writing - writing a Research article - Types of Research Designs - Choosing a Research Problem- The Abstract - The Introduction - The Literature Review - 6. The Methodology - The Results - The Discussion - The Conclusion - Citing Sources - Proofreading.

LISTENING

Listening to conversation - lectures - topics - discussions - listening comprehension on specific topics - listening to recognize formal and informal spoken English **(11)**

SPEAKING

Seminar skills - Engage in verbal role playing in Formal and Informal situation. - Express advice and personal opinions with supporting information - Paraphrase stories and information - Expressing requests - Suggestions - Complaints - Apology - Giving and Accepting compliments - Making invitations - Refusing invitations **(12)**

TOTAL : 45

REFERENCES

1. *Wisniewska, I., Riggenbach, H.,& Samuda, V. (2007). Grammar dimensions*
2. *Form, meaning, and use (4th Ed.). Boston, MA: Heinele Cengage Learning Longman Introductory Course for the TOFEL Test*
3. *Original publications and web- based resources will be reviewed as necessary.*

19HOE05 - ENGLISH FOR COMPETITIVE EXAMS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Listen to TOEFL exercises and formulate appropriate answers.

CO2 : Speak using right grammar and appropriate pronunciation on general and academic topics.

CO3 : Analyze the passage and answer the question.

CO4 : Generate and organize ideas on a given topic

LISTENING

Listening to conversation - Narration - Suggestion - Assumptions - Predictions - Implications - Problems - Academic conversations - Discussions - Lectures **(11)**

SPEAKING

Independent speaking - Integrated speaking - Speaking about a personal experience - Preferences - Report the speakers opinion - Explain a problem and solution - Give a summary of a academic lecture. **(13)**

READING

Read and understand short passages - Integrated reading tasks - Read the passage and choose the right summary of the passage - Reading for main ideas - Scanning the passage for synonyms - Making inferences - Identifying exceptions - Locating references. **(12)**

WRITING

Independent writing - Integrated writing - Writing short essays - Writing dialogues - Articles - Sentence construction **(9)**

TOTAL : 45

REFERENCES

1. *Sharpe J.Pamela. Barron's How to prepare for the TOEFL Test of English as a foreign Language. 11th Edition, Galgotia Publications Pvt. Ltd: New Delhi, 2004.*
2. *Sharpe J.Pamela. Barron's TOEFL iBT Internet- Based Test. 12th Edition, Galgotia publications Pvt.Ltd: New Delhi, 2009.*

19HOE06 - LIFE AND LITERATURE

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Compose an essay on the prose piece

CO2 : Analyse the poem and write a critical appreciation of it

CO3 : Read the story and find the moral values implied in the stories

CO4 : Write a review the fiction

Unit - 1 : Prose

The Postmaster by Rabindranath Tagore

Snapshot of a Dog by J G Thurber

On the Rule of the Road by A.G. Gardiner

The Village Schoolmaster by Oliver Goldsmith

Incident of the French Camp by Robert Browning **(13)**

Unit - 2 : Poems

Stopping By Woods on a Snowy Evening by Robert Frost

The Ballad of Father Gilligan by W.B. Yeats **(9)**

Unit - 3 : Short stories

The Model Millionaire by Oscar Wilde

The Ant and the Grasshopper by W. Somerset Maugham

The Doll's House by Katherine Mansfield, Biography

Albert Einstein and Steve Jobs **(11)**

Unit - 4 : Fiction

The Old Man and the Sea by Ernest Hemmingway

The Scarlet Pimpernel by Baroness Emma Orczy

Practice in creative writing, review writing **(13)**

TOTAL : 45

REFERENCES

1. *Xavier. ed. An Anthology of Popular Essays and Poems. Macmillan: New Delhi, 2009.*
2. *Kumara Pillai. ed. A Book of Modern Short Stories. Macmillan: New Delhi, 2009.*
3. *Colleen and Darius Krishnaraj. ed. Convergence , A Book of Short Stories. Macmillan: New Delhi, 2009.*
4. *Ernest Hemmingway. The Old Man and the Sea. Arrow: Warwickshire, 2000.*
5. *Baroness Emma Orczy, The Scarlet Pimpernel. Hutchinson : 1995.*

COIMBATORE INSTITUTE OF TECHNOLOGY

(Autonomous Institution affiliated to Anna University Chennai)

COIMBATORE - 641 014

DIAMOND JUBILEE
(1956 - 2016)

DEPARTMENT OF CHEMICAL ENGINEERING

B.Tech. CHEMICAL ENGINEERING

Curriculum and Syllabi

THIRD TO EIGHTH SEMESTER

Under Choice Based Credit System

(For the students admitted during 2019 - 2020 and onwards)

19CE32 - ENGINEERING GEOLOGY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, students will be able to

CO 1: Describe the importance of geology in civil engineering, weathering, type of soils, geological work of various geological agents, earthquake, interior and age of the earth, landslide mitigation.

CO 2: Explain geological surface and subsurface features

CO 3: Identify the elements of crystallography to classify minerals based on their system

CO 4: Identify minerals based on their physical properties and its distribution in India.

CO 5: Identify rocks based on mineralogy, texture, structure and mode of occurrence with its application in civil engineering purposes.

CO 6: Employ the geological knowledge for projects of dams & reservoirs, tunnels, coastal protection.

CO 7: Interpret subsurface geological features and properties of rocks using fundamental principles of geophysical methods.

PHYSICAL GEOLOGY AND GEOMORPHOLOGY

Applications of earth science in civil engineering practices - understanding internal structure –composition and age of the earth. Rock weathering – types and effects in civil engineering- soil – soil profile - types - mode of formation –process of mass wasting- landslides and related phenomenon- causes and control - geomorphological features developed by river, ground water, wind. Earthquake-theory-terminology - causes-seismic waves-measurements, Richter scale - Tsunami - impacts on civil engineering works.

(9)

STRUCTURAL GEOLOGY

Dip and strike-apparent dip and true dip- folds- parts of fold- types of fold- mechanism of fold-recognition of fold. Fault- fault terminology- classification of fault- effects of fault on out crop- significance of folds and fault- unconformities- types- recognition of unconformities- joints- classification of joints- structures due to denudation- outlier- Inlier- off lap- on lap.

(9)

MINERALOGY & CRYSTALLOGRAPHY

Physical properties of mineral - its composition - system of crystallization - ore forming and rock forming minerals – origin - uses –distribution in India. Quartz group- Feldspar group - Feldspathoid group - Silica group - Pyroxene group - Mica group - Olivine group - Chlorite group - Serpentine group - Clay mineral group- Alumino silicate group- Calcic minerals-Carbonate group-Economic minerals deposits in India

(9)

1.

PETROLOGY & STRATIGRAPHY

Rock cycle - Igneous, sedimentary and metamorphic rocks- mineralogical composition, texture and structure, classification, engineering properties of Igneous rocks - granite, gabbro, dolerite and basalt. Sedimentary Sandstone, Shale, Limestone, Laterite. Metamorphic Rock - Gneiss, Quartzite, Slate, Charnokite, Decorative Stones-Porphyries- Marble. Outline of stratigraphy-geologic time scale-stratigraphic units- origin and formation of coal-chemical and banded constituents of coal-ranks of coal-distribution of coal in India- petroleum formation-structural and stratigraphic controls-traps-distribution in India.

(9)

APPLIED GEOLOGY

Rocks as building stones-properties of building stones-road metals-geology of dam sites-dams terminology-types-problems associated with dam sites- geology of reservoirs-tunnels-bridges-constructional features-stability of bridges- foundation of bridges and coastal protection –geophysical survey-magnetic survey-electrical survey-seismic survey and radiometric survey-principles and applications

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Parbin Singh.,"A textbook of Engineering and General Geology'', kataria & sons, publishing house, Delhi,2012.

2. K. M. Bangar., "Principles of Engineering Geology, Standard Publishers distributors. NAI SARAK Delhi-2013

3. W.D. Thornbury .,"Principles of Geomorphology" Second Edition,- CBS-Publications, New Delhi; December 2004

REFERENCE BOOKS

1. Chenna Kesavulu N., "Textbook of Engineering Geology", Laxmi Publications, New Delhi, Second Edition, 2016.
2. Krynine and Judd, "Principles of Engineering Geology and Geotechnics", Tata McGraw Hill, New Delhi, 1998.
3. Dr. Savindra Singh, "Physical Geography" Pravalika Publications,Allahabad, India; 2015
4. Tyrrell, "Principles of Petrology", B.I .Publications, Bombay, 1998.
5. Billings, "Structural Geology", Asia Publishing House, New Delhi, 1989.
6. Dexter Perkins, Mineralogy, 3rd Edition; University of North Dakota@ 2011.
7. William E. Ford; Dana's textbook of mineralogy; CBS publishers & distributors, New Delhi; 2006.
8. Rutley's Elements of Mineralogy 27th edition revised by CD Gribble- CBS-publications, New Delhi ; December 2005.
9. Umeshwar Prasad; Economic Geology Economic Mineral Deposits second edition CBS publishers & distributors, New Delhi, 2006.
10. Petar Milanovic" Engineering Karstology of Dams and Reservoirs", CRC Press; 2016.
11. William Lowrie "Fundamentals of Geophysics" Third edition; Cambridge university press, 1997.

1.

19CE33 - MECHANICS OF FLUIDS

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

On successful completion of this course, students will have the ability to

CO1: Apply the storage and flow concepts of fluids and pressure acting on fluids

CO2: Apply the principles of static conditions on fluids

CO3: Analyse the principles of fluid flow using measuring devices

CO4: Analyse simple pipe systems for transport of liquids under different flow conditions

CO5: Apply the principles of dimensional analysis in solving fluid problems through model studies

PROPERTIES OF FLUIDS & FLUID PRESSURE

Introduction of basic properties – Viscosity – compressibility – surface tension – real and ideal fluids – Concept of Fluid pressure – Pressure head – Significance of pressure in fluid statics and dynamics – Various methods of pressure measurements. **(9)**

HYDROSTATICS

Total pressure and centre of pressure on plane submerged surfaces – simple problems – Buoyancy – Centre of buoyancy – Metacentre and metacentric height – conditions of equilibrium of floating and submerged bodies - Fluid mass subjected to uniform linear acceleration – fluid containers subjected to constant rotation

(9)

CONCEPTS OF FLUID FLOW

Classification of fluid flow – velocity and acceleration – velocity potential and stream function- continuity equation – Euler's equation of motion – Bernoulli's equation – applications – venturimeter, orifice meter, pitot tube – simple problems – Velocity and discharge through orifices and mouthpieces

(9)

FLOW THROUGH PIPES

Laminar flow in circular pipes – Hagen – Poisueills's equation – Turbulent flow – Darcy–Weisbach equation – major and minor losses – transmission of power through pipes – parallel, series pipes – flow through long pipes – flow between reservoirs – flow through siphon pipes – water hammer

(9)

DIMENSIONAL ANALYSIS AND MODEL STUDIES

Fundamental dimensions - dimensional homogeneity – Dimensional analysis by Rayleigh's method and Buckingham Pi-Theorem - Dimensionless parameters - Similitude and model studies – Distorted Models

(9)

Total: 45 Hours

1.

TEXT BOOK:

1. Bansal.R.K., “Text Book of Fluid Mechanics and Hydraulic Machines”, M/s. Lakshmi Publications, Madras, 2005.

2. Modi.P.N, & Seth.S.M., “Hydraulics And Fluid Mechanics Including Hydraulic Machines”, Standard Book House, 21st edition, New Delhi, 2017.

3. Rajput.R.K. “Fluid Mechanics and Hydraulic Machines", S.Chand and Co, New Delhi, 2015.

REFERENCE BOOKS:

1. Streeter, V.L., & Wylie, E.B., “Fluid Mechanics”, McGraw Hill, 2000.

2. Frank.M. White, “Fluid Mechanics”, Tata McGraw Hill, 7th Edition, New Delhi, 2017.

3. Ramamrutham.S, “Hydraulics Fluid Mechanics and Fluid Machines”, Dhanpat Rai Publishing Company (P) Ltd, 9th Edition, New Delhi, 2014.

4. Arora K.R., “Fluid Mechanics, Hydraulics and Hydraulic Machines”, Standard Publishers & Distributors,9th edition, 2005.

ONLINE RESOURCES

1. http://www.nptelvideos.in/2012/11/fluid-mechanics.html

2. https://www.classcentral.com/course/swayam-introduction-to-fluid-mechanics-7945

1.

19CE34 SURVEYING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1 - Assess the angles, distances and levels

CO2 - Identify the data collection methods and prepare field notes

CO3 - Demonstrate the application of survey instruments

CO4 - Interpret the survey data and compute areas and volumes

CO5- Describe the principles of photogrammetry and hydrographic surveying

MEASUREMENT OF DISTANCES AND DIRECTIONS

Importance of surveying to engineers, plane and geodetic surveying, principles of surveying, classification of surveys, Linear Measurements using chain, measuring tape, hypotenuse allowance. Measurement of angles, bearings and included angles using Compass, Measurement of angles by Vernier theodolite, Application of Electronic Theodolites.

(9)

LEVELLING AND COMPUTATION OF AREAS AND VOLUMES

Levelling- Basics definitions, types of levels and levelling staff, methods of levelling, Determination of levels- Height of Instrument Method - Rise and Fall method, Contouring- Characteristics and uses of Contours, Direct & Indirect methods of contour surveying, Areas - Determination of areas consisting of irregular boundary and regular boundary. Volumes - determination of volume of earth work in cutting and embankments, capacity of reservoirs.

(9)

THEODOLITE TRAVERSING AND TRIANGULATION

Theodolite Surveying - Types of Theodolites, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Traversing -Methods of traversing, traverse computations and adjustments, Gale's traverse table, Omitted measurements. Tachometric Surveying - Principles of Tachometry, stadia and tangential methods of Tachometry. Triangulation - baseline – satellite stations – reduction to centre- trigonometrical levelling – single and reciprocal observations

(9)

CURVES AND ADVANCED TOPICS IN SURVEYING

Curves: Types of curves and their necessity, elements of simple curve and setting out of simple curve, Introduction to compound, reverse, transition and vertical curves. Hydrographic Surveying-methods, applications and uses – Tides – MSL – Sounding methods – Three point problem – Strength of fix, Introduction to photogrammetry

(9)

1.

MODERN SURVEYING METHODS:

Total Station and Global Positioning System.- Basic principles, classifications, applications, comparison with conventional surveying. Electromagnetic distance measuring system - principle of working and EDM instruments, Components of GPS – space segment, control segment and user segment, reference systems, satellite orbits, GPS observations. Applications of GPS, GIS and remote sensing.

(9)

Total: 45 Hours

TEXT BOOKS:

1. Kanetkar.T.P and Kulkarni.S.V, 'Surveying and Levelling', Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2014
2. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, 'Surveying' (Vol – 1, 2 & 3)', Laxmi Publications (P) ltd., New Delhi. 2016
3. Chandra A M, 'Higher Surveying', New Age Publishers; New Delhi, 2015

REFERENCES:

1. Hoffman. B, H. Lichtenegga and J. Collins, 'Global Positioning System - Theory and Practice', Springer -Verlag Publishers, 2001.
2. R. Subramanian, 'Surveying and Levelling', Oxford university press, New Delhi. 2013
3. Duggal S K, "Surveying (Vol – 1 & 2)", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2016.
4. R. Agor, "Surveying and levelling", Khanna Publishers 2015.

ONLINE RESOURCES

1. http://www.nptelvideos.in/2012/11/surveying.html

1.

19CE35 - WATER SUPPLY ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, students will be able to

CO1: Identify the various sources and characteristics of water and analyse the importance and demand for planned water supply system.

CO2: Analyse the need and economic feasibility in the conveyance of potable water from the source using pipes and pumps.

CO3: Design various conventional treatment system to achieve the potable water quality standards specified.

CO4: Interpret advanced water treatment system available in current scenario to provide high quality drinking water.

CO5: Describe the basic requirements of water distribution system and determine the pipe flow rates and pressure heads using pipe network analysis.

SOURCES OF WATER

Importance and need for planned water supply scheme –Design period- Population forecasting methods -Water demand-types and per capita demand, factors affecting per capita demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir: Mass in-flow curve and analytical methods –Water characterization-physical, chemical and biological – Significance – Drinking Water quality standards (IS, CPHEEO and WHO)

(9)

CONVEYANCE FROM THE SOURCE

Intake structures, need and its types –Pipe materials, pipe appurtenances and valves used in transmission of water- laying, jointing and testing of pipes – Hydraulics design of pressure pipes – Pumps, pumping station and capacity of pumps – Selection of pumps.

(9)

WATER TREATMENT

Screening - Sedimentation – theory, types of settling, Stokes law - Coagulation – theory, chemicals used, flocculation - Jar test – design of sedimentation tank - Filtration – removal mechanisms, filter media, types, slow sand, rapid sand and pressure filters, filter design - Disinfection – methods. Chlorination – action, factors influencing, free chlorination, combined chlorination.

(9)

TERTIARY WATER TREATMENT

Water softening – Desalination – demineralization – Adsorption - Ion exchange– Membrane Systems – Reverse osmosis - Iron and Manganese removal - Defluoridation - Construction and Operation & Maintenance aspects – Recent advances - MBR process.

(9)

WATER DISTRIBUTION

Requirements of water distribution and its method – Components – Service reservoirs – Analysis and design of distribution network by equivalent pipe method and Hardy-Cross method of balancing– Leak detection – Corrosion and its control- Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing - Langelier saturation index (LSI).

(9)

Total: 45 hours

1.

TEXTBOOKS:

1. Garg, S.K., "Water supply Engineering",Vol.I, Khanna Publishers, New Delhi, 2010.
2. Birdie G.S. and Birdie J.S. "Water Supply and Sanitary Engineering" Dhanpat Rai Publishing Company New Delhi, 8th edition 2017.
3. Duggal.K.N., "Elements of Environmental Engineering", S.Chand& Co., New Delhi ,2007.
4. Punmia.B.C., Ashok Jain and Arun Jain, "Water supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2016.
5. Modi, P.N., Water Supply Engineering, Vol.I, Standard Book House, New Delhi, 2010.

REFERENCES:

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. IS10500:2012, Water Quality Standards, New Delhi 2012.
3. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", McGraw Hill Publishers, New Delhi, 2017.
4. Syed R. Qasim and Edward M. Motley Guang Zhu, "Water Works Engineering Planning, Design and Operation", Prentice Hall of India Learning Private Limited, New Delhi, 2009.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105104102/
2. https://nptel.ac.in/courses/105106119/

1.

19CEL36 - STRENGTH OF MATERIALS LABORATORY

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

After successful completion of the course, students will be able to

CO1 : Assess the tensile and shear strength of mild steel rod and compressive strength, water absorption and efflorescence of given bricks.

CO2 : Assess the hardness number of given metal pieces.

CO3: Assess the impact strength of given metal and stiffness of helical spring.

CO4: Assess the compressive strength and hardness properties of wooden specimens.

CO5 : Assess the flexural rigidity and modulus of elasticity of simply supported beams with rectangular, semi circular and trapezoidal cross section, fixed beam and cantilever beam of square cross section.

LIST OF EXPERIMENTS

1. Tension test on steel bars
2. Shear test on steel bars
3. Tests on bricks
4. Hardness test - Brinell hardness number
5. Hardness test - Rockwell hardness number
6. Impact flexure test on metals
7. Test on wood
8. Test on helical spring
9. Bending test on beams (simply supported, cantilever, fixed)
10. Torsion test on mild steel.

REFERENCE BOOKS

1. Rajput,R.K., "Essentials of Strength of Materials", S.Chand & Company Ltd.,NewDelhi,2015.
2. IS 432 Part I- 1982, "*Specification for Mild Steel and Medium Steel bars and hard-drawn steel wire for Concrete Reinforcement*", Bureau of Indian Standards, New Delhi.
3. IS 3495 Part I to IV- 1992, "*Methods of Tests of Burnt Clay Building Bricks*", Bureau of Indian Standards, New Delhi.

1.

19CEL37 SURVEY LABORATORY

ASSESSMENT: PRACTICAL

SURVEYING LABORATORY

L	T	P	C
0	0	2	1

Course Outcomes: After successful completion of the course, students will be able to

CO1 – examine the measurements of distance, area, angles, and levels

CO2 - evaluate the cutting and filling quantities

CO3 – determine the setting out works of buildings, bridges and other structures

LIST OF EXPERIMENTS:

Chain Survey

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset
2. Setting out works – Foundation marking using tapes single Room and Double Room
3. Setting out works – Curve marking using tape – offset method

Compass Survey

4. Compass Traversing – Measuring Bearings & arriving included angles

Levelling – Study of levels and levelling staff

5. Fly levelling using Dumpy level & Auto level
6. Check leveling, Measurement of L/S and C/S of Road - Differential Levelling

Theodolite – Study of Theodolite

7. Measurements of horizontal angles by reiteration and repetition and vertical angles
8. Determination of elevation of an object using single plane method when base is accessible/inaccessible.
9. Setting out works – Foundation marking using electronic theodolite

Tacheometry – Tangential system – Stadia system

10. Determination of Tacheometric Constants
11. Heights and distances by stadia Tacheometry

Total Station – Study of Total Station, Measuring Horizontal and vertical angles

12. Traverse using Total station and Area of Traverse
13. Determination of distance and difference in elevation between two inaccessible points using Total station
14. Setting out works – Foundation marking using electronic total station

REFERENCES:

1. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7th Edition, McGraw Hill, 2001.
2. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
3. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice‟ Hall of India, 2004.
4. Arora K.R., Surveying Vol I & II, 10th Edition, Standard Book house , 2008

1.

19CE41 - CONSTRUCTION TECHNOLOGY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Understand building components and its construction process.

CO2: Demonstrate the types of brick and stone masonry

CO3: Describe types of roofs and floors

CO4: Classify the different types of staircases based on geometrical configurations, doors and windows.

CO5: Describe the requirements for fire safety, thermal and sound insulation in a building.

FOUNDATIONS

Introduction - Building components - Site selection - Functions of foundation -Requirements of good foundation - Types of foundations- Selection, Description and Construction of Spread footing - Combined footing - Strap footing - Raft foundation - Grillage foundation - Types of piles - Pile driving - Under reamed pile foundation for black cotton soils - Setting out foundation - Excavation of foundation trenches - Timbering of trenches - Excavation in ground with sub-soil Water - Anti-termite treatment - Pre-construction & Post-construction treatment.

(9)

MASONRY

Types of bonds in brickwork - Construction methods in brickwork- 1½, 1, ½ thick brick walls- Classification of stone masonry - Joints in stone masonry -Concrete block walls - Types of concrete blocks – Construction Joints –need and materials used.

(9)

ROOFS AND FLOORS

Types of roofs - Flat, slope and curved - Types of roof truss - Wooden and Steel-Erection Methods- Purlins - Types of roof coverings- aluminium, steel sheets, corrugated iron and tiles -Market sizes. Drainage in roofs- slope and diameter - Flooring - Ground level flooring in poor Soils and Normal Soils. Floor-Different types of flooring materials- advantages and disadvantages - Construction methods of different types of floors. Causes and effect of dampness - Methods of damp proofing - Materials used for damp proofing course**.**

(9)

STAIRS, DOORS, WINDOWS AND FORM WORK

Staircase -Terminology and Specification- classification of staircase and its details -Construction details – Vertical movement - Staircase, Ramps, Elevators and Escalators - Types of doors and windows and ventilators - drawings - Materials for Doors and Windows - Standard sizes of Doors and Windows - Door and Window Fixtures- Formwork - Requirements - shuttering for columns - Shuttering for beam and slab floor - Formwork for Stairs & Walls. Shoring - Underpinning - various types of Scaffolding. **(9)**

1.

PLASTERING, PAINTING AND INSULATION

Plastering and pointing - Methods of plastering - Types of plastering- External wall cladding-Defects in Plastering - Treatment and repair techniques for defects in plastering - Different types of pointing - Paints - Types of paints - Paintings of Interior & Exterior walls, wooden and steel members-Fire protection - Fire resisting properties of common building materials - Fire safety equipment for buildings - Thermal Insulation and sound insulations.

(9)

TOTAL: 45 Hours

TEXT BOOK

1. Punmia. B.C., Ashok.K.Jain& Arun.K.Jain, "Building Construction", Laxmi Publications (P) Ltd, New Delhi, 2016.
2. S. C. Rangwala “Building Construction”,Charotar Publishing House(P) Ltd, Gujarat, 2017.
3. P.C Varghese “Building Construction”, Prentice-Hall of India, New Delhi, 2011.

REFERENCE BOOKS

1. Sharma S.K. and Kaul B.K., "Building Construction", S.Chand & Company Ltd., New Delhi, 2013.
2. Sushil Kumar., "Building Construction", Standard Publishers distributors, New Delhi, 2016.
3. S.P.Arora and S.P.Bindra, “ Building Construction” Dhanpat Rai publications,2010.

ONLINE COURSES

1. https://nptel.ac.in/courses/105106053/
2. https://nptel.ac.in/courses/105/102/105102176

1.

19CE42 -STRENGTH OF MATERIALS

ASSESSMENT: THEORY

L	T	P	C
3	1	0	4

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Determine slope and deflection of statically determinate beams subjected to Point load and UDL.

CO2: Sketch Shear force and bending moment diagram for the given statically indeterminate beams subjected to Point load and UDL.

CO3: Compute the stresses due to combined bending and axial load for short column and critical load calculation in long columns

CO4: Compute stresses in thin, thick cylinders subjected to fluid pressure and member forces in simple plane roof trusses.

CO5: Calculate the stresses due to unsymmetrical bending in the symmetrical and unsymmetrical sections and locate the shear centre for thin walled open sections with one axis of symmetry.

DEFLECTION OF DETERMINATE BEAMS

Governing differential equation - slope and deflection of beams - Double Integration method - Macaulay's method - Moment area method - Conjugate beam method

(12)

STATICALLY INDETERMINATE BEAMS

Analysis of propped cantilevers and fixed beams - Analysis of Continuous beams using Theorem of Three moments.

(12)

THEORY OF COLUMNS

Short columns -Stresses due to combined bending and axial Force - core of section - unsymmetrical sections - Elastic buckling of long columns - Euler's theory for long Columns - Critical loads with different end conditions - limitations of Euler's theory - Rankine's formula**.**

(12)

THICK CYLINDER AND MEMBER FORCES IN TRUSS

Stresses in thin walled cylindrical shells - Wire wound cylindrical Vessels - Thick cylinder - Lame's equations.

Plane roof trusses – Forces in the member - Method of Joints and method of sections

(12)

1.

UNSYMMETRICAL BENDING AND SHEAR CENTRE

Analysis of stresses and deflections due to unsymmetrical Bending - Significance of shear centre - Location of shear centre for Thin walled open sections with one axis of symmetry

(12)

TOTAL: 60 Hours

TEXT BOOKS

1.Rajput,R.K.,"Essentials of Strength of Materials",S.Chand & Company Ltd.,NewDelhi,2015.

2.BansalR.K.,"StrengthofMaterials",LaxmiPublications,NewDelhi,2018.

3.Punmia B.C, Ashok jain and Arun jain, “Mechanics of Materials”, Lakshmi Publications, NewDelhi, 2017.

REFERENCE BOOKS

1.Beer F.P.,Johnston E.R.,DeWolf J.T. and Mazurek D.,"Mechanics of Materials",McGraw-Hill Higher Education,6th edition,2011.

2. Negi L.S., "Strength of Materials",Tata Mc Graw Hill Education Pvt. Ltd,2017.

3. Sadhu Singh,"Strength of Materials",Khanna Publishers, NewDelhi,2016.

4.Prakash Rao D.S., "Strength of Materials” Volume I, Universities Press (India) Limited,Hyderabad,2004.

5.Lehri R.S.,Lehri A.S., "Strength of Materials",S K Kotaria & Press,NewDelhi,2012.

6. Timoshenko,S.P, Gere,J.M.,"Mechanics of Materials",CBS Publishers,New Delhi,2006.

7.Egor P .Popov, "Introduction to Mechanics of Solids", Prentice Hall of India, NewDelhi, 2003.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105105108/

2. https://nptel.ac.in/courses/112106141/

1.

19CE43 TRANSPORTATION ENGINEERING

ASSESSMENT: THEORY
COURSE OUTCOMES:

L	T	P	C
3	0	0	3

After successful completion of the course, student will be able to

CO1: Interpret the types of Indian roads, organizations and pavements

CO2: Design the geometrical components for Indian roads

CO3: Demonstrate the organizational set up and features of Indian Railways

CO4: Design the components of permanent way in Railway Stations

HIGHWAY PLANNING

IRC, CRRI and NHAI-Classification of roads-Road patterns-Planning Surveys-Master Plan and Phasing of master plan- New Highway alignment - Factors -Engineering surveys- Maximum dimension of road vehicles and loaded weight-Passenger Car Units- Pavements – flexible – rigid – comparison – soil subgrade, sub base and base course, wearing course - Highway drainage – significance – requirements

(9)

HIGHWAY GEOMETRIC DESIGN

Various Cross section elements - Friction, roughness, light reflecting characteristics-camber - IRC standards- Right of way- Sight distance-Design of Horizontal Alignments- Super elevation- Widening of pavement on horizontal curves-Transition curves-Types- Length-Examples. Design of vertical alignment-Gradient-Types- Vertical curves -Summit curves, Valley curves- Examples. **(9)**

HIGHWAY CONSTRUCTION

Materials - Properties of road aggregates and tests - Bituminous materials - Types- Requirements – Tests to determine the properties of Bitumen - Various Bituminous mixes - Highway construction procedures

(6)

ELEMENTS OF RAILWAY ENGINEERING

Comparison of railway and highway transport – organization of Indian railways – Railway board – Zonal railways, Permanent way – Gauges – Railway Track cross section – coning of wheels – Rails, Rail joints – Creep – effects- remedies – Sleepers – Ballast – Sub grade and Embankment –Track alignment- Surveys. Gradients – super elevation and cant deficiency – Negative super elevation- Curves – points and crossings – necessity –Turnouts – Switches – types of switches crossing–components, types

(12)

RAILWAY STATIONS AND SIGNALS

Stations and yards – requirements, classification, layout of station – Platform – Loops, siding and level crossing – Loco sheds – Derailing switches, Fouling marks, Buffer stop – Sand hump – rolling stock-Signalling –Object engineering principles – classification and types - Level crossings – Safety in Railways

(9)

Total: 45 Hours

1.

TEXT BOOK:

1. Khanna.S.K and Justo.C.E.G., "Highway Engineering", Khanna Publishers, Roorkee, 2001.
2. Saxena S.C and Arora S.P, “A Text book of Railway Engineering”, Dhanpat Rai Publications, New Delhi, 2005.

REFERENCE BOOKS:

1. Sharma S.K., "Principles, Practice and Design of Highway Engineering", S.Chand&co., New Delhi, 2012.
2. Kadayali., "Principles, Practice and Highway Engineering", Khanna Publishers, New Delhi, 2007.
3. J. S. Mundrey, “Railway Track Engineering”, Tata McGraw-Hill Education, New Delhi, 2010.
4. Clifford F. Bonnett, “Practical Railway Engineering”, Imperial College Press, London, 2005.
5. IRC Codes 15-2002, 37-2001, 38-1988, 52-1988, 62-1976, 66-1976, 73-1980, 58-2002 & IRC SP 23-1993.

ONLINE RESOURCES:

1. **https://nptel.ac.in/courses/105/101/105101087/**
2. **https://nptel.ac.in/courses/105/107/105107123/**

1.

19CE44 - APPLIED HYDRAULICS AND HYDRAULIC MACHINERY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the students will be able to

CO1: Obtain hydraulically best section for uniform flow in open channel and find the flow parameters through notches, weirs and flumes.

CO2 : Compute the flow characteristics of non-uniform flow in open channels based on geometrical and flow parameters.

CO3 : Analyse relative and absolute velocity on flat and curved vanes in rest and motion.

CO4 : Evaluate the performance tests on different types of hydraulic turbines.

CO5 : Estimate the performance parameters of different pumps and its applications.

UNIFORM FLOW IN OPEN CHANNELS

Uniform flow - Chezy's equation - Manning's equation - hydraulically best section for rectangular, trapezoidal and circular channels - circular sections running partially full - Flow over notches and weirs – flumes.

(9)

NON-UNIFORM FLOW IN OPEN CHANNELS

Non-uniform flow - critical depth - specific energy - flow characteristics - hydraulic jump - backwater curves - surges in channel.

(9)

IMPACT OF JETS

Impulse momentum principle - its applications on impact of liquid jets on plates and vanes at rest and in motion - moment of Momentum equation - its applications on plates and vanes mounted on wheels – jet propulsion.

(9)

TURBINES

Classifications - Applications of Impact of Jets on Vanes to Turbines - velocity triangles - work done and efficiencies - Study of Pelton wheel, Francis turbine and Kaplan turbine - characteristics curves - performance of turbines - specific speed – unit quantities - model testing of turbines - selection of turbines.

(9)

PUMPS

Classification - Centrifugal pumps - work done - minimum starting speed - NPSH - characteristic curves - multistage pumps - specific speed - model testing

Reciprocating pump - work done - effect of acceleration and friction on pressure head - maximum speed of the pump - air-vessels - work saved against friction **(9)**

TOTAL: 45 Hours

1.

TEXT BOOKS

1. Bansal.R.K., "A TextBook of Fluid Mechanics and Hydraulic Machines", M/s. Lakshmi Publications, Madras, 2017.

2. Modi.P.N, & Seth.S.M., " Hydraulics, Fluid Mechanics & Hydraulic Machinery", Metropolitan Book Company, New Delhi, 2017.

3. Arora K.R., "Fluid Mechanics, Hydraulics and Hydraulic Machines", Standard Publishers & Distributors, 2014.

REFERENCE BOOKS

1. Kumar.K.L, "Engineering Fluid Mechanics,'' M/s. S. Chand Co., Madras.2006.

2. Ramamrutham.S, "Fluid Mechanics, Hydraulics & Fluid Machinery", M/s. Dhanpat Rai & Sons, New Delhi, 2018.

3. R.K.Rajput, "A TextBook of Fluid Mechanics and Hydraulic Machines", M/s. S. Chand Publications, New Delhi, 2016.

4. R.S. Khurmi, "A TextBook of Hydraulics, Fluid Mechanics and Hydraulic Machines", M/s. S. Chand Publications, New Delhi, 2014.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105103021/
2. https://nptel.ac.in/courses/105103096/

1.

19CE45- WASTE WATER ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Recognize the origin and importance of effective conveyance of domestic sewage.

CO2: Analyse the hydraulic components of sewage and design sewers including sewage pumping stations.

CO3: Summarize the perspectives of various house drainage systems.

CO4: Demonstrate the physico-chemical and bio-chemical characteristics of domestic Sewage and also deploy the appropriate conventional treatment schemes.

CO5: Design sludge digesters and also to justify the effluent disposal standards and sludge disposal.

SEWERAGE SYSTEMS

Introduction - Necessity and objectives of sanitary engineering projects - Definitions - systems of Sanitation - Quantity of sanitary sewage - variation in quantity of sewage - quantity of storm sewage - Characteristics and composition of sewage - effluent standards - Sampling of sewage - Examination of sewage - DO, BOD,COD and their significance - Cycles of decomposition.

(9)

DESIGN OF SEWERS

Components and design period - Hydraulics of sewers - Self cleansing velocity, non-scouring velocity - Design of sewers - Sewer appurtenances - Drains and sewer section - Sewer materials and sewer joints - Construction and maintenance of sewer - Pumping of sewage –House drainage - Sanitary fixtures / fittings - systems of plumbing - General layout of house drainage - street connections - Testing of house sewers - Septic tanks and effluent disposal system.

(9)

PRIMARY TREATMENT OF SEWAGE

Objectives and basic principles of sewage treatment - Preliminary treatment - screens – Grit chamber - and Skimming tank - Design of Grit chamber - Primary treatment - Principles of sedimentations - Sedimentation tank types - surface overflow rate - detention time and Design of primary settling tanks.

(9)

SECONDARY TREATMENT

Basic principles of biological treatment - types - suspended and attached growth process - Activated sludge process (ASP) - flow diagram - process modification of ASP - aeration - diffuser, mechanical aeration - Design of ASP - Trickling filters - types - comparison and construction - recirculation - Recirculation ratio, operational problems - design of high rate and standard rate filters - Process description of Sequential batch reactor (SBR), Upflow anaerobic sludge blanket reactor (UASBR), fluidized bed reactor (FBR), packed bed reactor(PBR) and extended bed reactor (EBR) - Waste stabilisation ponds - Oxidation ponds and Aeration lagoons.

(9)

1.

SLUDGE DIGESTION AND DISPOSAL

Sludge disposal - Sludge volume calculation - Sludge characteristics - sludge digestion - Digestion process - stages - Design of sludge digesters - Disposal of digested sludge - Use of lagoons for disposal of raw sludge - Advantages in sludge treatment and disposal - Effluent disposal - Standards for disposal - Disposal methods – Dilution - zones of pollution in lakes - Eutrophication - self-purification of streams - oxygen sag curve - Land disposal.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Garg S. K., "Environmental Engineering", Vol. I & Vol. II, Khanna Publishers, New Delhi, 1994.
2. Birdie G.S., and Birdie, “Water Supply And Sanitary Engineering”, Dhanpat Rai Publishing Company (P) Ltd. New Delhi, 2011.
3. Metcalf and Eddy, "Wastewater Engineering Treatment, Disposal and Reuse", McGraw-Hill Publishing Co, Indian Edition, New Delhi, 2005.

REFERENCE BOOKS

1. Manual on wastewater and treatment CPHEEC, Ministry of Urban Affairs and Employment, Govt. of India, New Delhi, 1990.
2. Shah C. S., "Water supply and Sanitation", Galgotia publishing company, New Delhi, 1994.
3. Mark J. Hammer, "Water and Waste Water Technology", Prentice hall of India 2008.
4. Hussain S. K., "Text Book of Water Supply and Sanitary Engineering", Oxford and IBH, 1976.
5. Duggal K.N., "Elements of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.

Online Courses:

1. https://nptel.ac.in/courses/105/106/105106119/
2. https://nptel.ac.in/courses/105/105/105105048/

1.

19CE46 PROFESSIONAL PRACTICE AND ETHICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES:

After successful completion of the course, student will be able to

CO1: Acquire the knowledge of Building by laws and regulations and plan approval methods

CO2: Perform and establish approval process for any type of buildings including electrical supply and water supply.

CO3: Able to execute the Fundamentals for establishment of individual firms, registration with government agencies and membership in professional bodies.

CO4: Able to perform documentation and preparation of bills from commencement till the closure of the project.

CO5: Perform ethics and fundamentals in establishing professional practice with social responsibility.

BUILDING BY LAWS RULES AND REGULATION AND PLAN APPROVAL PROCESS

Building by laws - importance - acts and rules of public interest - state and central – approval bodies– Metros – Corporation – Municipalities - Town Panchayats. Preparation and Submission of Drawings and Documents for Building Approval and Layout. Land use Classification in urban & Mofussil Areas-Related Regulatory and approvals

(9)

MUNICIPAL SERVICES (WATER SUPPLY SEWAGE AND ELECTRICAL CONNECTIONS

Local approvals and clearances for residential, industrial and commercial Buildings - General specifications for water supply and sewers - Water Supply – Process for waste water connections to public Mains. Domestic water supply connection from public mains, types and sizes of pipes, special installation in multi-storeyed buildings. Connections to Public sewers.

General Specifications - Electrical supply for residential, industrial and commercial Buildings - List of procedures – Standards - Local approvals and clearances for residential, industrial and commercial Buildings-Temporary – Permanent Services-Consumer Guidance TNEB.

(9)

ESTABLISHMENT FOR PROFESSIONAL PRACTICE

Establishment of firm - Consultancy, Construction - Registration of firms with GST, CST, Companies –IT - Licensing from local bodies – Metros - Municipalities, town panchayats - Obtaining Chartered Engineership, approved valuership, registered valuership with income tax, Bank empanelment-Membership of other professional bodies- BAI, ACCE(I) Etc., - Registration of contractors with Government Departments, Public undertakings & Private organizations.

(9)

1.

DOCUMENTATION FOR PROJECT COMMENCEMENT AND CLOSURE AND TAX ASSESSMENT

Documentation for formal approval of work commencement - Procedures. Documentation for procurement and mobilization of resources – Record of works – Changes - Deviation - Preparation of running account bill & Final bill. Submission of project closure report. Handing over documents -Procedure for contract closure. **(9)**

ROLES AND RESPONIBILITIES

Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Multinational Corporations – Business Ethics - Environmental Ethics –Role in Technological Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

(9)

Total: 45 Hours

TEXT BOOKS:

1. Dutta B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2010.
2. Kohli D.D. and Kohli R.C., "A Text Book of Estimating and Costing (Civil)", Chand & Company Ltd., 2004.
3. W.M.Martin & R.Schinzinger.,"Ethics in Engineering"-, McGraw-Hill, 2005

REFERENCE BOOKS:

1. Hand Book of Consolidated Data - 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998, Standard Data Book for Analysis and Rates, IRC, New Delhi, 2003.

ONLINE RESOURCES:

1. Manual of Professional practice for civil engineers - https://pdfslide.net/documents/pice-manual-of-professional-practice-for-civil-engineers.html
2. TNEB - https://www.tangedco.gov.in/procedure.html
3. Municipal Administration & Water Resources Department - https://cms.tn.gov.in/sites/default/files/go/maws_e_18_2019_0.pdf

1.

19CEL47 HYDRAULICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOMES:

CO1: Examine the flow meters through venturimeter and Orifice meter and the losses of flow of water through pipes.

CO2: Compute the rate of flow of water from a tank and in an open channel

CO3: Examine the Bernoulli's theorem for varying cross section of pipe flow.

CO4: Determine the metacentric height of the model of the ship in hydrostatic condition.

CO5: Find the performance of centrifugal, reciprocating pumps, Pelton and Francis turbines through characteristics curves.

LIST OF EXPERIMENTS

1. Calibration of flow meters
2. Flow through pipes – Major & Minor losses
3. Flow through Orifices & Mouthpieces
4. Flow over Notches
5. Verification of Bernoulli's Theorem
6. Metacentric Height
7. Impact of Jets
8. Performance of Pumps
9. Performance of Turbines

REFERENCE BOOKS:

1."Hydraulic Engineering Laboratory Instruction Manual", Published by the Department of Civil Engineering, CIT, Coimbatore, 2015.

2. Bansal.R.K., "Text Book of Fluid Mechanics and Hydraulic Machines", M/s.Lakshmi Publications, Madras,2010.

3. Kumar.K.L, "Engineering Fluid Mechanics", M/s.S.Chand Co., Madras.2003.

1.

19CEL48 ENVIRONMENTAL ENGINEERING LABORATORY

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

At the end of this course, the students will be able to

CO1 : Ascertain the suitability of water samples for drinking and construction purpose.

CO2 : Ascertain the suitability of wastewater samples as per effluent standards.

CO3 : Select the degree of treatment based on the results of water and wastewater samples.

LIST OF EXPERIMENTS

1. Determination of Acidity of the given Water/Wastewater Sample.
2. Determination of Alkalinity of the given Water/Wastewater Sample.
3. Determination of Hardness of the given Water/Wastewater Sample.
4. Estimation of Chlorides in the given Water/Wastewater Sample.
5. Determination of Dissolved Oxygen Content in the given Water/ Wastewater Sample.
6. Assessment of Settleable, Total, Volatile, Fixed, Dissolved and Suspended Solids in Water/Wastewater Sample.
7. Determination of pH and Assessment of Optimum Coagulant Dose (OCD) to treat the given Water/Wastewater sample.
8. Assessment of Available Chlorine in the given Bleaching powder sample and Estimation of Residual Chlorine of the given Polluted Water/Wastewater Sample.
9. Assessment of Biochemical Oxygen Demand (BOD) of the given Water/Wastewater Sample.
10. Assessment of Chemical Oxygen Demand (COD) of the given Water/Wastewater Sample.

REFERENCES:

1. "Environmental Engineering Laboratory manual", Published by the Department of Civil Engineering, Coimbatore Institute of Technology, Coimbatore, 2018.
2. IS 10500, Drinking water Specification, Bureau of Indian Standards, New Delhi, 2012.
3. IS 3025, Methods of sampling and test (physical and chemical) for water and wastewater. Bureau of Indian Standards, New Delhi, 1986.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/103107084/

1.

19CE51- STRUCTURAL ANALYSIS I

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

After successful completion of the course, students will be able to

CO1 : Compute static and kinematic indeterminacy of structures.

CO2 : Calculate the forces of pin jointed plane and space trusses by method of tension coefficient.

CO3 : Apply energy concepts and theorems to determine the deflection of statically determinate beams, frames and plane trusses

CO4 : Analyze statically indeterminate beams and trusses by consistent deformation method.

CO5 : Analyze two hinged and three hinged parabolic and circular arches to determine bending moment, axial thrust and radial shear force.

CO6 : Construct influence line diagrams for concentrated and distributed moving loads and analyze determinate and indeterminate beams.

FUNDAMENTALS OF STRUCTURAL ANALYSIS AND ANALYSIS OF PIN JOINTED SPACE TRUSSES

Determination of static and kinematic indeterminacy- Principle of superposition- Analysis of Pin-jointed plane and space trusses by Method of Tension coefficient. **(9)**

ENERGY CONCEPTS

Strain energy and Complementary energy - Deflection by strain energy method for statically determinate beams. Virtual work - principle of virtual work for deformable bodies- unit load method - Deflection of determinate beams and plane trusses. Castigliano's theorems - deflection calculation for simple determinate beams - Maxwell's reciprocal theorem for deflection **(9)**

ANALYSIS OF STATICALLY INDETERMINATE BEAMS AND PLANE TRUSSES

Analysis of statically indeterminate beams - Consistent deformation method - Theorem of least work (beams upto 2 degrees of freedom only). Analysis of statically indeterminate plane trusses by Consistent deformation method - Lack of fit - settlement and temperature effects **(9)**

ANALYSIS OF ARCHES

Analysis of three hinged arches of parabolic and circular profiles - Analysis of two hinged symmetric parabolic and circular arches. Settlement and temperature effects. **(9)**

MOVING LOADS AND INFLUENCE LINES

Influence lines for shear force, bending moment and reactions in statically determinate beams - Calculation of shear force and bending moment due to concentrated and distributed moving loads - Influence lines for forces in members of statically determinate plane trusses. Influence lines for reactions, shear force and bending moment in statically indeterminate beams by Muller-Breslau principle - Application of Muller Breslau principle to beams with degree of static indeterminacy not exceeding one. **(9)**

TOTAL: 45 Hours

TEXT BOOKS

1. Gupta S.P and Pandit G.S, "Theory of Structures, Vol. I & II", Tata McGraw Hill, New Delhi, 2012.
2. Bhavikatti S.S, "Structural Analysis" Vol. I & II, Vikas Publishing House (P) Ltd., New Delhi, 2011.

1.

3.Vaidyanathan. R, and Perumal. P. “Structural Analysis”, Vol. I & II, Laxmi Publications (P) Ltd., New Delhi, 2008.

REFERENCE BOOKS

1. Rajasekaran S. and Sankarasubramanian G., "Computational Structural Mechanics" Prentice Hall of India, New Delhi, 2012.
2. Prakash Rao D.S., "Structural Analysis", Universities Press, Hyderabad, 2001.
3. Armenakas A.E., "Classical Structural Analysis", Mc-Graw Hill Book Co., NewYork, 1995.
4. Reddy C.S, "Basic Structural Analysis", Tata Mc-Graw Hill, New Delhi, 2012.
5. Junnarkar and Shah., "Mechanics of Structures" Vol.II, Charotar Publishing House, Anand, 2012.
6. Punmia B.C and A.K.Jain, "Strength of Materials and Theory of Structures", Vol.II, Laxmi Publications, New Delhi, 2005.
7. Wang C.K, "Intermediate Structural Analysis", Tata Mc-Graw Hill, New Delhi, 2010.
8. Ramamrutham. S. and Narayan R., “Theory of Structures” Dhanpatrai Publishing Company (P) Ltd., New Delhi, 2016.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/105/105105166/

1.

19CE52 - DESIGN OF REINFORCED CONCRETE STRUCTURAL ELEMENTS

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify the relevant material properties of concrete and steel, evaluate the connected strength parameters as per (LSM) and codal provisions of IS 456, 2000. Distinguish between the WSM and LSM and infer the benefits of LSM.

CO2 : Assess design loads, compute design strength required in flexure, shear, torsion and bond for Under-Reinforced, Doubly Reinforced and Flanged beams, apply design parameters as per LSM and IS 456 to satisfy both strength and serviceability criteria. Using LSM, analytically compute design strengths of existing beams. Complete structural detailing as per SP34.

CO3: Assess design loads, compute design strength required in flexure, shear and bond for one way, two way and staircase slabs to fulfill both strength and serviceability criteria as per IS 456 . Using LSM, analytically compute design strengths of existing slabs. Complete structural detailing as per SP34.

C04: Using interaction charts; compute design strengths as per LSM for both short and long columns in axial compression uniaxial and biaxial bending as per codal provisions. Analytically be able to evaluate structural strengths of existing columns. Complete structural detailing as per SP34.

CO5: Design as per LSM for strength in flexure, shear and bond for concrete wall footings, isolated and combined column footings. Apply IS 456 provisions for serviceability criteria of LSM. Complete structural detailing as per SP34.

MATERIALS FOR CONCRETE AND CONCEPT OF LIMIT STATE DESIGN

IS code regulations - Materials for concrete - Stress - Strain curve for concrete in compression – Concrete Grades, Types, Mix proportioning - Types of reinforcement, Grades - Plain and deformed bars - Stress - strain curve for reinforcing steel. Concept of WSD (No problems) and LSD - Difference between WSD and LSD - Characteristic loads and strengths - partial safety factor. Design of singly reinforced rectangular beams for flexure, shear and torsion. **(9)**

LIMIT STATE DESIGN OF BEAMS

Design of doubly reinforced rectangular and flanged beams for flexure, shear and torsion. Design of continuous beams using B.M. and S.F. coefficients as per IS code - detailing. **(9)**

LIMIT STATE DESIGN OF SLABS

Types of slabs - Design of one-way simply supported and continuous slab using BM and SF co-efficient as per IS code - design of two way, simply supported and continuous slab as per IS code Detailing. Staircase, Loads and types, Design of dog legged staircase slab and flat slab with drop - Detailing. **(9)**

LIMIT STATE DESIGN OF COLUMNS

Design of short and long rectangular and circular columns subjected to axial compressive load - Design of short columns subjected to combined axial compressive load, uni-axial and biaxial bending moments using Interaction Charts- Detailing. **(9)**

1.

DESIGN OF FOOTINGS

Design of wall footings - Design of isolated, square and rectangular footings for axial loads and bending, combined rectangular footings for axial loads - Detailing. **(9)**

TOTAL: 45 Hours

TEXT BOOKS

1. Unnikrishna Pillai and Devadas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Co, New Delhi, 2011.
2. Varghese PC., "Limit State Design of Reinforced Concrete", Prentice Hall of India Pvt. Ltd., 2004.

REFERENCE BOOKS

1. Subramanian N., "Design of Reinforced Concrete Structures", Oxford University Press, 2008.
2. Sinha N.C., and Roy S.K., "Fundamentals of Reinforced Concrete", S.Chand and Company, New Delhi, 2013.
3. Sinha S.N., "Reinforced Concrete Design", Tata McGraw - Hill Publishing Co, Ltd., New Delhi, 2012.
4. MacGregor J.G., "Reinforced Concrete Mechanics and Design", Prentice Hall, New Jersey, 2011.
5. Mallick S.K., and Gupta, A.P., "Reinforced Concrete", Oxford & IBH Publishing Co., New Delhi, 2012.
6. Ashok K Jain, "Reinforced Concrete Limit State Design". New Chand Bros, Roorkee, 2012.
7. Krishna Raju N. and Pranesh R.N., "Reinforced Concrete Design-IS:456 - 2000, Principles and Practice" New Age International Publishers, New Delhi, 2003.
8. Syal I. C., and GoelA.K.,"Reinforced Concrete Structure", A. H . Wheeler & Co, 2004.
9. IS: 456 - 2000, Indian Standard Code of Practice for Reinforced Concrete, Bureau of Indian Standards, New Delhi.
10. SP- 16 - 1980, Design Aids for reinforced Concrete, Bureau of Indian Standards, New Delhi.
11. SP- 24 – 1983, Explanatory Handbook for IS Code of Practice for Plain and Reinforced Concrete,Bureau of Indian Standards, New Delhi.
12. SP - 34 - 1987, Hand Book on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.

1.

19CE53 - MECHANICS OF SOILS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

On completion of the course, the students will be able to:

CO1: Determine the properties of soil and classify them.

CO2: Apply the principles of water flow through soil medium and estimate permeability of soil.

CO3: Estimate the vertical stresses acting on soil for the given load condition.

CO4: Understand and determine the phenomenon of consolidation and compaction of soil.

CO5: Estimate the shear parameters of soils and analyze the stability of slopes.

INTRODUCTION

Soil formation and soil types - Civil engineering problems related to soils - Nature of soil - Simple definitions - Phase relationships - Classification - IS Classification system. Compaction - Factors affecting compaction - Laboratory and field compaction methods. **(9)**

SOIL WATER

Principles of water flow - Darcy's law - Permeability - Laboratory Methods - Field measurement of permeability - Effective stress concept - Dry and saturated soils. **(9)**

STRESS DISTRIBUTION AND CONSOLIDATION

Stress distribution in soil media - Bousinesq's Analysis - Westergaard's Analysis - Intensity of vertical stress using influence charts. Consolidation - measurement of compressibility - e-log P curves - Terzaghi's one dimensional consolidation theory - Determination of coefficient of consolidation. **(9)**

SHEAR STRENGTH

Shear at a point - Mechanism of shear resistance - Mohr- Coluomb failure criterion - measurement of shear strength - Direct shear test - Triaxial shear test - Unconfined compression strength test – Vane shear test - Shear strength of clay soil - Shear strength of sand. **(9)**

STABILITY OF SLOPES:

Types of slopes - Stability of infinite slope - Stability of Finite slope - Total stress Analysis - Swedish circle method - Use of Taylor's stability number - Slope failure mechanism - Effect of Tension cracks. **(9)**

TOTAL: 45Hours

TEXT BOOKS

1. Gopal Ranjan and Rao, ASR, "Basic and Applied Soil Mechanics" New Age International (P) Limited Publication, New Delhi, Second Edition, 2010.

2.Venkataramaiah, "Geotechnical Engineering", New Age International Ltd., New Delhi Third Edition, 2012.

3.Punmia, B.C, "Soil Mechanics and Foundation Engineering", Laxmi Publications, New Delhi, Sixteenth Edition, 2005.

REFERENCE BOOKS

1. Alam Singh, "Modern Geotechnical Engineering", IBS Publications, New Delhi, 2010.

1.

2. Muni Budhu, "Soil Mechanics and Foundation Engineering", Wiley India Publication, New Delhi, Second Edition, 2010.
3. Braja M. Dass and Khaled Sobhan,“Principles of Geotechnical Engineering" Cengage learning, 2013.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/101/105101201/

1.

19CE54- CONCRETE TECHNOLOGY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1 : Assess the properties and select the concrete ingredients.
CO2 : Design the concrete mix as per IS code and ACI specifications.
CO3 : Employ the different methods of manufacture of concrete.
CO4 : Evaluate the properties of fresh and hardened concrete as per code requirements.
CO5 : Identify the appropriate special concrete for a specific requirement.

CEMENT AND AGGREGATES

Types of cement - properties and specific uses of various cements - Tests on cement -Fineness - Setting time – Consistency -Soundness - compressive strength. Properties of aggregates - shape, texture, bond, strength, soundness and thermal properties - grading - bulking of sand - Tests on aggregates - Flakiness index - Elongation index - Crushing value – Impact value- Abrasion value. **(9)**

WATER, ADMIXTURES AND CONCRETE MIX DESIGN

Quality of water for mixing and curing - use of Sea water for mixing concrete. Air-entraining agents - Accelerators - Retarders - Pozzolona - Water proofing agents - workability agents - plasticizers - super plasticizers**.** Factors affecting mix proportion - Water cement ratio - Aggregate cement ratio - Mix design by I.S.method and ACI method **(9)**

MANUFACTURE OF CONCRETE

Measurement of materials - Volume batching and weigh batching - Mixing of concrete - Types of mixers-Transporting of concrete - Placing of concrete - Compaction of concrete - Methods of compacting concrete- Tamping - Vibration - Vibroprocessing - Jolting - Rolling - Centrifugation - Curing of concrete - Different methods of curing. **(9)**

PROPERTIES AND TESTS ON FRESH AND HARDENED CONCRETE

FRESH CONCRETE

Workability Tests - Slump Test - Compacting factor Test - Flow test - Kelly Ball test - Vee Bee consistometer test - segregation and Bleeding.

HARDENED CONCRETE

Compressive Strength of concrete - Modulus of Rupture -Tensile Strength - Modulus of elasticity - Bond stress - Shrinkage of concrete - Factors affecting shrinkage of concrete - creep - Factors influencing creep - Factors affecting permeability - Thermal properties **(9)**

QUALITY CONTROL AND SPECIAL CONCRETES

Sampling - Frequency of sampling - Standard deviation - acceptance criteria as per IS 456 - 2000. Light weight concrete - Fibre Reinforced Concrete - High density Concrete - Polymer Concrete - Ferrocement- Shotcreting - Hot weather concreting - Cold weather concreting - High strength concrete - High performance concrete - Self compacting concrete - Ready mixed Concrete. **(9)**

TOTAL: 45Hours

1.

TEXT BOOK

1. Shetty M.S., "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2018

REFERENCE BOOKS

1. Neville.A.M., "Properties of Concrete", Pearson Education Limited, 2012.
2. Santhakumar A.R., "Concrete Technology" Oxford University Press, New Delhi, 2018
3. Krishnasamy K.T., "Concrete Technology", Dhanpat Rai, New Delhi, 2014.
4. Gambhir M.L., "Concrete Technology", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
5. IS 456- 2000 : Indian Standard Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi.
6. IS 10262-2019 : Guidelines for Concrete Mix Design proportioning.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/102/105102012/

1.

19CEL55 - COMPUTER AIDED CIVIL ENGINEERING DRAWING

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

At the end of this course, the students will be able to

CO1 : Create site plan, landscape design and arrange the components of building to satisfy the functional and orientation aspect as per National Building Code.

CO2 : Develop detailed drawings of plan, elevation and section of Buildings by manual and computer aided drawing

CO3 : Prepare drawings of types of doors, windows and staircases.

CO4 : Prepare the plumbing and electrical layout of a building.

DRAFTING TECHNIQUES

Architectural lines and pencils used - Architect's scales, templates, flexible rules, overlays, under lays - Architectural lettering - Layout of Drawing for presentation and submission.

BASIC HOUSE DESIGN

Concept of one and two storey - Split level design. Study of Function, location, shape and size and planning of the following building areas.

Living areas - living rooms, dining room entry way, foyer, patios and porches.

Sleeping areas - bedrooms with and without attached toilets.

Service areas - Kitchen, cabinets, Toilets, washing places, garages.

Fixing the size of doors, windows and sunshades.

PREPARATION OF DRAWINGS

Detailed drawings of floor plans, elevations and sections to show various features in a building.

Preparation of plot plans with a study of property lines - location of building on the site - Landscape plot plans.

PREPARATION OF WORKING DRAWINGS

Detailed drawings of different types of doors, windows with specifications.

Detailed layout design and drawing of different types of staircases.

Detailed planning and drawing of electrification and Plumbing layout in buildings.

Preparation and submission of building drawing using AutoCAD.

TEXT BOOK

1. Shah. M.G, Kale. C.M and Patki. S.Y, "Building Drawing", Tata McGraw Hill Book Co., 2007.

REFERENCES BOOKS

1. Clois E.Kicklighter., "Architecture, Residential Drawing and Design", The Good Heart - Willcox Company Inc., 2000.
2. Donald E. Hepler and Paul I. Wallach., "Architecture, Drafting and Design", Tata McGraw Hill Book Co., New Delhi, 1998.
3. Sikka V.B., A Course in Civil Engineering Drawing, 4th Edition, S.K.Kataria and Sons, 2015.
4. Verma.B.P., Civil Engineering Drawing and House Planning, Khanna Publishers, 2010.

1.

ONLINE RESOURCES:

1. www.sketchup.com
2. www.autodesk.in/products/3ds-max/overview

1.

19CEL56 - HIGHWAY ENGINEERING LABORATORY

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOMES:

After successful completion of the course, student will be able to

CO1: Determine the properties of Coarse aggregate related to highway requirements for laying pavement

CO2: Evaluate the properties of Bitumen related to flexible pavement

LIST OF EXPERIMENTS

TESTS ON COARSE AGGREGATE

1. Los Angeles Abrasion Test
2. Impact Test
3. Shape Test
4. Water Absorption and Specific Gravity Test.
5. Sieve Analysis Test
6. Bulk Density Test
7. Moisture Content Test
8. Crushing Test

TESTS ON BITUMEN

1. Ductility Test
2. Viscosity Test
3. Softening Point Test
4. Penetration Test

REFERENCE BOOKS

1. Highway Material Testing – S.K.Khanna & C.E.G. Justo, Nem Chand & Bros, Roorkee, 2013.
2. Bureau of Indian Standard Code of Practice for
   - Particle Size and Shape IS 2386 – Part I , 2016
   - Specific gravity, Density, Voids, Adsorption and Bulking IS 2386 – Part III, 2016
   - Mechanical Properties IS 2386 – 1963 Part IV, 2016

ONLINE RESOURCES

1. https://ts-nitk.vlabs.ac.in/transportation-engineering/List%20of%20experiments.html
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Transportation_Engineering_Lab/index.html

1.

19CE61 STRUCTURAL ANALYSIS II

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the students will be able to

CO1 : Analyze statically indeterminate structures by slope deflection method.

CO2 : Analyze continuous beams and plane frames using moment distribution method.

CO3 : Formulate flexibility matrix and apply to analyse indeterminate structures.

CO4 : Formulate stiffness matrix and apply to analyse indeterminate structures.

CO5 : Outline the basic concepts, applications and limitations of Finite Element Method.

SLOPE DEFLECTION METHOD

Application of slope deflection method to the analysis of statically indeterminate beams and rigid jointed plane frames - Effects of settlement of supports for beams only (Examples on structures having Kinematic indeterminacy not exceeding three). **(9)**

MOMENT DISTRIBUTION METHOD

Stiffness and carry over factors - Application of the method to the analysis of continuous beams and rigid jointed plane frames- effects of settlement of supports - Symmetric and skew symmetric loadings. **(9)**

MATRIX FLEXIBILITY METHOD

Element flexibility - Structure flexibility - Formulation of Structure flexibility matrix - Determination of forces - Application to simple indeterminate beams, frames and trusses. **(9)**

MATRIX STIFFNESS METHOD

Element stiffness - Structure stiffness - Formulation of Structure stiffness matrix - Application to simple indeterminate beams, frames and trusses. **(9)**

INTRODUCTION TO FINITE ELEMENT METHOD

Basic steps - Concept of an element - Various element shapes - Application of Finite Element Method - Limitations - Element stiffness matrix for one dimensional members - Procedure of assembly and solving equations (No problems). **(9)**

TOTAL: 45 Hours

TEXT BOOKS

1. Gupta S.P and Pandit G.S, "Theory of Structures, Vol. I & II", Tata McGraw Hill, New Delhi, 2012.
2. Bhavikatti S.S, "Structural Analysis" Vol. I & II, Vikas Publishing House (P) Ltd., New Delhi, 2011.

1.

3. Vaidyanathan R. and Perumal P., “Structural Analysis”, Vol. I & II, Laxmi Publications (P) Ltd., New Delhi, 2008.

REFERENCE BOOKS

1. Rajasekaran S. and Sankarasubramanian G., "Computational Structural Mechanics," Prentice Hall of India, New Delhi, 2012.
2. PrakashRao D.S., "Structural Analysis", Universities Press, Hyderabad, 2001.
3. Armenakas A.E., "Classical Structural Analysis" Mc-Graw Hill Book Co., New York, 1995.
4. Reddy C.S, "Basic Structural Analysis", Tata Mc-Graw Hill, New Delhi, 2012.
5. Junnarkar and Shah., "Mechanics of Structures" Vol.II, Charotar Publishing House, Anand, 2012.
6. Punmia B.C and A.K.Jain "Strength of Materials and Theory of Structures", Vol.II, Laxmi Publications, New Delhi, 2005.
7. Wang C.K, "Intermediate Structural Analysis", Tata Mc-Graw Hill, New Delhi, 2010.
8. Krishnamoorthy C.S., “Finite Element Analysis, Theory and Programming,” Tata McGraw Hill Company, 2008.
9. Reddy J.N., "An Introduction to the Finite Element Method", Tata McGraw Hill Company, NewDelhi, 2005.

1.

19CE62 - DESIGN OF STEEL STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to
CO1: Apply the Working Stress Method and Limit State Method design concepts
CO2: Analyze statically indeterminate beams and portal frames using plastic theory
CO3: Design the bolted and welded connections
CO4: Design the tension members as per IS code and concepts of shear lag
CO5: Design the compression members as per IS code
CO6: Design the laterally supported and unsupported beams as per IS code

CONCEPTS OF STRUCTURAL STEEL DESIGN

Working Stress Design - Limit State Design - Stress-strain relation of Mild steel - Modified stress-strain diagram - Assumptions in Plastic theory - Collapse load - load factor - plastic bending - Plastic hinge - Plastic moment of resistance - Plastic modulus - Shape factor - Plastic Analysis - Kinematic theorem, Static theorem and Uniqueness theorem - Propped cantilevers - Fixed beams and Continuous beams - Portal Frames. **(9)**

CONNECTIONS

Bolted and welded connections for axial forces- eccentric connections with bolt and weld. Beam to beam connection - framed connection. Beam to column connection - Unstiffened seat connection - stiffened seat connection - single and double stiffener angle. **(9)**

TENSION MEMBERS

Design of tension members subjected to axial tension- tension member subjected to bending - lug angles. Design of Tension Splice - Concept of Shear lag **(9)**

COMPRESSION MEMBERS

Design of compression members with single rolled steel sections - Angle struts. Design of built-up compression members - Design of lacings and battens - Eccentrically loaded column -column splices - column bases for axial and eccentric loads. **(9)**

BEAMS

Design of laterally supported beam for flexure, shear, web crippling and buckling and deflection. Built-up Beams - cross sections - beams with restrained and unrestrained compression flange. **(9)**

TOTAL:45 Hours

TEXT BOOKS

1. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2016.

2. Duggal.S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publication, 2019.

3. Jayagopal.L.S & Tensing.D, "Design of Steel Structures", Vikas Publication House Ltd, Noida, 2015.

4. Gambir M.L., "Fundamentals of Structural Steel Design", Tata McGraw Hill Publication, New Delhi, 2013

1.

REFERENCE BOOKS

1. Bhavikatti.S.S, "Design of Steel Structures by Limit State Design", I.K International Pvt. Ltd., New Delhi 2011.
2. Ramachandra, Virendra Gehlot, "Limit State Design of Steel Structures", Scientific Publishers, Jodhpur, 2017.
3. Shiyekar.M.R. "Limit State Design in Structural Steel", PHI learning Pvt. Ltd., Delhi, 2013.
4. IS 800 - 2007, "Code of Practice for use of Structural Steel in General Building Construction," Bureau of Indian Standards, New Delhi.
5. SP6 ISI Hand Book for "Structural Engineers and Application of Plastic Theory in Design of Steel Strictures", 1972.

1.

19CE63 - FOUNDATION ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Select and conduct suitable site investigation for the proposed civil engineering project.

CO2: Estimate the bearing capacity of soil based on shear and settlement criteria.

CO3: Understand the concepts of settlement and proportioning of footings.

CO4: Determine the load carrying capacity and settlement of piles.

CO5: Understand the Earth pressure theories and analyze the stability of retaining wall.

SOIL INVESTIGATION AND CHOICE OF FOUNDATION

Methods of Soil Exploration - Boring - Sampling - Disturbed and undisturbed Sampling - Sampling techniques - Bore log and soil investigation report - Function and requirements of good foundation -Choice of foundation based on soil conditions. **(9)**

BEARING CAPACITY

Location and depth of foundations- Bearing capacity of shallow foundations on homogeneous deposit - Terzaghi's Theory - IS Code method - Field tests - Factors influencing Bearing Capacity - Methods of improving bearing capacity. **(9)**

SETTLEMENT AND PROPORTIONING OFSHALLOW FOUNDATIONS

Types of Isolated footing, Combined footing, Mat foundation- Settlement of foundations - Components of settlement - Allowable and maximum differential settlement - Proportioning of footing (No structural design) - Methods of minimizing settlement. **(9)**

PILE FOUNDATIONS

Need for deep foundations -Types of piles - classification of piles - Load carrying capacity of piles in granular and cohesive soils -Static and Dynamic formulae - Pile carrying capacity by field tests - Pile loadTest - Group Capacity - Settlement of Pile group - Negative skin friction. **(9)**

EARTH PRESSURE AND RETAINING WALLS

Earth pressure theory - Plastic equilibrium in soil - active and passive state - Rankine's theory - Coulomb's wedge theory - Earth pressure on retaining walls of simple configurations - Stability of retaining wall -Culmann's graphical method for determining earth pressure. **(9)**

Total: 45 Hours

1.

TEXT BOOKS:

1. Varghese P.C., "Foundation Engineering", Prentice Hall of India, 2012.
2. GopalRanjan and Rao A.S.R., "Basic and Applied Soil Mechanics", New age International (P) Ltd Publications, New Delhi, Second Edition, 2010.

REFERENCE BOOKS:

1. Venkataramaiah.C, "Geotechnical Engineering", New Age International Ltd., New Delhi,2012.
2. Alam Singh., "Modern Geotechnical Engineering", IBS Publications, New Delhi, 2012.
3. Punmia.B.C., "Soil Mechanics and Foundation Engineering", Laxmi Publications, New Delhi, Sixteenth Edition, 2012.
4. Braja M. Dass, "Principles of Foundation Engineering", Thomson Brooks Gole, Singapore, 2010.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/105/105105185/

1.

19CEL64 - SOIL MECHANICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Classify the soil based on index properties.

CO2: Estimate the density and consolidation parameters of soil.

CO3: Assess the soil parameters for design of foundation and subgrade.

LIST OF EXPERIMENTS

1. Grain Size analysis of soil
2. Determination of Specific Gravity
3. Atterberg limits (liquid, Plastic and Shrinkage limits)
4. Determination of coefficient of permeability
5. Determination of field density
6. Proctor Compaction Test
7. Consolidation Test
8. Direct Shear Test
9. Unconfined compression Test
10. Vane shear Test
11. CBR Test
12. Triaxial test (Demonstration only)

REFERENCE BOOKS:

1. "Soil Engineering Laboratory Instruction Manual", Published by the Department of Civil Engineering. CIT, Coimbatore - 2016.
2. Head, K. H,"Manual of Soil Laboratory Testing (Vol-1 to 3)", John Wiley and Sons, Chichester,1998.
3. Lambe T. W., "Soil Testing for Engineers", John Wiley & Sons, New York, 1990.
4. "I.S. Code of Practice 2720 (Part I to XLI) - Indian Standard Codeof Practice for Methods of Tests for soil.
5. Saibaba Reddy, E. and Rama Sastri, K., "Measurement of Engineering Properties of Soils", New Age International Publishers,New Delhi, 2002.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/101/105101160/

1.

19CEL65 - QUANTITY SURVEYING AND PROJECT PLANNING LABORATORY

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

At the end of this laboratory, the students will be able to

CO1 : List items of work and prepare specifications.
CO2 : Prepare the detailed estimate and abstract to arrive the quantity of items of work.
CO3 : Estimate the cost and quantity of materials and Resources for items of work.
CO4 : Evaluate the value of existing civil engineering structures and project planning tools.

ESTIMATING AND COSTING

Methods of Estimating and costing- Preparation of specifications-preparation of Detailed Estimate using Excel- Datasheets Requirements of labour, non labour and materials for different types of work- Abstract Estimate using Excel- Estimation of quantities and rate Abstract for Single storey building, two storey building and other Civil Engineering structures.

PROJECT PLANNING USING PRIMAVERA AND MS PROJECT

Introduction to project planner and project management - defining Administrative categories- - preparing activity areas and bar/Gantt chart areas- updating and tracking projects using base line- producing reports -layout- filter - formatting, printing layout and reports.

TEXT BOOKS

1. DuttaB.N.,"Estimating and Costing in Civil Engineering", UBS Publishers and Distributors(P)Ltd., NewDelhi, 2003.
2. RangwalaS.C.,"Elements of Estimating and Costing", Charotar Publishing House, Anand-388001.
3. Dr.P.Vinayagam and Dr.A.Vimala," Planning and managing Projects with P6 Project Planner", I.K. International Publishing House Pvt. Ltd., New Delhi, 2015.

REFERENCE BOOKS

1. Jagannathan,G., "Getting more at less cost- The value Engineering way", Tata McGraw Hill Publishing Company, New Delhi, 2000.
2. Kohli,D.D and Kohli,R.C.," A Text Book of Estimating and Costing(Civil)", S.Chand & CompanyLtd.,2004.

1.

19CE71 - IRRIGATION ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the students will be able to

CO1: Compute the demand and the available quantity of water required for irrigating a given crop area

CO2: Determine the yield of a well

CO3: Produce hydraulic and geometrical design of storage and distribution systems to supply water for a given area

CO4: Demonstrate suitable techniques for the construction and maintenance of a reservoir and a canal network

CO5: Design, operate and maintain a canal

CO6: Plan and develop a procedure to implement an irrigation project given an agricultural command area

WATER AND IRRIGATION

Irrigation - Necessity - Advantages - ill-effects - Types - Methods - Quality of water - Standards - Crops - Seasons - Definitions related to agriculture and irrigation - Rotation of crops - Crop water requirements - Base period - Duty - Delta - Consumptive use Irrigation Efficiencies - Assessment of irrigation water - Water logging - Causes and effects - Remedies - Drainage – Necessity Advantages - Types. **(9)**

HYDROLOGY

Surface hydrology - Precipitation - Types, forms, Measurement - Evaporation measurement - Infiltration - measurement - Transpiration - Run-off - Hydrograph - Unit Hydrograph for single peaked storm-S-curve technique- Flood Estimation**.** **(9)**

GROUND WATER

Occurrence of ground water - aquifer - aquiclude - confined, unconfined and perched aquifer - Ground water yield - specific capacity of a well - measurement of yield of an open well by pumping test and recuperation test – Typical cross sections of types of open and tube wells - Elementary design of open and tube wells using direct discharge equation (without derivation of formula**).** **(9)**

CANAL ENGINEERING

Canals -Classification - Distribution network - Cross sectional details - Sedimentation in canals - Silt theories - Design of canals based on silt theories and use of charts - Balancing depth of cutting - Design procedure for fixing longitudinal section - Canal losses - Canal maintenance – Canal lining - types - Design of lined canals**.** **(9)**

RESERVOIR PLANNING

Dams - Brief idea about types of dam(detailed study not required) - Reservoir - Types, Investigations for reservoir planning - Selection of site for reservoir - Zones of storage - Capacity - Yield - Mass curve analysis - Capacity for specific demand and yield for given capacity - Fixing reservoir capacity Economic height of a dam - Reservoir sedimentation and control **(9)**

TOTAL: 45hours

1.

TEXT BOOKS

1. Garg S.K, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi, 2009.
2. Punmia B. C. and Pande B. B. Lal, "Irrigation and Water Power Engineering", Laxmi Publications, New Delhi, 2009.

REFERENCE BOOKS

1. Micheal A.M., "Irrigation - Theory & Practice", Vikas publishing house, New Delhi, 2006.
2. Sharma R.K., "Irrigation Engineering & Hydraulic Structures", Oxford and IBH Publishing Company, New Delhi, 2007

Online Resources

1. https://nptel.ac.in/courses/126/105/126105010/#

1.

19CE72 - EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Apply concepts of structural dynamics in determining response of free and forced vibration for a given SDOF and MDOF structural systems.
CO2: Analyse the role of natural calamity in the damage of structures.
CO3: Design and detail the RC structural elements and shear wall for seismic resistance as per Indian Standards.
CO4: Develop the skill to analyse and to apply in the practical problems.

STRUCTURAL DYNAMICS

Basic Concepts of vibration - Equation of motion- D'Alemberts Principle- Single Degree of Freedom system – Idealization of structure as SDOF System - Free vibration - Forced vibration - Damping - Measurement of damping by logarithmic decrement method-Simple problems on SDOF System- Introduction to Multi Degree of Freedom system. **(9)**

ENGINEERING SEISMOLOGY

Elements of Engineering seismology - Reid's Elastic rebound theory- Plate tectonics - Seismic waves –Behavior of RCC, steel and prestressed concrete structures under earthquake loading – Pinching Effect – Bouchinger Effect – Lessons learnt from past earthquakes - Seismograph and Accelerograph - Seismic Zoning map of India. **(9)**

SEISMIC ANALYSIS

Response Spectrum - Modal response contribution – Modal participation factor. Calculation of base shear as per IS 1893-2016 and IS 4326 provisions - Static and Dynamic method - Equivalent Static Lateral force method and Response spectrum method. **(9)**

EARTHQUAKE RESISTANT DESIGN

Design of Beams, Columns - Shear wall - Types of Shear wall - Design of Rectangular Shear wall with boundary elements (IS 13920 -2016) – Introduction to coupled shear wall system. **(9)**

IS CODE PROVISIONS

Ductility - Assessment of Ductility - Member / Element Ductility - Structural Ductility - Factors affecting Ductility- Ductile detailing of beams, column, joint and footings and special confining reinforcements as per IS 13920 - 2016. Behaviour of Masonry Structures as per IS 13827 and IS13828. Modern Concepts - Base isolation – Soil structure interaction. **(9)**

TOTAL: 45Hours

TEXT BOOKS

1. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of structures,” PHI Learning Pvt. Ltd., New Delhi, 2009
2. Duggal.S.K., "Earthquake Resistant of Structures", Oxford University Press, New Delhi,2007.
3. Anil K. Chopra, “Dynamics of Structures - Theory and Applications to Earthquake Engineering”, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.

1.

REFERENCE BOOKS

1. Amr S. Elnashai and Luigi Di Sarno, “Fundamentals of Earthquake Engineering”, John Wiley & Sons, Ltd., 2008.
2. Clough,R.W. and Penzien,J., “Dynamics of Structures”, McGraw-Hill, Inc, 1995.
3. Pauley and Priestly, “Seismic Design of Reinforced Concrete and Masonry Buildings”, John Wiley & Sons, 1992.
4. Moorthy C V R, “Earthquake Tips”, NICEE, IIT Kanpur 2002.
5. IS 1893: 2016 Part I Criteria for earthquake resistant design of structures.
6. IS 1893: 2016 Part II Criteria for earthquake resistant design of structures: Liquid retaining tanks
7. IS 4326: 1993 Code of practice for earthquake resistant design and construction of buildings.
8. IS 13920 - 2016, Indian Standard Code of Practice for Ductile Detailing of RC Structures, Bureau of Indian Standards, New Delhi.

ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc19_ce27/course

1.

19CE73 – CONSTRUCTION MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

After successful completion of the course, students will be able to

CO1: Describe construction management functions, various organization structures and duties of various construction team.

CO2: Employ the procedure for contractor's selection through tendering process.

CO3: Develop a realistic schedule for the optimum use of resources in construction projects.

CO4: Formulate construction resource planning and achieve project targets with managerial skills.

CO5: Plan, control and monitor construction projects with respect to time and cost.

CONSTRUCTION PROJECT AND ORGANISATION MANAGEMENT

Basics of Construction - Unique features of construction - Construction projects- Types and features, Phases of a project - Construction Project management - Importance, Functions & Scope - Project Organization - Forms of business organization - Structure of construction organization - Management levels - Construction team- Roles, Responsibilities and Skills of construction team - Factors behind the success of a construction organization. **(9)**

TENDERING AND CONTRACTING

Tender - Types, Terms and Conditions, issue procedure, opening, Scrutiny, Acceptance, Rejecting - Prepare Tender Notice - Technical terms - Administrative approval, Technical Sanction, Issue rate, Competent Authority, Secured Advance, Mobilization Advance, Earnest money deposit (EMD) and Security deposit (SD) – Contract - Introduction, Requirement, Types - Contract documents and Conditions of Contract -Contract agreement - Prequalification of Contract - Importance – Methods of getting work done in government organization through contracts - Measurement book, Muster roll, types of bills and recording - Cash book -Work register - imprest account.

(9)

CONSTRUCTION PLANNING, SCHEDULING AND TIME MANAGEMENT

Construction project planning - Stages of project planning: Pre-tender planning, Preconstruction planning, Detailed construction planning - Process of development of plans and schedules - work break-down structure- activity lists - assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data- Techniques of planning- Bar charts, Gantt Charts - Networks: basic terminology, types of precedence relationships, preparation of CPM networks - activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks - PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion. **(9)**

CONSTRUCTION RESOURCE MANAGEMENT

Planning and organizing construction site and resources - Site layout including enabling structures, developing site organization, Documentation at site - Manpower: planning, organizing, staffing, motivation - Materials: concepts of planning, procurement and inventory control - Equipment: basic concepts of planning and organizing - Funds: cash flow, sources of funds - Histograms and S-Curves - Earned Value - Resource Scheduling-resource aggregation, allocation, smoothening and leveling. **(9)**

1.

PROJECT MONITORING AND CONTROL

Project Monitoring & Control - Supervision, record keeping, periodic progress reports, periodical progress meetings - Updating of plans: purpose, frequency and methods of updating - Common causes of time and cost overruns and corrective measures - Basics of Modern Project management systems such as Lean Construction - Use of Building Information Modelling (BIM) in project management - Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. **(9)**

TOTAL: 45Hours

TEXT BOOKS

1. Dr.M.R.Sharma, "Fundamentals of construction planning and management", Kataria and Sons, New Delhi, 2015.
2. Seetharaman S., "Construction Engineering and Management", Umesh publications, New Delhi, 1997
3. Chris Hendrickson, "Project Management for Construction", Prentice Hall, 2000.

REFERENCE BOOKS

1. Kumar NeerajJha, "Construction Project Management", Pearsons Education India, 2011.
2. Memoria, C.B., and S.V.Kankar, "Personnel Management", Himalaya publishing co, 1997.
3. Harpal Singh, "Construction Management and Accounts", Tata McGraw Hill, New Delhi, 1981.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/104/105104161/
2. https://nptel.ac.in/courses/105/106/105106149/

1.

19CEL74 - COMPUTER APPLICATIONS LABORATORY

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

At the end of this laboratory, the student will be able to

CO1 : Modeling, Analysis and Design of frames and trusses using STAAD Pro

CO2 : Modeling, Analysis and Design of Bridge decks for moving loads using STAAD Pro

CO3 : Modeling, Analysis and Design of circular and rectangular water tanks using STAAD Pro

CO4 : Design of slab, beams, columns & Footings using EXCEL

ANALYSIS AND DESIGN PACKAGES

Introduction to STAAD Pro - Need for computer analysis - Analysis of basic structural elements like simply supported beams, cantilever beams, propped cantilever beams, continuous beams, sinking of supports and fixed beams. Analysis and design of 2D and 3D frames.

Analysis and design of 2D and 3D trusses - Analysis and design of space frame subjected to wind load and seismic load - Analysis, design and modelling of 2D frames and bridge deck with moving load-Analysis and design of rectangular and circular- ground level, underground and elevated water tank with and without bracings.

Design of structural elements like slab, beams, columns and footings Using Excel.

REFERENCE BOOKS

1. STAAD Pro - Manual, volume 1 and 2, Bentley Systems India private limited, New Delhi.
2. Dr.P.Vinayagam, "Analysis and Design of Structures using STAAD Pro ", Vaghai Publishers, Coimbatore, 2011

1.

19CEL75 - CONCRETE LABORATORY

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

On completion of the course the students will be able to

CO1: Identify Quality Control tests on cement, mortar and concrete as per Indian Standard

CO2: Design a concrete mix and evaluate the strength of the concrete as per Indian Standard

CO3: Evaluate the fresh properties of concrete by performing workability tests

CO4: Evaluate the hardened properties of concrete under tension, compression and transverse loading.

CO5: Assess the strength of existing concrete structures by performing NDT tests.

LIST OF EXPERIMENTS

I. Study of Equipment & Mix Design

1. Study of Concrete Mixer, Needle Vibrator, Table vibrator, Moulds, Proving ring, Jacks & Dial gauges
2. Concrete Mix Design as per IS: 10262 - 2019

II. Tests on Cement& Cement Mortar

3. Normal Consistency and Setting Time of Cement
4. Soundness Test on Cement
5. Compressive Strength Test for Cement
6. Flow Test on Mortar
7. Setting Time of Cement Mortar

III. Tests on Fresh Concrete

8. Slump Test
9. Compacting Factor Test
10. Vee - Bee Consistometer test
11. Kelly Ball Test

IV. Tests on Hardened Concrete

12. Compressive Strength of Concrete on Cube and Cylinder
13. Split Tensile Strength of Concrete on Cylinder
14. Modulus of Rupture of concrete

V. Non - Destructive Testing

15. Ultrasonic Pulse Velocity Test
16. Rebound Hammer Test
17. Windsor Pin System
18. Demo of Core Cutting Machine

TEXT BOOKS

1. A. M. Neville, “Properties of Concrete” by Pearson 5th edition Education ltd 2016.
2. M. S. Shetty, “Concrete Technology” by S. Chand & Co.2008

1.

REFERENCE BOOKS

1. Santhakumar A.R., "Concrete Technology" by Oxford University Press, New Delhi, 2012
2. Krishnasamy K.T., "Concrete Technology" by Dhanpat Rai, New Delhi, 2012.
3. Gambhir M.L., "Concrete Technology" Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.
4. Job Thomas, "Concrete Technology" by Cengage learning India Pvt Ltd 2015.
5. Indian Standards (IS 456-2000, IS 269-1989, IS 516-1959, IS 1786-1985, IS 1893-2002, IS 12269-1987, IS 9103-1999, IS 8112-1989)

ONLINE RESOURCES

1. **http://www.nptel.iitm.ac.in**
2. **https://freevideolectures.com/course/3357/concrete-technology**
3. **https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/**

1.

19CEE01- DESIGN OF CONCRETE STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1 : Understand the concepts of yield line theory.

CO2 : Design retaining walls.

CO3 : Analyse Building frames for gravity and wind loads

CO4 : Design water tanks using working stress method

CO5 : Design bridges

YIELD LINE THEORY

Introduction to yield line theory of slabs - Application to square and rectangular slabs with simply supported or fixed boundary conditions subjected to uniformly distributed loads (by upper bound theorem) **(9)**

RETAINING WALLS

Design of cantilever and counterfort retaining walls for level surface filled with/without uniform surcharge - stability requirements - Description of inclined backfill (no problems) **(9)**

BUILDING FRAMES

Difference between multi-storeyed load bearing and framed structures-Elastic analysis using substitute frames for gravity loadings approximate analysis of single and two bay frames up to 3 storeys for lateral loads using portal and cantilever methods. **(9)**

GROUND AND UNDER GROUND WATER TANK

Classifications- IS code provision - Design of ground level square, rectangular and circular tanks - Design of underground rectangular tank. **(9)**

OVERHEAD WATER TANK AND BRIDGES

Design of overhead rectangular (with problems). Design of staging for rectangular tank. Introduction to circular and Intz type tanks. Types of bridges - IRC loadings - Design of single span slab bridges for class A loadings only (Restricted to two lane) **(9)**

TOTAL: 45 HOURS

TEXT BOOKS

1. Unnikrishna Pillai and Devados Menon, "Reinforced Concrete Design", Tata Mc Graw Hill Publishing Co, New Delhi, 2011.
2. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and Distributors, Delhi, 2003.
3. Jain, O.P and Jaikrishna "Plain and Reinforced Concrete Vol.I and Vol.II", Nemchand and Brothers, Roorkee, 2007.
4. Vazirani V.N. and Ratwani, N.M.,"Concrete Structures", Khanna Publishers, New Delhi, 2004.

1.

REFERENCE BOOKS

1. Reynolds C.E., "Reinforced Concrete Designer's Hand Book", Cement and Concrete Association, London, 2002.
2. Johnson Victor D., "'Essentials of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi, 2003.
3. Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and Distributors, Delhi, 2003.
4. Syal I.C. and Goel A.K., "Reinforced Concrete Structures", Wheeler and Company, Private Limited, New Delhi, 1998.
5. Ashok K Jain, "Reinforced Concrete Limit State Design", New Chand Brothers, Roorkee, 2012.
6. IS 456 - 2000 Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
7. IS 3370 (Part I) - 1965 (Reestablished: 1999) - Code of Practice for Concrete Structures for the Storage of Liquids, Bureau of Indian Standards, New Delhi.
8. IS 3370 (Part II) - 1965 (Reestablished: 1999) - Code of practice for Concrete Structures for the Storage of Liquids, Bureau of Indian Standards, New Delhi.
9. IS 3370 (Part III) - 1965 (Reestablished: 1999) - Code of practice for Concrete Structures for the Storage of Liquids, Bureau of Indian Standards, New Delhi.
10. IRC:5 - 1998 - Standard Specification and Code of Practice for Road Bridges (Section I), Bureau of Indian Standards, New Delhi.
11. IRC:6 - 1966 - Standard Specification and Code of Practice for Road Bridges (Section II), Bureau of Indian Standards, New Delhi.
12. IRC:21 - 2000 - Standard Specification and Code of Practice for Road Bridges (Section III), Bureau of Indian Standards, New Delhi.
13. Design aids for Reinforced Concrete to IS : 456 - 1978, Bureau of Indian Standards, New Delhi.

1.

19CEE02- ADVANCED CONCRETE STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

On successful completion of this course, the student will be able to

CO1: Design the long column and deep beams
CO2: Design the grid slab and flat slab as per code requirements
CO3: Design the chimney as per IS code and bunker and silo.
CO4: Understand limit analysis and serviceability

DESIGN OF LONG COLUMNS AND DEEP BEAMS

Design of long column subjected to biaxial bending moment and axial load SP 16. Behavior of deep beams - Designs as per IS 456 - 2000. **(9)**

CHECK FOR SERVICEABILITY

Limit State of Serviceability - calculation of deflection and cracking - Check for deflection and cracking as per IS 456 - 2000. **(9)**

DESIGN OF FLAT SLAB AND GRID FLOOR

Grid and coffered floors, general features, rigorous and approximate method of analysis and design of grid floor - Design of flat slab with and without drop, column and middle strip, proportioning of flat slab element as per IS 456-2000 **(9)**

LIMIT ANALYSIS

Limit Analysis of RCC structures - Fundamental principles, concept of moment redistribution - moment rotation characteristics permissible rotation capacity - Cambridge method - A.L.L. Baker's method of Limit analysis. **(9)**

TALL STRUCTURES

Analysis of R.C. Chimneys by Elastic theory - Design by LSD. Design of square bunker using Rankine's theory. Design of circular Silo using Jansen's theory and Airy's theory (Derivation not required for both theories). **(9)**

TOTAL: 45Hours

TEXT BOOKS

1. Ashok K.Jain., "Reinforced concrete - Limit State Design", Nem Chand Brothers, Roorkee, 2006.
2. Krishnaraju N., "Advanced Reinforced Concrete Design", C.B.S Publishers and Distributors, New Delhi, 2013.

REFERENCE BOOKS

1. Jain and Jai Krishna., "'Plain and Reinforced Concrete", Nem Chand Brothers, Roorkee, 2007.
2. Mallick and Gupta., "Reinforced Concrete Design", Oxford and IBH, Publishers, Delhi, 1996.
3. IS456 - 2000, Code of "Practice for Plain and Reinforced Concrete" Bureau of Indian Standards, New Delhi.
4. IS 4995-1978 (Part 1), Criteria for design of reinforced concrete bins for the storage of Granular and Powdery materials, Bureau of Indian Standards, New Delhi.

1.

19CEE03- PRESTRESSED CONCRETE STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Determine the losses in prestressed concrete members.

CO2: Design the prestressed concrete beams for flexure and shear using Limit State method of design.

CO3: Design the end blocks, tension and compression members.

CO4: Design the composite prestressed concrete beams and shear connectors.

CO5: Analyze the continuous prestressed concrete beams

CONCEPTS OF PRESTRESSING AND LOSSES

Basic concepts, Advantage, Principles of prestressing, Material required-Methods and systems of prestressing - Classification of prestressed concrete structures-Materials-High strength concrete and High strength steel, Losses in prestress, Losses in pretensioned and post tensioned beams. Loss due to elastic shortening, creep, shrinkage, relaxation, friction – Approximate percentage of various losses in pretensioned and post tensioned beams. **(9)**

DESIGN OF FLEXURE MEMBERS

Theory and behaviour of prestressed concrete members in bending - Design of prismatic prestressed concrete members for bending for working loads by Magnel's graphical method - Check for ultimate load stage (Limit State Design), calculation of deflections, Design of beams for shear in working and ultimate loads **(9)**

END BLOCK DESIGN, TENSION AND COMPRESSION MEMBERS

Design of Anchorage Zone by Guyon's method (simple problems)-Concept of Magnel's method, IS1343 recommendations. Design of tension and compression members-Columns subjected to bending moment and axial compression. **(9)**

COMPOSITE BEAMS

Composite prestressed concrete beams- Design procedure-Calculation of stresses at important stages both for propped and unpropped constructions-Design of shear connectors- Differential Shrinkage stresses. **(9)**

STATICALLY INDETERMINATE STRUCTURES

Statically indeterminate structures- continuous beams-Concept of concordant cable and linear transformations- Sketching of pressure lines (simple problems). Partial and circular prestressing (Principles only), prestressed concrete water tank-concept (no problem). **(9)**

TOTAL:45 HOURS

TEXT BOOKS

1. Krishna Raju, N. "Prestressed Concrete", Tata McGraw Hill, New Delhi,2012.
2. Rajagopalan.N, "Prestressed Concrete", Alpha Science International Ltd., UK, 2005.
3. IS 1343:2012 - Code of Practice for Prestressed Concrete, Bureaus of Indian Standards, New Delhi.

1.

REFERENCE BOOKS

1. Lin T.Y. & Burns N., "Design of Prestressed Concrete Structures". John Wiley & Sons,1992.
2. Dayaratham N, "Prestressed Concrete Structures". Oxford & IBH Company, New Delhi, 2014.
3. Rajagopalan, "Prestressed Concrete", Narosa Publishers, New Delhi, 2013.
4. Edward G Nawy ,"Prestressed Concrete", A Fundamental Approach, 3rd Edition, Prentice Hall, Upper Saddle river, NewJersy, 2000
5. Mallik S.K. and Gupta A.P. ,"Prestressed Concrete", Oxford & IBH Publishing Co., Pvt. Ltd., India, 2nd Edition, 1986.

1.

19CEE04- DESIGN OF BRIDGES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES:

After successful completion of the course, student will be able to

CO1: Analyze various types of bridges and bridge components

CO2: Design of tee beam and deck slab bridges by Courbon's theory and Pigeaud's curves

CO3: Design of components in Prestressed concrete bridges

CO4: Design of stringers, cross girders and main girders of through type and deck type steel bridges

CO5: Design of Steel and RC bearings of bridges

REINFORCED CONCRETE DECK SLAB BRIDGES

Introduction - Classification of Bridges - Types of IRC loadings - Design of solid deck slab bridges for IRC loading -Concept of design of skew slab bridges **(9)**

REINFORCED CONCRETE TEE BEAM AND DECK SLAB BRIDGES

Design of tee beam and deck slab bridges- Courbon's theory - Pigeaud's curves -Concept of balanced cantilever and continuous bridges. **(9)**

PRESTRESSED CONCRETE BRIDGES

Design of prestressed concrete bridges -Design of girder section -Maximum and minimum prestressing forces -Eccentricity -Check for stresses at various sections -Design of End block. **(9)**

STEEL BRIDGES

Design of through type and deck type steel highway bridges for IRC loading - Design of stringers, cross girders and main girders **(9)**

BRIDGE BEARINGS

Types of bearings - Design of steel roller and rocker bearings - Design of RC rocker bearing - Design of elastomeric pad bearing **(9)**

TOTAL: 45 HOURS

TEXT BOOKS

1. Krishna Raju, N., "Design of Bridges", Oxford & IBH Publishing Co. Pvt. Ltd., 2018.

2. Johnson Victor, D, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co., 2019.

REFERENCE BOOKS

1. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, 2019.

2. Raina.V.K, “Concrete Bridge Practice”, Tata McGraw Hill, 2007

3. IRC 5:1998 Standard Specifications and code of practice for Road Bridges, Section I - General.

4. IRC 6:2014 Standard Specifications and code of practice for Road Bridges, Section I - Loadings.

5. IRC 83:2015 Standard Specifications and code of practice for Road Bridges, Bearings.

6. IRC 112:2011.Code of practice for concrete road bridges.

1.

19CEE05 - ADVANCED STEEL STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1 : Ascertain the element to find the load carrying capacity for stiffened and unstiffened member for a given section.

CO2 : Examine the necessary connections for structural steel members

CO3 : Determine the forces accompanied with Transmission line and Micro Wave towers.

CO4 : Design and develop structural members associated with industrial buildings.

CO5 : Diagnose the forces acting on bunkers and silos in their structural design.

LIGHT GAUGE STEEL MEMBERS

Light gauge sections - types of sections, material - local buckling of thin elements - stiffened and multiple stiffened compression members - Unstiffened elements - Laterally supported and unsupported flexural members - connections. **(9)**

CONNECTIONS

Connections - flexible, semi-rigid and rigid or moment resisting connections. Multistoreyed framed structures - Analysis for Vertical and lateral loads for frames with moment resistant connections only - Design for composite construction. **(9)**

STEEL TOWERS

Transmission line towers - Micro Wave Towers - Loads on Towers - Shape, Sag and Tension in Uniformly loaded conductors - Analysis of towers - Design of member in towers - Design of tower foundations **(9)**

INDUSTRIAL BUILDINGS

Requirements of Industrial Structures - Design of Gantry Girder. Industrial Building frames - General, framing, bracing, Crane Girders and columns - Welded Plate Girder - Elements of Plate Girder - Deign - Curtailment of Flange - Stiffeners and Splices-Analysis and Design of Single Bay Gable Frame with Knee Bent. **(9)**

BUNKERS AND SILOS

Pressure on side walls of bunkers and silos - Jansen's and Airy's theories - complete design of circular silos **(9)**

TOTAL: 45 Hours

TEXT BOOKS

1. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2013.
2. Duggal.S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publication, 2011.
3. Jayagopal.L.S & Tensing.D. "Design of Steel Structures", Vikas Publications House Ltd, Noida.

1.

REFERENCE BOOKS

1. Bhavikatti.S.S, "Design of Steel Structures by Limit State Design", I.K International Pvt. Ltd., New Delhi 2011.
2. Ramachandra, Virendra Gehlot, "Limit State Design of Steel Structures", Scientific Publishers. Jodhpur, 2010.
3. Shiyekar.M.R. "Limit State Design in Structural Steel", PHI learning Pvt. Ltd., Delhi, 2013.
4. IS 800 - 2007, "Code of Practice for use of Structural Steel in General Building Construction, Bureau of Indian Standards, New Delhi.
5. SP6 : Part 1 : 1964, Handbook for Structural Engineers - Structural Steel Sections
6. Ramchandra, "Design of Steel Structures" - Vol. I and II, Standard Publishers Distributers, New Delhi, 2002.
7. Bresler and Lin, "Design of Steel Structures", Wiley Eastern Pvt. Ltd., New Delhi. 1980.
8. Vazirani, V.N. and Ratwani, N.M., Honey Mehra "Design and Analysis of Steel Structures", Khanna Publishers, New Delhi, 2000.
9. IS 801: 1975, “Code of Practice for use of cold formed light gauge steel structural members in general construction,” Bureau of Indian Standards, New Delhi.
10. IS 802: Part 1 Section - 1, “Code for Practice for use of Structural Steel in Overhead Transmission line Towers, Materials and Loads and Permissible Stresses,” Bureau of Indian Standards, New Delhi, 1995.
11. IS 6533-2 (1989), “Code of Practice for Design and Construction of Steel Chimney,” Bureau of Indian Standards, New Delhi, 1989.

1.

19CEE06- ADVANCED STRUCTURAL ANALYSIS

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the students will be able to

CO1 :Outline basic concepts and compute static and kinematic indeterminacy of structures

CO2 :Apply energy concepts and the laws underlying the mechanics of structures in the mathematical framework of matrices.

CO3 : Formulate stiffness matrix by direct stiffness method and elemental approach and apply to analyse indeterminate beams, frames and trusses.

CO4 :Formulate flexibility matrix by elemental approach and apply to analyse indeterminate beams, frames and trusses.

CO5 :Identify and define the basic concepts, shape functions and methods of discretization in finite element method

BASIC CONCEPTS

Indeterminacy - Static, Kinematic - Generalized measurements - Degrees of Freedom - Constrained measurements - Behavior of Structures - Principle of Superposition - Equilibrium, Compatibility and Force displacement relations **(9)**

ENERGY CONCEPTS

Strain energy; stiffness and flexibility matrices for strain energy - Betti's law and its applications - Properties of stiffness and flexibility matrices - Contra gradient law- Co-ordinate transformations - Transformation of element matrices to structure matrices - orthogonal transformations. **(9)**

MATRIX STIFFNESS METHOD

Transformation of element stiffness matrices from local to global co-ordinates – Application of direct stiffness method to two span continuous beams and pin-jointed plane frames (frames of maximum three members) - Advantages of direct stiffness method.

Element stiffness matrices for truss, beam and plane frame elements - Development of structure stiffness matrix by element approach Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by matrix stiffness approach. **(9)**

MATRIX FLEXIBILITY METHOD

Element flexibility matrices for truss, beam and plane frame elements - Development of structure flexibility matrix by element approach –Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by flexibility matrix approach. Comparison of flexibility matrix and stiffness matrix methods. **(9)**

FINITE ELEMENT METHOD

Introduction to finite element analysis – Concept of discretization of continuum - Finite element analysis procedure – Relevant basics of elasticity – Stress-strain relation (Constitutive relation) - Strain-displacement relation – Concept of strain-displacement matrix – Types of 1-D, 2-D and 3-D finite elements –Displacement function – Convergence and compatibility requirements - Development of shape functions for truss element (2-noded and 3-noded), beam element and CST element **(9)**

TOTAL: 45Hours

1.

TEXT BOOKS

1. Pandit G. S. and Gupta S. P., Structural Analysis – A Matrix Approach, Tata McGraw Hill, New Delhi, 2008.
2. Rajasekharan S. and G. Sankarasubramanian, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2012.
3. Krishnamoorthy C. S., Finite Element Analysis – Theory and programming, Tata McGraw Hill, New Delhi, 2008.

REFERENCES

1. Hibbeler R. C., Structural Analysis, Pearson Education, New Delhi, 9th ed.,2017.
2. Ghali A., Neville A. M. And Brown T. G., Structural Analysis – A Unified Classical and Matrix Approach, Spoon Press, London and New York, 2017.
3. Manicka Selvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, Delhi, 2010.
4. Robert D. Cook, David S. Malkus, Concepts and Applications of Finite Element Analysis, John Wiley & Sons, Indian Edition, 2007.
5. William Weaver Jr. and James M. Gere, Matrix Analysis of Framed Structures, CBS Publishers, New Delhi, 2004.
6. Rajasekharan S., Finite Element Analysis in Engineering Design, S.Chand and Company Ltd., 2003.

ONLINE RESOURCE

https://nptel.ac.in/courses/105/106/105106050/

1.

19CEE07- PREFABRICATED STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

At the end of this course the students will be able to

CO1: Apply the principles of prefabrication towards economy, standardization, systems of prefabrication and its elements

CO2: Employ standard practices and techniques in precast concrete manufacturing and handling of elements

CO3: Apply the design principles involved in precast concrete structures

CO4: Choose joints and connections involved in prefabricated concrete structures

CO5: Apply the design principles of prefabricated structures subjected to abnormal loads

PRINCIPLES OF PREFABRICATION

Types of prefabrication - Advantages and disadvantages of prefabrication-Economy of prefabrication - Modular coordination - Standardisation - Prefabrication system and structural schemes - Prefabricated elements - Beams - Columns - Slabs-Roof and floor panels - Wall panels - Staircase. **(9)**

PRECAST CONCRETE-MANUFACTURING AND ERECTION TECHNIQUES

Standard practices and techniques of precast concrete manufacturing and handling -Cycle of precasting - Reinforcement- Preparation of moulds -Preparation and transportation of concrete-Production tolerances -Transportation and erection of prefabricated elements-Equipments for handling precast elements. **(9)**

DESIGN PRINCIPLES

Disuniting of structures-Structural behaviour of precast structures - Handling and erection stresses -Design of cross section based on efficiency of material used- Problems in design because of joint flexibility-Allowance for joint deformation. **(9)**

JOINTS AND CONNECTIONS

Types of precast element connections - Column to foundation connections -Column to column connections-Beam to column connections-Beam to beam connections-Floor to beam connections-Wall to wall connections- Joints for different structural connections - Dimensioning and detailing of joints for different structural connections - Construction and expansion joints in precast construction. **(9)**

DESIGN PRINCIPLES FOR ABNORMAL LOADS

Code provisions- Equivalent design loads for considering abnormal effects such as earthquakes, cyclones - Progressive collapse -Importance of avoidance of progressive collapse. **(9)**

TOTAL: 45Hours

TEXT BOOKS:

1. Haas A.M., “Precast Concrete- Design and Applications” Applied Science Publishers, London and NewYork, 1995.

2. Promyslov, V., “Design and Erection of Reinforced concrete structures”, MIR Publishers, Moscow, 1998.

1.

REFERENCE BOOKS:

1. Levit M., "Precast concrete materials, Manufacture properties and usage", Applied Science Publishers, London, 2000.
2. Glover C.W., "Structural Precast Concrete" Asia Publishing House, Bombay. 1967.
3. IS 15916-2010: "Indian Standard Code of Practice for Building Design and erection using Prefabricated Concrete", Bureau of Indian Standards, New Delhi.
4. Structural Design Manual, "Precast concrete Connection Details", Society for the Studies in the use of Precast Concrete, Netherland Behor Verlag, 2009.
5. Koncz T., "Manual of Precast Concrete Construction", Vol.I, II and III, Bauverlag, GMBH, 1976.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105105108/
2. https://nptel.ac.in/courses/112106141/

1.

19CEE08 - ADVANCED SURVEYING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of this course, the student will be able to

CO1 : Determine the distance, angles, area by tacheometry and Geodetic Survey

CO2 : Identify the errors in measurements and determine most probable values of given quantities

CO3 : Determine true meridian, latitude, longitude and time corrections using astronomical survey

CO4 : Interpret the aerial photographs to find ground co-ordinates

CO5 : Prepare topographical area map of given larger field using Electronic total station and scanner

CO6 : Create map through interpretation techniques using Remote Sensing, GPS and GIS

TACHOMETRIC SURVEYING AND THEORY OF ERRORS

Introduction, purpose, principle, instruments, stadia constants, methods of tacheometry, anallatic lens, reduction of readings- Problems.

Introduction, types of errors, definitions, laws of accidental errors, laws of weights, theory of least squares, rules for giving weights and distribution of errors to the field observations, determination of the most probable values of quantities - Problems.

(9)

FIELD ASTRONOMY

Introduction, purposes, astronomical terms, determination of azimuth, latitude, longitude and time corrections to the observations.- Problems.

(9)

AERIAL PHOTOGRAMMETRY AND MODERN SURVEYING INSTRUMENTS

Introduction, Principle, Uses, Aerial camera, Aerial photographs, Definitions, Scale of vertical and tilted photograph, Ground Co-ordinates, Displacements and errors, Ground control, Procedure of aerial survey, Photomaps and mosaics, Stereoscopes, Parallax bar.

Electromagnetic spectrum, Digital self-leveling levels, Scanners for Topographical survey,Drones surveying – introduction, mission and mapping, Applications of DGPS (Differential Global Positioning Systems) and Ground Penetrating Radar (GPR).

(9)

CONSTRUCTION SURVEYING

Marking a control station(Establishing a point) - Marking Building Corner-Marking a line-Marking grades-Slopes Stakes- Setting out of works for large structures-Vertical controls-Setting out a Building

Setting out of grades of Sewer, Pipelines, Roads and Railways-Setting out slopes in embankments and cutting- Setting out of culverts and bridges-Use of laser beams in Setting works- Setting out of tunnels

(9)

1.

HYDROGRAPHIC SURVEYING

Horizontal and vertical control- Shoreline Survey-Tides and Mean sea level- Tide gauges- Sounding –simple problems, Eqipment for sounding- Sounding Party- Making Sounding- Locating Sounding- Plotting of Sounding.

(9)

TOTAL : 45 Hours

TEXT BOOKS

1. Agor R., "Advanced Surveying", Khanna Publishers, New Delhi, 2018.

REFERENCE BOOKS

1. Dr. B.C. Punmia, "Surveying, Vol. I, II and III", Laxmi Publishers, New Delhi, 2016
2. Kanetkar T.P. and Kulkarni S.V., "Surveying and Levelling, Vol. I and II", VidhyarthiGruh, Pune, 2016
3. Dr. K.R. Arora, "Surveying, Vol. I, II and III", Standard Book House, New Delhi, 2019
4. Duggal S. K., "Surveying, Vol. I and II", Tata Mcgraw Hill, New Delhi, 2017
5. Basak N.N., "Surveying and Levelling", Tata Mcgraw Hill, New Delhi, 2017
6. Agor R., "Surveying and Levelling", Khanna Publishers, New Delhi, 2015
7. Roy S.K., "Fundamentals of Surveying", Prentice Hall of India, New Delhi, 2010
8. Subramanian, R., "Surveying and Leveling", Oxford University Press, New Delhi, 2013
9. Bhatia B., "Remote Sensing and GIS", Oxford University Press, New Delhi., 2011
10. Lillesand T.M., Kiefer R.W., and Chipman J.W., "Remote sensing and Image interpretation", 5th edition, John Wiley and Sons, India, 2015
11. James M Anderson and Adward M Mikhail, "Surveying : theory and practice", 7th Edition, Tata McGraw Hill Publication, 2014

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/103/105103176/
2. https://nptel.ac.in/courses/105/107/105107121/
3. https://nptel.ac.in/courses/105/101/105101206/

1.

19CEE09 - NUMERICAL METHODS FOR CIVIL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

At the end of this course, the students will be able to

CO1 : Solve linear simultaneous equations by direct and iterative methods.

CO2 : Apply finite difference methods to compute shear force, bending moment and deflection in beams.

CO3 : Apply numerical integration techniques to find the deflection of non prismatic beams.

CO4 : Apply eigen values and eigen vectors to find the principal planes, principal axes, principal stresses and principal moment of inertia.

CO5 : Solve ordinary and partial differential equations to apply in fluid flow problems.

LINEAR SIMULTANEOUS ALGEBRAIC EQUATION

Direct methods: Gauss-elimination, Gauss-Jordan, Triangulation and Partition methods. Iterative methods: Jacobi and Gauss- Seidel methods.

(9)

FINITE DIFFERENCE METHODS

Applications: Shear force, Bending moment and Deflection variation in statically determinate beams - Deflection in Statically indeterminate beams - Vibration of beams - Bending of laterally loaded thin plates. **(9)**

NUMERICAL INTEGRATION

Trapezoidal Rule, Simpson's one third Rule - Gaussian quadrature formula - Application of quadrature rule to deflection of non- prismatic simple beams

(9)

EIGEN VALUES AND EIGEN VECTORS

Iterative method (Power method) - Jacobi method - Applications: Principal stresses and Principal planes - Principal moment of inertia and principal axes - difference in eigen value problems to buckling of columns

(9)

ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Ordinary Differential Equations: Taylor series method - modified Euler's method - Runge-kutta method of fourth order - Milne's predictor - corrector method. Partial Differential Equations: Finite difference approximation - solution of partial differential equations - Laplace equation - Liebmann's iteration process- Poisson's equation parabolic equation - Bender-schmidt and Crank-Nicholson scheme- Hyperbolic equation.

(9)

TOTAL: 45Hours

1.

TEXT BOOKS

1. Krishna Raju, N. and Muthu K.U., "Numerical Methods for Engineering Problems", Macmillan India Limited, 2011.

2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Numerical Methods", S. Chand &Company Limited, 2005.

REFERENCE BOOKS

1. Jain.M.K, Iyengar.S.R.K, and Jain.R., "Numerical Methods for Scientific and Engineering Computation", New Age International (P) Ltd, Publishers, 2004.

2. Scarborough.J.B, "Numerical Mathematical Analysis", Oxford and IBH Publishing Company, 1992.

3. Rajasekaran.S., "Numerical Methods in Science and Engineering (A Practical approach)", A.H. Wheeler & Co.1987.

1.

19CEE10 - FINITE ELEMENT METHOD

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Identify and define the basic concepts, shape functions and methods of discretization in finite element method

CO2: Ascertain the principles and methods utilized for solving finite element problems

CO3: Calculate and ascertain the combinations of plane stress and strain problems involving finite element analysis

CO4: Derive and assemble the stiffness matrix to evaluate the output element stresses and forces for trusses.

CO5: Derive and assemble the stiffness matrix to evaluate the output element stresses and forces for beams and frames

BASICS OF FINITE ELEMENT METHOD

General description - Basic element shapes - Discretization process - Node numbering - Mesh generation - Steps involved in finite element method - Application of finite element method - Advantages and disadvantages of finite element method.

(9)

APPROXIMATE METHODS OF ANALYSIS

Energy principles - Variational methods - Rayleigh Ritz method - Method of collocation - Subdomain method - Galerkin Method - Least squares approach

(9)

PLANE STRESS AND PLANE STRAIN PROBLEMS

Basic concepts of plane stress and plane strain - derivation of stiffness matrix for constant - strain, linear strain triangular elements - rectangular elements - Iso-parametric elements - Lagrange and Serendipity elements - static condensation - axisymmetric elements.

(9)

ANALYSIS OF TRUSSES

Stiffness matrix for an axial element - Direct stiffness approach - Element assembly into global stiffness matrix -two dimensional trusses - displacement of joints - forces in the members.

(9)

ANALYSIS OF BEAMS AND FRAMES

Beam stiffness - Direct stiffness approach - Element assembly into global stiffness matrix - solution for beam problems - Two Dimensional beam element - rigid plane frames.

(9)

TOTAL: 45 Hours

1.

TEXT BOOKS

1. Reddy J N, "An Introduction to Finite Element Method", McGraw Hill, Singapore, 2006.
2. Daryl L.Logan, "Finite Element Method", Thomson Canada Ltd., India Edition, 2007.

REFERENCE BOOKS

1. Singiresu S. Rao, "The Finite Element Method in Engineering", Butterworth-Heinemann, India Edition, 2001.
2. Krishnamoorthy C.S, "Finite Element Analysis", Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. Rajasekaran S, "Finite Element Analysis in Engineering Design", S.Chand and Company Ltd., 2003.
4. Larry J.Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, New York, 2010.
5. Robert D.Cook, David S.Malkus, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, India Edition, 2007.

1.

19CEE11- INDUSTRIAL STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

The students are able to,

CO1: Acquire the knowledge about the planning and functional requirements of Industrial structures.

CO2: Understand the current design trends of multi storey building systems and industrial structures.

CO3: Design the crane girder and gantry girder.

CO4: Design the silos, bunkers and bins along with supporting structures.

CO 5: Understand and design the environmental control structures.

PLANNING AND FUNCTIONAL REQUIREMENTS

Planning of an industrial building based on the functional requirements, Lighting and ventilation - Fire safety norms - factories act, Different types of loadings.

(9)

INDUSTRIAL FRAMING

Types of roofing Design of Roof, Portals, Pre Engineered Buildings - Design of multi storied deck slab, Steel platform, wind columns - Foundations and pedestals.

(9)

MATERIAL HANDLING SYSTEMS

Cranes –Types-design of EOT - Manual overhead travelling cranes – Jib Cranes-Design of A-cranes, monorails. Design of conveyers, conveyer towers

(9)

INDUSTRIAL STORAGE STRUCTURES

Design of silos, bins and bunkers – Design of supporting system for storage hoppers and bunkers.

(9)

ENVIRONMENTAL CONTROL STRUCTURES

Concept of Electro-static precipitators, functioning and components – wet and dry scruppers- Design of chimneys – Self-supporting, Guyed and braced.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", Birkhauser Publishers,2004.

REFERENCE BOOKS

1. Bye law's of Inspector of Factories
2. Alexander Newman, “Metal Building System – Design and specifications”, Second Edition, Mc Graw Hill, NewDelhi-2004
3. PunmiaB.C., Ashokkumar Jain, “Design of Steel Structures”,Laxmi Publictions, New Delhi-2004
4. Gaylord E H,Gaylord N C and Stall Meyer J E, “Design of Steel Structures”, Third Edition, McGraw Hill Publications,1992

1.

19CEE12 - SMART MATERIALS AND STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Define the role of actuators and sensors in smart structures.
CO2: Define the engineering principles underlying the behaviour of smart materials
CO3: Define the control methods used in smart structures
CO4: Define the role of actuators and sensors in smart structures.
CO5: Define the signal processing, control systems and biometrics used in smart structures

SMART MATERIALS

Introduction to Smart Materials and Structures -definitions and implications - Instrumented structures functions and response - Sensing systems - Self-diagnosis - Signal processing consideration - Actuation systems and effectors.

(9)

PROPERTIES OF MATERIALS

Materials used in smart systems - Piezoelectric Materials - Piezoelectric properties - Actuation of structural components - Shape Memory Alloys - Constitutive modeling of the shape memory effect - vibration control - Embedded actuators -Applications of shape memory alloys. Electro rheological and magneto rheological fluids - Mechanisms and Properties - Applications of ER and MR fluids - Fiber Optics - Fiber characteristics - Fiber optic strain sensors – Applications of optical fibers.

(9)

CONTROL OF STRUCTURES

Control modeling of structures - Control strategies and limitations - classification of control systems Classical control - Modern control - Optimal control and Digital control - Active structures in practice.

(9)

SENSORS AND ACTUATORS

Sensing Technology -Characteristics of sensors - Types of Sensors - Physical Measurement using Piezo Electric Strain measurement - Inductively Read Transducers - The LVOT - Fiber optic Techniques.Chemical and Bio-Chemical sensing in structural Assessment - Absorptive chemical sensors Spectroscopes - Fibre Optic Chemical Sensing Systems and Distributed measurement.Actuator Techniques - Actuator and actuator materials - Piezoelectric and Electrostrictive Material -Magnetostructure Material - Shape Memory Alloys - Electro rheological Fluids- Electromagnetic actuation- Role of actuators and Actuator Materials.

(9)

1.

SIGNAL PROCESSING AND CONTROL SYSTEMS AND BIOMIMETICS

Features - Active systems - Adaptive system - Characteristics of control system - Application examples. Characteristics of natural structures, Biomimetic structural design, Biomimetic sensing, Challenges and opportunities for Biomimetics, Chemical and biochemical sensing in structural assessment, Absorptive chemical sensors, Spectroscopes.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Brain Culshaw, "Smart Structure and Materials", Artech House, Borton, London, 1996.
2. Srinivasan, A.V., and Michael McFarland. D., "Smart Structures - Analysis and Design", Cambridge University Press, 2001.

REFERENCE BOOKS

3. Brian Culshaw, "Smart Structures and Materials", Artech House, Boston, 1996
4. Gandhi.M.V and Thompson.B.S, "Smart Materials and Structures", Chapman and Hall, NewYork, 1992
5. L.S.Srinath, "Experimental stress Analysis", Tata McGraw-Hill, 1998.
6. Michelle Addington and Daniel L. Schodeck, "Smart Materials and Technology", Elsevier, 2005.
7. Yoseph Bar Cohen, "Smart Structures and Materials," The international society for optical Engineering, 2003.

1.

19CEE13- SAFETY IN CIVIL ENGINEERING PRACTICE

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Recognise the role and responsibility of a professional Civil Engineer in health and safety.

CO2: Investigate and report the accident occurring at site.

CO3: Apply safety practice and provide safety premises.

CO4: Assess work injury and calculate various rate indices pertaining to safety.

CO5: Apply Safety Training and Safety Education.

ROLES AND RESPONSIBILITIES

Construction Safety Management – Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. role of safety officers, responsibilities of general employees, safety committee, safety training, incentives and monitoring. Writing safety manuals, preparing safety checklists and inspection reports. **(9)**

SAFETY AUDIT

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor. **(9)**

ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident. **(9)**

SAFETY PERFORMANCE MONITORING

ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety "t" score, safety activity rate – problems. **(9)**

SAFETY EDUCATION AND TRAINING

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, safety laws. **(9)**

TOTAL: 45Hours

1.

TEXT BOOKS:

1. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay,1997.
2. Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 1982.

REFERENCE BOOKS:

1. Handbook of Occupational Health and Safety, NSC Chicago, 1982.
2. James, D., Fire Prevention Handbook, Butterworths, London, 1986.
3. Gupta R.S., Handbook of Fire Technology, Orient Longman, Bombay, 1997.
4. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons, 1979.
5. Alexandrov, M.P., Material Handling Equipment, Mir Publishers, Moscow, 1981.
6. Rudenko N., Material Handling Equipments, Mir Publishers, Moscow, 1981.

1.

19CEE14- REMOTE SENSING AND GIS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Explain the principle and methods of remote sensing
CO2: Integrate the basic elements of visual photo interpretation and aerial photography
CO3: Illustrate the components of imageries and imaging devices
CO4: Apply the concepts of Remote Sensing and GIS in the field of Civil Engineering

PRINCIPLES AND CONCEPTS

Definition - Historical Importance of remote sensing - Principles - and methods of remote sensing - Electromagnetic spectrum Electromagnetic Radiation and radiation sources - Interference -Atmospheric effects on remote sensing - Energy interaction with energy surface features

(9)

AERIAL PHOTOGRAPHY

Definition - Types of air photographs - Geometry of air photo - Parallax - pair of photos - Height determination - Flight planning - Stereoscopy - Monovision - Binocular vision - Aerial photo interpretation - Basic elements - Techniques of photo interpretation - Application of aerial photo interpretation - photographs versus maps.

(9)

IMAGERY

Landsat imagery - Digital image processing - Comparison with aerial photographs - Imaging devices - Aerial camera - Panoramic camera – Satellites – Geo Stationery – Sun Synchronous Satellites – Platforms and Sensors – types - Characteristics.

(9)

GIS

GIS – Structure of GIS – various components of GIS – vector and raster data – analysis of data –Introduction to various GIS softwares – Introduction to GPS – Principles

(9)

APPLICATIONS OF GIS AND REMOTE SENSING

Application of Remote Sensing and GIS in water resources engineering, land use studies, soil sciences, geology, agriculture, forestry, oceanography.

(9)

TOTAL: 45 Hours

TEXT BOOKS:

1. Bhatia S.C, "Fundamentals of remote sensing", New Delhi Atlantic Publishers, 2008.

REFERENCE BOOKS:

1. Floyd F.Sabins, J.R., WH, "Remote Sensing Principles Interpretation", Freeman and Company and Francis Conpany, France, 1996.
2. Lillesand, Thomas.M and RaiphW.Kiefer, "Remote Sensing and Image Interpretation", John Wiley Sons, 2003.

1.

Online Resources:

1. https://nptel.ac.in/courses/105/108/105108077/
2. https://nptel.ac.in/courses/105/103/105103193/

1.

19CEE15- GROUND IMPROVEMENT TECHNIQUES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the students will be able to

CO1: Identify problematic soil properties and select a suitable ground improvement technique to improve the same.

CO2: Acquire a fundamental knowledge on various ground improvement techniques.

CO3: Design simple ground improvement techniques.

PROBLEMATIC SOIL AND IMPROVEMENTTECHNIQUES

Role of ground improvement in foundation engineering – Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.

(9)

DEWATERING

Dewatering Techniques - Well points – Vacuum and electro osmotic methods – Seepage analysis for two dimensional flow for fully and partially penetrated slots in homogeneous deposits – Design for simple cases

(9)

INSITU TREATMENT OF COHESIONLESS AND COHESIVESOILS

Insitu densification of cohesionless soils - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.

(9)

EARTHREINFORCEMENT

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism - Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications

(9)

GROUTING TECHNIQUES

Types of grouts – Grouting equipments and machinery – Injection methods – Grout monitoring – Stabilization with cement, lime and chemicals – Stabilization of expansive soil.

(9)

TOTAL: 45Hours

TEXTBOOKS:

1. Purushothama Raj. P, “Ground Improvement Techniques”, Firewall Media,2005.
2. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill,1994.

1.

REFERENCES:

1. Moseley, M.P., "Ground Improvement Blockie Academic and Professional", Chapman and Hall, Glasgow,2004.
2. Moseley, M.P and Kirsch. K., 'Ground Improvement mediation", Sponress, Taylor and Francis Group, London,2004.
3. Jones C.J.F.P. "Earth Reinforcement and Soil Structure", Thomas Telford Publising,1996.
4. Winterkorn, H.F. and Fang, H.Y. "Foundation Engineering Hand Book". Van Nostrand Reinhold,1994.
5. Das, B.M., "Principles of Foundation Engineering" (seventh edition), Cengage learning, 2010.
6. Coduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt.Ltd. New Delhi,2011.
7. Koerner, R.M., "Designing with Geosynthetics" (Fourth Edition), Prentice Hall, Jersey, 2012.
8. IS Code 9759 : 1981 (Reaffirmed 1998) "Guidelines for Dewatering During Construction", Bureau of Indian Standards, NewDelhi.
9. IS Code 15284 (Part 1): 2003 "Design and Construction for Ground Improvement – Guidelines" (Stone Column), Bureau of Indian Standards, NewDelhi.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/108/105108075/

1.

19CEE16 - DESIGN OF DEEP FOUNDATION

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Explain classification and selection of piles as per requirements**.**

CO2: Compute load carrying capacity and settlements of pile and pile groups**.**

CO3: Analyze behavior of piles subjected to lateral load and uplift loads.

CO4: Analyze and design pile and pile group as per requirements

CO5: Analyze stability of caissons for different influencing factors and understand IRC guidelines

PILE CLASSIFICATIONS

Function - classification of piles - Factors governing choice of pile foundation - Load transfer principles - piling equipments and methods - changes in soil condition during installation of piles - requirement of code of practice - responsibility of engineer and contractor. **(9)**

AXIALLY LOADED PILES AND PILE GROUPS

Allowable load evaluation of piles and pile groups - Static method - cohesive - cohesionless soil - time effects - Dynamic method-pile driving formulae - Wave equation application - modeling - theoretical analysis - Interpretation of field test results and pile load test results - Settlement of Piles and Pile groups. **(9)**

LATERAL AND UPLIFT LOAD EVALUATION

Piles subjected to Lateral loads - Broms method, elastic -p-y curve analyses - Batter piles - response to moment - pile subjected to uplift loads - load -deformation behaviour - Lateral and uplift load test data interpretation. Foundation on week compressible-collapsible soil - case studies **(9)**

STRUCTURAL DESIGN OF PILE AND PILE GROUPS

Pile foundation - structural design - pile cap analysis, pile - raft system basic interactive analysis - pile and pile groups subjected to vibrations - fundamental solutions. **(9)**

CAISSONS

Caissons types - Stability of caissons - principles of analysis and design, seismic influences - IRC Guidelines. **(9)**

TOTAL:45 Hours

REFERENCE BOOKS

1. Das B.M., "Principles of Foundation Engineering, Design and Construction", Fourth Edition, PWS Publishing, 1999.
2. Poulos H.G., Davis, E.H., "Pile foundation analysis and design", John Wiley and Sons, New York, 1980.

1.

3. Tomlinson M.J., "Foundation Engineering", ELBS, Longman Group, U.K. Ltd., England 1995.
4. Cernica J.N., "Geotechnical Engineering Foundation Design", John Wiley and Sons, Inc. 1995.
5. Bowles J.E., "Foundation Analysis and Design", Fifth Edition, McGraw Hill, New York, 1996.
6. Donald P., Coduto, "Foundation Design Principles and Practices", Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996.

1.

19CEE17 EARTHQUAKE RESISTANT DESIGN OF MASONRY AND TIMBER STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Understand the basic concepts of structural design of masonry and timber structures

CO2: Design the brick masonry structures as per Indian standards

CO3: Design the timber structures as per Indian standards

CO4: Design the brick masonry and timber structures for seismic resistance as per Indian standards

FUNDAMENTALS OF STRUCTURAL DESIGN

Classification of structures-function, material and shape- different structural systems-requirements of structures- stability, strength and stiffness-design methods-working stress method- limit state method of design- Different types of load- Codes of practice. Engineering Seismology-Terms associated with earthquakes-Characteristics of ground motion- Seismic zones of India.

(9)

DESIGN OF BRICK MASONRY STRUCTURES

Classification of brick masonry structures- Design considerations of brick masonry-Permissible stresses- Load bearing walls- Design of load bearing walls and columns-Pressure calculation of masonry walls.

(9)

EARTHQUAKE RESISTANT DESIGN OF BRICK MASONRY STRUCTURES

General planning and design- recommendations for masonry wall-behaviour of unreinforced and reinforced masonry wall under gravitational and lateral loading-limit state design of reinforced brick masonry- lintel band- Free standing walls- Behaviour of masonry structures during past earthquakes- Codal provisions.

(9)

DESIGN OF TIMBER STRUCTURES

Properties and strength of timber used in constructions- Permissible Stresses- Grading of timber. Joints in timber structures- Design of bolted and nailed joints. Timber beams (rectangular) - Solid columns- Combined bending and direct stress. **(9)**

1.

EARTHQUAKE RESISTANT DESIGN OF TIMBER STRUCTURES

Review of structural timber element design-Introduction to design of shear walls and flexible diaphragm walls- seismic design considerations- Connections to resist the lateral forces- Behaviour of timber structures during past earthquakes- Codal provisions.

(9)

TOTAL:45 Hours

TEXT BOOKS

1. Anand S. Arya, "Masonry and Timber Structures including Earthquake Resistant Design", Nemchand & Bros., Roorkee, 2006.
2. Dayarathnam, P., "Brick and Reinforced Brick Structures", Oxford & IBH Publishing House, 1997.

REFERENCE BOOKS

1. Ramchandra, V. Gehlot, “Design of Steel Structures (Vol. 1)” Scientific Publishers, 2016.
2. Duggal, S.K., "Earthquake Resistant Design of Structures", Oxford University Press, 2007.
3. IS: 1905 – Code of Practice for Structural use of Unreinforced Masonry, 1987.
4. SP 20 (S & T),”Hand Book on Masonry Design and Construction”, Bureau of Indian Standards, 1991.
5. IS: 883, “Code of Practice for Design of Structural Timber in Building”, Bureau of Indian Standards, 1994.
6. IS: 2366, “Code of Practice for Nail- Jointed Timber Constructions”, Bureau of Indian Standards, 1983.
7. IS 13827: 1993, “Improving Earthquake Resistance of Earthen Buildings- Guidelines”, Bureau of Indian Standards, 1993.
8. IS 13828: 1993, “Improving Earthquake Resistance of Low Strength Masonry Buildings - Guidelines”, Bureau of Indian Standards, 1993.

1.

19CEE18 BUILDING SERVICES AND MAINTENENCE ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to:

CO1: Evaluate and suggest appropriate fire safety system as per the NBC for buildings..

CO2: Formulate electrical layout for buildings based on specifications, methods, usage and codal regulations.

CO3: Evaluate AC loads for small halls/rooms and suggest suitable systems.

CO4: Finalise the plumbing layout and waste water systems required for buildings as per guidelines.

CO5: Formulate maintenance plan for all building services and equipment.

FIRE SAFETY INSTALLATIONS

Causes of fire in buildings - Safety regulations - NBC - Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Heat and smoke detectors - Fire alarm system- Firefighting pumps and water storage - Dry and wet risers - Automatic sprinklers. Special features required for physically handicapped and elderly.

(9)

ELECTRICAL SYSTEMS IN BUILDINGS

Basics of Single/Three phase supply - Protective devices – Earthing, types of earthing - Types, sizes of wires, wiring systems- main and distribution boards – Load calculations – Planning electrical wiring for buildings – Back-up generator- Transformers -Solar off grid supply and back up, calculations. Lift systems-types-capacity calculations and standards.

(9)

AIR CONDITIONING

Psychrometric properties – Psychrometric chart – Psychrometric processes – Cooling and Heating load calculations - air conditioning cycles - winter, summer and year round, unitary (window & split) air conditioning systems - effective temperature - comfort conditions. Duct design (theoretical treatment) – economic considerations and methods - air distributing systems - humidification - air cleaning – controls. **(9)**

1.

PLUMBING AND WASTE WATER SYSTEMS IN BUILDINGS

Planning for plumbing-water supply scales-capacity calculations-UGT and OHT requirement-FU's-pipe sizing-Hazen-Williams formula/ charts-Types and design of systems for Multi-storey buildings. Waste water appliances-DU's-calculations-Pipe Layout-One/Two Pipe, Stack systems for multi storey buildings.

(9)

MAINTENANCE MANAGEMENT

Building maintenance/facilities management-Planning-Budgeting-Maintenance Teams-Maintenance standardsand contracts/AMC's-MIS for building maintenance-BMS-Economic maintenance decisions.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. David V Chadderton-Building Services Engineering, 5th Edition (2007)
2. Frank Booty, Facilities Management Handbook
3. Basic Electrical Engineering –T.K.Nagasarkar and M.S. Sukhija Oxford University
4. Domkundwar and Arora, "A course in Refrigeration and Air Conditioning", Dhanpat Rai and Co. (P) Ltd., 2007.
5. SP7 : 2016, National Building Code of India.

REFERENCE BOOKS

1. Barrrie Chanter, Peter Swallow-Building Maintenance Management –Wiley Blackwell (2007).
2. William H. Severns and Julian R. Fellows, "Air-conditioning and Refrigeration", John Wiley and Sons, London, 1988.
3. A.F.C. Sherratt, "Air-conditioning and Energy Conservation", The Architectural Press, London, 1980.
4. SP 32 (1986) – Lighting and Ventilation.
5. SP 30 (2011) – National Electrical Codes.
6. SP 35 – Handbook on water supply and Drainage
7. IS 14665 (2000)- Part I, Part II, Part IV- Lifts

1.

8. IS 1172(Reaffirmed 2002) -Code for basic Requirement for Water Supply, Drainage and Sanitation

9. IS 2065(Reaffirmed 1996) - Code of Practice for Water Supply in Buildings.

10. IS 1742(Reaffirmed 2002) - Code of practice for building drainage

11. IS 12183(Reaffirmed 2004) - Code of Practice for Plumbing in Multi-Storeyed Buildings.

12. Mahesh M Rathore, Thermal Engineering, Tata McGraw-Hill, 2018.

13. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., Third Edition, 2007.

14. Domkundwar and Arora, "A course in Refrigeration and Air Conditioning", Dhanpat Rai and Co. (P) Ltd., 2007.

1.

19CEE19 OPTIMIZATION TECHIQUES IN CIVIL ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Apply various optimization techniques in real world problems related to civil engineering.

CO2: Solve the linear programming problems for minimizing project cost and maximizing its profit.

CO3: Formulate multi-objective problems and analyze the non linear methods of optimization.

CO4: Solve multi-stage decision problems to get optimal solution.

CO5: Solve transportation, assignment and resource allocation problems and conduct simulation analysis to examine the robustness of optimal solutions.

LINEAR PROGRAMMING

Formulation of problems - Graphical solution- Standard form - Slack, surplus and artificial variables - Canonical form - Basic feasible solution - Simplex method - Two phase method - Zi- Cj method - Big M method - Duality Theory - Primal and Dual algorithm.

(9)

NON - LINEAR PROGRAMMING

One dimensional minimization - search methods - Exhaustive search - Dichotomous search - Fibonacci method - Golden section method - Descent methods - Cauchy's method - Fletcher - Reeves method. Constrained optimization - Penalty Function method.

(9)

GEOMETRIC PROGRAMMING

Polynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - unconstrained and constrained problem with zero difficulty - concept of solving problem with one degree of difficulty.

(9)

1.

DYNAMIC PROGRAMMING

Bellman's principle of optimality - Representation of a multi stage decision problem - concepts of suboptimazion problems using classical and tabular methods.

(9)

ALLOCATION MODELS AND SIMULATION IN CONSTRUCTION SYSTEM

Transportation models - Assignment models - Sequencing problems - Simulation approach and models - generation of data - Monte carlo simulation.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Rao S.S., "Optimization Theory and Applications", New Age International Publishers, New Delhi, 1999.
2. Vohra N.D., "Quantitative Techniques in Management", Tata Mcgraw Hill Education Private Limited, 2011

REFERENCE BOOKS

1. Stark R.M. and Nichols, "Mathematical Foundation for Design of Civil Engineering Systems", Mc Graw Hill, Newyork, 1995.
2. Ossenbruggen P.J., "Systems Approach to Civil Engineering Planning and Design", John Wiley & Sons, Canada , 1987.
3. Jewell T.K., "Systems Approach to Civil Engineering Planning and Design", Harper & Row, Publishers, New York, 1991.

ONLINE RESOURCE:

1. https://nptel.ac.in/courses/105/108/105108127/

1.

19CEE20 THEORY OF ARCHITECTURE

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Present architectural designs associated with spaces, mass, visual and emotional effects.

CO2: Explain the design components and 3D structural concepts

CO3: Explain components of building circulation, space requirements.

CO4: Present the Design of buildings based on harmony, colour and punctuation effect.

CO5: Present the acoustical design of buildings, classrooms, concert halls with suitable absorption materials.

OVERVIEW OF ARCHITECTURE

Definition of Architecture - Elements of Architecture - need and fulfilment - Architecture design - An analysis - Integration of aesthetic and function - Mass and space, visual and emotional effects of geometric forms & their derivatives.

(9)

COMPONENTS OF DESIGN

Space - Form - Composition - Dimension - proportion, scale, balance, rhythm, symmetry, hierarchy, pattern and axis with building examples. Concept development - 3D design structural concept - structural arrangement, stability and load paths - rule of thumb sizing - Designing from a brief for specific user needs - Role of Brief and Basic brief development.

(9)

CIRCULATION

Function of building circulation - components of building circulation - The building approach, the building entrance, configuration of the path, Path space relationship, form of circulation space with examples. Simple circulation diagram for building.

Congregate living - housing - neighborly space outside dwelling - Integrated architecture design of medium depth space - Hierarchies of public / private space. Relationships between structure, Construction and spatial order. Understanding and meeting standards. **(9)**

1.

PRINCIPLES OF COMPOSITION

Unity, harmony & specific qualities of design to include dominance ,punctuating effect, dramatic effect, fluidity, climax accentuation and contrast with building examples. - Rendering - Developing an understanding the importance of colour schemes in design presentation as well as its application on built forms to create pleasing environment.

(9)

ARCHITECTURE ACOUSTICS

Sound waves - frequency - Intensity - wavelength - Decibel scale - Tone structure - Outdoor noise levels - Acceptable indoor noise levels - absorption co-efficient - measurement - Choice of absorption materials - Treatment for interior surfaces - basic principles in designing open air theatres- Cinemas - Broadcasting studios - Concert halls - Classrooms - Lecture halls and Theatres.

(9)

TOTAL: 45 Hours

REFERENCE BOOKS

1. Sir Bannister Fletcher, "A History of Architecture", Butterworths, London, 1987.
2. Fransis D.K. Ching, "Architecture - Form, Space and Order", Van Nostrand Publications, New York, 1979.
3. Ven Meiss, "Elements of Architecture", Van Nostrand Publications, London, 1986.
4. https://nptel.ac.in/courses/124/107/124107012/

1.

19CEE21 GREEN BUILDING CONCEPTS AND PRACTICES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Outline the basic concept of green building.

CO2: Assess the different components of the green building.

CO3: Assimilate the green building rating system.

CO4: Apply the green building auditing for effective Management.

GREEN BUILDING PERSPECTIVE:

Introduction to Green Buildings: Definition of green buildings and sustainable development - Impact of design, construction & maintenance of buildings on our environment and natural resources - Components of Green Building ––Operational energy in Building and Life cycle energy- Embodied energy - Opportunities of Green Building - benefits of green buildings towards sustainable development.

(9)

SITE SELECTION AND PLANNING

Criteria for site selection- preservation of landscape-minimizing urban heat island effect-maximize comfort by proper orientation of building facades - Rainwater harvesting methods for roof & non-roof, reducing landscape water demand with recycle and reuse of waste water systems.

(9)

MATERIAL CONSERVATION AND INDOOR ENVIRONMENTAL QUALITY

Waste reduction during construction -materials with recycled content- local materials selection -material reuse-certified wood -Rapidly renewable building materials and furniture - day lighting -air ventilation, exhaust systems - low VOC paints, materials & adhesives -Air conditioning - Indore air quality - Sick building syndrome -Reasons for poor IAQ- Measures to achieve Acceptable IAQ levels.

(9)

GREEN BUILDING RATING SYSTEM

Green Building initiatives in India - Benefits Experienced in Green Buildings - Indian Green Building Council- - Launch of Green Building Rating Systems - Green Performance rating - requirements of LEED - GRIHA - Energy Conservation Building Code requirements - Concepts of Overall Thermal Transfer Value (OTTV).

(9)

CASE STUDY:

Case study on Green building Auditing- Energy management – water management – carbon footprint- preliminary Audit and Detailed audit – suggestions. **(9)**

Total: 45 hours

1.

TEXT BOOKS

1. Kent Peterson, Standard for the design for High Performance Green Buildings, IGCC, 2009

2.Tomwoolley and Samkimings, Green Building Hand Book,Volume 1, Taylor & Francis 2009.

REFERENCE BOOKS:

1. Handbook on Green Practices, Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

2. Wines James &Jodido Philip, "Green Architecture – The Art of Architecture in the age of Ecology", Tachen Publishers, New York, 2000.

3. Mackenzie Dorothy, "Green design: design for the Environment", Laurence King, London, 1997.

4. Farmer John & Richardson Kenneth, "Green Shift: Changing attitudes in architecture to the Natural World", Architectural Press, Boston, 1999.

5. Energy Conservaton Building Code , Bureau of Energy Effeciency, Ministry of Power, Government of India, 2017.

ONLINE RESOURCES

1. NPTEL Resources related to green building systems.

1.

19CEE22- DESIGN OF ENVIRONMENTAL STRUCTURES AND DRAWING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME:

At the end of this course the student will be able to,

CO1: Design the various units of conventional water and wastewater treatment.

CO2: Illustrate the different environmental structures

CO3: Design the plumbing system for both water supply and wastewater collection

CO4: Employ the techniques, skills, and modern engineering tools necessary for environmental engineering practices.

CO5: Interpret the current needs to control water usage by adopting suitable technical skills in the design of water supply works.

WATER TREATMENT UNITS

Objective of Water Treatment- Layout of Water Treatment Plant – Objective, Principle, Design and Drawing of Sedimentation Tank –Clarifloculator–Slow and Rapid Sand Filter.

(9)

WASTEWATER TREATMENT UNITS.

Objective of Municipal and Industrial Waste Water Treatment – Objective, Principle, Design and drawing of Screens – Grit Chamber - Primary and Secondary Settling Tanks - Trickling filter - Activated Sludge Process.

(9)

DIGESTION AND DISPOSAL UNITS

Objective, Principle, Design and Drawing of –UASB Reactor- Sludge Digestion Tank – Sludge Drying Bed – Septic Tank with Dispersion Trench and Soak Pit – Imhoff Tank.

(9)

SEWAGE TREATMENT PLANT WORKS

General Layout of Sewage Treatment Plant – Design and Drawing of Domestic Sewage Treatment Plant for a Town – General Principles Governing the Design of Sanitary Plumbing System – Minimum Sanitary Fixtures for Different types of Buildings (Indian standards) - Systems of Plumbing of Drainage work in a Building.

(9)

WATER TREATMENT PLANT WORKS

Water piping systems in buildings – Design Considerations – Water Demand for a Building – Required flow for various water supply fixtures and drawing - Design and Drawing of Rain water Harvesting system – Design and drawing of water treatment plant for a town.

(9)

TOTAL: 45Hours

TEXT BOOKS:

1. Garg S. K., "Environmental Engineering", Vol. I Khanna Publishers, New Delhi, 33rd edition.

2. Garg S. K., "Environmental Engineering", vol. II, Khanna Publishers, New Delhi, 39th edition.

1.

3. Metcalf and Eddy, "Wastewater Engineering Treatment, Disposal and Reuse", McGraw-Hill Publishing Co, Indian Edition, New Delhi, 2005.

REFERENCE BOOKS:

1. Mark J. Hammer, "Water and Waste Water Technology", Prentice hall of India 2008.
2. Hussain S. K., "Text Book of Water Supply and Sanitary Engineering", Oxford and IBH, 1994.
3. Duggal K.N., "Elements of public Health Engineering", S.Chand and Company Ltd, New Delhi, 1998.
4. Manual on Sewerage and Sewage Treatment Systems, CPHEEO Manuals, Ministry of Housing and Urban Affairs , Govt. of India, New Delhi, 2013.

ONLINE RESOURCES:

1. www.digimat.in/nptel/courses/video/105106119/L01.html

1.

19CEE23 - AIR POLLUTION AND CONTROL

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Outline the quality of air and its impact on the environment based on the national air quality standards.

CO2: Design the effective stack height to disperse the plume generated from industries in a given locality.

CO3: Demonstrate the procedure for air sampling and reporting the extent of air pollutant in a locality.

CO4: Interpret the procedure for controlling the air pollution through controlling methods.

CO5: Evaluate the level of air pollution inside a building based on indoor air quality standards

CLASSIFICATION AND EFFECTS OF AIR POLLUTION

Sources and classification of air pollutants - major emissions from global sources, importance of Anthropogenic sources - effect on human health, vegetation, animals, property, aesthetic value and visibility- Photochemical smog - green house gases - ozone layer depletion - Ambient Air Quality and Emission standards - Air Pollution Indices - Emission Inventories. **(9)**

METEOROLOGY AND SAMPLING

Effects of meteorology on Air Pollution - horizontal atmospheric motion, vertical motion in atmosphere, Atmospheric stability,Temperature Inversion, Wind rose diagram and stack plume patterns- Atmospheric Diffusion Theories - Dispersion models, Plume rise - Design of effective stack height - Air pollution sampling and measurement - Types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling, analysis of air pollutants - sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and ozone, hydrocarbons, particulate matter **(9)**

CONTROL OF PARTICULATE CONTAMINANTS

Air pollution control methods and equipment - Control methods, source correction methods, Factors affecting Selection of Control Equipment - particulate emission control - working principle, design and application of gravitational settling chambers, cyclone separators, electrostatic precipitators and depth filters. **(9)**

CONTROL OF GASEOUS CONTAMINANTS

Factors affecting Selection of Control Equipment - Control of gaseous emissions -Dry methods, wet scrubbing methods, combustion, biological methods - Control of specific gaseous pollutants -Control of sulphur dioxide emission, desulphurisation of flue gases, Control of nitrogen oxides, Modification of operating conditions, effluent gas treatment

1.

methods, Carbon monoxide control, control of hydrocarbons-Carbon monoxide poisoning - Hydrogen Sulphide poisoning. **(9)**

INDOOR AIR QUALITY MANAGEMENT

Sources, indoor and outdoor concentration - models -simple box model, complex model - control of indoor air Quality- indoor emission - sick building syndrome types - Radon Pollution and its control - Membrane process - UV photolysis - risk related to poor indoor air quality - strategies for creating premium indoor air quality (IAQ) - indoor air quality (IAQ) and green building rating systems - LEED rating system **(9)**

TOTAL: 45 Hours

TEXT BOOKS

1. Noel de Nevers, "Air Pollution Control Engineering", McGraw Hill, New York, 1995.
2. Lawrence K. Wang, Norman C. Parelra, YungTse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
3. C.S.Rao., "Environmental Pollution Control Engineering", Wiley Eastern Ltd, Delhi.

REFERENCE BOOKS

1. David H.F. Liu, Bela G. Liptak "Air Pollution", Lweis Publishers, 2000.
2. Anjaneyulu. Y., "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India, 2002.

1.

19CEE24 - SOLID AND HAZARDOUS WASTE MANAGEMENT

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Outline the salient features of solid waste management and handling.

CO2: Deduce the source reduction, recycling and reuse techniques of solid waste.

CO3: Analyze the collection systems and method of transfer of solid waste.

CO4: Describe the processing techniques for solid and hazardous waste.

CO5: Select the suitable methods for disposal of solid and hazardous waste.

CO6: Interpret the legislation for management, handling and disposal of solid and hazardous waste.

CHARACTERISTICS AND SOURCE REDUCTION OF SOLID WASTE

Definition, sources, and types of solid waste - Composition, physical, chemical and biological Properties of solid wastes - Per capita generation rates - Sampling and characterization of solid waste - Source reduction of wastes -Waste exchange - Recycling and reuses - Salient features of Indian legislations on management and handling of municipal solid wastes. **(9)**

COLLECTION AND TRANSPORT OF SOLID WASTE

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing- Collection services: municipal and commercial - Industrial services - Collection systems: Hauled-container system (HCS) and stationary container system (SCS) - Vehicle and labour assessment - Assessment of collection route - Transfer and transport-Transfer station location- Means and methods of transfer. **(9)**

PROCESSING AND DISPOSAL OF SOLID WASTE

Objective of processing - material separation and processing technologies- biological, chemical and thermal conversion technologies- disposal in Landfills: site selection methods and operations, leachate and gas generations and movement and control of gas and leachate techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes. **(9)**

HAZARDOUS WASTE CHARACTERIZATION AND MANAGEMENT

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste- Typical hazardous wastes in MSW - Hazardous waste management: minimization, collection, storage, handling, transport, and disposal - design of hazardous waste landfills - TCLP tests - National and International legislation for hazardous waste management - Atomic Energy Regulatory Board -International Atomic Energy Agency - Department of Atomic Energy - Nuclear Power Corporation - Nuclear power plants in India. **(9)**

NUCLEAR WASTEAND e-WASTE

Sources - classification - effects of nuclear waste- initial treatment of nuclear waste - vitrification, ion exchange, synroc - long term management - above ground disposal,

1.

geological disposal, ocean dumping, transmutation, space disposal - reuse of waste - nuclear safety and waste regulation - case study on nuclear disaster - source of e- waste - material composition of e - waste - recycling and recovery - integrated approaches to e - waste recycling - socio economic factors - treatment option - disposal option - e - waste legislation. **(9)**

TOTAL:45 Hours

TEXT BOOKS

1. Tchobanoglous, G. et al., "Integrated Solid Waste Management", McGraw-Hill Publication., New York,1993.
2. Ronald E. Hester,Roy M. Harrison "Electronic Waste Management", Royal Society of Chemistry, 2009.

REFERENCE BOOKS

1. Peavy, SH, Rowe, RD and Tchobanoglous, G, "Environmental Engineering", McGraw-Hill Inter Edition,1985.
2. Charles, A.W., "Hazardous Waste Management", McGraw-Hill Publications, 2002.

1.

19CEE25 - ENVIRONMENTAL IMPACT ASSESSMENT

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Outline the overall perspectives of Environmental Impact Assessment.
CO2: Design the necessary tools pertaining to assessment of various impacts.
CO3: Recognize and synthesis the diversified socio-economic impacts on the society.
CO4: Design and develop the significant protocols for Environment Management Plan.
CO5: Synthesize and discretise the various impacts originating from typical developmental projects.

ENVIRONMENTAL IMPACT ASSESSMENT PERSPECTIVES

Impact assessment introduction -Historical perspective -Scope and goals of EIA - Legal and Regulatory aspects in India - Types and limitations of EIA - Scope studies for Environmental Impact Studies (EIS). Preparation for EIS Planning, Public Participation and Review of EIS. **(9)**

ASSESSMENT AND MONITORING

Environmental setting - environmental impact assessment methodology- cost benefit analysis, environmental indices and indicators for describing affected environment, Life cycle assessment. Role of remote sensing and GIS in Environmental Impact Assessment

(9)

SOCIO-ECONOMIC IMPACT ASSESSMENT

Types, steps in performing socio-economic impact assessment, analysis of public services and facilities impacts, social impacts, impacts of economic profile of the community. **(9)**

ENVIRONMENTAL MANAGEMENT PLAN

Environmental Management Plan - preparation, implementation and review - Mitigation and Rehabilitation Plans - Policy and guidelines for planning and monitoring programmes - Post project audit - Ethical and Quality aspects of Environmental Impact Assessment. **(9)**

SECTORAL ENVIRONMENTAL IMPACT ASSESSMENT

EIA related to the following sectors - Infrastructure -construction and housing Mining - Industrial - Thermal Power - River valley and Hydroelectric projects-Nuclear Power- EIA for coastal projects. **(9)**

TOTAL: 45 Hours

1.

TEXT BOOKS

1. Canter.R.L, "Environmental Impact Assessment", McGraw Hill, New Delhi, 1996.
2. Shukla,S.K., Srivastava.P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.

REFERENCE BOOKS

1. Rao, J.G., and Wotten, D.C., "Environmental Impact Analysis, Handbook", McGraw-Hill, 1980.
2. Van Nostr, and Reinhold, J.E. Heer, Hagerty,D. J., "Environmental Assessment and Statement", 1977.
3. Canter, L.W., "Environmental Impact Assessment", McGraw-Hill, New York, 1996.
4. "Environmental Assessment Source book", Vol. I, II &III, The World Bank, Washington, D.C, 1991.

1.

19CEE26- INDUSTRIAL WASTEWATER MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Outline the waste water characteristics and environmental implications of various industrial effluents

CO2: Interpret the Wastewater minimization techniques.

CO3: Illustrate the importance of Advanced Wastewater Treatment systems.

CO4: Interpret the manufacturing processes of industries and compare the characteristics of Industrial effluents.

CO5: Implement the suitable treatment process for the industries based on the characteristics of Wastewater.

INDUSTRIAL WASTEWATER PERSPECTIVES

General characteristics of industrial wastewaters - Objectives and management of industrial wastewaters - Effluent and stream standards for disposal of wastewaters - Sewer ordinance - Effects of untreated and/or partially treated wastewaters on disposal into land, rivers, sea and ocean-zero Liquid discharge, effluent treatment - individual and common effluent treatment plant

(9)

WASTEWATER MINIMIZATION AND ADVANCED WASTEWATER TREATMENT

Volume and strength reductions - Reduce, Reuse and Recycle concepts - waste auditing - Objectives, principles and process description of equalization, neutralization, floatation process, types of aeration system -Chemical oxidation, chemical precipitation, adsorption, membrane filtration process, gas stripping and ion exchange process- evaporators.

(9)

CASE STUDIES -1

Process description, wastewater characteristics and effluent treatment for iron and steel, thermal power plants, sugar, paper and pulp industry.

(9)

CASE STUDIES - 2

Process description, wastewater characteristics and effluent treatment for tannery, distilleries, diary and textiles – Dyeing.

(9)

CASE STUDIES - 3

Process description, wastewater characteristics and effluent treatment for oil refineries, pharmaceutical plants, corn-starch industry and food processing industry.

(9)

TOTAL: 45hours

1.

TEXT BOOKS

1. Rao, M.N and Datta, A.K. "Waste Water Treatment", Oxford and IBH Publishers Co, New Delhi, 1995.
2. Metcalf and Eddy, “Wastewater Engineering Treatment, Disposal and Reuse", McGraw-Hill Publishing Co, Indian Edition, New Delhi, 2005.

3. Eckenfelder (jr), “Industrial Water Pollution Control", McGraw-Hill Book Co, New York, 2000.

REFERENCE BOOKS

1. Nemerow N. L., "Industrial Water Pollution", Addison - Wesley Publishing Company Inc., USA, 1996.
2. Mahajan S. P. "Pollution Control in process industries", Tata McGraw Hill Publishing Co Ltd., New Delhi, 1989.
3. World Bank Group, “Pollution Prevention and Abatement Handbook - Towards Cleaner Production”, World Bank and UNEP, Washington D.C., 1998

ONLINE RESOURCES:

1. http://nptel.ac.in/courses/105106119/36#

1.

19CEE27- GEO ENVIRONMENTAL ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

On completion of the course, the student is expected to

CO1: Understand basic knowledge of concepts and principles of Geo-environmental Engineering..

CO2: Be capable of selecting site for safe disposal of waste.

CO3: Aware of soil stabilization by utilizing solid waste.

CO4: Assess the contamination in the soil and to select suitable remediation methods based on contamination.

CO5: Prepare the suitable disposal system for particular waste.

GENERATION OF WASTES AND CONSQUENCES OF SOIL POLLUTION

Introduction to Geo environmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil pollution interaction clay minerals - Failures of foundation due to waste movement.

(9)

SITE SELECTION AND SAFE DISPOSAL OF WASTE

Safe disposal of waste – Site selection for landfills – Characterization of land fill sites and waste – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system – Application of geosynthetics in solid waste management – Rigid or flexible liners.

(9)

TRANSPORT OF CONTAMINANTS

Contaminant transport in sub surface–Advection, Diffusion, Dispersion–Governing equations –Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation –Hydrological consideration in land fill design – Ground water pollution

(9)

WASTE STABILIZATION

Stabilization - Solidification of wastes – Micro and macro encapsulation – Absorption, Adsorption, Precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement

(9)

REMEDIATION OF CONTAMINATED SOILS

Exsitu and insitu remediation - Solidification, bio-remediation, incineration, soil washing, electro kinetics, soil heating, vetrification , bio-venting.

(9)

TOTAL: 45hours

TEXT BOOKS

1. Manoj Datta," Waste Disposal in Engineered landfills", Narosa Publishing House, 1997.
2. Manoj Datta, B.P. Parida, B.K. Guha, "Industrial Solid Waste Management and Landfilling Practice", Narosa Publishing House, 1999.

1.

REFERENCE BOOKS

1. Hari D. Sharma and Krishna R. Reddy, "Geo-Environmental Engineering" –John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., "Geotechnical Practice for waste disposal", Chapman & Hall, London 1993.
3. Westlake, K, "Landfill Waste pollution and Control", Albion Publishing Ltd., England, 1995. 4. Wentz, C.A., "Hazardous Waste Management", McGraw Hill, Singapore, 1989.

Online Resources

https://nptel.ac.in/courses/105/101/105101196/

1.

19CEE28- PAVEMENT ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Describe the principles of rigid and flexible pavements along with their components

CO2 : Design the flexible pavement using IRC, CBR and plate bearing methods

CO3 : Design the rigid pavement using IRC and PCA methods

CO4 : Evaluate the pavements in structural and functional aspects

PRINCIPLES OF PAVEMENT DESIGN

Types of pavement-flexible and rigid- Components of pavement and their functions, Provisions of IRC Guidelines for each component, Comparison between highway and airport pavements, Factors influencing pavement stability: Vehicle and traffic factors-ESWL and Wheel Load Factor- Moisture and climate, soil-CBR, Plate Bearing method for finding modulus of subgrade reaction stress distribution factor- Boussinesq and Burmister theories.

(9)

DESIGN OF FLEXIBLE PAVEMENT

Empirical method based on classification-Group Index method- Methods based on arbitrary strength-CBR method-Provisions of IRC 37- Theoretical and semi-theoretical methods- Burmister Design method.

(9)

STRESSES AND JOINTS IN RIGID PAVEMENT

Advantages and Disadvantages of rigid pavement, Stresses in rigid pavement due to wheel load-Westergaard theory – Stresses due to change in temperature-warping stress- Critical combination of stresses. Types of joints, Types of rigid pavement based on reinforcement, Design of reinforcement in longitudinal and transverse direction, tie bars and dowel bars.

(9)

DESIGN OF RIGID PAVEMENT

Modulus of Rupture of concrete, Design of airport pavement-Portland Cement Association method and Corps of Engineers method- Design of rigid highway pavement- IRC 58 method and PCA method.

(9)

PAVEMENT DISTRESS, EVALUATION AND REHABILITATION

Flexible pavement distress - rigid pavement distress - condition surveys - Types of roughness - present serviceability index - skid resistance - structural evaluation - Bituminous and flexible overlays on rigid pavements - Pavement Management System

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Kadiyali L.R., "Principles and Practice of Highway Engineering", Khanna Tech Publications, New Delhi, 2004.

2. Sharma S. K," Principles, Practice and Design of Highway Engineering", S. Chand and Company Ltd., New Delhi, 2014.

1.

REFERENCE BOOKS

1. Yoder E. J. and Witezak M. W., "Principles of Pavement Design", John Wiley and Sons Inc., New York, 2011.
2. Yang H. Huang, “Pavement Analysis and Design”, Pearson Education, 2008
3. IRC: 37-2018, Guidelines for the Design of Flexible pavements, Indian Road Congress, New Delhi, 2018.
4. IRC: 58-2015, Guidelines for the Design of Rigid Pavements for Highways, Indian Road Congress, New Delhi, 2015.
5. IRC: SP: 72 – 2015, Guidelines for the design of flexible pavements of low volume rural roads, Indian Road Congress, New Delhi, 2015.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/104/105104098/
2. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-19.pdf
3. http://www.digimat.in/nptel/courses/video/105105107/L37.html

1.

19CEE29- AIRPORT AND HARBOUR ENFINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Identify the parameters required for planning and constructing an airport

CO2: Design the runway and taxiway in airport as per geometrical standards

CO3: Explain the air traffic controls, airfield pavement strength assessment, failures and maintenance for safe functioning of airport

CO4: Outline the elements and components related to Harbour and Docks

AIRPORT PLANNING

Regional planning - Planning Consideration- Airport Site evaluation - factors affecting airport location - Surveys - Drawings - Role of ICAO, FAA, DGCA and AAI - Airport capacity - Terminal area - Building and building area - facilities in terminal area-Vehicular circulation - Parking area - Apron - Hanger - other components

(9)

GEOMETRIC DESIGN OF RUNWAY AND TAXIWAY

Design of runway - Factors affecting setting - Orientation of Runway - windrose diagram - number of runways - factors affecting runway length - length of runway - stop ways - clear ways - take off length requirement - landing length requirement. Design of taxiways, aprons, holding bays- functional requirement - taxiway- width - curve - junction - intersection

(9)

AIR TRAFFIC CONTROL AND PAVEMENT MAINTENANCE

Aircraft Characteristics - Future trends in aircrafts design- Visual Aids - Airport Marking - Airport Lighting - Need for Air traffic control - Air traffic control network - Air traffic control Aids - ILS - Need for maintenance of pavement - Airfield Pavement failures - Maintenance - Strengthening of airfield pavements - Drainage - Characteristics and requirements

(9)

HARBOUR

Definitions: Harbour, port, marine terminal, offshore mooring, anchorage area, turning basin, length, beam, draft, load line, dead weight tonnage, warehouse, Transit shed - Planning, site selection - layout of harbours - classification of harbours

(9)

DOCKS

Break water - classification and sections of different types of break waters - Docks - Classification - Jetty, quay, quay wall - Dolphins - fenders - navigational aids- necessity and types.

(9)

TOTAL: 45Hours

TEXT BOOKS

1. Khanna .S.K., Arora M.G., and S. S. Jain, "Airport Planning and Design", Nem Chand, Roorkee, 2017

2. Saxena S. C, " Airport Engineering Planning and Design", CBS Publications, 2020

1.

3. Hasmukh P. Oza and Gautam H. Oza., "Dock and Harbour Engineering", Charotar Publishing House, Anand, Gujarat, 2016.
4. S.P. Bindra, " Dock and Harbour Engineering", Dhanpar Rai Publishers, 2010

REFERENCE BOOKS

1. Robert Horonjeff., "The Planning and Design of Airports", McGraw Hill Book Co., 1994.
2. Quinn, "Design and Construction of Port and Marine Structures", McGraw Hill, 1972.
3. BIS IS 4651-4, 2014, Code of Practice for Planning and Design of Ports and Harbours, General Design Consideration, BIS, New Delhi.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/114/106/114106025/
2. https://nptel.ac.in/courses/105/107/105107123/
3. http://www.nptelvideos.in/2012/11/transportation-engineering-ii.html

1.

19CEE30- TRAFFIC ENGINEERING

ASSESSMENT: THEORY

COURSE OUTCOME

L	T	P	C
3	0	0	3

After successful completion of the course, student will be able to

CO1: Understand the traffic parameters and systems

CO2: Design Channelized islands, Intersections, signals and parking arrangements

CO3: Develop an effective Traffic management System

TRAFFIC CHARACTERISTICS

Physical, Physiological, Psychological, Environmental Characteristics, PIEV Theory -Traffic Stream Characteristics, Vehicle Characteristics –Urban Road and Road Characteristics – Geometric Design- Overview.

(9)

SURVEYS AND STUDIES IN TRAFFIC ENGINEERING

Conventional and Modern Methods of Traffic Survey and Studies – Volume and Capacity – LOS for uninterrupted traffic flow – Headway concepts and applications – Speed and Delay – Origin and Destination, Parking, Accident – Level of Service (LoS)

(9)

DESIGN OF TRANSPORT INFRASTRUCTURE

Design of roads – Design Speed, Terrain, Gradient curves – Horizontal and Vertical, Super elevation, Sight Distance –Traffic Sign, Road Markings, Traffic Control Aids, simple problems.

(9)

INTERSECTION DESIGN AND CONTROL

Design of Intersection – At grade intersection – Uncontrolled, Channelization, Rotary, Traffic Signal Control, Signal Co-ordination, Grade Separated Intersection - Types, Design and Analysis.

(9)

TRAFFIC MANAGEMENT

Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, Intelligent Transport System

(9)

Total: 45 Hours

TEXT BOOKS

1. Kadiyali.L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 1999
2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management, 2018
3. Salter. R.I and Hounsell N.B, “Highway Traffic Analysis and design”, Macmillan Press Ltd.1996.

REFERENCES:

1. Wolfgang S. Homburger et.al., „Fundamentals of Traffic Engineering“ 15th Edition, Institute of Transportation Studies, University of California, Berkely, 2001

1.

2. James L. Pline (Edr) „Traffic Engineering Hand Book", Institute of Transportation Engineers,
3. Nicholas T.Garber, Lester A Hoel, „Traffic and Highway Engineering", Revised Second Edition, ITP, California, USA, 1999
4. Thomas Curinan, „An Introduction to Traffic Engineering – A Manual for Data Collection and Analysis, Books Cole, UK, 2001
5. Washington DC, USA, 1999Pignataro, L.J., Traffic Engineering – Theory & Practice, John Wiley, 1985. 6 AASHTO A Policy on Geometric Design of Highway and Streets
6. Highway Capacity Manual (2000), Transportation Research Board, USA.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-32.pdf

1.

19CEE31- URBAN TRANSPORTATION PLANNING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Design, conduct and administer surveys to provide the data required for transportation planning.

CO2: Develop and calibrate modal split, trip generation rates for specific types of land use developments.

CO3: Adopt the steps that are necessary to complete a long-term transportation plan.

UNIT I PRINCIPLES OF TRANSPORTATION PLANNING

Introduction - Interdependence of land use and traffic – transportation planning – different stages – various surveys – difficulties in planning - Collection of data – Organisation of surveys and Analysis, Study Area, Zoning, Types and Sources of Data, Road Side Interviews, Home Interview Surveys, Commercial Vehicle Surveys, Sampling Techniques

(10)

UNIT II TRIP GENERATION AND DISTRIBUTION

Purpose of Trip – Trip Generation – Trip Distribution – factors – various models – analysis – traffic assignment – modal split - simple problems

(10)

UNIT III DESIGN OF VARIOUS ELEMENTS

Design of intersections – at grade – grade separated interchanges – Parking – Demand – type of parking – Design of Multi Storied and Surface Parking facility - traffic signal design – methods – simple problems

(10)

UNIT IV URBAN TRANSPORTATION MODES

Public transport – planning - fares and subsidy – Intermediate public transport – types – characteristics – other urban transportation modes

(6)

UNIT V URBAN TRANSPORTATION PROBLEMS

Problems in Present Traffic conditions –– traffic and Environment – Air Pollution – Noise Pollution - fuel crisis – remedial measures **(9)**

TOTAL: 45 Hours

1.

TEXT BOOKS

1. Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 1999
2. Hutchinson, B.G, 'Principles of Urban Transport Planning", McGraw Hill. 1974
3. Khisty C.J. and Kent B Lall, 'Transportation Engineering' Prentice Hall. 2017
4. Papacostas,' Transportation Engineering and planning', Tata McGraw Hill, 2015

REFERENCE BOOKS

1. Mayer M and Miller E, 'Urban Transportation Planning: A decision oriented Approach', McGraw Hill.
2. Bruton M.J., 'Introduction to Transportation Planning', Hutchinson of London.
3. Dicky, J.W., 'Metropolitan Transportation Planning', Tata McGraw Hill.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/107/105107067/
2. https://nptel.ac.in/courses/105/106/105106058/
3. https://nptel.ac.in/courses/124/105/124105016/
4. http://www.nptelvideos.in/2012/11/urban-transportation-planning.html

1.

19CEE32 INTELLIGENT TRANSPORT SYSTEM

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Understand the concepts and need for Intelligent Transport Systems.

CO2: Acquire the basic knowledge on data collection using ITS.

CO3: incorporate the knowledge of management and automation of traffic systems

CO4: Apply the concepts of ITS in the field of Transportation planning

INTRODUCTION TO ITS

Introduction to Intelligent Transport System (ITS) – Definition of ITS and Identification of ITS- Need for ITS, Objectives, Historical Background, Benefits of ITS

(9)

DATA COLLECTION TECHNIQUES

ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection

(9)

FUNCTIONAL AREAS

Telecommunication in ITS - functional areas of ITS – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS)

(10)

TRAFFIC MANAGEMENT AND AUTOMATION

ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management, Mobile Applications; Automated Highway Systems - Overview of ITS implementations in developed countries, ITS in developing countries.

(10)

ITS in Indian Cities

Incorporation of ITS technologies in Indian cities – Transportation Planning applications – Metro rail systems – user friendly apps – case studies

(7)

TOTAL : 45 Hours

TEXT BOOKS

1. Srinivasa R Kumar 'Intelligent Transport Systems', Orient Blackswan Pvt Ltd, 2021

2. Pradip Kumar Sarkar & Amit Kumar Jain 'Intelligent Transport Systems', PHI Learning, 2018

3. Dr. L. R. Kadiyali 'Traffic Engineering and Transport Planning', Khanna Publishers, 2012

REFERENCE BOOKS

1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles

1.

NPTEL - ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/101/105101008/
2. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-32.pdf
3. National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM).

1.

19CEE33 - HYDRAULIC STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Select the hydraulic structure based on its purpose, location, function and materials used.

CO2: Explain the principles of design of a weir as a part of diversion headwork.

CO3: Demonstrate the procedure for the design of canal structures.

CO4: Develop the procedure for stability analysis and design of rigid and non rigid dams based on Geological and hydrological data.

CO5: Illustrate the constructional features and the method of operation and maintenance of irrigation tanks.

RIVER STRUCTURES

Diversion Head Works – Brief description of component tparts - their functions –Design principles - Seepage Theories - Weir, Barrage and impervious floor as a part of diversion head work and their design based on seepage theories - River training works-types (Theoretical aspects only)

(9)

CANAL STRUCTURES

Canal regulators – Types – Functions – Parts of a regulator – Canal falls – Types –Brief Description – design aspects of notch - type canal fall – Cross Drainage works – Types – selection –Design aspects of siphon aqueducts – Canal outlets and fumes (Theoretical aspects only)

(9)

STORAGE STRUCTURES - GRAVITY DAMS

Gravity Dams – Description – Forcesacting – Elementary and Practical profile –Design (procedure only) of high and low gravity dam- Zoning of gravity dam – Galleries – Types - Joints, Water stops and Key ways – Types – Spillways – Types - Functions.

(9)

STORAGE STRUCTURES - EARTHEN DAMS

Earthdams – Various types of sections – Cross –sectional Details –Design data of components –Causes of failure –Typical cross sections to suit site conditions and available materials-Phreatic line- Determination by graphical method – Seepage control in earthen dams.

(9)

OTHER STORAGE STRUCTURES

Arch Dams - Types (Description only) - Buttress dams - Types (Description only). Tanks – Classification – Components of tanks - Types of bunds - Design aspects of bunds-Tank

1.

surplus weir - tower head sluice- wing wall type sluice (Description only)-Tank regulation arrangements.

(9)

TOTAL: 45 Hours

TEXT BOOK

1 .GargS.K , "Irrigation Engineering and Hydraulic Structures ",Khanna Publishers ,New Delhi ,2009.

REFERENCE BOOKS

1. Punmia B.C, Pande,B.B. Lal., "Irrigation and Water Power Engineering", Laxmi Publications, New Delhi,2009.
2. Sahasra BudheS.R. ,"Irrigation Engineering and Hydraulic Structures Including Hydrology and Water Power Engineering", S.K.Kataria Publications, Sixth Edition, 1996(Reprint2000).

Online Resources

1. https://nptel.ac.in/courses/105/105/105105110/

1.

19CEE 34- ENGINEERING HYDROLOGY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1:Summarize the factors governing the movement of water through atmosphere, lithosphere and hydrosphere

CO2: Collect, analyse and interpret the rainfall data over a basin

CO3: Estimate the precipitation losses occurring due to evaporation, transpiration and infiltration

CO4: Determine the flow in a river resulting from a storm of given duration through rainfall-runoff models

CO5: Estimate the flood in a stream through flood routing techniques

GENERAL HYDROLOGY

Hydrology – definition –development – hydrologic design – hydrologic failure - weather-general circulation –water shed hydrology –geomorphology –effect ofl and use in hydrology.

(9)

PRECIPITATION

Precipitation – Types of precipitation – forms of precipitation – rainfall measurement – gauges –recorders – processing precipitation data –check for consistency – supply of missing data-areal mean- mass curve technique – intensity duration, frequency curves.

(9)

EVAPORATION AND INFILTRATION

Process of evaporation, transpiration, infiltration - factors affecting evaporation and infiltration- measurement of evaporation and infiltration – Infiltration indices.

(9)

RUN-OFF

Factors affecting runoff – Rainfall – Runoff process – hydrograph theory and its applications-hydrograph components - hydrograph separation – unit hydrograph and its derivation-synthetic hydrograph – Scurve Technique

(9)

FLOOD AND STREAM FLOW MEASUREMENTS

Flood estimation – flood routing through reservoir (ISD method)-routing through channels (Muskingham method)- flood control- flood forecasting .Stream flow measurements - methods-Stage Discharge Relation –Stream gauging Network.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Raghunath H.M.,"Hydrology :Principles, Analysis and Design", New Age International (Pvt.) Ltd., NewDelhi, 2nd Revised Edition2007
2. Raghunath H.M., "GroundWater" ,New Age International (P)Ltd. ,NewDelhi, 2nd Edition, Reprint2003

1.

REFERENCE BOOKS

1. Jayarami Reddy P.," A Text Book of Hydrology "University Science Press, (Unit of Laxmi Publications) NewDelhi, 3rd Edition,2011
2. David Keith Todd and Larry W.Mays," Ground Water Hydrology" John Wiley Publications, 3rd Edition, 2005
3. Subramanya K., "Engineering Hydrology", TataMc GrawHill Publishing Company Ltd.,2000
4. Chow V.T.," Applied Hydrology",Tata McGraw Hill Publishing Company Ltd.,1988

Online Resources

1. https://nptel.ac.in/courses/105/101/105101002/

2. https://nptel.ac.in/courses/105/107/105107129/

1.

19CEE35- VALUATION OF IMMOVABLE PROPERTIES

ASSESSMENT: THEORY

COURSE OUTCOME

L	T	P	C
3	0	0	3

After successful completion of the course, student will be able to

CO1: Value different types of land used for construction of buildings.

CO2: Value different types of buildings.

CO3: Apply appropriate method for valuation specific to the purpose.

PRINCIPLES OF VALUATION AND VALUATION OF LAND & BUILDING

Definition - Cost, Price and Value - Types of Properties under Valuation - Various Purposes of Valuation - Different types of Value - Factors affecting Value - Different Methods of Valuation.

Types of Land - Location of Land and its Value - Belting Method of Valuation - Market Value and Guideline Value of Land - Building FSI - Plot Coverage - Types of Structure - Life of Various types of Building - Methods of Calculating Depreciation - Valuation by Land and Building Method.

(9)

FREE HOLD AND LEASE HOLD PROPERTIES AND FIXATION OF FAIR RENT

Free hold and Lease hold Properties - Lease, Rent and License - Different forms of Lease - Lessor - Lessee - Sub-lessee - Reversion - Lessor' Rights - Lessee's Rights - Meaning of Different Rents - Fixation of Fair Rent - Principles of fixation of fair rent-Amenities to be considered - Rent fixation for Residential & Non-Residential purposes, Commercial Buildings, Apartments

(9)

VALUATION OF APARTMENTS

FSI - Super Built-up Area - Undivided Share of Land - Different Methods of Valuation - Procedure of Valuation by Composite Rate Method - Valuation by Other Methods - Procedure for Valuation of Flat under Construction - Stage Value of a flat - Valuation of an existing flat - Joint Venture Agreement

(9)

VALUATION FOR BANKS

Purposes - Security - Primary and Collateral - Present, Market, Forced Sale and Auction Value - Valuation of Building under Construction - Valuation of Ready Built House - Valuation of Ready built Flats - Valuation of Flats under construction - Valuation of Properties offered as Collateral Security - How to become a Panel Valuer of Banks - Problems involved in Bank Valuation - Precautions to be taken in Bank Valuation - Points to be remembered in Bank valuation.

(9)

VALUATION FOR TAXATION

Direct and Indirect Taxes - Valuation for Income Tax - Estimation of Cost of Construction by Plinth area rate method - Valuation by CPWD and State PWD Rates - Cost of Construction by accounting method - Valuation for Capital Gains Tax - Fair Market Value as on 01.04.1981 and 01.04.2001 - Section 50C of Income Tax Act - Valuation for individual Property - Valuation of Apartment

(9)

TOTAL: 45 Hours

1.

REFERENCE BOOKS

1. Kanagasabapathy B., "Practical Valuation", Volumes I - X, No 1, Prestige Flats, Reynolds Road, Trichy.
2. Ashok Nain, "Principles of Valuation", Tata McGraw Hill Publishing House, July 2010.
3. Roshan H. Namavati, "Theory and Practice of Valuation", Lakhani Book Depot, Mumbai, 2009.
4. Banerjee D. N., "Principles and Practice of Valuation", J.A. Parks, Eastern Law House, Delhi 5th Edition, 1998.

1.

19CEE36- ENGINEERING ECONOMICS

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon successful completion of this course, student will be able to

CO1: Recognize the fundamental economic concepts applicable to engineering.

CO2: Select appropriate techniques of incorporating inflation factor in economic decision making.

CO3: Apply the basics of economics and cost analysis to engineering.

CO4: Identify economically sound decisions.

INTRODUCTION TO ECONOMICS

Introduction to Economics- Flow in an economy, Law of supply and demand, Macro economics and micro economics - Concept of Engineering Economics - Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis - Material selection for product - Design selection for a product, Process planning.

(9)

VALUE ENGINEERING

Make or buy decision, Value engineering - Function, aims, Value engineering procedure. Interest formulae and their applications-Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

(9)

CASH FLOW

Methods of comparison of alternatives - present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

(9)

REPLACEMENT AND MAINTENANCE ANALYSIS

Replacement and Maintenance analysis - Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a

1.

new asset - capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

(9)

DEPRECIATION

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions - procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. PanneerSelvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
2. Khanka S.S., "Entrepreneurial Development", S.Chand & Co. Ltd, New Delhi, 1999.
3. Hisrich R. D. and Peters M. P., "Entrepreneurship", 5th Edition, Tata McGraw-Hill, 2002.
4. Naidu N.V.R., "Management of Entrepreneurship", I.K. International Pvt Ltd., New Delhi.

REFERENCE BOOKS

1. Chan S. Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald G. Newman, Jerome P. Lavelle, "Engineering Economics and Analysis," Engg. Press, Texas, 2010.
3. Degarmo E.P., Sullivan W.G and Canada J.R., "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan, "Engineering Economy", Dorling Kindersley, 2012.
5. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.

ONLINE RESOURCES:

1. NPTEL Course: https://nptel.ac.in/courses/112/107/112107209/

1.

19CEE37- MAINTENANCE AND REHABILITATION OF STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME:

On completion of the course the students will be able to

CO1: Assess the strength and quality of existing concrete structures by NDT

CO2: Evaluate the damages in concrete structure due to climate, temperature, chemicals, corrosion.

CO3: Plan and Suggest suitable repair materials and techniques for repairing of distressed concrete structures.

CO4: Dismantle and demolish structures which cannot be repaired in an environment friendly, with maximum saving of materials and in a safe way.

SERVICEABILITY AND DURABILITY OF CONCRETE

Quality assurance for concrete construction - concrete preparation - strength, permeability, thermal properties, cracks - effects due to climate, temperature, chemicals, corrosion – construction errors - strength evaluation of existing structures by NDT (Rebound Hammer Test, Ultrasonic Pulse Velocity Test).

(9)

MAINTENANCE AND REPAIR STRATEGIES

Maintenance, Repair and Rehabilitation, facets of maintenance, importance of maintenance - various aspects of inspection, Assessment procedure for evaluating a damaged structures, causes of deterioration.

(9)

CRACKS

Cracks in concrete - intrinsic cracking and structural cracking - causes and remedies - plastic cracks and remedies – Thermal contraction cracks - Long term drying shrinkage cracks - Sulphate attack cracks - Alkali aggregate reaction cracks.

(9)

MATERIALS FOR REPAIR

Material for Repair: Concrete chemicals, special elements for accelerated strength gain - Expansive cement - Polymer concrete - Sulphur infiltrated concrete - Ferro cement - Fibre reinforced concrete.

(9)

REPAIR AND DEMOLISION TECHNIQUES

Repair techniques: Rust eliminators and polymer coating for steel bars during repairs - formed concrete, mortar and dry pack - Vacuum concrete - Gunite, shotcrete and Grouting - Epoxy injection - Mortar repair for cracks - shoring and under pinning.

Demolition Techniques: Engineered demolition techniques for dilapidated structures - Case studies.

(9)

TOTAL: 45 Hours

1.

TEXTBOOKS:

1. Varghese.P.C Maintenance Repair and Rehabilitation and Minor works of building, Prentice Hall India Pvt Ltd 2014.
2. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
3. Vidivelli.B Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.

REFERENCES:

1. Dodge Woodson.R Concrete Structures, Protection, Repair and Rehabilitation, Butterworth- Heinemann, Elsevier, New Delhi 2012
2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987
3. Shetty M.S. Concrete Technology-Theory and Practice, S.Chand and Company, 2008.
4. Dov Kominetzky.M.S., "Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001
5. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.
6. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
7. Gambhir. M. L., "Concrete Technology", McGraw Hill, 2013
8. SP:25 Causes, Prevention and Remedies of Cracks in Building and National Building Code of India 2016

ONLINE RESOURCES:

1. http://www.cpwd.gov.in/Units/handbook.pdf
2. https://nptel.ac.in/courses/105/106/105106202/
3. https://nptel.ac.in/courses/105104030/

1.

19CEE38- ADVANCED CONSTRUCTION TECHNOLOGY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to:

CO1: Demonstrate the advanced construction techniques for sub structure and super structure

CO2: Identify suitable underground construction technique for a given soil strata

CO3: Discuss the methods, equipments and features involved in offshore construction.

CO4: Explain the methods and techniques of Long span bridge construction.

CO : Express the basic aspects and stages of precast and prefabrication construction

SPECIALIZED CONSTRCTION TECHNIQUES

Construction aspects and procedures of specialized construction techniques - Box pushing -Box type retaining walls - Slip form for Chimney and Silo construction - Sheet piling and Diaphragm walls - Well and Caisson - Underpinning - Shotcreting & Guniting - Vacuum dewatering – Finishing & Curing method **(9)**

UNDERGROUND CONSTRUCTION

Site investigation and Geological studies - Drilling - Pneumatic breakers - Explosives - Blasting. Tunneling technology- Mechanized shield- Micro method- Cut and cover method-Pipe Jacking - Hazards and safety measures in underground construction. **(9)**

OFFSHORE CONSTRUCTION

Underwater construction - Stages of offshore structure, Construction, Facilities and Methods of fabrication- Equipments- Crane barges derrick barges - Drilling vessels **(9)**

BRIDGE CONSTRUCTION TECHNIQUES

Types of Bridge- Based on span- Material- Type of super structure- Support condition -Position of floor -High flood level- Bridge construction methods – In situ and Precast construction methods- Balanced cantilever methods - Span by span method - Incremental launching method. **(9)**

PRE-CAST AND PRE-FABRICATION CONSTRUCTION

Planning, Analysis and Design considerations for Precast and Prefabrication constructions - Materials, Moulds and Modular Coordination, Standardization - Precast systems - Joints in Precast constructions- Curing techniques- Handling- Transportation and Erection techniques - Fabrication and Erection of Steel Structural Elements. Case study – Precast and prefabricating technology for Low c ost and Mass Housing Schemes. **(9)**

TOTAL:45 Hours

1.

TEXT BOOKS

1. Roy Chudley and Roger Greeno, "Advanced Construction Techniques," Pearson Prentice Hall, 2006.
2. Beer, G., "Technology Innovation in Underground construction", CRC Press, 2009.
3. Gerwick, B., "Construction of marine and offshore structures", CRC Press, 2007.

REFERENCE BOOKS

1. Levitt, "Precast concrete - Materials, manufacture properties and usage", Taylor & Francis, 2007.
2. Hurd M. K., "Formwork for concrete", American Concrete Institute, Detroit, 1995.
3. Chew Yit Lin, Michael, "Construction Technology for Tall Buildings", Singapore University Press, World Scientific Publishing company, 2009.
4. Richardson, J.G., "Pre-cast concrete Production", Cement and Concrete Association, 1973.

1.

19CEE39- CONTRACT MANAGEMENT

ASSESSMENT: THEORY

COURSE OUTCOME

L	T	P	C
3	0	0	3

After successful completion of the course, students will be able to

CO1: Recognize, Explain & Relate to Contract Types and Identify where/when Administered.

CO2: Employ the procedure for contractor's selection through tendering process.

CO3: Indicate Best Choice & Apply Construction Contracting Practices Used at Industry-Level.

CO4: Proactively identify construction contract conflicts and resolve through arbitrations and legal procedures.

CO5: Assess the impact of labor regulations and their impact on managing contracts.

CONSTRUCTION CONTRACTS

Elements of Contracts – Types of Contracts – Features – Suitability – Salient Features of Indian contract Act 1872 as Relevant to Construction Contracts – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts– Contract for Engineering and Architectural Services– Contract between Owner and Contractor.

(9)

TENDERS

Types of Tenders – Notice Inviting Tender – Prequalification – Preparation and Submission of –Bid Documents & Tenders – Bidding – Acceptance/Rejection of Tenders – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Tamilnadu Transparency in Tenders Act – Local and International Competitive Bidding – Global Tendering.

(9)

CONTRACT ADMINISTRATION AND MANAGEMENT

Selection of Project Management Team – Possession of Construction Site – Duties of Employers – Duties of Contractors – Selection of Sub-contractors – Handling of Contract Matters – Settlement of Variations & Clarifications in Construction – Documentation and Maintenance of Construction Progress Records – Field Diary –Maintenance of Feed Back Reports and Documentation – Quality control Inspection Reports and Outcomes.

(9)

ALTERNATE DISPUTE RESOLUTION

Claims and Disputes in Construction contracts – Various Methods of Settlement of Disputes – Alternate Dispute Resolution – Negotiation, Mediation, Conciliation and Arbitration – Salient Features of The Arbitration and Conciliation Act 1996 – Formation of Arbitration Tribunal – Interim Award – Conduct of Arbitration Proceedings – Award Writing and Setting aside of Award.

(9)

1.

LEGAL REQUIREMENTS IN CONSTRUCTION INDUSTRY

Insurance and Bonding – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations – Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Tamilnadu Factory Act – Child Labour Act - Other Labour Laws.

(9)

TOTAL : 45Hours

TEXT BOOKS

1. Jimmie Hinze, Construction Contracts, McGraw Hill, 2001
2. B. S. Ramaswamy, Contracts and Their Management, LexisNexis Butterworths, 2005
3. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M.Tripathi Private Ltd., Bombay, 1982

REFERENCE BOOKS

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M.Tripathi Private Ltd., Bombay, 1982

2. Jimmie Hinze, Construction Contracts, McGraw Hill, 2001

3. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.

4. Kwaku, A., Tenah, P.E. Jose M.Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.

5. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 2006.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/103/105103093

1.

19CEE40- CONSTRUCTION EQUIPMENTS AND TECHNIQUES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

After successful completion of the course, student will be able to

CO1: Apply engineering fundamentals and analysis to the planning, selection, utilization of earthwork and material handling equipment.
CO2: Describe Concreting and aggregate production equipment, its application and utilization.
CO3: Demonstrate various Equipment for Construction and Rehabilitation works.
CO4: Identify Sub-structure construction techniques and explain their utilization in Construction Industry.
CO5: Apply appropriate techniques for the construction of Super-structures.

EARTHWORK AND MATERIAL HANDLING EQUIPMENTS

Importance of construction equipments their classification, selection and contribution rate of production (Output), Owning and operating cost.
Fundamentals of earth work operations - Selection of equipment for earth work- Types of earth work equipment – Tractors, Motor graders, Scrapers , Front end waders, Earth movers. Material handling equipment – Forklifts and related equipment – conveyors-hauling equipment.

(9)

EQUIPMENTS FOR AGGREGATE PRODUCTION AND CONCRETING Crushers-Feeders- screening equipment – handling equipment- batching and mixing equipment-hauling, pouring and pumping equipment, RMC equipment.

(9)

OTHER CONSTRUCTION EQUIPMENTS

Equipment for Foundation, Pile driving equipment, micropiling – Equipment for compaction, Equipment for dewatering and grouting. Equipment for Demolition. Rehabilitation techniques.

(9)

SUBSTRUCTURE CONSTRUCTION

Techniques for box jacking, pipe jacking, diaphragm wall construction – piling techniques – driving well and caisson – cofferdam – sheet piles – dewatering and stand by plant equipment for underground open excavation.

(9)

SUPERSTRUCTURE CONSTRUCTION

Vacuum dewatering for concrete flooring - Techniques for continuous concreting operations – Concrete paving technology – Erection techniques of tall structures – pre stressing in high rise structures. Launching girders, bridge decks – Eco buildings and Green building concept – Natural buildings – Passive buildings – Intelligent (smart) buildings – Building automation – Energy efficient buildings for various zones

(9)

Total: 45 Hours

TEXT BOOKS:

1. Sharma S.C. “Construction Equipment and Management”, Khanna Publishers New Delhi, 2017.

1.

2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", 9th Edition, McGraw Hill, 2018.
3. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 2010.
4. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2012.
5. Varghese, P.C Building construction, Prentice Hall of India Pvt. Ltd., New Delhi.
6. Dr. Mahesh Varma, "Construction Equipment and its Planning and Application", Metropolitan Book Company, New Delhi, 2005.

REFERENCE BOOKS:

1. Rangwala, S.C., "Construction of Structures and Management of Works", 5th edition, Charotar publishers , 2005
2. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.
3. "Construction Equipment Management" by John Schaufelberger.

1.

19CEE41- FORMWORK FOR CONCRETE STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, students will be able to

CO1: Recognize the correlation of the structural design and construction of scaffolding, formwork and shoring.

CO2: Apply economy and safety principles and considerations in formwork design.

CO3: Gain engineering judgment on formwork materials and their allowable stresses.

CO4: Apply formwork analysis and design, erect and inspect formwork, scaffolding and shoring in construction projects.

CO5: Identify and assess the criteria and requirements for erecting and stripping of formwork and false-work structures and thereby assess constructability and structural safety.

PLANNING, SITE EQUIPMENT & PLANT FOR FORM WORK

Introduction – Formwork as a temporary structure – Requirements for formwork – classification of formwork- Key areas of cost reduction of formwork – Economical planning of form materials- Planning for Safety - Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan – Transporting plant

(9)

MATERIALS, ACCESSORIES, PROPRIETARY PRODUCTS & PRESSURES

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on columns and walls.

(9)

DESIGN OF FORMS AND SHORES

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Slab props - Heavy Duty props.

(9)

BUILDING AND ERECTING THE FORM WORK

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems – Flying system forms- Prefabricated panel systems –Giant forms- curved wall forms- Beam or girder forms – suspended forms. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

(9)

FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS

Formwork for domes - Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method -

1.

Continuous Advancing Slope method. Slip Forms - Principles -Types - advantages - Functions of various components - Safety in slip forms special structures built with slip form Technique - Types of scaffolds – timber scaffolds, metal scaffolds and some proprietary scaffolds – possible causes for collapse of scaffold systems.

(9)

TOTAL: 45Hours

TEXT BOOKS

1. Kumar Neeraj Jha., Formwork for concrete structures, McGraw Hill Education (India) Private Limited, New Delhi,2017.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996.

REFERENCE BOOKS

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.
2. Michael P. Hurst, Construction Press, London and New York, 2003.
3. Robert L. Peurifoy and Garold D. Oberlender, Formwork For Concrete Structures, McGraw Hill , 1996.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/105/104/105104030/

1.

19CEE42 - ENTREPRENEURSHIP IN CIVIL ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Define the concepts of entrepreneurship and analyze the business environment in order to identify business opportunities

CO2: Define the industrial enterprises and identify the elements of success of entrepreneurial ventures

CO3: Explain the basic structure and key rules of business taxation law

CO4: Demonstrate knowledge of the legal and ethical environment impacting business

CO5: Define the banking financial services, auditing and insurance for enterprises and consider the legal and financial conditions for starting a business venture

CONCEPT OF ENTREPRENEURSHIP

Entrepreneur- Qualities of an Entrepreneur - Functions of Entrepreneurs -Classification of Entrepreneurs -Entrepreneurship - Meaning - Factors influencing Entrepreneurship – Intrapreneurship -Corporate Entrepreneurship/Intrapreneurship- Entrepreneurial Organizations and Strategic Management- Innovation and Entrepreneurial Marketing- Managerial Competencies as an Entrepreneurial Manager- Business idea generation techniques - Identification of Business opportunities - Feasibility study - Preparation of Project Report - Tools of Appraisal.

(9)

INDUSTRIAL ENTERPRISES

Classification of industries - large, Micro, Small and Medium small (MSME), heavy, light, private, public, joint cooperative sector, multinational, cottage, tiny, village, ancillary, basic, capital intensive, labour intensive industries. Institution for the development of small scale industries - NSIC, SIDCO, SIDO, SISI, TANSI, DIC, Concessions, rebates, incentives and subsidies to small scale units- All India Financial Institutions -Commercial Banks - Startup India, Stand Up India, Mudra Loan - Industrial Estates-Special Economic Zones(SEZ)-Export Oriented Units(EOU) Procedures in setting of small scale units - Licensing - Registration - Financing - Working

(9)

BUSINESS TAXATION

Direct and indirect taxes-Income Tax- Income Tax Act 1961 - Basic Concepts and Definitions - Income, Assessee, Person, Previous Year, Assessment Year, Gross Total Income, Total Income. Meaning of Permanent Account Number, Return of Income, TDS, Advance Tax, Rates of Taxation, Assessment Procedure. Service Tax-Customs Duty, Excise Duty -Goods And Services Tax (GST)-Definitions- computations- Deductions-exemptions--Registration of an Assessee- Payment of Tax- Furnishing of Return- Interest as Delayed Payment of Tax- Punishments/ Penalties Relating to Taxes- Appeal before the respective Commissioners- Appeal before Appellate Tribunal.

(9)

CORPORATE BUSINESS LAW AND AUDITING

Indian Contract Act - Formation - Terms of contract - Forms of contract - Offer and Acceptance Considerations. Capacity - Flaw in consent, Void agreements - Illegal agreements. Memorandum of Association - Contents and Alteration - Doctrine of Ultra Vires

1.

- Articles of Association - Contents - Distinction between the Two - Share Capital - Kinds of Shares - Voting Rights - Borrowing powers of companies -Membership in a company - Directors - Legal position - Appointment, removal, Rights, Duties and Powers - Qualification and Disqualification. Meetings and Resolutions - Statutory Meeting - Annual General Meeting – Extra Ordinary General Meeting - Resolutions - Ordinary & Special. Definition of Audit - Difference between auditing and accountancy - Scope of auditing -Objectives of auditing - Nature and Scope of internal audit - Financial vs. operational audit - Internal control; nature and scope - Verification of evidence - Detailed checking vs. sample checking - Internal audit and statutory audit - Interface between internal auditor and statutory auditor. **(9)**

BANKING FINANCIAL SERVICES

Central Banking and Role of RBI and their functions. Commercial Banks - E - Banking -ATM Cards, Debit cards, Personal Identification Number - Electronic Fund Transfer-Electronic Clearing System. Negotiable Instruments - Promissory Note - Bills of Exchange, Cheque, Draft - Definitions, Features - Crossing - Endorsement - Material Alteration - Paying Banker - Rights and Duties - Statutory Protection - Dishonour of Cheques - Merchant Banking - Functions - Issue Management - Managing of new issues - Underwriting - Capital market - Stock Exchange - Role of SEBI-Leasing and Hire purchase - Concepts and features - Types of lease Accounts-Factoring - Functions of Factor - Consumer finance - Venture capital - Mutual Funds - Credit Rating. Insurance - Different types - Life, marine, fire, motor, health, pension plan, annuity, rural insurance.

(9)

TOTAL: 45 Hours

TEXT BOOKS

1. Srinivasan N.P, C.B Gupta., "Entrepreneurial Development", Sultan Chand and Sons Publishers, 2014.
2. J.S. Saini, S.K. Dhameja., "Entrepreneurship and Small Business", Rawat Publications, 1998.

REFERENCE BOOKS

1. B.N. Tandon, S. Sudharsanam, S. Sundharabahu., "A Handbook of Practical Auditing", S.Chand Limited, 2006.
2. B. Santhanam., "Banking and Financial Systems", Margham Publishers, 2012.
3. B. Santhanam., "Financial Services", Margham Publishers, 2016.
4. Dr. M.N. Mishra., "Law of Insurance", Central law agency.
5. H.P. Machiraju., "Indian Financial System", Vikas Publishing House Pvt. Ltd, 2007.
6. S. Badre Alam ., P. Saravanavel ,"Mercantile Law".
7. Vinod K. Singhania .,"Indirect Tax".

ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc20_ge08/preview

1.

OPEN ELECTIVES
19CEOE01- TOWN PLANNING AND ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES:

After successful completion of the course, student will be able to

CO1: interpret the geometric forms and aesthetic qualities of Architecture
CO2: integrate the various elements of architecture and orientation of buildings
CO3: describe the development plans and planning regulations
CO4: incorporate the development control rules in town and country planning

PRINCIPLES OF TOWN PLANNING

Evaluation of planning – Objects of town planning – principles of town planning- origin of towns – growth of towns – origin – direction – various forms of planning

(9)

ELEMENTS OF ARCHITECTURE

Introduction of architecture - definition - Evaluation of geometric forms - function and history - Sphere, Cube, Pyramid, Cylinder and Cone - aesthetic qualities of Architecture - Proportion, Scale, Balance, Symmetry, Rhythm and axis - Contrast in Form - Harmony.

(9)

PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS

Factors affecting orientation - Sun-Wind-Rain - Orientation criteria for Indian conditions - Principles governing the theory of planning - Planning of residential buildings.

(7)

DEVELOPMENT PLAN

Principles of city planning - levels of planning- scope and contents of regional plan, master plan, detailed development plan and structure plan - preparation and implementation - planning of new towns – slum clearance and urban renewal.

(9)

PLANNING LEGISLATION AND DEVELOPMENT CONTROL RULES

Planning legislation and administration - Tamil Nadu Town and Country Planning Act, Tamil Nadu Housing Board Act, Tamil Nadu slum clearance and Improvement Act. Zoning regulations - sub division regulations – building regulations - Floor Space Index - minimum plot sizes - open spaces - minimum standard dimensions

(11)

Total: 45 hours

1.

TEXT BOOKS:

1. RangwalaS.C., “Town Planning”, Charotar Publishing House, Anand, 2013.
2. Francis D.K., Ching, “Architecture Form, Space and Order”, Oxford University Press, 2014.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/124/107/124107001/
2. https://nptel.ac.in/content/storage2/courses/109104047/pdf/lecture40.pdf

1.

19CEOE02- CLIMATE CHANGE AND ADAPTATION

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, students will be able to

CO1: Outline the earth's system which influences the climatic factors of the earth.

CO2: Infer the evidences and observed changes in the climate and environment on a global scale and in India.

CO3: Analyse the impacts of climate change on various sectors and the uncertainties over the projected impacts of climate change.

CO4: Investigate the various adaptation and mitigation options in various sectors and examine the mitigation efforts made in India.

CO5: Correlate future clean technology and alternate energy options inferred in clean development mechanism.

EARTH'S CLIMATE SYSTEM

Introduction-Climate in the spotlight-The Earth's Climate Machine – Climate Classification – Global wind systems – Trade Wind Systems – Trade Winds and the Hadley Cell – The Weserlies – Cloud formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – EI Nino and its Effect – Green House Gases and Global Warming – Carbon Cycle.

(9)

OBSERVED CLIMATE CHANGE AND ITS CAUSES

Observation of Climate Change – Changes in pattern of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change - Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India.

(9)

IMPACTS OF CLIMATE CHANGE

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for different regions – Uncertainties in the Projected Impacts of Climate Change.

(9)

CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES

Adaptation Strategy/options in various sectors – Water – Agriculture – Infrastructure and Settlement including coastal zones. Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and practices – Energy supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbon sequestration – Carbon Capture and Storage (CCS) - Mitigation Efforts in India and Adaptation funding.

(9)

CLEAN TECHNOLOGY AND ENERGY

Clean Development Mechanism – Carbon Trading – Examples of future Clean Technology – Biodiesel – Natural Compost – Eco-friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power.

(9)

Total: 45 hours

1.

TEXT BOOKS:

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.
2. UNIPCC Fifth Assessment Report, 2014.
3. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

REFERENCES:

1. Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.
2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998.
3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998.
4. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

ONLINE RESOURCES:

1. "An Inconvenient truth (2006)"- video
2. https://climate.nasa.gov
3. https://unfccc.int
4. https://environment .gov.au

1.

19CEOEO3 - METRO SYSTEMS AND ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

After successful completion of the course, student will be able to

CO 1: Integrate the basic elements of MRTS, BRTS, LRTS and other transportation systems

CO 2: Illustrate the components of metro rail systems

CO 3: Apply the concepts of ITS in the field of Transportation Engineering

PRINCIPLES OF TRANSPORTATION SYSTEMS

Transportation systems in India – various modes of transport – public transport – Intermediate public transport – types – characteristics – other urban transportation modes – drawbacks- various transit systems

(9)

MRTS

Definition – Mass Rapid Transit System – History of MRTS - Need for MRTS – connectivity in Indian conditions – cities having MRTS – infrastructure – operations – fares and ticketing - case study.

(8)

BRTS and LRTS

Bus Rapid Transit System – terminology – history -features - performance – cost - drawbacks – Light Rail Transit System – necessity – types – gauge- capacity integration with cycles – comparison to other rail modes

(9)

METRO RAIL SYSTEMS

History of Metro trains - Need for Metro rail – connectivity in Indian conditions – cities having Metro - construction techniques adopted in Metro Rail stations - Case study – Delhi Metro (DMRC) – Chennai Metro (CMRL)

(10)

ITS

Definition – Intelligent Transport System – Principles - Application of ITS technologies in various countries – smart transportation - case studies

(9)

Total: 45 Hours

1.

TEXT BOOKS:

1. Pradip Kumar Sarkar, Vinay Maitri, G. J. Joshi ·"Transportation Planning Principles, Practices and Policies", Prentice Hall India Pvt., Limited 2017
2. D. Johnson Victor, S. Ponnuswamy, "Urban Transportation Planning, Operation and Management" Tata McGraw-Hill Education, 2012
3 Mashrur A. Chowdhury, Adel Wadid Sadek "Fundamentals of Intelligent Transportation Systems Planning" Artech House · 2003

4 Sumit Ghosh, Tony S. Lee, "Intelligent Transportation Systems Smart and Green Infrastructure Design, Second Edition" CRC Press · 2010

ONLINE RESOURCES

1. https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_48.pdf

1.

19CEOE04- RENEWABLE ENERGY RESOURCES

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1 : Infer the current energy scenario and future energy usage in India.

CO2 : Interpret the concepts of solar energy, wind energy, tidal energy and biomass energy.

CO3 : Compare the energy utilization from wind energy, solar energy, biomass energy and tidal energy.

CO4 : Correlate the challenges and problems associated with the use of energy sources.

ENERGY PERSPECTIVES

Conventional and non conventional energies - Energy and sustainable development - Global energy scenario - Energy scenario in India - Energy consumption pattern in rural and urban regions in India - Energy efficiency and economy - Energy losses and its control - Renewable energy potential mapping - Plant load factor

(9)

SOLAR ENERGY PERSPECTIVES

Concept of solar energy - Solar energy to light and to thermal conversions - Total energy and necessary infrastructure – Units and measurement of solar radiation - Temperature dependent collecting devices and their efficacies - Design aspects – Typical applications: heating, cooling, lighting, power generation and cooking.

(9)

WIND ENERGY PERSPECTIVES

Wind potential in India - Wind turbines and their types - Merits and demerits - Wind power and appropriate coefficient – Efficiency and performance of wind machines -Energy conversion and storage - Synchronous invertors - Various storage aspects: battery, fly wheel, hydrogen and compressed air.

(9)

BIOMASS ENERGY PERSPECTIVES

Biomass potential in India - Gobar gas and producer gas - Characteristics of biomass - Operation and design of biogas plants - Objectives, principles and operational aspect of biogassifiers - Pyrolysis and incineration - Power generation from municipal solid waste and industrial Sludges - Application of biodiesel plants - Fuel cells.

(9)

TIDAL ENERGY PERSPECTIVES

Tidal aspects in coastal India - Tidal energy conversion system: mechanical to electrical and thermal to electrical - Tidal force calculation and power generation - conceptualization and potential of geothermal energy - Geothermal vents.

(9)

TOTAL: 45 Hours

TEXT BOOKs

1. Sukathme, S.P, Nayak J.K., "Solar Energy", Tata McGraw-Hill Book Co., New Delhi, 2017.
2. Rai, G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2010.

1.

3. P.Kothari, K.C Singal, Rakesh Ranjan “Renewable Energy Sources and Emerging Technologies”, PHI Learning Pvt.Ltd, New Delhi, 2013.
4. Scott Grinnell, “Renewable Energy & Sustainable Design”, CENGAGE Learning, USA, 2016.

REFERENCE BOOKS

1. Richard A. Dunlap,” Sustainable Energy” Cengage Learning India Private Limited, Delhi, 2015.
2. Godfrey Boyle, “Renewable energy”, Open University, Oxford University Press in association with the Open University, 2004.
3. Shobh Nath Singh, ‘Non-conventional Energy resources’ Pearson Education ,2015.

Online resources:

1. https://swayam.gov.in/nd1_noc20_ge06/preview
2. https://swayam.gov.in/nd2_nou20_cs09/preview

1.

19CEOE05- PRINCIPLES OF SUSTAINABLE DEVELOPMENT

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Identify the components, factors and environmental issues affecting Sustainable development.

CO2: Assess the role of International summits, conventions and Environmental aspects on Sustainable development.

CO3: Interpret the necessity and importance of Indian and International Socio –economical and legal aspects in Sustainability.

CO4: Illustrate the different strategies to achieve Sustainable development.

CO5: Assess the role of Life cycle Assessment, Cleaner Production and Sustainable Chemistry to achieve sustainable development. .

CONCEPTS OF SUSTAINABLE DEVELOPMENT

Sustainable development- Evolution of Environmental awareness and Sustainable development, global Sustainable development goals -components and factors affecting Sustainable development-Demographic dynamics and sustainability- Environmental issues and crisis- ozone layer depletion, global warming and climate change

(9)

ENVIRONMENTAL ASPECTS

International Environmental summits, conventions and agreements-Tiwari committee recommendation – Role of Pollution Control Board - Transboundary issues - Ecological indicators- Ecological foot print- Carbon foot print - Basic concept of Environmental impact assessment

(9)

SOCIO ECONOMIC AND JUDICIAL ASPECTS

UN Sustainable development policies through trade- World Trade Organization- International monetary fund and World bank –Circular Economy and Sustainable Development - Socio economic policies for sustainable Development- Role of Judiciary in Sustainable Development – Major Environmental Cases in India – Development of Environmental Policies in India - Environment Protection Act, 1986 – EIA notification 2006 - National Conservation Strategy and Policy Statement on Environment and Development, 1992 - Policy Statement for the Abatement of Pollution, 1992 - National Environment Policy, 2006. SDG India Index – Baseline Report 2018

(9)

STRATEGIES FOR SUSTAINABLE DEVELOPMENT

Economic growth and Sustainable Development - Resource depletion and resource protection- – Internet of things and Sustainable Development – Sustainable Management of Forest, Land, water- Natural Disaster management- case studies.

(9)

1.

CLEANER PRODUCTION, LIFE CYCLE ASSESSMENT – GREEN/SUSTAINABLE CHEMISTRY

Cleaner Production, definition, aim, application-Generic process of Cleaner Production Assessment- Life cycle Assessment - definition, necessity and elements- ISO Environmental standards- Environmental Audit –Green Chemistry – twelve Principles of Green Chemistry – case studies.

(9)

TOTAL : 45 Hours

TEXT BOOKS

1. Ramakrishnan, P. S., "Ecology and Sustainable Development", National Book Trust, New Delhi, 2001

2. Paul Robbins, John Hintz, and Sarah A. Moore, "Environment and Society: A Critical Introduction", Wiley-Blackwell, 2014

3. Bimal N. Patel and Ranita Nagar, “Sustainable Development and India”, Oxford University Press, 2018.

REFERENCE BOOKS

1. Nick Hanley, Jason F. Shogren and Ben White, "Environmental Economics in Theory and Practice", Macmillan Publishers,
UK, 1997

2. Tietenberg T. and Lynne Lewis, "Environmental and Natural Resource Economics", Harper Collins, Routledge, 2016

3. Kirkby, J.O., Keefe, P., and Timberlake, "Sustainable Development", Earthsean Pub., London, 2001

Online Resources:

1.https://nptel.ac.in/courses/107/103/107103081/

1.

19CEOE06 - DISASTER MANAGEMENT

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

At the end of this course, the student will be able to

CO1 : Identify natural and manmade disasters

CO2 : Explain in detail about causes and effects of natural and manmade disasters.

CO3 : Apply geospatial techniques (including GIS) that can enhance vulnerability assessments

CO4 : Identify and analyse the factors that give rise to differential vulnerabilities and levels of community resilience and suggest necessary mitigation plans

CO5 : Assess and manage these vulnerabilities through disaster planning and policy-making.

NATURAL DISASTERS

Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche.

(9)

MAN MADE DISASTERS

Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster- Forest Fire- Oil fire -accident in Mines.

(9)

GEOSPATIAL TECHNOLOGY

Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping.

(9)

RISK ASSESSMENT AND MITIGATION

Hazards, Risks and Vulnerabilities - Disasters in India, Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans.

(9)

DISASTER MANAGEMENT

Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism.

(9)

TOTAL: 45 Hours

1.

TEXT BOOKS

1. Khanna B K, "All You Wanted To Know About Disasters", New India Publishing Agency, New Delhi, 2005.
2. Ramana Murthy, "Disaster Management", Dominant, New Delhi, 2004.
3. Rajdeep Dasgupta, "Disaster Management and Rehabilitation", Mittal Publishers, New Delhi, 2007.

REFERENCES

1. Disaster Management in India- A Status Report- Published by the National Disaster Management Institute, Ministry of Home Affairs, Govt. of India, 2004.
2. Murthy D. B. N., "Disaster Management: Text and Case Studies", Deep and Deep Publications (P) Ltd., New Delhi, 2007.
3. Sundar I. and Sezhiyan T., "Disaster Management", Sarup and Sons, New Delhi, 2007.

1.

ONE CREDIT COURSES

19CEOC01 BUILDING CONSTRUCTION PROCESS- AN OVERVIEW

L	T	P	C
1	0	0	1

1. **Introduction of building Construction Process – Step by Step**
    a. Site Selection
    b. Marking
    c. Earth works excavation
    d. Concreting
    e. Brick works
    f. Plastering
    g. Flooring
    h. Painting **[2]**
2. **Quantity measurement of Building**
    a. Quantity Calculation of each element
    b. Material calculation
    c. Rate arriving per unit

    [2]
3. **Building Material and its Selection process**
    a. What are materials available in the market and How to select with practical approach?

    [2]
4. **Good Concrete making**
    a. Batching
    b. Mixing
    c. Transporting
    d. Compacting
    e. Finishing
    f. Curing

    [2]
5. **Construction Practices**
    a. Do's and don'ts in construction practices

    [2]
6. **Cement Manufacturing Process, Types of cement and It's application**
    a. Cement Manufacturing process
    b. Types of cement
    c. What are the cements available in the market
    d. Testing of cement – Physical and Chemical
    e. Application of cement in construction

    [2]

TOTAL : 12+3 (Evaluation) = **15hours**

1.

19CEOC02 APPLICATIONS OF IoT IN CIVIL ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
1	0	0	1

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe what IoT is and how it works today

CO2: Design and program IoT devices

CO3: Design an IoT device to work with a Cloud Computing infrastructure.

CO4: Transfer IoT data to the cloud and in between cloud providers

CO5: Define the infrastructure for supporting IoT deployments

Introduction to IoT Defining IoT

Characteristics of IoT - Physical design of IoT - Logical design of IoT - Functional blocks of IoT - Communication models & APIs **(3)**

IOT Standards and Components

Requirement of international standard (case study) - Design of IOT systems - Development of prototypes for civil engineering projects. **(2)**

Relevance of IOT for the future.

IOT in Construction site - Internet of Everything - IOT and Individual Privacy. **(3)**

IOT in Indian Scenario

IOT and Aadhaar - IOT for concrete and curing services - IOT for rural empowerment **(2)**

IOT Applications (Case Studies)

Intelligent Traffic systems - Smart Parking - IOT for smart cities. **(2)**

TOTAL : 12+3 (Evaluation) = **15hours**

TEXT BOOKS

1. Micahel Miller "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", Pearson Education, USA, 2015.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-onApproach)", 1st Edition, VPT, 2014

REFERENCE BOOKS

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

1.

19CEOC03 CERTIFICATION AND CAREER ROAD MAP IN CIVIL ENGINEERING

ASSESSMENT: THEORY

L	T	P	C
1	0	0	1

COURSE OUTCOME:

At the end of the course, the students will be able to

CO1: understand the District Town and Country Planning approval process

INTRODUCTION

Planning Approval Meaning, Controls / Regulating Competent Authority, Types of Approval, Checklist for Approval, E-DCR Online Drawing Submission

CORPORATION/LOCAL BODY APPROVAL

Residential - Group Housing / Villas, Apartments, Commercial include office buildings, warehouses, and retail buildings, Industrial & Institutional - Factories and other premises used for manufacturing, altering, repairing, Schools & Colleges or any other educational Institutions.

THE DISTRICT TOWN & COUNTRY PLANNING OFFICE

Residential - Group Housing / Villas, Apartments, Commercial include office buildings, warehouses, and retail buildings, Industrial & Institutional - Factories and other premises used for manufacturing, altering, repairing, Schools & Colleges or any other educational Institutions.

DTCP CHENNAI APPROVAL

Residential - Group Housing / Villas, Apartments, Commercial include office buildings, warehouses, and retail buildings, Industrial & Institutional - Factories and other premises used for manufacturing, altering, repairing, Schools & Colleges or any other educational Institutions.

E-DCR ONLINE DRAWING APPROVAL

E-DCR online drawing submission, E-DCR stages, E-DCR scrutiny process, Scope of the E-DCR system, E-DCR drawing specification,

TOTAL : 12+3 (Evaluation) = **15hours**

Reference:

1. Guidelines on Preparation of Layout & Building Plans under Tamilnadu Combined Development and Building Rules, 2019

1.

19CEOC04 ENVIRONMENTAL MONITORING

ONE CREDIT COURSE

L	T	P	C
1	0	0	1

ASSESSMENT: THEORY

COURSE OUTCOME

At the end of this course, the student will be able to

CO1: Outline the significant aspects of environmental monitoring and sampling

CO2: Assess the air and water quality monitoring methods

CO3: Interpret the status and trends using monitoring data collected for water and air.

CONCEPTS OF ENVIRONMENTAL MONITORING

Objectives and functions of monitoring - Selection of monitoring sites - Sampling: Grab Sampling, Composite Sampling, Integrated Composite Sampling - Sampling Frequency and Preservation - Preparation of standard solutions: primary standards, secondary standards , stock solution, standard solution , normality, molarity, percent solution, standardization of solutions, Expression of results; mg/l, ppm.

(3)

AIR QUALITY MONITORING

Ambient air quality monitoring - Source of air quality monitoring - Frequency and mode of sampling: Sampling time and sampling locations for air quality monitoring - Environmental procedures for determination of: NOx, Sox, CO, PM (Particulate Matter) - Structure of monitoring report for air quality monitoring.

(4)

WATER QUALITY MONITORING

Physical water characteristics: Colour True and apparent colour, Temperature, Odor – Threshold method, Turbidity – Visual and Instrumental method, Solids – Total solids , Total suspended solids, total dissolved solids - Inorganic and non-metallic constituents: pH, Potentiometric method, Alkalinity, Hardness, Acidity, Chlorides and Sulphates, Metallic constituents: Chromium , Fe, by spectrophotometer - Organic constituents: BOD and COD - Structure of monitoring report for water quality monitoring.

(5)

TOTAL : 12+3 (Evaluation) = **15hours**

TEXT BOOKS

1. Maiti, S.K., "Handbook of methods in Environmental Studies (Vol.I and II)", Oxford Book Company, 2004

1.

2. Garg S. K., "Environmental Engineering", Vol. I Khanna Publishers, New Delhi, 33rd edition.

3. Garg S. K., "Environmental Engineering", vol. II, Khanna Publishers, New Delhi, 39th edition.

4. H.V.N. Rao and M.N. Rao, “Air Pollution”, Tata McGraw-Hill Publishing Company Limited, 2004.

REFERENCE BOOKS

1. IS: 5182, Methods for measurements of air pollution (Part- I, II, IV, V, X), Bureau of Indian Standards, New Delhi, 2003.

2. IS 3025, Methods of sampling and test (physical and chemical) for water and wastewater.

Bureau of Indian Standards, New Delhi, 1986.

Online Reference:

https://nptel.ac.in/courses/103/106/103106162/

1.

19CEOC05 PYTHON FOR CIVIL ENGINEERS

ASSESSMENT: THEORY

L	T	P	C
1	0	0	1

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Develop simple Python program in interactive and script mode.

CO2: Construct Python programs using functions and strings.

CO3: Make use of Python lists ,set, tuples, dictionaries to represent compound data.

CO4: Build Python Programs to read and write data from/to files.

CO5: Develop python programs to handle exceptions.

BASICS OF PYTHON PROGRAMMING

Introduction-Python interpreter- interactive and script mode; values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

(2)

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON

Conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Functions: Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion.

(3)

DATA STRUCTURES: STRINGS, LISTS, SET

Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions ; list processing : list comprehension, searching and sorting, Sets: creating sets, set operations.

(3)

DATA STRUCTURES: TUPLES, DICTIONARIES

Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries.

(2)

CIVIL ENGINEERING APPLICATIONS

Programming for Concrete Mix Design, Concrete quantity calculation, Brickwork material Calculation, Cement and Sand material calculation for Mortar.

(2)

Total :12+3 (Evaluation)= 15Hours

TEXT BOOKS:

1. Ashok NamdevKamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018.

2. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.

1.

REFERENCES

1. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

1.

19CEOC06 3D PRINTING OF CIVIL ENGINEERING STRUCTURES

ASSESSMENT: THEORY

L	T	P	C
1	0	0	1

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe about 3D printing methodology.

CO2: Identify the process required for fabricating.

CO3: Draft the necessity models in the CADD Software.

CO4: Design the concrete mix with various materials.

CO5: Identify the challenges in the field for new methodology.

INTRODUCTION

Three-Dimensional Printing – Introduction, Prototyping fundamentals, Historical development, Classification, Commonly used terms.

ADDITIVE MANUFACTURING TECHNOLOGY

Definition, Additive vs Conventional Manufacturing, Advantages of AMT, Classification of AMT Process – Stereolithography – Fused Deposition Modelling – Selective Laser Sintering – 3D Printing, Applications to various fields.

3D PRINTING IN CONSTRUCTION

Problems in Construction Industry – Need for Automation, Application of 3D Printing – Contour Crafting – Advantages and Limitations, 3D Printing software – Computer Aided Drafting.

CONCRETE MIX FOR 3D PRINTING

Mix goals – Criteria – Compressive strength – Extrudability – Flowability – Buildability – Setting time, Materials – binders – additives – mineral admixtures – fibres, Mix proportioning.

CASE STUDIES AND CHALLENGES

3D printed structures using contour crafting, 3D printed buildings in India, Challenges in 3D printing –curing time – bonding – automated fabrication –connections.

TEXT BOOKS

1. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017

1.

2. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi

REFERENCE BOOKS

1. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.

1.

19CEOC07 ALTERNATIVE BUILDING MATERIALS FROM WASTE

ASSESSMENT: THEORY

L	T	P	C
1	0	0	1

COURSE OUTCOME

CO1: Identify the characteristics related to waste

CO2: Evaluate the properties of blended materials for non-load bearing purpose

CO3: Evaluate the properties of blended materials for load bearing purpose

INTRODUCTION

Environmental issues – Global warming – Eco friendly materials – Materials related to energy and carbon di oxide emission

(2)

BLOCKS & BRICKS

Waste based blocks and bricks – Advantages – Disadvantages – Applications

(2)

CEMENTS

Pozzolana – Types – Agro and industrial based waste – Characterization – - Process adopted to improve properties - Applications in cement / mortar / concrete

(3)

AGGREGATES

Artificial aggregates – Waste as replacement for aggregates – Characterization – Applications in Cement / mortar / concrete

Recycled coarse aggregate – Recycled fine aggregate

(3)

MISCELLANEOUS ELEMENTS

Wastes used for non-structural elements - Partitions – Walls – Roofing system – windows

(2)

TOTAL : 12+3 (Evaluation) = **15hours**

REFERENCE BOOKS

1. Neville, A. M., “Properties of concrete”, Pearson Education Limited, 2012.
2. Santhakumar A. R., “Concrete Technology”, Oxford University Press, New Delhi, 2018.

1.

19CEOC08 STRUCTURAL DRAWING

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1: Describe and write the design procedures for steel and concrete elements and structures

CO2: Draw details of connections, splices, columns, column bases and plate girders as per IS code

CO3: Draw the different concrete and steel elements and structural components to appropriate scale as per design and codal requirements

CO4: Draw details of slabs, beams, columns, footings, water tanks and retaining walls as per IS code

STEEL

Detailed drawing of the following structure

1. Bolt Connections - framed, stiffened seat & unstiffened seat connections
2. Welded Connections - framed, stiffened seat & unstiffened seat connections
3. Tension and column splices
4. Battened and laced Columns
5. Column bases
6. Welded plate girders

CONCRETE

Detailed drawing of the following structure

1. One way floor slab and two way floor slab.
2. Continuous beams.
3. Column with footing
4. Dog legged staircase
5. Water tanks.
6. Retaining walls

TOTAL: 12+3 (Evaluation) = **15hours**

TEXT BOOKS

1. Krishnamurthy,D, "Elementary Structural Design and Drawing", CBS Publishers and Distributors, 2018.
2. Duggal, SK, "Limit State Design of Steel Structures", Tata McGraw Hill Publication, 2017.
3. Sinha, SN, "Handbook of Reinforced Concrete Design", Tata McGraw Hill Publication, 2006.

1.

REFERENCE BOOKS

1. Krishna raju, N, “Structural Design and Drawing”, Universities Press, 2009

2. Bhavikatti, SS, "Design of Steel Structures by Limit State Design", IK International Pvt. Ltd., 2011.

3. Shiyekar, MR, "Limit State Design in Structural Steel", PHI learning Pvt. Ltd., 2013.

4. Gambhir, ML, “Design of Reinforced Concrete Structures”, PHI learning Pvt. Ltd., 2008

1.

19CEOC09 SUSTAINABILITY IN CONSTRUCTION

ASSESSMENT: THEORY

L	T	P	C
1	0	0	1

COURSE OUTCOMES:

CO1: Understand the definition, concept & objectives of sustainable construction.

CO2: Integrate with architects, designers and builders, to improve a building's performance.

CO3: State the concept of energy efficient design used in construction.

CO4: Select the suitability of eco-friendly building materials for construction.

CO5: Assess the appropriate technology for sustainable construction practice.

FUNDAMENTALS OF SUSTAINABLE BUILDING

The context and principles of sustainable design - A view of the current state of sustainable building in national and internationally - Physical, psychological and financial benefits of Sustainable construction.

(3)

SUSTAINABLE ARCHITECTURE AND DESIGN

Role of architecture in sustainable construction - An introduction to sustainable site planning and ecological design - Importance of transportation planning, siting and relationship to sustainability - Benefits of adopting a natural systems-based approach - Bio-mimicry as a design tool based on ecosystem analogy.

(3)

ENERGY EFFICIENT DESIGN

Importance of building energy systems - impacts of energy with human experience and the global environment –Low Energy Building Strategies - Fundamental building energy systems: HVAC, lighting and water conservation.

(3)

SUSTAINABLE MATERIALS SELECTION

Factors in material selection–Material considerations when designing a green construction – Eco friendly building materials: Environmental impact study of building materials about composition, production and recycling, physical properties - Life cycle assessment.

(3)

SUSTAINABLE BUILDING TECHNOLOGIES

Introduction to alternative building technologies: Traditional, vernacular, advanced technological such as interlocking blocks, composite beam and panel, cavity walls, core unit slabs, filler slabs, ferro-cement walls and earthen buildings.

(3)

TEXT BOOKS:

1. Sustainable Construction – Green Building Design & Delivery,Kibert,Wiley 4th Edition, 2016

1.

2. Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004
3. Alternative Building Materials and Technologies, K S Jagadeesh, B V Venkatta Rama Reddy & K S NanjundaRao – New Age International Publishers, 2017
4. Green Building: Project Planning and Cost Estimating, Karolides, A, R S Means - 3rd Edition 2010
5. Integrated Sustainable Design of Buildings, Paul Appleby, Routledge; 1st edition - 2015

1.

19CEOC010 INTRODUCTION TO IMAGE PROCESSING AND GIS

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	2	1

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Carry out remote sensing and GIS applications of various industrial needs.
CO2: Demonstrate the various environmental change detections.
CO3: Use the instrumental data for decision support system
CO4: Create a map incorporating the required features as required.
CO5: Analyze, model and create a database management system

LIST OF EXPERIMENTS

1. Starting up a GIS map and layer editing & exploring
2. Using tools : Hyperlink, identify and navigate
3. Exploring feature- attribute relationship
4. Exploring benefits of the feature-attribute relationship
5. Creating a map layout
6. Reversing a map layout
7. Finding places by using coordinates
8. Determination of Measurements on maps using Mercator projection, Mollweide projection and Winkel Tripel projection
9. Implementation of Vector and Raster data in ArcMap
10. Working with geographic data and exploring
11. Exploration of Query data based on attributes and locations
12. Analyzing data using Buffer and Overlay
13. Analyzing the GIS analysis process using tools, query and combinations

TEXT BOOKS :

1. Floyd F.Sabins, J.R., WH, "Remote Sensing Principles Interpretation", Freeman and Company and Francis Company, France, 1996.
2. Lillesand, Thomas.M and Raiph W.Kiefer, "Remote Sensing and Image Interpretation", John Wiley Sons, 2002.

REFERENCE BOOKS :

1. Burrough.P.A., "Principles of GIS for Land Resources Assesment, Oxford Publication, 1998.
2. Thomas.M.Lillesand and Ralph.W.Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, 2003.

1.

19CI41 - DATA STRUCTURES AND ALGORITHMS - II

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Explain the various file organization and access methods.*

CO2 : *Analyze sorting, searching algorithms with their complexities and their application to real world problems*

CO3 : *Describe various memory management algorithms as used in different operating Systems*

CO4 : *Choose the appropriate data structure and algorithm design method to implement real world problems.*

FILES

External Storage Devices - Definitions and Concepts - Record Organization - Sequential Files - Indexed Sequential Files: Structure and Processing - Other Method of File Organizations: VSAM - Multiple KeyAccess: Multilist, Inverted List. **(7)**

SORTING

Introductory Considerations - Internal Sorts: Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Shell Sort, Heap Sort, Quick Sort, Radix Sort, Address Calculation Sort - External Sorts: Polyphase Sort, Oscillating Sort, Sorting on Discs-Extended Run List-Time Complexity for Sorting Algorithms. **(9)**

SEARCH STRATEGIES

Sequential Search - Binary Search -Extended Binary Tree - Huffman Coding- Search Trees: Height Balanced Trees, 2-3 Trees, Weight Balanced Trees, B-Tree, B+ Trees, Tries, Red Black Trees, Tournament Trees. **(9)**

HASH TABLE METHODS

Introduction- Hashing Functions - Hashing Methods - Collision Resolution Techniques - Time complexity for Searching Algorithms. **(5)**

DYNAMIC STORAGE MANAGEMENT

First Fit - Best Fit - Storage Release - Boundary Tag Method - Buddy System - Garbage Collection - Compaction. **(7)**

ALGORITHMS DESIGN

Basic Steps in Complete Development of an Algorithm - Algorithms and Design Methods: Sub Goals, Hill Climbing and Working Backward, Heuristics, Back Track Programming, Branch and Bound, Simulated Annealing - Knapsack Problem (Back Tracking)- Traveling Salesmen Problem (Branch and Bound). **(8)**

* Note : Algorithms will be taught in Sparks like notation.

TOTAL : 45

TEXT BOOKS

1. *Jean Paul Tremblay, Paul G. Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill, Second Edition, 2008. (Files,Sorting,Hash Table Methods,Search Strategies, Dynamic Storage Management)*
2. *Horowitz E., Sahni S., and Rajasekaran Sanguthevar, "Fundamental of Computer Algorithms", Universities Press (Computer Science), Second Edition, 2008. (Algorithms Design)*

REFERENCES

1. *Alfred V. Aho, John. E. Hopcroft, Jeffrey D, Ullman, "Data Structures and Algorithms", Pearson Education, 2002.*
2. *Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson, Third Edition, 2011*

19CI42 - DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Knowledge in basic concepts, the architecture of database management systems, data models, relational database theory and the features of ER Model.*

CO2 : *Ability to apply relational algebra operations and write appropriate SQL queries with suitable constraints for a given database application*

CO3 : *Master the sound design principles of relational database design using normalization concepts.*

CO4 : *Ability to use different Database Storage structures, access techniques and Indexing methods in Database applications.*

CO5 : *Knowledge in transaction processing concepts, Concurrency Control mechanism and Database Recovery methods and the ability to apply the concepts in the design of Database applications.*

INTRODUCTION

Purpose of DBMS - Applications - Views of data - Data Abstraction - Instances and Schemas - Data Models - Database Languages - Relational Databases - Database Architecture - Database users and administrators - History of Database systems. Entity-Relationship(E-R) Model: Basic concepts - Constraints - E-R Diagram - Weak Entity Sets - Reduction of Relational schemas. BigData - Introduction. **(9)**

RELATIONAL MODEL

Structure of Relational Databases - Relational Algebra Fundamentals - Codd's Rule- Additional and extended relational algebra operations - Null values - Modification of Database.SQL: Basic Structure - Set operations - Aggregate functions - Nested Sub queries - Complex queries - Views - Modification of the database - Integrity constraints - Referential Integrity - Triggers - Assertions - Embedded SQL. **(10)**

DATABASE DESIGN

Features of good relational design - Atomic domains and First Normal Form - Decomposition using Functional Dependencies - Functional Dependency theory - Normalization using Functional Dependencies - Decomposition using Multi-valued Dependencies. **(7)**

STORAGE

Data Capturing Technique: Bar code - QR code. RAID, Indexing and Hashing: Basic concepts, Ordered Indices: Dense and Sparse Indices - MultiLevel Indices - Index Update. B+-Tree Index Files: Structure of a B+-Tree - Queries in B+-Trees. Static Hashing, Dynamic Hashing **(8)**

TRANSACTION MANAGEMENT

Transaction Concepts and States - Concurrent Executions - Serializability. Concurrency control: Lock Based Protocols: Locks, Granting of Locks, 2-phase locking protocol - Timestamp Based Protocols - Validation based protocols - Deadlock Handling.Recovery Systems: Failure classification - Log based Recovery - Recovery with concurrent Transactions. **(11)**

TOTAL : 45

TEXT BOOK

1. *Abraham Silberschatz, Henry F.Korth,S.Sudharshan,"Database System Concepts", McGraw-Hill, Seventh Edition, 2019.*

REFERENCES

1. *Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, Seventh Edition, 2015.*
2. *Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill Education, Third Edition, 2014.*
3. *Peter Rob, CorlosM.Coronel, "Database Systems: Design, Implementation and Management," Thompson Learning Course Technology, Tenth Edition, 2012.*
4. *Thomas M.Connolly and Carolyn E.Begg, " A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2014.*

19CI43 - COMPUTER ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Demonstrate the working of the algorithm for performing arithmetic operations, using the registers and ALU within the processor.*

CO2 : *Illustrate the control sequences and draw data flow path during the instruction execution.*

CO3 : *Discuss the concept of pipelining and examine hazards and techniques to enhance the performance of the system.*

CO4 : *Given a memory module specifications, choose the appropriate memory mapping procedure to enhance the performance of the system.*

CO5 : *Discuss the communication of I/O interface and ports with the processor*

MACHINE INSTRUCTIONS AND ARITHMETIC OPERATIONS

Memory Locations and Addresses : Byte Addressability - Big-Endian and Little-Endian-Word Alignment -Accessing Numbers and Characters. Instruction and Instruction sequencing: Register Transfer Notation - Assembly Language Notation - RISC and CISC Instruction Sets - Instruction Execution and Straight Line Sequencing - Branching. Addressing modes - Stacks - Subroutines - CISC Instruction sets - RISC and CISC styles. Arithmetic algorithms for Additions, Subtraction, Multiplication and Division on Signed magnitude, 2's complement numbers and Floating point Numbers. **(10)**

BASIC PROCESSING UNIT

Fundamental Concepts - Instruction Execution: Load - Store - Arithmetic and Logical Instructions. Hardware components: Register File - ALU - Data path - Instruction Fetch Section. Instruction Fetch and Execution Steps: Branching - Waiting for Memory. Control signals - Hardwired Control: Data path Control Signals - Dealing with Memory Delay. CISC Style Processor: Interconnect using Buses - Micro programmed Control. **(9)**

PIPELINING

Basic Concepts - Pipeline Organization - Pipelining Issues - Data Dependencies: Operand Forwarding - Handling Data Dependencies in Software. Memory Delays - Branch Delays: Unconditional Branches - Conditional Branches - Branch Delay Slot - Branch Prediction. Resource limitations - Performance Evaluation: Effects of stalls and penalties - Number of pipeline stages. Superscalar Operation: Branches and Data Dependencies - Out-of-Order Execution - Execution Completion - Dispatch Operation. **(9)**

MEMORY SYSTEM

Memory Hierarchy - Memory Address Map - Memory Connection to CPU - Associative Memory: Hardware Organization - Match Logic - Read and Write Operation. Cache Memory: Associative mapping - Direct Mapping - Set Associative Mapping - Writing into Cache - Cache Initialization. Virtual Memory: Address Mapping using Pages - Associate Memory - Page Table - Page Replacement. **(8)**

I/O ORGANIZATION

Accessing I/O Devices: I/O Device Interface - Program-Controlled I/O. Interrupts: Enabling and Disabling Interrupts - Handling Multiple Devices - Controlling I/O Device Behavior - Processor Control Register. Direct Memory Access - Bus Structures - Bus Operation: Synchronous Bus - Asynchronous Bus. Arbitration - Interface circuits: Parallel Interface - Serial Interface **(9)**

TOTAL : 45

TEXT BOOKS

1. *Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraj Manjikian, "Computer Organization and Embedded Systems", McGraw-Hill, Sixth Edition, 2017.*
2. *Morris Mano, "Computer System Architecture ", Prentice Hall of India, Third Edition, 2008. (for Arithmetic Algorithms and Memory System).*

REFERENCES

1. *William Stallings, "Computer Organization and Architecture - Designing for Performance", Pearson Education, Tenth Edition, 2016.*
2. *David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware / Software Interface", Morgan Kaufmann, Fifth Edition, 2013.*
3. *John P. Hayes, "Computer Architecture and Organization", McGraw Hill, Third Edition,2017.*

19CI44 - OPERATING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Outline the basic functionalities of operating systems, operating system components, various types of operating system and system software.*

CO2 : *Apply process scheduling to demonstrate process execution.*

CO3 : *Understanding of various process synchronization techniques.*

CO4 : *Knowledge in various memory management schemes.*

CO5 : *Infer about secondary storage management techniques file organization and access methods.*

OPERATING SYSTEM OVERVIEW

Introduction to system software - Objectives and functions of OS - Evolution of OS - Distributed system - Real-Time systems - Operating system components - Interrupts -System call - Virtual machines - Symmetric Multiprocessing - Microkernel. **(7)**

PROCESS DESCRIPTION AND CONTROL

Process - Process states - Process description - Process control -Processes and Threads Uniprocessor Scheduling: Types of Processor Scheduling - Scheduling Algorithms: FCFS, SJF, SRT, Round Robin, Priority, Multi-Level Queue, Multi-level Feedback, Fair Share - Overview of Multiprocessor Scheduling and Real time scheduling. **(10)**

MUTUAL EXCLUSION AND SYNCHRONIZATION

Principles of concurrency - Mutual exclusion: Software and hardware approaches - Semaphores - Monitors - Message Passing - Readers/ Writers problem. Deadlock and Starvation: Principles of deadlock - Deadlock Prevention - Deadlock Detection - Deadlock Avoidance. **(10)**

MEMORY MANAGEMENT

Memory management requirements - Memory partitioning - Loading and Linking - Paging - Segmentation. Virtual Memory: Hardware and control structures - Virtual Memory Management Policies: Fetch Policy, Placement policy, Replacement policy- Resident set management - Cleaning policy - Load control. **(10)**

I/O MANAGEMENT AND FILE MANAGEMENT

I/O devices - Organization of I/O function - OS design issues - I/O buffering - Disk scheduling. File management: Overview - File organization and access - File directories - File sharing - Record blocking-Secondary storage management. **(8)**

TOTAL : 45

TEXT BOOK

1. *William Stallings, "Operating Systems Internals and Design Principles", Pearson Education, Ninth Edition, 2018.*

REFERENCES

1. *Silberchatz, Galvin, Gagne, "Operating System Concepts", John Wiley, Tenth Edition, 2018.*
2. *Dhananjay M. Dhamdhere, "Operating System a Concept Based Approach " McGraw Hill Publication, Third Edition ,2017.*

19CI45 - SOFTWARE ENGINEERING

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe the various software life cycle models and choose an appropriate model for a given application.*

CO2 : *Identify the functional requirements, prepare data flow, ER diagrams and SoftwareRequirement Specifications.*

CO3 : *Employ suitable architectural styles, software design methodologies, coding standards and practices in developing practical applications*

CO4 : *Discuss various testing techniques and their application in defect removal.*

INTRODUCTION

The Software Engineering Discipline - Software Development Projects - Software Life Cycle Models: Use of Life Cycle Models - Classical Waterfall Model-Iterative Waterfall Model-Prototype model-Evolutionary Model-Spiral Model **(9)**

SOFTWARE REQUIREMENTS AND ANALYSIS

Requirements Analysis and Specification - Requirements Gathering and Analysis- Value of good SRS - Requirement process- Requirement Specification - desirable characteristics, components and Structure of requirements document - Functional Specification with use cases - basics - developing Use Cases -DFDs - Data Dictionary - ER Diagrams. **(8)**

SOFTWARE DESIGN

Design concepts - Cohesion and Coupling- The Open-Closed Principle - Function Oriented Software Design: Structured charts - Structured design methodology - Detailed Design: Logic / Algorithm design - State Modeling of Classes. **(10)**

CODING

Programming principles and guidelines - Structured programming - Information hiding - some programming practices - Coding standards - Code inspection - Planning- Self review - Group review meeting. **(7)**

TESTING

Testing Fundamentals -Black Box Testing: Equivalence Class Partitioning - Boundary Value Analysis White box Testing: Control Flow based criteria - Data Flow based Testing - Levels of Testing: Unit Testing - Integration Testing - System Testing - Acceptance Testing. **(11)**

TOTAL: 45

TEXT BOOKS

1. *Pankaj Jalote,"Software Engineering A precise Approach", Wiley India, Third Edition, 2012.*
2. *Rajib Mall, "Fundamentals of Software Engineering", PHI Learning Private Limited, Third Edition, 2013. (Introduction only)*

REFERENCES

1. *Roger.S.Pressman, "Software Engineering A Practitioner's Approach", McGraw Hill International Edition, Eighth Edition, 2019.*
2. *Ian Sommerville, "Software Engineering", Dorling Kindersley(India) Private Ltd., Eighth Edition, 2008.*

19CS41 - FORMAL LANGUAGES AND AUTOMATA THEORY

L	T	P	C
2	0	0	2

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: To construct automata for any given pattern and to find its equivalent regular expressions*

CO2 *: To design a context free grammar for any given language and to understand PDA*

CO3 *: To understand the capability of Turing machines and to design TM for a given language*

FINITE AUTOMATA

Chomsky Hierarchy of languages-Finite Automata -DFA, NFA - Equivalence and Minimization of Automata. **(7)**

REGULAR EXPRESSIONS AND LANGUAGES

Regular Expressions - FA and Regular Expressions -Proving languages Not to be Regular -Pumping lemma for regular languages **(7)**

CONTEXT FREE GRAMMAR AND PUSH DOWN AUTOMATA

CFG -Definitions-Derivations- Parse Trees - Push Down Automata: Definition - Languages of a Pushdown Automata - Equivalence of Pushdown Automata and CFG, Deterministic PDA. **(8)**

TURING MACHINE

Turing Machine: Notation -Instantaneous description-Transition diagrams - Languages of TM - Programming Techniques for TM **(8)**

TOTAL : 30

TEXT BOOKS

1. *J.E.Hopcroft, R.Motwani and J.D Ullman, Introduction to Automata Theory, Languages and Computations, Fourth Edition, Pearson Education, 2010.*
2. *Peter Linz - An introduction to formal Languages and Automata, Fifth Edition, 2012.*

REFERENCES

1. *Micheal Sipser, Introduction of the Theory and Computation, Thomson Brokecole, Third Edition, 2012.*
2. *J.Martin, - Introduction to languages and the Theory of Computation, Fourth Edition, TMH, 2011.*
3. *H.R.Lewis and C.H.Papadimitriou, Elements of the Theory of Computation, Second Edition, PHI, 2003.*

19CIL46 - DATABASE MANAGEMENT SYSTEMS LABORATORY

L	T	P	C
0	0	3	1.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Practice various DDL,DML,TCL commands so as to perform various database operations and solve queries for given application.*

CO2 : *Demonstrate open database connectivity by establishing connections between front end and databases*

CO3 : *Experiment various PL/SQL features such as procedures, functions, triggers and report generation.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Database Creation, Insertion and Deletion.
2. Queries based on DML commands.
3. Aggregate Functions.
4. Sub-Queries and Joins.
5. Group by clause and DATE functions.
6. Views and Triggers.
7. PL/SQL Procedures.
8. Using Cursors and Functions in PL/SQL blocks.
9. ODBC Connectivity.

19CIL47 - DATA STRUCTURES AND ALGORITHMS LABORATORY

L	T	P	C
0	0	3	1.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: Selection and application of suitable data structures in implementing practical problems.*

CO2 *: Apply searching and sorting algorithms for real world problem.*

CO3 *: Identify suitable graph based algorithms and apply them for solving problems that arise in the real world scenarios.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Operations on Stacks, Queues and Linked List
2. Applications using Stacks and Queues
3. Polynomial operations using Linked List
4. Trees - Binary Tree Traversals, Binary Search Tree operations
5. Traversals on graphs
6. Implementation of shortest path algorithms in Graph
7. Implementation of search algorithms
8. Implementation of sorting algorithms

19CI51 - COMPUTER NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe the layered architecture of computer networks, factors influencing the performance of networks.*

CO2 : *Discuss the services of application layer protocols and develop applications for client server model using socket functions.*

CO3 : *Demonstrate the working of TCP and UDP protocols.*

CO4 : *Discuss IP address range for subnets and routing protocols used in computer networks.*

CO5 : *Describe the link layer access protocols and their functions in networking.*

INTRODUCTION

Internet- The Network Core-Packet Switching, Circuit Switching- Delay, loss, throughput in packet switched networks- Protocols layers and their service models. **(6)**

APPLICATION LAYER

Principles of Network applications- The web and HTTP- overview of HTTP, Persistent and non-persistent connections, HTTP message format- FTP-Electronic Mail in the Internet-DNS-Peer-Peer applications- Socket Programming: creating Network Applications. **(9)**

TRANSPORT LAYER

Introduction and Transport Layer services-Multiplexing and Demultiplexing- connectionless Transport: UDP- Connection oriented Transport: TCP-TCP segment structure, Round-Trip Time Estimation and Timeout, TCP Connection Management-TCP congestion control. **(10)**

NETWORK LAYER

Introduction-Virtual Circuit and Datagram Networks-The Internet Protocol (IP): Forwarding and Addressing in the Internet-Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm-Broadcast and Multicast Routing-Routing in the Internet: Inter-AS Routing: BGP. **(10)**

LINK LAYER

Introduction to the Link Layer-Multiple Access Links and Protocols: Random Access Protocols-Switched Local Area Networks: Link-Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks (VLANs)- Multiprotocol Label Switching (MPLS). **(10)**

Total : 45

TEXT BOOKS

1. *James F. Kurose & Keith W. Ross, Computer Networking A Top-down approach, Sixth Edition, Pearson Education, 2013.*

REFERENCES

1. *Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill, 2013.*
2. *William Stallings, Data and Computer Communications, 8th edition, Pearson PrenticeHall, 2007.*
3. *Larry L .Peterson and Bruce S. Davie, Computer Networks A Systems Approach, Fifth edition, Morgan Kaufman, 2012.*
4. *Andrew S Tanenbaum and David J. Wetherall, Computer Networks, Fifth Edition, Pearson, 2010.*

19CS51 - UNIX INTERNALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Outline the architecture of Unix Operating System and the internal operations of file system and process management.*

CO2 *: Discuss Allocation of Disk Blocks and Manipulation of inode for process and File Management.*

CO3 *: Examine Process Scheduling and memory management strategies on Unix Operating System.*

CO4 *: Summarize the working Methodology of various IPC Mechanisms and device driver Interfaces.*

INTRODUCTION TO KERNEL

Basic Commands & Directory Hierarchy: Basic commands, Navigating directories, Intermediate commands.

Kernel Concepts: Architecture of UNIX operating system - Introduction to system concepts - Kernel data structures. - The Buffer Cache: Buffer headers - Structure of Buffer pool - Scenarios for retrieval of a buffer - Reading and writing disk blocks - Advantages and disadvantages of Buffer Cache. **(9)**

INTERNAL REPRESENTATION OF FILES

Inodes - Structure of regular file - Directories - Conversion of pathname to an inode - Super block - Inode assignment to a new file - Allocation of disk blocks - Overview of System Calls for the file system: Open, Close, Read, Write, File Creation, Creation of Special files, Link, Unlink. **(9)**

STRUCTURE OF PROCESSES

Process States and Transitions - Layout of System Memory - The Context of a Process - Saving the Context of a Process - Manipulation of the Process Address Space - Sleep.

Process Control: Process Creation, Signals, Process Termination, Awaiting process termination, invoking other programs.**(9)**

PROCESS SCHEDULING AND MEMORY MANAGEMENT POLICIES

Process Scheduling: Algorithm - Scheduling parameters - examples of Process Scheduling - Controlling Process priorities - Fair Share Scheduler. Memory Management Policies: Swapping - Demand Paging - A Hybrid system with Swapping and Demand Paging. **(9)**

I/O SUB SYSTEM AND INTERPROCESS COMMUNICATION

Driver Interfaces - Disk Drivers - Terminal Drivers - Streams. Inter Process Communication: Pipes, Shared Memory, Messages, Semaphores - Network communication **(9)**

Total : 45

TEXT BOOKS

1. *Maurice J Bach, "The Design of Unix Operating System ", Pearson Education, First Edition, 2015.*
2. *Brian Ward, "How Linux works", No Starch Press, Second Edition, 2015.*

REFERENCES

1. *Uresh Vahalia, "Unix Internals: The New frontiers", Pearson Education, Second Edition, 2010.*
2. *Robert Love, "Linux Kernel Development - Developer's Library", 3rd Edition, Pearson Education, 2010.*
3. *John Strang, Jerry Peek, Grace Todino, "Learning the UNIX OS", O'Reily, Fifth Edition, 2014.*
4. *Remy Card, Eric Dumas, Franck Mevel, "The Linux Kernel Book", Wiley India, 2013.*

19CI52 - DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe the basic concepts, modeling, architectures of data warehouse and sketch different data warehouse schema for the real world applications*

CO2 : *Demonstrate the multidisciplinary fields of data mining and illustrate the techniques for data pre-processing.*

CO3 : *Ability to apply frequent pattern and association rules mining techniques for data analysis.*

CO4 : *Analyse different types of data using classification and clustering techniques.*

CO5 : *Discuss mining of various complex data types and its application to real world problems.*

DATA WAREHOUSE

Data Warehouse: Basic concepts - Data Warehouse Modeling: Data Cube and OLAP - Design and Usage - Implementation. **(6)**

DATA MINING AND DATA PREPROCESSING

Data Mining-Kind of Data-Data Patterns- Data Mining Technologies- Targeted Applications - Major Issues in Data Mining. Data Pre-processing: Major tasks in data pre-processing - Data Cleaning- Data Integration - Data Reduction: Attribute subset selection - Clustering - Data Transformation by normalization. **(10)**

ASSOCIATION RULES

Definition-Apriori Algorithm-Partitioning Algorithm-Pincer Search -Dynamic Item Set Counting Algorithm-FP Tree Algorithm-Discussion on different Algorithms-Incremental Algorithm-Border Algorithm-Generation of Association Rules. **(10)**

CLUSTERING AND CLASSIFICATION

Cluster analysis - Types of data -Requirements for cluster analysis - Categorization of major clustering methods - Partitioning K-Means and K-Medoid algorithm - CLARA - CLARANS - Hierarchical clustering - BIRCH - Density based clustering - DBSCAN - Classification: Decision tree induction - Attribute selection measures - Tree Pruning. **(10)**

MINING COMPLEX TYPES OF DATA

Mining Complex Data Types : Mining sequence data: Time - Series, Symbolic sequences & Biological sequences - Mining graphs and networks - Mining other kinds of data - Other methodologies of data mining-Data mining applications. **(9)**

Total : 45

TEXT BOOKS

1. *Jiawei Han & Micheline kamber, "Data Mining-Concepts and Techniques" Morgan Kaufmann Publishers, Third Edition, 2012.*
2. *Arun K Pujari, "Data Mining Techniques" Universities Press India Ltd., Fourth Edition, 2017. (Association Rules and Partitioning - CLARA, CLARANS)*

REFERENCES

1. *Dunham, "Data Mining- Introductory and Advanced Topics", Pearson Education, New Delhi, First Edition, 2006.*
2. *Pieter Adriaans, Dolf Zantinge, "Data Mining", Pearson Education, Delhi,Third Edition, 2009.*
3. *Sam Anahory, Dennis Murray, "Data Warehousing in the Real World", Pearson Education,Seventh indian Reprint New Delhi,2003.*
4. *George M. Marakas, "Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, First Edition, 2003*
5. *Paulraj Ponnaiah, "Data Warehousing Fundamentals", Wiley Publishers, Singapore, First Edition, 2001.*

19CS52 - STATISTICAL DATA ANALYSIS

L	T	P	C
2	1	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Students will demonstrate proficiency with statistical analysis of Data.*

CO2 *: Students can analyze statistical data graphically using frequency distributions.*

INTRODUCTION TO STATISTICS

Introduction-Why Study Statistics? - What is Statistics? -Descriptive and Inferential Statistics- Types of Data -Levels of Measurement- Types of Variables - Applications of Statistics. **(9)**

ORGANIZING AND SUMMARIZING DATA

Describing data with Tables and Graphs- Describing data with averages- Describing Variability - Normal Distribution and Standard (z) scores-Relationships among Data: Correlation- Regression. **(9)**

PROBABILITY

Population and Samples- Random Sampling- Probability- Definition- Addition Rule-multiplication rule- Probability and statistics- Sampling distribution of the mean. **(9)**

INFERENTIAL STATISTICS

Introduction to Hypothesis Testing (Z test)-Why hypothesis testing? - Confidence Intervals - t Test for one sample - One factor Analysis of Variance- Two sources of variability - f test. **(9)**

CHI-SQUARE TEST FOR NOMINAL DATA

One variable chi-square test- two variable chi-square test- Tests for ordinal data. **(9)**

Total : 45

TEXT BOOK

1. *Robert S.Witte, John S.Witte, " Statistics", Eleventh Edition, - Wiley Publications, 2017.*

REFERENCES

1. *Sheldon M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Third edition, Academic Press , 2004*
2. *R. Lyman Ott and Michael Longnecker, "An Introduction to Statistical Methods & Data Analysis", Seventh Edition, Cengage Learning, 2016*

19CIL54 - COMPUTER NETWORKS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1 : *Implement different models of servers using Socket functions.*

CO2 : *Simulate the working of protocols used in different layers of networks.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. TCP Socket
2. UDP Socket
3. Concurrent Server
4. Sliding window protocol
5. Error detection and control
6. FTP, TELNET
7. Multicasting
8. Broadcasting
9. Case Study on Software Defined Network (SDN)
10. Real time working knowledge of Networking equipment like L2 Switch, Routers, Unifi WiFi and LAN

19CIL48 - OPERATING SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1 : *Knowledge in using different system and I/O calls, UNIX commands and shell programming.*

CO2 : *Demonstrate algorithms for process scheduling, process synchronization, Inter process communication and memory management.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. System calls - fork, exec, getpid, exit, wait, close, stat, opendir, readdir.
2. I/O system calls -open, close, read, write, create, lseek, dup.
3. Simulate UNIX commands - ls, grep, chmod, passwd, who, date.
4. Shell programming.
   - Simple functions.
   - Basic tests.
   - Loops.
   - Patterns.
   - Expansions.
   - Substitutions.
5. Process Scheduling- FCFS, SJF, Priority and Round robin.
6. Synchronization using semaphores
7. Implementation of Interprocess Communication.
8. Implementation of memory management schemes -first fit, Best fit, worst fit and page replacement algorithms.

19CI53 - EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe the features of Embedded system*

CO2 : *Understand the architecture of ARM Processor*

CO3 : *Develop simple Assembly Language Programs*

CO4 : *Understand about Exceptions and interrupts*

CO5 : *Design and develop embedded applications*

INTRODUCTION TO EMBEDDED SYSTEM

Characteristics of Embedded system - Challenges in Embedded System - Embedded System Design Process - CPU Power Consumption.-Components for embedded programs - Models of programs - Performance analysis and optimization of program size - Power analysis and optimization. **(10)**

ARM PROCESSOR

Architecture overview - Registers - Special Registers - Operation mode - Stack memory operations - Reset sequence- 5 Stage pipeline organization - Arm instruction execution. **(8)**

ARM ASSEMBLY LANGUAGE PROGRAMMING

Data Processing instructions-Data Transfer Instructions- Control flow Instructions - Writing Simple ALP - Memory Map - Bit Band Operations -Unaligned transfers - Exclusive access -Endian mode -Memory protection unit Overview - Power Management. **(9)**

EXCEPTION AND INTERRUPTS

Advanced Microcontroller Bus architecture - reset types and reset signals-Exception types-vector tables - Fault exceptions - Nested Vector Interrupt Controller overview- Basic interrupt configuration - Software interrupt - SYSTICK timer - Interrupt behavior : Sequence interrupt latency - Faults related to interrupts. **(9)**

DEVELOPMENT AND TESTING

Host and target machines - Tool chain for building Embedded software - In-Circuit Emulator - Logic analyzer - Debugging : JTAG Boundary scan test architecture , Core sight - Applications: Alarm Clock, Audio Player. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Marilyn Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman, Third Edition, 2012.*
2. *Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", 2nd Edition, Newnes, (Elsevier), 2010.*

REFERENCE

1. *Steve Furber, ARM System-on-Chip Architecture, Second Edition,Pearson,2015.*

19CS61 - INTERNET OF THINGS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Describe the physical and logical design of IoT with suitable enabling technologies.*

CO2 *: Discuss the various IOT protocols*

CO3 *: Demonstrate Knowledge on Physical devices such as Arduino and Raspberry Pi.*

CO4 *: Applying cloud technology and data analytics for IoT.*

CO5 *: Discuss some IoT applications in specific domains.*

INTRODUCTION TO INTERNET OF THINGS

Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security. **(5)**

COMPONENTS IN INTERNET OF THINGS

Control Units - Communication modules - Bluetooth - Zigbee - Wifi - GPS- IOT Protocols -IPv6, 6LoWPAN, RPL, CoAP, MQTT **(12)**

PROGRAMMING THE MICROCONTROLLER FOR IOT

Working principles of sensors - IOT deployment for Raspberry Pi /Arduino/Equivalent platform - Reading from Sensors, Communication: Connecting microcontroller with mobile devices- communication through Bluetooth, WIFI and USB - Introduction to Contiki OS- Cooja Simulator. **(8)**

FROM THE INTERNET OF THINGS TO THE WEB OF THINGS

The Future Web of Things - Set up cloud environment -Cloud access from sensors- Data Analytics for IOT- Case studies: Structural Health Monitoring **(10)**

IOT APPLICATIONS

Smart city, Home Automation, Smart health and wearable devices, Environment monitoring and surveillance, Smart Agriculture **(10)**

Total : 45

TEXT BOOKS

1. *ArshdeepBahga, Vijay Madisetti, "Internet of Things - A hands -on approach", Universities Press, 2017.*
2. *J.P Vasseur, A. Dunkels, "Interconnecting Smart Objects with IP: The next Internet", Morgan Kufmann, 2010 (COMPONENTS IN INTERNET OF THINGS)*
3. *Z.Shelby, C.Bormann, 6LOWPAN: The wireless Embedded Internet", Wiley, first edition, 2011 (6LOWPAN)*
4. *Z.Shelby, K. Hartke, C.Bormann, "The Constrained Application Protocol(COAP)", RFC 7252, 2014.*

REFERENCES

1. *Charalampos Doukas, "Building Internet of Things with Arduino", Create space, April 2002.*
2. *Dr. Ovidiu Vermesan and Dr. Peter Friess, "Internet of Things: From research and innovation to Market deployment", Rive publishers, 2014.*
3. *Contiki: The opensource for IOT, www.contiki-os.org*

19CS62 - MACHINE LEARNING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe and give examples of supervised and unsupervised learning methods.*

CO2 : *Discuss probability theory, make rational decisions to minimize risk and learn association rules from data.*

CO3 : *Ability to choose a subset of important features and understand feature extraction methods that form fewer new features from original data.*

CO4 : *Use decision trees for classification,describe learning algorithms to build the decision trees and gain an understanding of ensemble methods.*

CO5 : *Ability to understand the back-propagation algorithm to train a multi layer perceptron for different applications.*

CO6 : *Ability to understand the basics of Q learning in reinforcement learning.*

INTRODUCTION

Machine Learning - Machine Learning Applications - Learning Associations - Classification - Regression - Unsupervised Learning - Reinforcement Learning - Supervised Learning: Learning a Class from Examples - Vapnik - Chervonenkis (VC) Dimension - Probably Approximately Correct (PAC) Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm **(7)**

BAYESIAN DECISION THEORY

Classification - Losses and Risks - Discriminant Functions - Association Rules - Parametric Methods: Introduction - Maximum Likelihood Estimation - Evaluating an Estimator: Bias and Variance - The Bayes' Estimator - Parametric Classification - Regression **(9)**

DIMENSIONALITY REDUCTION

Introduction - Subset Selection - Principal Components Analysis - Factor Analysis- singular value decomposition and matrix factorization-Multidimensional Scaling - Linear Discriminant Analysis- Isomap **(7)**

DECISION-TREE LEARNING AND ENSEMBLE METHODS

Concept Learning - Concept learning Task - Concept Learning as search -Finding a maximally specific hypothesis - Version Spaces and Candidate elimination Algorithm -Inductive Bias Decision Tree Learning - Decision Tree representation -Problems for Decision Tree Learning -Hypothesis Search space - Inductive Bias in Decision Tree Learning - Issues in Decision Tree Learning. AdaBoost Algorithm-Bagging Algorithm-Random Tree Ensembles:Random Forest. **(8)**

MULTILAYER PERCEPTRON AND DEEP LEARNING

Introduction- The Perceptron - Training a Perceptron - Learning Boolean Functions - Multilayer Perceptrons - MLP as a Universal Approximator- Backpropagation Algorithm - Training Procedures: Improving convergence - Tuning the Network Size. Convolution Networks: The Convolution Operation-Pooling-Convolution and Pooling as an infinitely strong prior - Structured Outputs -Data Types -Efficient Convolution Algorithms. **(9)**

REINFORCEMENT LEARNING

Introduction - learning task - Q learning - The Q function - Algorithm for Q learning -convergence - updating sequence -Non deterministic rewards and actions -Temporal difference learning. **(5)**

Total : 45

TEXT BOOKS

1. *EthemAlpaydin, "Introduction to Machine Learning", PHI Learning Pvt. Ltd Third edition, 2015, ISBN: 978-8120350786. (Introduction, Baysian Decision Theory , Dimensionality Reduction, Multilayer Perceptron)*
2. *Zhi-Hua Zhou,"Ensemble Methods:Foundations and Algorithms", A Chapman & Hall Book, CRC Press, 2012. (AdaBoost Algorithm, Bagging Algorithm, Random Tree Ensembles)*
3. *Tom Mitchell, "Machine Learning", McGraw-Hill, First Edition, 2017, ISBN: 978-1259096952. (Concept Learning And Decision Tree Learning, Reinforcement Learning)*
4. *MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar "Foundations of Machine Learning", MIT Press, Second Edition, 2018, ISBN 978-0262039406 (Convolution Networks)*

REFERENCES

1. *Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman Hall/CRC Second Edition, 2014, ISBN: 978-1466583283*
2. *Stuart Russel and Peter Norwig, "Artificial Intelligence A modern approach ",Pearson Education India; 2015, ISBN 978-9332543515*
3. *https://www.dropbox.com/s/j2pjnybkm91wgdf/visual_notes.pdf?dl=0 (Convolution Networks)*
4. *https://indoml.com/2018/03/07/student-notes-convolutional-neural-networks-cnn-introduction/(Convolution Networks)*

19CSL63 - EMBEDDED SYSTEMS AND IOT LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: Develop Simple Assembly Language Program.*

CO2 *: Develop Embedded C programs.*

CO3 *: Develop applications based on IOT and Sensors.*

EMBEDDED EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Basics of Assembly Language Programming
2. Peripheral Interfacing:
   - Seven Segment Display
   - Matrix Keyboard
   - LCD Display
   - Buzzer
3. Programming Robots
4. Digital circuit development using FPGA
5. PIC Microcontroller based application

IOT EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Temperature Sensing and control
2. Smart lighting
3. Smart Appliances
4. Smoke/Gas Detectors
5. Pollution Monitoring
6. Connecting with EDGE devices and data analysis
7. Smart irrigation

19CSL64 - MACHINE LEARNING LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: Apply various classification techniques for problems using tools like R and Python.*

CO2 *: Apply feature selection and dimensionality reduction techniques on datasets.*

CO3 *: Implement solutions for various prediction problems using tools.*

CO4 *: Design and develop a neural network for any real world problem.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Study and usage of R tool and python
2. Implement a Bayesian classifier for a product sales data
3. Implement a feature selection technique on any public dataset
4. Implement PCA (Dimensionality reduction technique) on text / image data
5. Implement factor analysis (Dimensionality reduction technique) on text/image data
6. Implement a decision tree algorithm for sales prediction/classification in retail sector
7. Implement a predictive model for predicting house prices (regression)
8. Implement a neural network model to forecast the electricity consumption of a household/commercial complex/university/ college

Note : Datasets for the above exercises available in Kaggle and UCI repository mentioned below:

i) https://www.kaggle.com

ii) http://archive.ics.uci.edu/ml/datasets.html

19CS65 - MINI PROJECT

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Apply computing algorithms and techniques in designing simple solutions and examine the outcome of real- time projects.*

CO2 : *Integrate various interdisciplinary areas to enhance domain knowledge.*

CO3 : *Develop technical skills in providing feasible solutions for real-life problems and enhance technical writing ability.*

CO4 : *Demonstrate effective communication and collaborative working in peer groups.*

19CS71 - PRINCIPLES OF COMPILER DESIGN

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Understand the different phases of compilers.*

CO2 : *Construct automata for regular languages.*

CO3 : *Learn different parsing techniques.*

CO4 : *Understand the functions of compiler in code optimization and code generation.*

INTRODUCTION

Compilers and Interpreters - The structure of a Compiler - Phases of a compiler : Lexical analysis, Syntax analysis, Intermediate code generation, Code optimization, Code generation, Error handling - Passes of a compiler - Interleaving phases - Preprocessors- Compiler construction tools. **(3)**

HIGH-LEVEL PROGRAMMING LANGUAGES

Definition of Programming languages -The Lexical and Syntax structure of a language - Data environment - Parameter transmission - Storage management. **(2)**

LEXICAL ANALYSIS

Finite Automata and Lexical Analysis: The role of Lexical Analyzers, Input Buffering - A simple approach to the design of Lexical analyzer - Regular expressions - Finite automata - Regular expression to Finite Automata - Minimizing the states of a DFA - A language for specifying lexical analyzers - Implementation of a lexical analyzer. **(7)**

SYNTACTIC SPECIFICATION OF PROGRAMMING LANGUAGES

Grammar: Definition, Context sensitive, Context free, Regular grammar - Regular expression and Regular Grammers - Context Free Grammars: Notations - Derivations and Parse trees. **(4)**

BASIC PARSING TECHNIQUES

Bottom up parsing: Handle, Handle pruning - Operator precedence parsing - Simple precedence parsing- Top down parsing: Recursive descent parsing, Predictive parsers-LR parsers: SLR parser, LALR Parser. **(9)**

SYNTAX DIRECTED TRANSLATION

Syntax directed translation schemes- Synthesized and Inherited attributes - Implementation of syntax directed translators - Intermediate code - Postfix notation - Parse trees and Syntax trees - Three address code, Quadruples and Triples - Translation of assignment statement - Boolean expressions - Statements that alter the flow of control - Array references - Symbol tables: Contents, Structure. **(8)**

INTRODUCTION TO CODE OPTIMIZATION

The Principle Sources of Optimization -Loop Optimization - The DAG representation of Basic Blocks - Global data flow analysis- Dominators- Reducible flow graphs - Loop invariant computations - Induction variable elimination - Other loop optimizations. **(7)**

CODE GENERATION

Object programs - Issues in Code generation - A simple code generator - Register allocation and assignment - Code generation from DAG - Peephole optimization. **(5)**

TOTAL : 60

TEXT BOOKS

1. *Alfred V.Aho, Monica S.Lam, Ravi Sethi and Jeffrey D.Ullman "Compilers: Principles, Techniques and Tools", Pearson Education,Inc., Second Edition,2013.*
2. *Alfred V. Aho and Jeffrey D. Ullman, "Principles of Compiler Design", Narosa Publishing House pvt. ltd., Twenty fifth Reprint 2002.*

REFERENCE

1. *Jean Paul Tremblay and Paul G.Sorenson., "Theory and Practice of Compiler Writing", BS Publication, Reprint 2008.*

19CI61 - ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Illustrate real world problems from the perspective of Intelligent agents to achieve problem oriented goal.*

CO2 *: Apply various informed search strategies in optimal decision making.*

CO3 *: Employ first order logic for building knowledge base to infer reasoning using knowledge Engineering.*

CO4 *: Describe representation of uncertain knowledge, Bayesian Networks and Temporal models.*

CO5 *: Describe several learning algorithms to improve the performance of intelligent agents.*

INTRODUCTION

Foundation of AI - Agents and Environments- Concept of Rationality - Nature of Environments - Structure of Agents-Problem-Solving Agents and examples - Uninformed Search Strategies - Searching with Partial Information. **(8)**

SEARCH TECHNIQUES

Search Strategies : A*Search-Heuristic Functions Local Search Algorithms and Optimization Problems-Constraint Satisfaction Problems-Backtracking Search for CSPs-Local Search for Constraint Satisfaction Problems-Structure of Problems-Games- Optimal Decisions in Games - Alpha-Beta Pruning. **(8)**

KNOWLEDGE AND REASONING

Logic -Propositional Logic - Syntax and Semantics of First - Order Logic - Using First - Order Logic - Knowledge Engineering in First - Order Logic - Propositional vs. First - Order Inference - Forward Chaining - Backward Chaining - Resolution. **(8)**

UNCERTAIN KNOWLEDGE AND REASONING

Acting under uncertainty - Bayes' rule and Its use - Representing Knowledge in an Uncertain Domain -The Semantics of Bayesian Networks - Exact Inference in Bayesian Network - Approximate Inference in Bayesian Networks - Hidden Markov Models - Kalman Filters. **(9)**

LEARNING

Forms of Learning - Learning Decision Trees - Artificial Neural Networks - Ensemble Learning - Logical Formulation of Learning-Knowledge in Learning - Explanation Based Learning - Learning Using Relevance Information - Inductive Logic Programming - Statistical Learning - Learning with Complete Data - EM Algorithm - Passive Reinforcement Learning - Active Reinforcement Learning. **(12)**

Total : 45

TEXT BOOK

1. *Stuart J Russell and Peter Norvig, "Artificial Intelligence- A Modern Approach", Pearson Education Series, Third Edition, 2015.*

REFERENCES

1. *Deepak Khemani, "A First Course in Artificial Intelligence", Mc Graw Hill Education, First Edition, 2013.*
2. *Dan W. Patterson "Introduction to AI and ES", Pearson Education,First Edition, 2007.*
3. *Patrick Henry Winston, "Artificial Intelligence", Addison Wesley publishers, Third Edition, 1992.*
4. *Elaine Rich, Kevin Knight and Shivashankar, "Artificial Intelligence", McGraw Hill, Third Edition, 2009.*

19CI71 - CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Apply the symmetric ciphering algorithms for security attacks and threats.*

CO2 : *Apply the asymmetric ciphering algorithms for security attacks and threats.*

CO3 : *Use of hashing and message authentication concepts to generate digital signatures.*

CO4 : *Describe the concepts of key management and user authentication techniques.*

CO5 : *Select suitable Intrusion detection system and Firewall to prevent intrusion.*

INTRODUCTION

Computer and Network Security Concepts: Security Attacks - Security Services - Security Mechanisms. Introduction to number theory :Fermat's and Euler's theorems-Testing on Primality. Modular arithmetic-Euclidean Algorithm. Classical Encryption Techniques: Symmetric Cipher Model - Substitution Techniques - TranspositionTechniques. Block Cipher and the Data Encryption Standard-Advanced Encryption Standard-Block Cipher Operation: Electronic codebook-Cipher block Chaining mode-Cipher Feedback mode-Output feedback mode-Counter mode. **(12)**

ASYMMETRIC CIPHERS

Public Key Cryptography and RSA:Principles of Public key Cryptosystems - RSA Algorithm-Diffie-Hellman Key Exchange - Elliptic Curve Arithmetic - Elliptic Curve Cryptography. **(7)**

CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS

Cryptographic hash functions: Applications-Requirements and Security-Secure Hash Algorithm-SHA-3.Message Authentication Codes : Requirements - Functions.Digital Signatures: Digital Signatures-NIST Digital Signature Algorithm- Elliptic Curve Digital Signature Algorithm. **(8)**

MUTUAL TRUST AND NETWORK SECURITY

Key Management and Distribution: Distribution of public keys-X.509 Certificates- Public-Key Infrastructure. User Authentication: Kerberos. Transport Layer security: Transport Layer security -Secure Shell (SSH).Electronic Mail Security : Pretty Good Privacy-S/MIME. IP Security: Policy- Encapsulating Security Payload - Cryptographic primitives in block chain **(12)**

INTRUSION DETECTION SYSTEM

Intruders - Intrusion detection - Malicious Software : Viruses and Related Threats - VirusCountermeasures - Distributed DoS attacks. Firewalls : Firewall Design Principles. **(6)**

Total : 60

TEXT BOOKS

1. *William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall of India, Seventh Edition, 2017.*
2. *William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall of India, Fourth Edition, 2005.(Intrusion Detection System)*

REFERENCES

1. *Behrouz A.Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill, Third Edition, 2015.*
2. *Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, Third Edition, 2013.*
3. *Wade Trappe, Lawrence C.Washington, "Introduction to Cryptography with coding theory", Pearson education, Second Edition, 2011.*
4. Bruce Schneier, "Applied Cryptography", John Wiley and Sons, New York, Second Edition, 2006.

19CSL72 - COMPILER DESIGN LABORATORY

L	T	P	C
0	0	3	1.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: Learn the usage of LEX and YACC tool.*

CO2 *: Practice experiments using LEX and YACC tool.*

CO3 *: Demonstrate ability to design a simple compiler for a given grammar using Lex and Yacc.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Implementation of Finite Automata.
2. Study of LEX and YACC Tool.
3. Programs using LEX and YACC Tools.
4. Implementation of Parsing Techniques.
5. Design of a simple compiler for a given grammar.

19CSL73 - ARTIFICIAL INTELLIGENCE LABORATORY

L	T	P	C
0	0	3	1.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: Analyse and formalize the problem as a state space graph, design heuristics and apply different search techniques in game playing and problem solving.*

CO2 *: Attain the capability to represent various real life problems using logic based techniques and use this to perform inference or planning.*

CO3 *: Formulate and solve problems with uncertain information using fuzzy inferences.*

CO4 *: Apply knowledge representation and natural Language processing concepts in implementing chat bot applications and semantic search.*

EXPERIMENTS USING THE FOLLOWING CONCEPTS

1. Implementing state space search algorithms
   - Hill climbing algorithms
   - A* Algorithm
2. Designing a Chat bot application.
3. Information retrieval using semantic search
4. Adversarial search and Game Playing
5. Knowledge representation and inference - Predicate logic
6. Reasoning with uncertainty - Fuzzy inference
7. Solving 4-Queens problem
8. Solving travelling salesman problem

19CS74 - PROJECT PHASE-I

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Apply computing algorithms and techniques in designing simple solutions and examine the outcome of real- time projects.*

CO2 : *Integrate various interdisciplinary areas to enhance domain knowledge.*

CO3 : *Develop technical skills in providing feasible solutions for real-life problems and enhance technical writing ability.*

CO4 : *Demonstrate effective communication and collaborative working in peer groups.*

19CS81 - PROJECT PHASE-II

L	T	P	C
0	0	10	5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Apply computing algorithms and techniques in designing simple solutions and examine the outcome of real- time projects.*

CO2 : *Integrate various interdisciplinary areas to enhance domain knowledge.*

CO3 : *Develop technical skills in providing feasible solutions for real-life problems and enhance technical writing ability.*

CO4 : *Demonstrate effective communication and collaborative working in peer groups.*

19CIE01 - AD-HOC NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Recognize the issues involved in designing MAC protocol and describe the different type of MAC protocols in wireless Ad-Hoc Network*

CO2 : *Choose appropriate routing protocols for a given networking scenario and demonstrate the routing process with its merits and demerits*

CO3 : *Point out the characteristics and compare the qualitative behavior of various multicast routing protocols.*

CO4 : *Discuss various transport layer solutions employed in wireless Adhoc networks.*

CO5 : *Outline the QoS support and energy management schemes in wireless Adhoc networks.*

MAC PROTOCOLS

Ad Hoc Wireless Networks & MAC Protocols: Introduction - Issues in Ad Hoc Wireless Networks - Issues in Designing a MAC Protocol for Ad hoc Wireless Networks - Classification of MAC Protocols - Contention-Based: MACAW, Busy Tone Multiple Access Protocols - Contention-Based with Reservation Mechanisms: Distributed Packet Reservation Multiple Access Protocol - Collision Avoidance Time Allocation Protocol - Contention-Based with Scheduling Mechanisms: Distributed Priority Scheduling - MAC Protocols that use Directional Antennas. **(9)**

ROUTING PROTOCOLS

Issues in Designing a Routing Protocol for Ad hoc Wireless Networks - Classifications of Routing Protocols- Table-Driven: Destination Sequenced Distance Vector Routing Protocol, Cluster-Head Gateway Switch Routing Protocol On-Demand: Dynamic Source Routing-Ad Hoc On Demand Distance Vector Routing Protocol-Location- Aided Routing-Signal Stability based Adaptive Routing Protocol - Hybrid : Core Extraction Distributed Ad Hoc Routing Protocol- Zone Routing Protocol **(9)**

MULTICAST ROUTING

Issues in Designing a Multicast Routing Protocol - Operation of Multicast Routing Protocols - Classification of Multicast Routing Protocols - Tree-Based: Bandwidth efficient Multicast Routing Protocol-Multicast Core Extraction Distributed Ad Hoc Routing-MAODV - Mesh-based: On Demand Multicast Routing Protocol, Core Assisted Mesh Protocol-Multicasting with Quality of Service Guarantees - Application Dependent Multicast Routing. **(10)**

TRANSPORT LAYER PROTOCOLS & SECURITY ISSUES

Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks-Classification of Transport Layer Solutions-TCP over Ad Hoc Wireless Networks - Security in Ad-Hoc Wireless Networks-Requirements-Issues-Attacks-Key Management in Ad Hoc Wireless Networks-Secure Routing: Secure Efficient Ad Hoc Distance Vector Routing Protocol, Authenticated Routing for Ad Hoc Networks. **(7)**

QUALITY OF SERVICE & ENERGY MANAGEMENT

Issues and challenges in providing QoS in Ad Hoc Wireless Networks - Classifications of QoS Solutions: MAC Layer Solutions: Cluster TDMA - Network Layer Solutions: Ticket Based Protocol-QoS Frameworks for Ad Hoc Wireless Networks: INSIGNIA-INORA-SWAN- Energy Management in Ad Hoc Wireless Networks: Classification - Battery Management Schemes - System Power Management Schemes. **(10)**

TOTAL : 45

TEXT BOOK

1. *C.Siva Ram Murthy, B.S.Manoj, "Ad-Hoc Wireless Networks- Architectures and Protocols", Prentice Hall, First Edition, 2012.*

REFERENCES

1. *C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education, First Edition, 2009.*
2. *Carlos DE MoraisCordeiro. Dharma Prakash Agrawal, " Ad-Hoc and Sensor Networks -Theory and Applications", World scientific Publishing corporation pvt ltd,Second Edition, 2011*

19CIE02 - BIG DATA ANALYTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Understand the basics of big data analytics and exposure to state-of-the-art data analytic tools and techniques.*

CO2 *: Apply appropriate Map Reduce Logic for solving computational problems.*

CO3 *: Demonstrate Big data analytics using Hadoop and related tools such as Pig, HBase.*

CO4 *: Acquire knowledge on fundamental techniques and principles in data stream analytics.*

BIG DATA

Introduction to Big Data concepts: divide-and-conquer, parallel algorithms, distributed virtualized storage, distributed resource management, orchestration and scheduling, lambda architecture, data flow paradigm, real-time event processing. Big data characteristics - Data in the Warehouse and Hadoop - Big Data Use Cases- Understanding Big Data Storage - A General Overview of High-Performance Architecture - HDFS - Map Reduce and YARN **(6)**

MAPREDUCE

MapReduce (MR) basics: Functional Programming Roots, Mappers and Reducers, The Execution Framework, Partitioners and Combiners , MR algorithm design: Local Aggregation, Pairs and Stripes, Computing Relative Frequencies, Secondary Sorting, Relational Joins ,Inverted Indexing for Text Retrieval: Web Crawling, Inverted Indexes - Baseline and Revised Implementation **(12)**

HADOOP ECOSYSTEM

Hadoop distributed file system: HDFS Concepts, Hadoop File systems, Data Flow, Parallel Copying with distcp. PIG: Pig Latin, User defined functions, Data processing operators, HBASE: HBase data model, Installation, Clients, Examples, H Base Vs RDBMS. **(10)**

MINING DATA STREAMS

Stream data model - Sampling data streams - Filtering Streams- counting distinct elements in a stream - Estimating moments- Counting ones in a window- Decaying Windows **(9)**

GRAPH ALGORITHMS

Graph Representations - Parallel Breadth - First Search- PageRank - Efficient Computation of PageRank- Topic-Sensitive PageRank - Link Spam- Hubs and Authorities- Issues with Graph Processing. **(8)**

TOTAL: 45

TEXT BOOKS

1. *Jimmy Lin and Chris Dyer, "Data Intensive Text Processing using MapReduce", Morgan and Claypool Publishers, USA, First Edition, 2010.(MapReduce, Graph Algorithms)*
2. *Tom White, "Hadoop: The Definitive Guide", O`Reilly Publishers, USA, Third Edition, 2012.(Hadoop ecosystem)*
3. *Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, Second Edition, 2012. (Mining Data Streams, Graph Algorithms)*

REFERENCES

1. *Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015.*
2. *Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS BusinessSeries, First Edition, 2012.*
3. *Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis",Elsevier, First Edition, 2007.*
4. *Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.*
5. *David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.*

19CIE03 - BIOINFORMATICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Description of fundamental concepts in molecular biology and genomics.*

CO2 *: Analyse gene sequences using appropriate sequence alignment methods.*

CO3 *: Illustrate the structure of protein, its classification, functions and the steps in drug discovery and development.*

CO4 *: Demonstrate the usage of sequence alignment tools and bioinformatics search engines to retrieve data.*

INTRODUCTION TO BIOINFORMATICS

Introduction- Historical overview- Definition-Applications- Major Databases- Data management & Analysis - Molecular Biology and Bioinformatics - Central Dogma of Molecular Biology.

Information search & data retrieval: Introduction, Tools for Web Search, Data Retrieval Tools and Data Mining of Biological Databases. **(8)**

GENOME ANALYSIS IDENTIFICATION AND PREDICTION

Introduction - Genome Analysis - Genome Mapping - The Sequence Assembly Program - Cloning the entire Genome - Genome Sequencing - The Human Genome Project.

Gene identification & prediction : Basis of Gene Prediction, Pattern Recognition, Gene Prediction Methods. **(10)**

ALIGNMENTS AND PHYLOGENETIC TREES

Introduction to Sequence Alignment - The dotplot - Dotplots and Sequence Alignments - Measures of Sequence similarity - Computing the Alignment of two sequences - The dynamic programming algorithm Signature of alignments - Multiple sequence alignment - Applications - Phylogeny - Phylogenetic trees. **(10)**

PROTEIN STRUCTURE AND DRUG DISCOVERY

Protein Stability and Folding - Applications of Hydrophobicity - Superposition of structures - DALI - Evolution of Protein Structures - Classification of Protein Structures - Protein Structure prediction and modeling - Assignment of protein structures to genomes - Prediction of protein function - Drug discovery **(10)**

TOOLS IN BIOINFORMATICS

Sequence Alignment Tools : FASTA - BLAST - CLUSTAL.Accessing Database Archives: ENTREZ -ExPASy-SRS-Ensembl. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Rastogi. S. C, Mendiratta. N and Rastogi. P. Bioinformatics Methods and Applications : Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt. Ltd.4th Edition, 2013.*
2. *Arthur M Lesk, "Introduction to Bioinformatics", Oxford University Press, India, Fourth Edition, 2013. (Alignments And Phylogenetic Trees, Protein Structure And Drug Discovery, Tools In Bioinformatics)*

REFERENCES

1. *Jin Xiong, "Essential Bioinformatics", Cambridge University Press, 2006.*
2. *Affward T.K., Parry Smith D.J., "Introduction to Bioinformatics:, Pearson Education, Reprint, 2007.*
3. *Dr. ZhumurGhosh, Dr. BibekanandMallick, "Bioinformatics. Principles and Application", Oxford University Press, India, Reprint, 2008.*

19CIE04 - BLOCKCHAIN TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Understand and apply the fundamentals of Cryptography in Cryptocurrency*

CO2 *: Gain knowledge about various operations associated with the life cycle of Blockchain and Cryptocurrency*

CO3 *: Deal with the methods for verification and validation of Bitcoin transactions*

CO4 *: Demonstrate the general ecosystem of several Cryptocurrency*

CO5 *: Educate the principles, practices and policies associated Bitcoin business*

INTRODUCTION TO CRYPTOGRAPHY & CRYPTOCURRENCIES

Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency. **(7)**

BLOCK CHAIN

Decentralization-Centralization vs. Decentralization-Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets. **(10)**

MECHANICS OF BITCOIN

Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements. The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies, Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash. **(10)**

BITCOIN AS A PLATFORM

Bitcoin as an Append only Log, Bitcoins as "Smart Property", Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source-Prediction Markets and Real World Data Feeds. **(8)**

ALTCOINS AND THE CRYPTOCURRENCY ECOSYSTEM

Altcoins: History and Motivation, A Few Altcoins in Detail, Relationship Between Bitcoin and Altcoins, Merge Mining-Atomic Cross chain Swaps-6 Bitcoin Backed Altcoins, "Side Chains", Ethereum and Smart Contracts., Recent Trends & applications. **(10)**

TOTAL : 45

TEXT BOOK

1. *Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S, Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press., 2016*

REFERENCES

1. *Antonopoulos, A. M, Mastering Bitcoin: unlocking digital cryptocurrencies. "O'Reilly Media, Inc.", 2014*
2. *Franco, P. Understanding Bitcoin: Cryptography, engineering and economics. John Wiley & Sons, 2014*

19CIE05 - CLOUD AND VIRTUALIZATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Knowledge on the basics of cloud computing and various services deployed from a cloud architecture supported by different providers.*

CO2 *: Understand the concepts of virtualization and virtual machines and to explore the types of virtualization.*

CO3 *: Ability to configure and setup cloud and virtual environments and identify security challenges and manage risks.*

CO4 *: Critically analyse case studies to derive the best practice model for cloud and virtualization based applications.*

INTRODUCTION

Evolution of Cloud Computing -System Models for Distributed and Cloud Computing - NIST Cloud Computing Reference Architecture -IaaS - On-demand Provisioning - Elasticity in Cloud - Examples of IaaS Providers - PaaS - Examples of PaaS Providers - SaaS - Examples of SaaS Providers - Public , Private and Hybrid Clouds - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus **(9)**

VIRTUALIZATION

Basics of Virtual Machines - Process Virtual Machines - System Virtual Machines - Emulation - Interpretation - Binary Translation - Taxonomy of Virtual Machines. Virtualization -Management Virtualization -- Hardware Maximization - Architectures - Virtualization Management - Storage Virtualization - Network Virtualization. **(9)**

VIRTUALIZATION INFRASTRUCTURE

Comprehensive Analysis - Resource Pool - Testing Environment -Server Virtualization - Virtual Workloads - Provision Virtual Machines -Desktop Virtualization - Application Virtualization - Work with AppV - Mobile OS for smart phones - Mobile Platform Virtualization - Collaborative Applications for Mobile platforms. **(8)**

COMPUTER CLUSTERS FOR SCALABLE PARELLEL COMPUTING

Clustering for Massive Parallelism: Development Trends - Objectives - Fundamentals Cluster Design Issues - Computer Clusters and MPP Architectures: Cluster Organization and Resource Sharing - Node Architectures and MPP Packaging - Cluster System Interconnects - Hardware, Software and Middleware Support - GPU Clusters for Massive parallelism - Cluster Job and Resource Management: Scheduling Methods - Management Systems - Load Sharing Facility for Cluster Computing. **(10)**

CLOUD INFRASTRUCTURE AND SECURITY

Architectural Design of Compute and Storage Clouds - Inter Cloud Resource Management - Resource Provisioning and Platform Deployment - Global Exchange of Cloud Resources - Security Overview - Cloud Security Challenges - Software as a Service Security - Security Governance - Risk Management - Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.*
2. *Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.*
3. *Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.*
4. *John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.*

REFERENCES

1. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.*
2. *Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009.*
3. *Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.*

19CIE06 - DIGITAL FORENSICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Acquire knowledge on the Computer Forensics fundamentals.*

CO2 *: Familiarize with evidence collection and analysis procedures and ability to deploy in practice.*

CO3 *: Gain knowledge on the investigative measures, surveillance tools and information act*

INTRODUCTION TO COMPUTER FORENSICS

Computer Forensics Fundamentals - Types of Computer Forensics Technology - Types of Computer Forensics Systems - Types of Vendor and Computer Forensics Services. **(9)**

CYBER CRIME INVESTIGATION AND EVIDENCE

Introduction to Cyber Crime Investigation - Evidence collection and data seizure: Collection options - Types of evidence - Rules of evidence - Duplication and preservation of digital evidence - Documentation and Reporting. **(9)**

COMPUTER FORENSICS ANALYSIS

Discovery of electronic evidence - E-Discovery - Identification of data - Data Recovery Tools and Procedures - Importance of Log Analysis in forensic analysis - Storage Formats for Digital Evidences - Performing RAID data acquisitions. **(9)**

INTRUSION DETECTION

Network forensics scenario, Network vs. Host based detection - Network based and host based intrusion detection systems: Architecture - Detection engine - Benefits and challenges, Detection mechanism, Signatures, Traffic analysis, Intrusion detection **(9)**

SURVEILLANCE AND IT-ACT

The Information Warfare Arsenal of the Future - Surveillance Tools for Information Warfare of the Future - IT Act: Concepts - Sections, Digital laws and legislation, Basics of Indian evidence act: IPC - CrPC. **(9)**

TOTAL : 45

TEXT BOOK

1. *John R. Vacca, "Computer forensics: Computer Crime Scene Investigation", Second Edition, Charles River Media, Firewall, 2015.*
2. *Paul E Proctor, "The Practical Intrusion Detection Handbook", Prentice Hall, USA, 2007.*
3. *Vivek Sood, "Cyber Law Simplified", Tata McGraw Hill, New Delhi, 2008.*

REFERENCES

1. *Warren G Kruse II and Jay G Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, USA, 2010.*
2. *Eogen Casey, "Digital Evidence and Computer Crime", Elsevier, USA, 2011.*
3. *Chad Steel, "Windows Forensics: The Field Guide for Conducting Corporate Computer Investigations" Wiley India, 2006.*

19CIE07 - ENTREPRENEURSHIP SKILL DEVELOPMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Develop an entrepreneurial mindset by learning key skills such as creative thinking, innovations and funding for business*

CO2 *: Formulate a business plan*

CO3 *: Assess the strengths and weaknesses of business plan*

CO4 *: Prepare a business plan for selecting a product*

LAUNCHING ENTREPRENEURIAL VENTURES

Creativity, Innovations, Methods to Initiate Ventures, Legal Challenges, Search for Entrepreneurial Capital **(8)**

BUSINESS PLAN FOR NEW VENTURES

Meaning and Objectives of a Business Plan, Advantages and cost of preparing a Business Plan, Elements, Critical Assessment **(9)**

Strategic Perspectives - Strategic Growth, Need for Strategic Planning, Understanding the growth stage, Unique managerial Concerns of growing enterprise, Valuation Concerns **(10)**

Entrepreneurship - Indian Perspective: Historical Perspective, Global Indian Entrepreneurs, Institutions, Modern Entrepreneurs **(9)**

Project Work - Students have to prepare a detailed business plan selecting product(s), Presentation of such business plans and submission after necessary corrections suggested by subject faculty. **(9)**

TOTAL : 45

TEXT BOOK

1. *Robert D Hisrich, Michael P Peters & Dean Shepherd, "Entrepreneurship", Tata McGraw Hill, 2013*

REFERENCES

1. *Thomas W.Zimmerer, Norman M.Scarborough, "Essentials of Entrepreneurship and Small Business Management", Prentice Hall of India, 2009*
2. *G.S.Sudha, "Management and Entrepreneurship Development", Indus Valley Publication, 2009*

19CIE08 - GRAPH THEORY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Knowledge about Graph Theoretical Concepts.*

CO2 : *Familiarize with Special types of Graphs for Modelling and analysing real-world complex networks.*

CO3 : *Ability to Deploy Graph Colouring Techniques to solve topological problems.*

CO4 : *Knowledge in solving Combinatorial Optimization and Geometrical problems using Graph Theoretic approaches.*

CO5 : *Relate Graph Theory Algorithms in their respective field of Engineering.*

FOUNDATIONS

Foundations: Graphs - Paths - Cycles and Trails - Vertex Degrees and Counting - Directed Graphs. Trees and Distances: Properties - Spanning Trees and Enumerations - Optimization and Trees. **(8)**

MATCHING AND FACTORS

Matching and Factors: Matching and Covers - Bipartite Graphs Matching - Matching in General Graphs. **(5)**

PATHS CONNECTIVITY AND GRAPH COLORING

Paths and Connectivity: Cuts and Connectivity - k-Connected Components - Network Flow Problems. Graph Coloring: Vertex Colouring and its Upper Bound Analysis - k-chromatic graph structures and Enumerative aspects of Graph Colouring. **(10)**

PLANAR GRAPHS

Planar Graphs: Embedding - Properties of Planar Graphs and Planarity Parameters. **(6)**

EDGES AND CYCLES

Line Graphs and Edge - colouring - Hamiltonian cycles - Planarity graphs - Coloring and Cycles: Taits Theorem - Grinberg's Theorem. **(6)**

MATROIDS AND EIGEN VALUES OF GRAPHS

Matroids: Properties- The Span function-The Dual of a Matroid. Eigen Values of Graphs: Characteristic Polynomial-Linear Algebra of Real Symmetric Matrices- Eigen Values and Graph Parameters - Eigen Values of Regular Graph. **(10)**

TOTAL : 45

TEXT BOOK

1. *Douglas. B. West," Introduction to Graph Theory", Pearson Education, Second Edition, reprint 2017.*

REFERENCES

1. *Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Dover Publications, First Edition, 2016.*
2. *Reinhard Diestel, "Graph Theory", Springer Publications, 4th Edition, 2010.*
3. *Bondy. J.A. and Murthy. U.S. R, "Graph Theory with Applications", Elsevier science ltd / North - Holland 1976.*

19CIE09 - GRAPHICS AND MULTIMEDIA SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Demonstrate the working of graphics output primitive algorithms, clipping algorithms and apply two dimensional geometric transformations.*

CO2 : *Illustrate three dimensional object representation, transformations and concepts involved in spline representation.*

CO3 : *Describe the Multimedia concepts, its architecture and its real world applications.*

CO4 : *Ability to understand the importance of various multimedia applications.*

CO5 : *Analyze various compression techniques for the efficient transmission of Multimedia data.*

GRAPHICS PRIMITIVES, 2D TRANSFORMATION AND VIEWING

Output primitives: points and lines - line drawing algorithms - circle and ellipse drawing algorithms - polygon generating and filling algorithms. 2D Transformations: Basic Transformations - matrix representation - translation - rotation - scaling - general pivot point rotation - general fixed point scaling - general scaling directions - reflection - shear. Viewing: window to view port coordinate transformation - point clipping - Cohen and Sutherland line clipping algorithm - Sutherland and Hodgeman polygon clipping algorithm. **(9)**

3D CONCEPTS, TRANSFORMATION AND VIEWING

3D display methods- 3D object representation: polygon surfaces - curved lines and surfaces - Quadric surfaces - Introduction to Spline Representations - Bezier curves and surfaces. 3D Transformations: Translation - Rotation - Scaling - 3D Viewing: view plane - projections - clipping. **(9)**

MULTIMEDIA SYSTEM DESIGN

Elements - Applications - Multimedia system architecture - Evolving technologies for Multimedia system - Defining objects - Multimedia Data Interface standards - Multimedia databases. **(9)**

COMPRESSION AND DECOMPRESSION

Need for Data Compression - Types - Binary Image Compression Schemes - Color, Gray Scale & Still Video Image Compression -Video Image Compression - Audio Compression **(9)**

MULTIMEDIA APPLICATIONS

Content Based Information Retrieval - Multimedia Communications- Multimedia Information Sharing and Retrieval - Applications - Social Media Sharing, Online Social Networking- Virtual Reality- Multimedia for Portable Devices- Collaborative Multimedia Applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Donald Hearn and Pauline Baker M., "Computer Graphics", Prentice Hall of India, Second Edition, 2008.*
2. *Prabhat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", Prentice Hall of India, Reprint 2007. (Multimedia Systems Design, Compression and Decompression)*
3. *Ze Nian Li, Mark S Drew and Jiangchuan Liu, " Fundamentals of Multimedia", Second Edition, Springer,2014. (Multimedia Applications)*

REFERENCES

1. *Steve Harrington, "Computer Graphics - A Programming Approach", McGraw Hill Book Co., Second Edition, 2007.*
2. *John F.Koegal Buford, "Multimedia System", Pearson Education Limited, Reprint 2008.*
3. *Ranjan Parekh, "Principles of Multimedia", Tata McGraw Hill, Second Edition, 2013.*

19CIE10 - INFORMATION SECURITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Identify and analyse the security threats and attacks and apply device suitable security policies and standards.*

CO2 : *Assess the risks and apply suitable risk control strategies.*

CO3 : *Understanding of Information Security Policies, Standards and Blue print.*

CO4 : *Employ appropriate intrusion detection and prevention systems to ensure information security.*

CO5 : *Discuss various national and international laws of information security and its framework.*

INTRODUCTION, NEED, ETHICAL AND PROFESSIONAL ISSUES

Introduction to Information Security - The History of Information Security- Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing Components - Balancing Information Security and Access - The Systems Development Life Cycle - The Security Systems Development Life Cycle. The Need for Security: Introduction - Business Needs First -Threats -Attacks. Ethics and Information Security - Codes of Ethics and Professional Organizations. **(7)**

RISK MANAGEMENT AND INFORMATION SECURITY

Introduction - An Overview of Risk Management - Risk Identification -Risk Assessment - Risk Control Strategies - Selecting a Risk Control Strategy - Risk Management Discussion Points - Documenting Results - Recommended Practices in Controlling Risk. **(6)**

POLICIES, STANDARDS, PRACTICES AND BUSINESS CONTINUITY

Introduction - Information Security Policy, Standards and Practices -The Information Security Blueprint: ISO 17799/BS 7799, ISO 27001and its controls - NIST Security Models - Design of Security Architecture - Security Education, Training and Awareness Program - Continuity Strategies. **(9)**

SECURITY TECHNOLOGY: INTRUSION DETECTION, ACCESS CONTROL, AND SECURITY TOOLS

Introduction - Intrusion Detection and Prevention Systems: IDPS - Terminology, Use of IDPS, Strengths and Limitations of IDPS - Honey Pots, Honey Nets, and Padded Cell Systems - Scanning and Analysis Tools - Access Control Devices - Physical Security - Security and Personnel. **(11)**

BIOMETRIC CONTROLS

Biometrics - Nature of Biometrics Identification/Authentication Techniques - Biometric Techniques - Matching and Enrolment Process in Biometrics - Benefits Over Traditional Authentication Methods **(4)**

SECURITY OF WIRELESS NETWORKS

Attacks on Wireless Networks: Other Security Risks in Wireless Networks - Management and Mitigations for Wireless Networks Attacks. **(3)**

LAWS AND LEGAL FRAMEWORK

Introduction - Information Security and the Law: The Rising Need -Understanding the Laws for Information Security: A Conceptual Framework - The Indian IT Act - Laws for Intellectual Property Rights (IPR) - Health Insurance Portability and Accountability Act (HIPAA) -Gramm-Leach-Bliley Act (GLBA) - Overview of Sarbanes-Oxley (SOX) - Building Security into Software/System Development Life Cycle. **(5)**

TOTAL : 45

TEXT BOOKS

1. *Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Course Technology, New Delhi, Sixth Edition, 2017.*
2. *Nina Godbole, "Information Systems Security-Security Management, Metrics, Frameworks and Best Practices", Wiley India Pvt. Ltd., New Delhi, Second Edition, 2017. (Biometric Controls, Security of Wireless Networks, Laws and Legal Framework)*

REFERENCES

1. *Thomas R.Peltier, "Information Security Fundamentals", Auerbach Publications, Second Edition, 2013.*
2. *Micki Krause and Harold F.Tipton, "Information Security Management Handbook", Auerbach Publications, Sixth Edition,2008.*
3. *Mark Merkow and Jim Breithaupt," Information Security - Principles & Practices", Second Edition,Pearson Education, 2014.*

19CIE11 - INFORMATION STORAGE MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe Data Centre Infrastructure, various storage technologies and disk performance.*

CO2 : *Discuss Intelligent Storage Systems, Analyze and implement RAID solutions.*

CO3 : *Analyze Storage Attached Networks and Network Attached Storage technologies and identify suitable solutions for practical applications.*

CO4 : *Describe Content Addressed Storage and storage virtualization techniques.*

CO5 : *Compare different backup, restoration and replication methods and select suitable solutions to ensure business continuity.*

INTRODUCTION TO STORAGE TECHNOLOGY

Information Storage - Evolution of Storage Technology and Architecture - Data Centre Infrastructure - Key challenges in Managing Information - Information Lifecycle. Storage System Architecture: Component Storage System Environment - Disk Drive Components and Performance - Laws Governing Disk Performance - Logical Components of Host - Application Requirement and Disk performance. **(7)**

DATA PROTECTION AND INTELLIGENT STORAGE SYSTEMS

Implementation of RAID - RAID Array Components - RAID levels - RAID Comparison - RAID impact on Disk Performance - Hot Spares - Component of an Intelligent Storage System - High - end Storage Systems - Midrange Storage System. **(6)**

DIRECT ATTACHED STORAGE AND SCSI

Directly Attached Storage and Introduction to SCSI: Types of DAS - DAS benefits and limitations - Disc Drive Interfaces - Introduction to parallel SCSI - SCSI Command Model. **(4)**

SAN AND NAS

Storage Area Networks: Fibre Channel overview - The SAN and its evolution - Components of SAN - FC Connectivity - Fibre Channel Ports - Fibre Channel Architecture- Zoning - Fibre Channel Login Types - FC Topologies

Network Attached Storage: General Purpose Servers vs NAS devices - Benefits of NAS - NAS file I/O- Components of NAS-NAS Implementation - NAS File Sharing Protocols - NAS I/O operations - factors affecting NAS performance and availability. **(9)**

IP SAN, CONTENT ADDRESSED STORAGE AND STORAGE VIRTUALIZATION

IPSAN: iSCSI - FCIP - Content Addressed Storage: fixed content and archives - types of archives - features and benefits of CAS - CAS Architecture Storage Virtualization: overview- Forms of Virtualization- Storage Virtualization Challenges- Types of storage Virtualization. **(10)**

INFORMATION AVAILABILITY AND MONITORING

Introduction to Business Continuity - Information Availability - BC Terminology - Failure Analysis - Backup and Recovery -Backup Purpose - Backup Consideration - Backup - Granularity - Methods - Backup and Restore operations - Local Replication - source and target - uses of local replica - Data Consistency - Local Replication Technologies - Restore and Restart consideration - Creating Multiple replicas - Remote replication - Modes of remote Replication - Remote replication Technology - Network infrastructure **(9)**

TOTAL : 45

TEXT BOOK

1. *Emc2 Corporation, "Information Storage and Management", Wiley, Second Edition, 2012.*

REFERENCE

1. *Robert Spalding, "Storage Network - The Complete Reference", Tata McGraw Hill, Osborne, First Edition, 2017.*

19CIE12 - INFORMATION THEORY AND CODING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Gain insight on the fundamentals of probability, essential parameters of information theory and employ it in source coding and channel coding techniques to compute various operational parameters.*

CO2 : *Identify and devise error detecting and error correcting capabilities of the code and sketch the encoder configurations.*

CO3 : *Determine the final code word by choosing the suitable text compression technique for the given scenario and discuss various kinds of speech compression techniques.*

CO4 : *To analyze image and audio compression techniques and infer about the encoding and decoding of digital data streams.*

CO5 : *To understand the principles of video compression techniques and the various standards associated with them.*

FUNDAMENTALS OF INFORMATION THEORY

Uncertainty - Information and Entropy - Information rate - conditional and Joint entropies - Mutual information.

Source Coding : Prefix codes - Kraft McMillan Inequality.

Entropy Coding : Source Coding Theorem - Shannon - Fano Coding - Static Huffman Coding.

Channel Coding : Discrete Memory less Channel - Channel models - Cascaded channels - Channel capacity - Channel coding theorem - Information capacity theorem. **(10)**

ERROR CONTROL CODING

Linear Block codes: Introduction to Error Control Coding- Basic Definitions- Matrix description of linear block codes - Decoding of Linear Block codes - Syndrome decoding.

Cyclic codes: Generator polynomial - Parity check polynomial - Encoder of cyclic codes - Calculation of syndrome.

Convolution codes: Introduction - Code Tree, Trellis, State diagram - Encoding - Decoding: Feedback decoding, Sequential decoding and Viterbi algorithm. **(12)**

TEXT AND SPEECH COMPRESSION

Text Compression : Dynamic Huffman Coding - Arithmetic coding - Adaptive Dictionary: LZ77-LZ78 - LZW- Subband Coding : The Basic Subband Coding Algorithm - Speech Compression : Channel Vocoder - Linear Predictive Coder - Code excited Linear Prediction- Mixed Excitation Linear Prediction -Wideband Speech Compression : ITU-T G.722.2 **(9)**

IMAGE AND AUDIO COMPRESSION

Lossless Image Compression: CALIC- JPEG-LS Wavelet -based Image Compression: Embedded Zero Tree Coder - Set Partitioning in Hierarchical Trees- JPEG 2000 - Audio compression : MPEG Audio Coding -- Dolby AC-3 **(9)**

VIDEO COMPRESSION

Motion Compensation - H.261 - MPEG-1 Video Standard - MPEG-2 Video Standard- H.264 **(5)**

TOTAL : 45

TEXT BOOKS

1. *Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw Hill, Second Edition, Eighth Reprint, 2010.*
2. *Khalid Sayood, "Introduction to Data Compression", Elsevier, Fourth Edition, 2012.*

REFERENCES

1. *Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education Limited, Fourth impression, 2009.*
2. *Todd K.Moon, "Error Correction Coding: Mathematical Methods and algorithms", John Wiley & Sons, First Edition, 2005.*

19CIE13 - NEURAL NETWORK AND DEEP LEARNING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Understand the basics of neural network and deep learning*

CO2 *: Understand and implement basic neural network model with hidden layers*

CO3 *: Analyze optimization and generalization in deep learning*

CO4 *: Understand convolutional neural network (CNN, or ConvNet) and implement to analyze visual imagery applications.*

CO5 *: Understand Recurrent Neural Network (RNN) and implement real-time applications.*

INTRODUCTION

Basics: Biological Neuron, Biological Neuron, Idea of computational units, McCulloch-Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. **(9)**

FEEDFORWARD NETWORKS

Representation Power of Feedforward Neural Networks, Backpropagation, Empirical Risk Minimization, Regularization, Autoencoders. Applications: speech recognition, image recognition, and machine translation. **(9)**

DEEP NEURAL NETWORKS

Difficulty of training deep neural networks, Greedy layerwise training. Gradient Descent (GD), Stochastic Gradient Descent (GD), Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), Regularization methods (dropout, drop connect, batch normalization). Applications: Vision, NLP, Speech. **(9)**

CONVOLUTIONAL NEURAL NETWORKS

Architecture, LeNet, AlexNet, Visualizing Convolution Neural Networks: Applications: Image recognition, Video analysis, Drug discovery. **(9)**

RECURRENT NEURAL NETWORKS

Long Short Term Memory, Bidirectional LSTMs, Bidirectional RNNs. Applications: Machine Translation, Robot control, Handwriting recognition **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ian Goodfellow and Yoshua Bengio and Aaron Courville., " Deep Learning ",MIT Press, 2016.*
2. *Christopher Bishop., " Pattern Recognition and Machine Learning ", Springer,2007.*

REFERENCES

1. *Raúl Rojas, " Neural Networks: A Systematic Introduction ", Springer-Verlag, Berlin,1996.*
2. *Yegnanarayana, B., " Artificial Neural Networks ", PHI Learning Pvt. Ltd, 2009.*
3. *Golub, G.,H., and Van Loan,C.,F., " Matrix Computations ", JHU Press,2013.*

19CIE14 - OBJECT ORIENTED ANALYSIS AND DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe the fundamental aspects of Object Models.*

CO2 : *Identify classes and Objects and establish relationships among classes and objects.*

CO3 : *Selection and Application of appropriate object oriented design Methodologies in real world applications.*

CO4 : *Construct Class, Use Case and Interaction Diagrams for software specifications.*

CO5 : *Illustrate the object-oriented software development process and work flow.*

OBJECTS AND OOS

Objects-Attributes: object state and properties-Object behaviour and methods-Object Respond to messages-Encapsulation and information Hiding-Class Hierarchy -Polymorphism-Aggregation and Object Containment-The software development Process-Building High Quality Software-Reusability. **(7)**

OBJECT ORIENTED METHODOLOGIES

Rumbaugh - Booch - Jacobson - Patterns - Frameworks - Unified approach. **(9)**

UNIFIED MODELING LANGUAGE

Static and dynamic models -UML Diagrams :Class diagram : Notation- Object diagram - Class interface notation - Binary Association notation, Association Rule - Qualifier -Multiplicity - OR Association - Association Class - N-ary association - Aggregation and Composition - Generalization. Use case diagram : Actors-Use Cases-Use case Diagram-Include and Extend Relationships-Generalization. Interaction Diagrams : Sequence Diagrams - Collaboration Diagrams. State chart diagram: Activity diagram Implementation diagrams: Component diagram - Deployment diagram. **(11)**

OBJCET ANALYSIS AND DESIGN

Classification Theory-Noun Phrase Approach-Classes, Responsibilities and Collaborators. **(9)**

PROCESS

Macro Process: Content Dimension - Time Dimension - Milestones and Phases - Iterations

Micro Process: The analysis and Design Process - Micro process and levels of abstraction - Associations-Super-Sub Class Relationships-A-Part-of Relationships-Aggregation-Object-Oriented Design Axioms-Corollaries **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ali Bahrami, "Object Oriented System Development", McGraw Hill International Edition, Singapore, Second Reprint, 2008.*
2. *Grady Booch, Robert A.Maksimchuk, Michael. W. Engle, Bobbi J. Young, JIM Conallen, Kelli A. Houston "Object Oriented Analysis and Design with Applications", Third Edition, Pearson Education Inc., USA, 2007.*

REFERENCES

1. *Rumbaugh J, Blaha M, Premerlani W, Eddy F and Lorensen W, "Object Oriented Modeling and Design", Prentice Hall of India/ Pearson Education, New Delhi, 2004.*
2. *Kendall Scott, martin Fowler, "UML Distiled : A brief guide to the standard Object modeling Language", Addison Wesley, USA, 2009.*
3. *Atul Kahate, "Objetct Oriented Analysis and Design", Tata McGraw-Hill, New Delhi 2007.*

19CIE15 - OPEN SOURCE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *State the various open source Licenses and understand the Linux build systems.*

CO2 : *Illustrate the concept of NoSQL Database and to choose the Appropriate No-SQL DataBase Types*

CO3 : *Implement NoSQL Database for real world application*

CO4 : *Ability to learn and use PHP and Python programming languages/scripts to develop and demonstrate real time applications.*

INTRODUCTION TO OPEN SOURCE TECHNOLOGIES

Overview of Free/Open Source Software - Definition of FOSS & GNU - History of GNU/Linux and the Free Software Movement - Linux Distributions - Advantages of Free Software and GNU/Linux - Free Software Licenses- GNU Build systems: Autoconf , Automake, Libtool, Autogen, GNU make - Linux Installation and Hardware Configuration- Apache Web Server : Introduction - Starting, Stopping and restarting Apache- Configuration. **(8)**

OPEN SOURCE NON RELATIONAL DATABASES

Why NoSQL - Aggregate Data Models - More Details on Data Models - Distribution Models -Consistency. **(9)**

IMPLEMENTATION OF NON RELATIONAL DATABASES

Key Value Databases - Document Databases - Column-Family Stores - Graph Databases Beyond NoSQL. Case study: Querying on Non relational Databases. **(10)**

OPEN SOURCE PROGRAMMING LANGUAGES

PHP: Essential PHP- Operators and flow control- Strings and Arrays - Functions - PHP Browser Handling power - Working with PHP and MYSQL database **(9)**

OPEN SOURCE PROGRAMMING LANGUAGES

Python-Regular expressions: Match function-Search function-Matching Vs Searching-Modifiers-Patterns, Database:Executing queries-Transactions- Python numpy, Python Pandas, Python Matplotlib. **(9)**

TOTAL : 45

TEXT BOOKS

1. *James Lee and Brent Ware, "Open Source Web Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP", Addison Wesley Publiser, First Edition, 2002. (Introduction to Open Source Technologies, Open Source Programming Languages, Open source web server)*
2. *Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled A Brief Guide to the Emerging World of Polyglot Persistence", AddisonWesley, Reprint 2013. (Open Source Non Relational Databases, Types of Non Relational Databases, Implementation of Non Relational Databases)*
3. *Mark Lutz, "Learning Python", O'Reilly Media Fifth Edition, 2013.(Python)*
4. *Steven Holzner, "PHP: The Complete Reference", TMH Edition Second Reprint 2007*

REFERENCES

1. *N. B. Venkateshwarlu, "Introduction to Linux: Installation and Programming (Ed)", BS Publishers (An NRCFOSS Publication) Reprint 2014.*
2. *Wesley J.Chun, "Core Python Programming" Prentice Hall, Second Edition, 2007.*
3. *Linux Administration URL: http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/.*

19CIE16 - PARALLEL ARCHITECTURE AND PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe Thread-Level Parallelism, Interconnection Networks and basics of parallel architecture.*

CO2 : *Apply parallelism primitives like patterns and data distribution for program parallelization.*

CO3 : *Appraise various performance metrics and CPU performance for Parallel programs*

CO4 : *Apply message passing programming for parallelisation using MPI*

CO5 : *Employ threads scheduling to achieve parallelism by pthreads and OpenMP.*

PARALLEL COMPUTER ARCHITECTURE

Parallel Architecture and Technology Trends - Flynn's Taxonomy of Parallel Architectures - Memory Organization of Parallel Computers - Thread-Level Parallelism: Simultaneous Multithreading, Multicore Processors - Interconnection Networks: Cube, Mesh, Bus, Crossbar, Omega, Butterfly. **(9)**

PARALLELIZATION OF PROGRAMS

Levels-of-Parallelism : Instruction Level, Data Parallelism, Loop Parallelism, Functional Parallelism. Parallel Programming Patterns: Creation of Processes threads, fork-join, Parbegin-Parend, SPMD and SIMD, Master-Slave, Client-Server, Pipelining, Task Pools, Producer-Consumer. Data distributions for Arrays: Cyclic and Checkerboard distribution. Information Exchange: Shared Variables, Communication Operations, Parallel Matrix-Vector product. **(9)**

PERFORMANCE ANALYSIS OF PARALLEL PROGRAMS

Evaluation of CPU performance - MIPS and MFLOPS - Performance of Processes with Memory Hierarchy - Performance Metric for Parallel Programs: Speedup, Efficiency-Scalability of Parallel Programs. **(8)**

MESSAGE-PASSING PROGRAMMING

MPI Point-to-Point communication - NonBlocking operation in communication modes-Collective communication in MPI-Process groups and Communicators. Introduction to MPI-2: Dynamic Process Generation in Management. **(8)**

THREAD PROGRAMMING

Programming with pthreads - Threads Coordination - Implementation of a Task Pool - Parallelism by Pipelining - Thread Scheduling with pthreads. Introduction to openMP: Designing Parallel Algorithms for Matrix-Vector Multiplication, Floyd's Algorithm, Quicksort. **(11)**

TOTAL : 45

TEXT BOOK

1. *Thomas Rauber,Gudula Runger,"Parallel Programming: for Multicore and Cluster Systems", Springer, Second Edition,2013.*

REFERENCES

1. *Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman, First Edition 2011.*
2. *Michael J Quinn, "Parallel programming in C with MPI and OpenMP ",McGraw-Hill Higher Education, First Edition, 2004.*
3. *David.E.Culler, Jaswinder Pal Singh, Anoop Gupta, "Parallel Computer Architecture - A Hardware/Software Approach", Morgan Kauffman Publishers, First Edition, 2002.*

19CIE17 - RESOURCE MANAGEMENT TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Solve linear programming problem, transportation & Assignment problem which exist in the real life applications.*

CO2 : *Apply the knowledge gained on inventory models, simulation & queuing theory to provide descisions for common business problems.*

CO3 : *Analyze the network model through CPM & PERT techniques to the problems that occur in project management.*

CO4 : *Design the resource allocation problem as dynamic programming & solve them.*

CO5 : *Determine the replacement policies using available resources & time for Industrial problems.*

LINEAR PROGRAMMING

Linear inequalities - Feasible solutions - Equality principles - Simplex algorithm and its variants: Artificial Variables Techniques, Duality in LPP-Primal - Dual relationship - transportation and assignment problems-Integer Programming: Gomory's cutting plane methods. **(10)**

INVENTORY

Functions of inventories - Costs associated with inventory - Elementary inventory models - Price break model - Economic order quantities - Safety stocks. **(6)**

QUEUING THEORY AND SIMULATION

Poisson arrivals - Exponential service times - Basic equations - Single channel model : (M/M/1) : (?/FCFS), (M/M/1) : (N/FCFS), Simulation: Monte - Carlo technique, use of random numbers. **(7)**

PERT/CPM

Critical Path Methods (CPM) - Program evaluation and review techniques (PERT) -Time - Cost analysis - Crashing **(6)**

DYNAMIC PROGRAMMING

Characteristic features, functions, equations - Analysis - Computational procedures for solution - Stage Coach problem, Cargo loading problem, Resource allocation problem. **(8)**

REPLACEMENT MODELS

Individual replacement Policy: Basic concept Money Value, Present Worth Factor (PWF) and Discount Rate, Group replacement policy. **(8)**

TOTAL : 45

TEXT BOOK

1. *Hamdy A.Taha, "Operations Research: An Introduction", Pearson Education, Tenth Edition, 2016.*
2. *Dharani Venkatakrishnan, "Operations Research - Principles and Problems", Keerthi Publication, First Edition, 2005.*

REFERENCES

1. *Operations Research - Kandiswarup, P. K. Gupta, Man Mohan, S. Chand &Sons Education Publications, New Delhi, Fifteenth Edition, 2010.*
2. *Sasieni, Yaspan and Friedman, "Operation Research - Methods and Problems", Literary Licensing, LLC,First Edition, 2013.*
3. *F.S. Hillier and G.J. Lieberman: Introduction to Operations Research - Concepts and Cases, Ninth Edition, Tata Mc Graw Hill, 2010.*

19CIE18 - SERVICE ORIENTED ARCHITECTURE AND WEB SERVICES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe web browser, Web service frameworks and recognize its internal functionalities.*

CO2 : *Discuss various SOA delivery strategies, service oriented analysis and modeling guidelines.*

CO3 : *Select suitable business process design for structured, unstructured data and security mechanism using xml..*

CO4 : *Design and implement business logic for real time systems using advanced web service technologies and standards.*

CO5 : *Describe the types of security issues and security attacks related to web services.*

SOA AND WEB SERVICES FUNDAMENTALS

Introduction to SOA: Fundamental SOA - Common characteristics of contemporary SOA - Common misperceptions about SOA - Common tangible benefits of SOA - Common pitfalls of adopting SOA. Evolution of SOA: SOA timeline - Continuing evolution of SOA - The roots of SOA. Web Services and Primitive SOA: The Web services framework - Services (as Web services) - Service descriptions (with WSDL) - Messaging (with SOAP). **(9)**

BUILDING SOA (PLANNING & ANALYSIS)

SOA Delivery Strategies: SOA delivery lifecycle phases - The top-down strategy - The bottom-up strategy - The agile strategy. Service Oriented Analysis: Introduction to Service oriented analysis - Benefits of business centric SOA - Deriving business services - Service modeling - Service modeling guidelines - classifying service model logic - contrasting service modeling approaches. **(9)**

BUILDING SOA (TECHNOLOGY & DESIGN)

Service Oriented Design: Introduction to service oriented design - WSDL related XML schema language basics - WSDL language basics - SOAP language basics - service interface design tools - SOA Composition Guidelines: Steps to composing SOA - considerations for choosing service layers - considerations for positioning core SOA standards - considerations for choosing SOA extensions - Service Design - Business Process Design. **(9)**

ADVANCED WEB SERVICES TECHNOLOGIES AND STANDARDS

Conversations overview- Web Services Conversation Language (WSCL)-WSCL interface components-Relationship between WSCL and WSDL - Workflow-Business Process Management-Workflows and work flow management system - BPEL-ACID Transactions-Scaling Transactions to web services-Other Web services Transaction Protocols. **(9)**

SECURITY IN WEB SERVICES

Web service security issues-Types of security attacks and threads-web services security roadmap-WS-security-Quality of service (QOS)Overview -QoS metrics for web services - Holes- Design patterns and best practices- Building QoS into web services and applications-QoS enabled web services -QoS enabled applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Thomas Erl, "Service-Oriented Architecture: Concepts, Technology and Design", Prentice Hall of India, Ninth Edition, 2019.*
2. *Sandeep Chatterjee,"Developing Enterprise Web services, An architect's Guide", Pearson Education, First Edition 2005. (Advanced Web Services Technologies and Standards, Security in Web Services)*

REFERENCES

1. *Dirk Krafzig, Karl Banke, Dirk Salma, "Enterprise SOA: Service- Oriented Architecture Best Practices", Pearson Education, First Edition, 2004.*
2. *Thomas Erl, "SOA Principles of Service Design", Prentice Hall of India, First Edition, 2007.*
3. *Frank P.Coyle ,"XML ,Web services and the Data Revolution". Pearson Education, First Edition, 2002.*

19CIE19 - SOFTWARE METRICS AND MEASUREMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Understand the representational theory of measurement, scales and various software metrics.*

CO2 *: Classify software measures, describe data collection procedures and apply suitable data analysis techniques*

CO3 *: Understand the measures for various internal and external product attributes*

CO4 *: Knowledge in various metrics on Product quality, Process quality and Software Maintenance*

CO5 *: Describe software reliability problem and reliability models to measure software reliability.*

FUNDAMENTALS OF SOFTWARE MEASUREMENT

Measurement: Measurement in software engineering - scope of software metrics. Basics of Measurement: representational theory of measurement-measurement and models- measurement scales and scale types - nominal scale - ordinal scale- interval scale- ratio scale- absolute scale - meaningfulness in measurement. **(7)**

GOAL BASED FRAMEWORK AND DATA COLLECTION

Classifying software measures - determining what to measure - software measurement validation. Empirical Investigation - Principles of empirical studies. Software metrics data collection: Defining good data, data collection for incident reports, how to collect data, reliability of data collection procedures. Analyzing software measurement data: Statistical Distributions and hypothesis testing, classical data analysis techniques, examples of simple analysis techniques, overview of statistical tests. **(10)**

PRODUCT ATTRIBUTES MEASUREMENT

Measuring internal product attributes: size - properties of software size - code size - design size - requirements analysis and specification size - functional size measures and estimators. Measuring internal product attributes: structure - Aspects of structural measures - control flow structure of program units - design level attributes. Measuring external product attributes: modeling software quality - measuring aspects of quality - usability measures - security measures. **(13)**

QUALITY METRICS

Product quality metrics, In - process quality metrics - software maintenance metrics. In-process metrics for software testing: Test Progress S curve, Testing defect arrivals over time, Testing defect backlog over time. **(7)**

SOFTWARE RELIABILITY MEASUREMENT

Basics of reliability theory- software reliability problem - parametric reliability growth models: Jelinski- Moranda Model, other models based on Jelinski Moranda, little wood model, littlewood-verrall model - the recalibration of software reliability growth prediction **(8)**

TOTAL : 45

TEXT BOOKS

1. *Norman Fenton and James Bieman, "Software Metrics - A Rigorous & Practical Approach", CRC press, Third Edition, 2015.*
2. *Stephen H Kan, "Metrics and Models in Software Quality Engineering", Pearson Education, Second Indian Reprint, New Delhi, 2016.(In-process metrics for software testing)*

REFERENCES

1. *Capers Jones, "Applied Software Measurement: Global Analysis of Productivity and Quality", McGraw Hill Publishing, Third Edition 2008.*
2. *International Function Point Users Group "IT Measurement - A Practical Advice from the Experts", Pearson Education, Asia, 2002.*

19CIE20 - SOFTWARE TESTING AND QUALITY ASSURANCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Describe testing fundamentals, Testing principles, TMM levels and classify the defects*

CO2 : *Apply suitable Black box and White Box testing techniques and design Test cases in practice.*

CO3 : *Understand the levels of Testing, develop Test Plans, Testing goals & policies and perform reviews for practical applications.*

CO4 : *Ability to test different types of Web Applications, understand security and performance aspects of testing.*

CO5 : *Outline Software Quality attributes and Software Quality Assurance functions and Prepare Software Quality Assurance plans.*

INTRODUCTION TO TESTING AND TEST DESIGN STRATEGIES-I

Introduction to Testing as an Engineering Activity: The role of Process in Software Quality, Testing as a Process, Overview of Testing Maturity Model(TMM) - Testing Fundamentals: Basic Definitions, Software Testing Principles, Tester's Role in a Software Development Organization - Defects, Hypothesis and Test: Origins of Defect, Defect Classes, the defect Repository and Test Design.

Strategies and Methods for Test Case Design I: Test Case Design strategies -Black Box Approach to Test Case Design- Random Testing- Equivalence Class Partitioning- Boundary Value Analysis- Other Black Box Test Design Approaches- COTS- Black box Methods and TMM level 2 goals. **(9)**

TEST DESIGN STRATEGIES-II

Strategies and methods for test case design II: White Box Approach to Test Case Design- Test Adequacy Criteria -Coverage and Control flow graphs - Covering Code Logic- Paths- Additional White Box Test Design Approaches: Data Flow, Loop Testing, Mutation Testing- White Box Testing Methods and the TMM. **(6)**

LEVELS OF TESTING

Need for levels of testing - Unit Test : Functions, Procedures, Classes, and Methods as Units- Unit Test planning - Designing the Unit Tests - The Class as a Testable Unit and Special Considerations - Test Harness. Integration test: Goals - Integration strategies for Procedures, Functions and Classes- Designing Integration Tests- Integration test Planning.

System test: Functional testing, Performance testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing- Regression Testing- Alpha, Beta, Acceptance Testing.

Testing Goals, Policies & Plans: Introductory concepts -Testing/Debugging goals & Policies - Test planning -Test Plan Components- Reporting test results -Role of three critical groups.

Reviews: Types of Reviews-Inspection - walkthroughs - Components of Review plan-Review Check List-Review Metrics. **(13)**

TESTING WEB APPLICATIONS

Testing Concepts for Web Apps- the Testing Process- Content Testing- User Interface Testing- Component Level Testing- Navigation Testing- Configuration Testing- Security Testing - Performance Testing. **(5)**

SOFTWARE QUALITY ASSURANCE, STANDARDS AND PROCESS MODELS

Quality Concepts - Quality - Software Quality - Garvin's Quality Dimensions - McCall's Quality Factors - ISO 9126 Quality factors - Cost of Quality - Achieving software Quality - SQA Infrastructure - CASE Tools for Software Quality

Software Quality Assurance: Elements of SQA - SQA tasks, Goals, Attributes & Metrics - Statistical SQA - Software Reliability - ISO 9000 Quality standard - SQA Plan

Software process Improvements: The CMMI - The People CMM **(12)**

TOTAL: 45

TEXT BOOKS

1. *Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2010, Reprint.*
2. *Roger. S. Pressman "Software Engineering A Practitioner's Approach, 7e", McGraw Hill International Edition, 2014. (Testing Web Applications, Software Quality and Quality Assurance, Quality Standards and Process Models)*
3. *Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009 (CASE Tools form Software Quality, SQA Infrastructure)*

REFERENCES

1. *Yogesh Singh, " Software Testing", Cambridge University Press, 2012*
2. *Kshirasagar Naik, Priyadhrshini Tripathy, "Software Testing and Quality Assurance", John wiley & sons Inc Publication, 2008*
3. *Nina S Godbole, " Software Quality Assurance-Principles and Practice", Narosa Publishing, Second Edition, 2016*

19CIE21 - WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Describe the sensor network architecture and its applications.*

CO2 *: Describe the different MAC protocols used in wireless sensor networks and their applications.*

CO3 *: Demonstrate knowledge of routing protocols developed for WSN.*

CO4 *: Describe and explain the function of Transport control protocols for WSN.*

CO5 *: Outline the features of OS and performance models of wireless sensor networks*

INTRODUCTION

BASIC sensor network Architecture-Generation of sensor network - challenges - hardware and software components of wireless nodes-operating environment - Applications: Home control. Building Automation- Medical applications. **(9)**

MAC PROTOCOLS

Schedule based protocols: Self-organizing MAC for Sensor nets (SMACS), Low Energy Adaptive Clustering Hierarchy (LEACH)-Random Access based protocols - Sensor MAC protocol, IEEE 802.15.4 and Zigbee Reference Model - Super frame structure-Frame types - Modes of operation: Contention based channel Access - Beacon less mode. **(10)**

ROUTING PROTOCOLS

Data Dissemination and Gathering - Challenges and Design Issues - Flooding - Sensor Protocols for Information via Negotiation (SPIN) - LEACH - Power Efficient Gathering in Sensor Information System (PEGASIS) - Directed Diffusion - Geographical routing. **(11)**

TRANSPORT CONTROL PROTOCOLS

Design issues - Congestion Detection and Avoidance (CODA) - Event to Sink Reliable Transport (ESRT) - Reliable Multi Segment Transport (RMST) - Pump Slowly Fetch Quickly (PSFQ) - GARUDA - Ad-hoc Transport Protocol (ATP). **(8)**

OPERATING SYSTEM AND PERFORMANCE MODELS

OS Design Issues - Features of Tiny OS, MANTIS - Performance Modeling of WSN : Performance Metrics - Basic Models: Traffic Models - Energy Models - Node model - Network models: MAC model - Routing Model - System Model. **(7)**

TOTAL : 45

TEXT BOOK

1. *Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks-Technology, Protocols, and Applications", Second Edition, John Wiley, 2011.*

REFERENCES

1. *Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication, First Edition, 2005.*
2. *Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks",Wiley, First Edition, 2007.*
3. *Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2010.*
4. *Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks - A Networking Perspective", Wiley India,First Edition, 2014.*

19ECI01 - PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP (NALAYA THIRAN)

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

On completion of the course, the students will be able to:

CO1 *: Upskill in emerging technologies and apply to real industry-level use cases*

CO2 *: Understand agile development process*

CO3 *: Develop career readiness competencies, Team Skills / Leadership qualities*

CO4 *: Develop Time management, Project management skills and Communication Skills*

CO5 *: Use Critical Thinking for Innovative Problem Solving*

CO6 *: Develop entrepreneurship skills to independently work on products*

Choosing a Project : Selecting a project from the list of projects categorized various technologies & business domains.

(2 weeks)

Team Formation : Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves. **(1 week)**

Hands on Training : Students will be provided with hands-on training on selected technology in which they are going to develop the project. **(2 weeks)**

Project Development : Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform. **(6 weeks)**

Code submission, Project Doc and Demo : Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub. **(3 weeks)**

Mentor Review and Approval : Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team. **(1 week)**

Evaluation and scoring : Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics. **(1 week)**

TOTAL : 16 weeks

19CSE01 - DATA SCIENCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Provide with the knowledge and expertise to become a proficient data scientist.*

CO2 *: Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.*

CO3 *: Produce Python code to statistically analyze a dataset.*

CO4 *: Critically evaluate data visualizations based on their design and use for communicating stories from data.*

INTRODUCTION

Data science- Benefits and uses of data science and big data- Facets of data- The data science process- The big data ecosystem and data science. **(9)**

STATISTICAL INFERENCE AND THE DATA SCIENCE PROCESS

Statistical Thinking in the Age of Big Data - Exploratory Data Analysis- The Data Science Process- Overview of the data science process- Defining research goals and creating- Retrieving data - Cleansing, integrating, and transforming data - Exploratory data analysis- Build the models - Presenting findings and building applications. **(9)**

LEARNING ALGORITHMS AND MODELS

Need for machine learning in data science - The modeling process- Types of machine learning - Semi-supervised learning- Three Basic Algorithms - Linear Regression -k- Nearest Neighbors (k-NN) -k-means. **(9)**

DATA VISUALIZATION (Matplotlib / Seaborn)

Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density and Contour Plots - Histograms, Binnings, and Density- Customizing Plot Legends Customizing Color bars - Multiple Subplots Text and Annotation Customizing. Ticks Customizing- Matplotlib: Configurations and Stylesheets - Three - Dimensional Plotting in Matplotlib - Geographic Data with Base map Visualization with Seaborn. **(9)**

APPLICATIONS AND RECENT TRENDS

Social network analysis- Social Network Analysis at Morning Analytics- Terminology from Social Networks- Data Leakage-case study- Avoid Leakage- Evaluating Models. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly, First Edition, 2013. (UNIT II,UNIT III ,UNIT V).*
2. *Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science" Manning Publications, 2016 (UNIT I, II, III)*
3. *Jake VanderPlas ,"Python Data Science Handbook Essential Tools for Working with Data, 2016 (UNIT IV)*

URL REFERENCE

https://colab.research.google.com/github/jakevdp/PythonDataScienceHandbook/blob/master/notebooks/04.00-Introduction-To-Matplotlib.ipynb

19CSE02 - NATURAL LANGUAGE PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Knowledge in construction of system models that are used to devise procedures for syntactic analysis.*

CO2 : *Exposure in parsing methodologies that support checking of syntactic structure of languages.*

CO3 : *Analyze state-of-art techniques in language generation and conversations that involves both syntactic and semantic structure of dialogues.*

CO4 : *Knowledge about linguistic corpora and designing algorithm to access and infer knowledge from them.*

BASIC FOUNDATION

Knowledge in speech and language processing - Ambiguity - Models and Algorithms - Language, Thought and Understanding. Regular Expressions and automata: Regular expressions - Finite-State automata. Morphology and Finite-State Transducers: Survey of English morphology - Finite-State Morphological parsing - Combining FST lexicon and rules - Lexicon-Free FSTs: The porter stammer - Human morphological processing **(7)**

SYNTAX

Word classes and part-of-speech tagging: English word classes - Tagsets for English - Part-of-speech tagging - Rule-based part-of-speech tagging - Stochastic part-of-speech tagging - Transformation-based tagging - Other issues. Context-Free Grammars for English: Constituency - Context-Free rules and trees - Sentence-level constructions - The noun phrase - Coordination - Agreement - The verb phase and sub categorization - Auxiliaries - Spoken language syntax - Grammars equivalence and normal form - Finite-State and Context-Free grammars - Grammars and human processing. Parsing with Context-Free Grammars: Parsing as search - A Basic TopDown parser - Problems with the basic Top-Down parser - The early algorithm - Finite State parsing methods. **(10)**

ADVANCED FEATURES AND SYNTAX

Features and Unification: Feature structures - Unification of feature structures - Features structures in the grammar - Implementing unification - Parsing with unification constraints - Types and Inheritance. Lexicalized and Probabilistic Parsing: Probabilistic context-free grammar - problems with PCFGs - Probabilistic lexicalized CFGs - Dependency Grammars - Human parsing. **(11)**

SEMANTIC

Representing Meaning: Computational desiderata for representations - Meaning structure of language - First order predicate calculus - Some linguistically relevant concepts - Related representational approaches - Alternative approaches to meaning. Semantic Analysis: Syntax-Driven semantic analysis - Attachments for a fragment of English - Integrating semantic analysis into the early parser - Idioms and compositionality - Robust semantic analysis. Lexical semantics: relational among lexemes and their senses - WordNet: A database of lexical relations -The Internal structure of words - Creativity and the lexicon. **(9)**

APPLICATIONS

Word Sense Disambiguation and Information Retrieval: Selectional restriction-based disambiguation - Robust word sense disambiguation - Information retrieval - other information retrieval tasks. Natural Language Generation: Introduction to language generation - Architecture for generation - Surface realization - Discourse planning - Other issues. Machine Translation: Language similarities and differences - The transfer metaphor - The interlingua idea: Using meaning - Direct translation - Using statistical techniques - Usability and system development. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Daniel Jurafsky and James H.Martin, "Speech and Language Processing", Pearson Education (Singapore) Pvt. Ltd., 2008.*
2. *James Allen, "Natural Language Understanding", Pearson Education, 2003.*

19IT61 - MOBILE COMPUTING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 *: Identify the strength, limitations of mobile networks and discuss the technologies for mobile communication.*

CO2 *: Describe the basic working principle of Mobile IP and express different scenarios for performing mobile communication.*

CO3 *: Analyze TCP variations for mobility support and discuss WAP architecture.*

CO4 *: Explain different types of data dissemination and synchronization mechanisms for mobile computing.*

CO5 *: Develop simple android mobile applications using development tools.*

INTRODUCTION

Mobile Communication - Mobile Computing - Mobile Computing Architecture - Mobile Devices - Mobile System Networks - Data Dissemination - Mobility Management - Security - Introduction to Cellular Systems - Global System for Mobile Communication -General Packet Radio Services and their architectures. **(9)**

MOBILE IP NETWORK LAYER

Mobile IP overview - IP packet delivery - Agent Discovery registration - Tunneling and Encapsulation - Route optimization - Reverse Tunneling - IPv6 - IP Micro Mobility Support - Dynamic Host Configuration Protocol. **(9)**

MOBILE TRANSPORT AND APPLICATION LAYER

Mobile TCP - Fast Retransmit / Fast Recovery - Transmission Timeout Freezing - Selective Retransmission - Transaction oriented TCP - TCP over 2.5/3G Wireless Networks. WAP Architecture, Datagram Protocol, Transport Security, Transaction Protocol, Session Protocol - Application Environment-WML - WML Script - Wireless Telephony Application **(9)**

DATA DISSEMINATION AND SYNCHRONIZATION

Data Delivery Mechanisms - Synchronization - Synchronization Software - Synchronization Protocol- SyncML - Synchronized Multimedia Markup Language (SMIL). **(9)**

MOBILE APPLICATION DEVELOPMENT

Features of Palm OS, Symbian OS, Android OS: Development framework - Developing application for android - Development tools - Application Lifecycle - Externalizing Resources - Application class - Android activities. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Raj Kamal, "Mobile Computing", Oxford University Press, New Delhi, Third Edition 2019.*
2. *Jochen Schiller, "Mobile Communications", Pearson Education India, Second Edition, 2008. (Mobile Transport And Application Layer)*
3. *Reto Meier, "Professional Android 4 Application Development", Wiley India Pvt Ltd, Third Edition ,2012. (Mobile Application Development)*

REFERENCES

1. *Stojmenovic and Cacute," HandBook of Wireless Networks and Mobile Computing", Wiley, 2006.*
2. *Reza Behravanfon , " Mobile Computing Principles: Designing and Developing Mobile Applications with UML & XML" , Cambridge University Press , 2004.*

19IT62 - INTERNET TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Identify working models and learn basic web concepts to develop Static and Dynamic web pages.*

CO2 : *Understand the basic programming with XML and the role of XML in libraries.*

CO3 : *Demonstrate an ability to use static and dynamic design techniques to construct an interactive web page using Client/ Server side technologies.*

CO4 : *Understand and discuss the concepts in e-business models and e-marketing.*

CO5 : *Demonstrate use of Ruby on Rails framework in developing interactive web applications.*

INTRODUCTION

Basic Web Concepts - Web based Client/Server model -Web Protocols- Working of web browser - Browser & Server Communication - History of HTML / XHTML / HTML5 - HTML5 Structural Elements-Images - HTML5 Form Elements and Attributes-DHTML-CSS3-Selectors-Positioning elements - Colors - Shadows - Gradients -Transitions and Transformations. **(9)**

XML

Introduction to XML - XML fundamentals - Well-formed XML documents - components of XML document - XML tools - XML Namespaces - XML Vocabularies - Document Object Model(DOM) - Simple API for XML(SAX) - Extensible Stylesheet Languages (XSL)- XML database program. **(10)**

SCRIPTING LANGUAGES

Client Side scripting - Introduction to Javascript - Arrays - Control statements -Events - Cookies - Introduction to CGI Concepts - Server Side Technologies: PERL - Arrays - Strings - files - Database. **(9)**

SERVER SIDE TECHNOLOGIES

Java Server Pages - System Architecture -Basic JSP life cycle-JSP elements: Variables and objects - Methods-Implicit objects-Parsing Request Strings-Session Management. - Java Servlets - Design-Servlet life cycle- Reading HTTP Request Headers-Writing HTTP Response Headers. **(9)**

WEB BASED APPLICATIONS AND ITS TECHNOLOGIES

Rails: Overview of Rails - Document request - Processing forms - Rails application with databases - Layouts - Introduction to Ruby - MVC Framework- Ajax: Ajax based web application, alternatives of Ajax - E-Business Models - E-Marketing - Online payments and Security. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Deitel & Deitel, "Internet and World Wide Web-How to Program", Pearson Education Fifth Edition, 2011.*
2. *Rashim Mogha, V.V Preetham. V.V. "Java Web Services Programming", Wiley Dreamtech, New Delhi, Java 2 Enterprise Edition, 2011. (Server Side Technologies)*
3. *Robert W.Sebesta, "Programming with World Wide Web", Pearson Education, Eighth Edition, 2015.(Web Based Applications and its Technologies)*

REFERENCES

1. *Scot Johnson, Keith Ballinger,Davis Howard Chapman, "Special Edition Using Active Server Pages", Prentice Hall of India, paperback 1999.*
2. *Ravi Kalakota and Andrew B Whinston, "Frontiers of e-commerce", Addison Wesley, 1st Edition, 2002.*
3. *Jeffrey C. Jackson," Web Technologies: A Computer Science Perspective", Pearson Education, Second Edition 2007.*

19IT71 - DISTRIBUTED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : *Discuss the challenges and issues in applying various distributed system models in real time applications.*

CO2 : *Demonstrate interprocess communication using Remote Method Invocation and Remote Procedure Call*

CO3 : *Describe the architecture and security provided by the OS layer to support the Distributed System.*

CO4 : *Identify the design issues related to naming services, synchronization and use synchronization algorithms in various distributed system scenarios.*

CO5 : *Classify various consistency models and describe the approaches to achieve fault tolerance in a distributed environment.*

INTRODUCTION

Characterization of Distributed Systems - Examples - Resource Sharing - Challenges - web. System Models - Architectural and Fundamental Models. **(9)**

PROCESSES AND DISTRIBUTED OBJECTS

InterProcess Communication - The API for the Internet Protocols - External Data Representation and Marshalling - Client- Server Communication - Group Communication - Distributed Objects and Remote Invocation - Communication Between Distributed Objects - Remote Procedure Call. **(9)**

OPERATING SYSTEM SUPPORT AND NAMING SERVICES

The OS Layer - Protection - Processes and Threads - Communication and Invocation - OS Architecture Distributed File Systems : File Service Architecture-Name Services: Name Services and the domain Name System-Directory Services. **(8)**

SYNCHRONISATION AND MUTUAL EXCLUSION

Time and Global States : Clocks, Events and Process States - Synchronizing Physical Clocks - Logical Time And Logical Clocks - Global States. Coordination and Agreement: Distributed Mutual Exclusion - Elections - Multicast Communication **(9)**

CONSISTENCY AND REPLICATION

Data-centric consistency models: Continuous consistency- Consistent ordering of operations. Client-centric consistency models: Eventual consistency - Monotonic Reads - Monotonic Writes - Read your writes - Writes Follow Reads. Replica Management: Replica-Server Placement - Content Replication and Placement -Content Distribution. Consistency protocols: Continuous Consistency - Primary-Based Protocols - Replicated-Write Protocols - Cache- Coherence Protocols. **(10)**

TOTAL : 45

TEXT BOOKS

1. *George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Pearson Education, Fifth Edition, 2017.*
2. *Andrew S Tanenbaum, Maartenvan Steen,"Distributed Systems -Principles and Paradigms", Pearson Education, Second Edition, 2015. (consistency&replication only)*

REFERENCES

1. *Ajay. D Kshem Kalyani, Mukesh Singhal, "Distributed computing principles, Algorithms and Systems", Cambridge University Press, First Edition, 2011.*
2. *Mukesh Singhal, Niranjan G. Shivaratri, "Advanced concepts in Operating Systems", First Edition, Tata McGraw Hill, 2017.*
3. *M.L. Liu, "Distributed computing Principles and Applications", First Edition ,Pearson Education, 2019.*

19CIOC01 - C++ PROGRAMMING

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Be able to explain the difference between object-oriented programming and procedural programming.*

CO2 : *Be able to program using C++ features such as objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, exception handling, etc.*

CO3 : *Be able to build C++ classes using appropriate encapsulation and design principles.*

TRAINING BASED ON THE FOLLOWING CONCEPTS

C++ Overview - Classes and Encapsulation- Member Functions- Instantiating and Using Classes- Constructors and Destructors- Overview of Inheritance- Defining Base and Derived Classes-Types of Inheritance- Overview of Polymorphism and Abstract Classes-Exceptions- Inheritance and Exceptions- Exception Hierarchies.

REFERENCES

1. *E.Balagurusamy, "Object Oriented Programming with C++", McGraw Hill Company Ltd., 7th Edition, 2018.*
2. *Bjarne Stroustrup, "The C++ Programming Language", Addison Wesly , 4th edition, 2013.*

19CIOC02 - R PROGRAMMING

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: To explore and understand the usage of R Libraries.*

CO2 *: To understand and use Data Frames, Statistical Methods and Data Visualization.*

TRAINING BASED ON THE FOLLOWING CONCEPTS:

INTRODUCTION

Introducing to R - R Data Structures - Help functions in R - Vectors - Scalars - Declarations - recycling - Common Vector operations - Using all and any - Vectorized operations - NA and NULL values - Filtering - Vectorised if-then else - Vector Equality - Vector Element names.

MATRICES, ARRAYS AND LISTS

Creating matrices - Matrix operations - Applying Functions to Matrix Rows and Columns - Adding and deleting rows and columns - Vector/Matrix Distinction - Avoiding Dimension Reduction - Higher Dimensional arrays - lists - Creating lists - General list operations - Accessing list components and values - applying functions to lists - recursive lists.

DATA FRAMES

Creating Data Frames - Matrix-like operations in frames - Merging Data Frames - Applying functions to Data frames - Factors and Tables - factors and levels - Common functions used with factors - Working with tables - Other factors and table related functions - Control statements - Arithmetic and Boolean operators and values - Default values for arguments - Returning Boolean values - functions are objects - Environment and Scope issues - Writing Upstairs - Recursion - Replacement functions - Tools for composing function code - Math and Simulations in R.

STATISTICAL GRAPHS

Box Plot, Histograms, Scatter Plotter, Line chart, Bar Chart, Heat maps, Histograms.

DATA EXPLORATION AND VISUALIZATION

Using the ggplot2 package to visualize data -Applying themes from ggthemes to refine and customize charts and graphs - Building data graphics for dynamic reporting.

REFERENCE S

1. *Hadley Wickham and Garrett Grolemund, "R for Data Science", O. Reilly, 2017.*
2. *Tilman M. Davies, "The Book of R : A First course in Programming and Statistics", No Starch Press, 2016.*

19CIOC03 - APPLICATIONS OF PROBABILITY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *To understand the generic structure of probabilistic models and their basic properties.*

CO2 : *Ability to understand and apply the discrete random variables to model real world problems and analyse their characteristics.*

CO3 : *To gain an understanding of the continuous random variables and the application of it to model real world problems.*

CO4 : *Ability to quantify the relationship between two random variables using covariance and correlation.*

TRAINING BASED ON THE FOLLOWING CONCEPTS:

SAMPLE SPACE AND PROBABILITY

Sets: Set Operations - The Algebra of Sets - Probabilistic Models: Sample Spaces and Events - Sequential Models - Probability Laws - Discrete Models - Continuous Models - Conditional Probability - Total Probability Theorem and Bayes' Rule - Independence - Counting - Case study.

DISCRETE RANDOM VARIABLES

Basic Concepts - Probability Mass Functions: The Bernoulli Random Variable - The Binomial Random Variable - The Geometric Random variable - The Poisson Random Variable - Functions of Random Variables - Expectation, Mean and Variance - Case study.

GENERAL RANDOM VARIABLES

Continuous Random Variables and Probability Density Functions (PDF): Exponential Random Variable - Cumulative Distribution Functions (CDF): The Geometric and Exponential CDFs - Normal Random Variables - The Continuous Bayes' Rule - covariance and correlation - Case study.

REFERENCES

1. *Dimitri P. Bertsekas and John N. Tsitsiklis, "Introduction to Probability", Athena Scientific, Second Edition, 2008. ISBN: 978-1886529236.*
2. *Veerarajan T, "Probability Statistics and Random Process," McGraw Hill Education, Third edition, 2017. ISBN: 978-007066925.*
3. *Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, "An Introduction to Probability and Statistics", Wiley India, Second Edition, 2008. ISBN: 978-8126519262.*

19CIOC04 - USER INTERFACE DESIGN

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

The Students should be able to:

CO1 *: Design the User Interface for mobile and Web Applications*

CO2 *: Create the visual elements and define Interactivity to the UI elements*

CO3 *: Add movement between screens*

INTRODUCTION

The User Interface-Introduction, Overview, The importance of user interface - The importance of Good design, Characteristics of graphical and web user interfaces-wireframing.

TOOLS FOR UI DESIGN

Wireframing Tools- Adobe XD -Figma- Pencil Project -Invisionstudio.

REFERENCES

1. *Wilbert O. Galitz, "The Essential Guide to User Interface Design", John Wiley & Sons, Second Edition 2002*
2. *Web References - Open Source Tools for UI Design*

19CIOC05 - OPEN-SOURCE TOOLS FOR NETWORK ANALYSIS

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 *: To understand the working principle of Network analysis tools.*

CO2 *: Analyze packet /file transmission between networks using Wireshark, Nmap and Cisco tools.*

TRAINING BASED ON THE FOLLOWING CONCEPTS

Wireshark- Introduction to Wireshark- Features of Wireshark- Packet Capture and Protocol Analysis- IP Address, TCP/UDP Port Filters- Packet Sniffing Usernames, Passwords, and Web Pages

Nmap- Nmap Introduction and Installation- Scanning Techniques- Discovery Options

Cisco Packet Tracer- Introduction and Installation- packet tracing on switches and Routers

Case Study

1. Layer 2- packet Analysis
2. Discovering Packet based attacks
3. Identifying the packet data and assign dynamic IP in Switches and Routers.

19CIOC06 - COMPREHENSIVE EXAM TRAINING

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *To prepare and equip the students for various competitive exams*

CO2 : *To relearn and refresh the core concepts in the domains like Data Structures, Digital Design, Database Management Systems, Programming, Computer Architecture, Operating Systems and Automata Theory.*

TRAINING BASED ON THE FOLLOWING CONCEPTS:

C PROGRAMMING

Programming in C, Recursion, Arrays, Structures and Pointers.

DATA STRUCTURES AND ALGORITHMS

Linked Lists, Stacks, Queues, Trees, Graphs, Sorting and Searching.

DIGITAL DESIGN

Boolean algebra, Combinational and Sequential circuits, Minimization, Number representations, Fixed and floating point computer arithmetic.

DATABASE MANAGEMENT SYSTEMS

ER-model, Relational model: relational algebra, tuple calculus, SQL, Integrity constraints, Normal forms, B+ tree indexing, Transactions and concurrency control.

COMPUTER ARCHITECTURE

Machine instructions and Addressing modes, ALU, Data-path and Control unit, Instruction pipelining, Pipeline hazards, Memory hierarchy: cache, main memory and secondary storage, I/O interface: interrupt and DMA mode.

OPERATING SYSTEMS

System calls, Processes, Threads, Deadlock, CPU and Disk scheduling, Memory management and Vrtual memory.

FORMAL LANGUAGES AND AUTOMATA THEORY

Regular Expressions and Finite Automata, Context-Free Grammars and Push-Down Automata, Contex-Free Languages, Pumping lemma, Turing machines.

19HOC31 - COMMUNICATION SKILLS FOR ENGINEERS - I

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1 : *Gain confidence, enhance Personality and develop positive attitude in their work and life.*

CO2 : *Effectively communicate and present opinions using appropriate functional expressions for a given situation.*

CO3 : *Compose Emails, Reports for a given business scenario using appropriate sentence construction and in the prescribed format.*

CO4 : *Generate ideas and speak on a given topic in a competitive scenario like Debate, Group Discussion, and Public Speaking.*

PERSONALITY DEVELOPMENT

Motivation and Self Confidence, SCOT Analysis - Personality Development - What is Personality, Developing Positive Attitude towards work and life, Building Relationship with others - Personality Development - Paradigms of Human Interaction, Fear Management. **(4)**

VERBAL COMMUNICATION

English Conversation - Asking and Giving Opinions - English Conversation -Thanking People, Asking and Giving Suggestions - English Conversation - Asking for Direction, Agreeing and Disagreeing - Role Play-Business. **(5)**

BUSINESS COMMUNICATION

Email Writing - Format, Etiquettes and Tips - Report Writing -Introduction, elements and tips - Drafting a report - Error Identification - Rules, Common Mistakes and Exercises - Sentence Completion Filler (fill in the blanks using apt words). **(5)**

PUBLIC SPEAKING

How to start and sustain a conversation - Debate - Extempore - Group Discussion - Importance and Process - Public Speaking - Introduction, Tips - Drafting a Public Speech - Interview - Types, Dos and Don'ts - Mock Press. **(6)**

TOTAL : 20

REFERENCES

1. *https://nptel.ac.in/content/storage2/courses/109104030/references/references.pdf (online resource)*
2. *John Seelay, Oxford Guide to Effective Writing and Speaking, 2nd Edition, Kindle Edition by Oxford University Press, 2007.*
3. *Sabina Pillai, Agna Fernandez, Soft Skills and Employability Skills - Published by Cambridge University Press, 2017.*

19HOC41 - COMMUNICATION SKILLS FOR ENGINEERS - II

L	T	P	C
0	0	2	1

COURSE OUTCOMES

Students will be able to

CO1 *: Solve objective questions on analogy, Statement and Argument, Statement and Conclusion, Data Sufficiency and Sentence improvement within a given time.*

CO2 *: Construct grammatically correct sentences.*

CO3 *: Speak confidently to describe a process, present information on the specified topic and disseminate information in a professional manner.*

SELF EVALUATION

Self belief and self Esteem - Activities based on Current Events **(2)**

VERBAL AND LOGICAL REASONING

Analogy - Introduction, Types and Exercises - Statement and Argument - Statement and Conclusion - Data Sufficiency - Sentence Improvement - Critical Reasoning / Theme Detection **(5)**

GRAMMAR

Basic Grammar- Subject Verb Agreement - One word substitute - Preposition- Cause and Effect - Basic level questions and Moderate level questions. **(4)**

PRESENTATION TECHNIQUES

Describing a Process - Presentation Skills - Introduction, Planning and Preparation - Presentation on a Topic - Group Discussion - Dos and Don'ts - Functional Expressions used in Group Discussion - Interview Skills - Ideal Grooming for an interview, Preparing for the Interview **(9)**

TOTAL : 20

REFERENCES

1. *Sanjay Kumar, Pushp Lata, Communication Skills SECOND EDITION, published by Oxford University Press, New Delhi, India, 2015.*
2. *Anthony Manning, Chris Sowton and Craig Thaine, Cambridge Academic English, published by Cambridge University Press, U P, India, 2012.*

19HOC51 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - I

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1 : *Solve objective questions on Syllogisms, Data Interpretation, Critical Reasoning, Theme Detection, Sentence Completion and Business Vocabulary*

CO2 : *Develop appropriate responses for business phone calls and negotiate effectively.*

CO3 : *Speak with appropriate body language for a technical speaking task.*

CO4 : *Project the appropriate grooming and the right etiquettes, for interview and group discussion task.*

VERBAL APTITUDE

Syllogisms-Paragraph Comprehension -Data Interpretation -Critical Reasoning/Theme Detection - Grammar -Sentence Completion Filler - Business Vocabulary- Foreign phrases used in English **(3)**

PROFESSIONAL COMMUNICATION

Telephonic Conversation Skills - Telephonic Interview -Etiquettes - Professional, Dining & Telephone - Employability skills - Importance and Employability level of present Y and Z Generation - Interpersonal Skills - Negotiation Skills - Types, Expressions used in formal and informal negotiations, Stages of Negotiation - Time Management - Pareto principle, Prioritizing tasks, Barriers to time management **(7)**

THE ART OF SPEAKING

Types of Speaking - Barriers to Speaking - Presentation on a Technical Topic - Speaking on Current Trends in the Industry **(5)**

NON-VERBAL COMMUNICATION

Interview Skills -Non Verbal Communication - Smiling, Posture, Handshake, Tone of Voice and Eye Contact - GD tips & techniques and Mock GD- Body Language - Grooming. **(5)**

TOTAL : 20

REFERENCES

1. *Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams and Leaders. Washington, DC: Pfeiffer & Company, 2013.*
2. *Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.*
3. *John Hayes. Interpersonal Skills at Work. Second Edition. Routledge publication, 2005*

19HOC61 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - II

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1 *: Exhibit Corporate Etiquettes with assertiveness and personal effectiveness.*

CO2 *: Build teams and solve problems at workplace.*

CO3 *: Manage conflicts in a professional manner*

CO4 *: Simulate an actual Job Interview scenario to prepare a candidate for a real Interview*

CORPORATE ETIQUETTE

Corporate Etiquette: Dos and Don'ts, - Conversational dos and don'ts - Creating elusive first impression- Assertiveness-Personal Effectiveness **(4)**

LEADERSHIP AND TEAM MANAGEMENT

Leadership Skills - Understanding Traits and Styles - Team Building: Bonding, Development and Delegation - Adaptability and Work Ethics - Handling Team Dynamics- Giving and Receiving Feedback- Problem Solving Skills **(5)**

STRESS AND CONFLICT MANAGEMENT

Emotional Intelligence : Recognition, Understanding and Managing - Stress Management: Techniques and Benefits - Conflict Management: Introduction - Handling Conflicts - Conflicts settlement **(6)**

GROUP DISCUSSION AND INTERVIEW SKILLS

Mock GD - Interview Skills - Answering challenging questions - Common Interview Questions **(5)**

TOTAL : 20

REFERENCES

1. *Barun K Mitra., Personality Development and Soft Skills. Second Edition. Oxford University Press, 2016*
2. *N.Krishnaswamy & Lalitha Krishnaswamy - Mastering Communication Skills and Soft Skills. New Delhi. Bloomsburry, 2015*
3. *Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.*

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.E COMPUTER SCIENCE AND ENGINEERING

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2019 - 2020 and onwards)

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2. Hsu.H.P and Rakesh Ranjan, "Signals and Systems", Schaums's Outlines, Tata Mc Graw Hill, 2nd Edition, 2008.
3. Sanjit Kumar Mitra , "Signals and Systems", Oxford University Press, 2015
4. Lathi. B. P, "Linear Systems and Signals", Oxford University Press, 3rd Edition 2018.
5. Ronald E. Ziemer, William H. Transter and Ronald. D. Fanmin, "Signals and Systems - Continuous and Discrete", Pearson Higher Education, 4th Edition, 1998.

19EC34 COMPUTER ARCHITECTURE AND ORGANIZATION

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Describe the concepts of computer architecture, Instruction set design and addressing mode.
CO2: Illustrate the concepts of CPU design with fixed point and floating point arithmetic.
CO3: Interpret the concepts of control design using hardwired and micro programmed control unit.
CO4: Exemplify the functions of memory subsystems to integrate with CPU.
CO5: Illustrate the methodologies for interfacing I/O devices and explain the concepts of parallelism and
concurrency in computers.

CPU ARCHITECTURE AND INSTRUCTION SET PRINCIPLES
Computer Functional units -Processor role and design goals-Processor Design Process- Datapath and Control Unit Organization - Instruction set design - Instruction Types and operations - Addressing Modes.

(9)

CPU DESIGN AND DATA PATH
Arithmetic and Logic Unit – Shifters – ALU design - Fixed point datapath- Floating point datapath - Fixed Point Arithmetic: Booth's Multiplication algorithm -Non-Restoring Division Algorithm - Floating Point Arithmetic.

(9)

INSTRUCTION PROCESSING AND CONTROL UNIT
Basic Processing concepts-Instruction Cycle - Single bus processor - Hardwired Control - Micro programmed Control.

(9)

MEMORY ORGANIZATION
Memory Parameters-Classification of Memory-ROM & RAM subsystem design-Memory Allocation-Cache and Virtual Memory- Associative memory.

(9)

SYSTEM ORGANIZATION
Accessing I/O devices- Interrupt Handling – Bus Arbitration Techniques- Bus concepts- Interface circuits and I/O Controllers- Parallelism & Pipelining- Concept of Superscalar architecture, Vector Computing and Array Processing.

(9)

TOTAL: 45

TEXT BOOKS

1. B.Govindarajalu, "Computer architecture and Organisation: Design principles and Applications", Tata McGraw Hill Education, 2nd Edition, 2010.
2. John P.Hayes, "Computer architecture and Organization", Tata McGraw - Hill, 3rd Edition, 2012.

REFERENCES

1. P.Pal Chaudhuri, "Computer organization and design", Prentice Hall of India, New Delhi, 3rd Edition, 2008.
2. William Stallings, "Computer Organization and Architecture: Designing for Performance" ,Prentice Hall, 9thEdition, 2012.
3. Kai Hwang and Faye A Briggs, “Computer Architecture and Parallel Processing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
4. Morris Mano, "Computer System Architecture", Prentice Hall of India, 3rd Edition, 2007.

5. Nicholas Carter, "Computer Architecture", Tata McGraw Hill Education, 2008.

15HSS01 - SCIENCE OF CREATIVITY AND PROFESSIONAL ETHICS

L	T	P	C
1	0	0	1

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to,

1. Describe the principles of karma yoga and functioning of mind and consciousness.
2. Hypothesize the evolution of Universe and living beings in a global and societal context
3. Infer the principles of Yoga to practice it and know the value of health.
4. Interpret the philosophy of introspection procedures for better living
5. Assess, take personal responsibility and follow professional ethics for sustained growth in career and life

LIFE FORCE, MIND AND CONCIOUSNESS

Science of Creativity and Personality Development – Objectives - Principles of Karma Yoga – Duty Consciousness – Communism and Capitalism – Law of Nature - Life Force – Origin – Potentiality of the Life Force - Premordial State – Wave Theory – Consciousness - Pancha Thanmatras – Secret of Revelations – Mind - Biomagnetism – Physical Transformation of Biomagnetism.

(7)

EVOLUTION OF THE UNIVERSE AND LIVING BEINGS

Evolution of the Universe: **C**reation Theory – Evolution Theory – Theory of Permanence – Theory of Mithya – Evolution of Living Beings: Absolute Space and Force - Plants Experience Pain – Two Eyes and Two Ears – Seven Constituent Layers in the Body. **(5)**

YOGA AND ITS BENEFITS

Simple and Safe Yoga – Upa Yoga Practices: Yoga for Peace – Yoga for Health - Yoga for Joy – Yoga for Love – Yoga for Well-being - Yoga for Success. Physical Exercise - Meditation – Seven Centers of Meditation – Benefits - Effect of Good Vibrations - Cause and Effect System.

(6)

INTROSPECTION

Attachment, Detachment and Moderation in Enjoyment - Imaginary Expectations - Harmony in Life: Self, Family, Society and Nature – Introspection: Analysis of Thought, Moralization of Desire, Neutralization of Anger, Eradication of Worries and Self Realization.

(6)

HUMAN VALUES

Morals, Values and Ethics – Integrity – Work Ethics - Service Learning – Virtues – Respect for Others – Living Peacefully – Caring – Sharing - Honesty – Courage – Valuing Time – Co-operation - Commitment – Empathy – Self Confidence – Challenges in Work Place – Impact of cyberspace on individuals. **(6)**

THEORY: 15
PRACTICE: 15
TOTAL: 30

TEXT BOOKS

1. Yogiraj Vethathri Maharishi, “Karma Yoga – The Holistic Unity”, Vethathri Publications, IV Edition, 2009. (Chapters 1-7, 10-12)
2. R.S.Naagarazan, “A Textbook on Professional Ethics and Human Values”, New Age International Publishers, New Delhi, 2011.

REFERENCES

1. Sadhguru, “Body the Greatest Gadget and Mind is your Business”, Diamond Pocket Books Pvt. Ltd, Isha Foundations, 2013.
2. Swami Vivekananda and Swami Nikhilananda, “Karma Yoga and Bhakti Yoga”, II Edition, Ramakrishna Vivekananda Publications, 2008.
3. Henry Dreyfuss, “The Measure of Man and Woman: Human Factors in Design”, John Wiley and Sons Publications, 2012.
4. Mike W. Martin and Roland Schinzinger,”Ethics in Engineering”, IV Edition, McGraw Hill, NewYork, 2005.
5. M. Govindarajan, S. Natarajan, V.S. Senthilkumar, “Engineering Ethics”, I Edition, Prentice Hall of India, 2009.

19ECL35 DIGITAL ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon the completion of the course, students will be able to demonstrate an ability to
CO1: Design, Construct and Simulate combinational logic circuit using Digital ICs
CO2: Design, Construct and Simulate Sequential logic circuit using Digital ICs
CO3: Develop communication skills and capability to work in team

LIST OF EXPERIMENTS

- Verification of De-Morgans theorem
- Adders and Subtractors
- Four bit binary adder/subtractor and BCD adder
- BCD to Excess 3 converters and Excess 3 code to BCD converters
- Binary to gray code and Gray code to binary converters
- Multiplexers and De-multiplexers
- Encoders and Decoders
- Ripple counter and Modulus counter
- Synchronous Up/Down counter

TOTAL: 30

REFERENCES

1. Digital Circuits Laboratory Manual prepared by ECE Department, CIT.
2. M. Morris Mano, "Digital Design", Pearson Education, 5th Edition, 2013.

L	T	P	C
0	0	2	1

19ECL36 ANALOG ELECTRONICS LABORATORY

ASSESSMENT: PRACTICAL
COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Construct and test diode based wave shaping and rectifier circuits
2. i) Design and test different types of biasing circuits for given specifications and calculate their stability factors
   ii) Design, test and analyze the frequency response of BJT and FET amplifiers with and without feedback
   iii) Design and test power amplifiers
3. Develop communication skills and capability to work in teams

LIST OF EXPERIMENTS

- Wave Shaping Circuits
- Rectifier circuits
- Self Bias and Fixed Bias circuits using BJT
- Voltage divider Bias circuits using BJT and FET
- Common Emitter Amplifier
- Direct coupled and RC Coupled amplifiers
- Current series and Current shunt feedback amplifiers using BJT
- Voltage series and Voltage shunt feedback amplifiers using FET
- Class A , Class B and Class C power amplifiers

TOTAL : 30

REFERENCES

1. Laboratory Manual prepared by ECE Department, CIT.
2. M. H. Rashid, "Introduction to PSPICE using ORCAD for Circuits and Electronics", Prentice Hall of India Pvt. Limited, 4th edition, 2015.

19EC41 PROBABILITY AND STOCHASTIC PROCESSES

L	T	P	C
3	1	0	4

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate ability to

1. Understand the basic concepts of probability and discrete random variables
2. Understand the concepts of continuous and pairs of random variables and its usage in communication systems
3. Understand the moment generating function for families of random variables
4. Interpret the usage of stochastic process in communication systems
5. Analyze the response of random inputs to linear time invariant systems and to understand the concept of power spectral density of a random sequence

PROBABILITY AND DISCRETE RANDOM VARIABLES

Probability Axioms – Conditional Probability: Law of Total Probability, Baye's Theorem – Independence.

Discrete Random Variables: Probability Mass Function – Bernoulli, Binomial and Poisson Random Variables – Cumulative Distribution Function - Expectations.

(11)

CONTINUOUS AND PAIRS OF RANDOM VARIABLES

Continuous Random Variables: Probability Density Function – Uniform, Exponential and Gaussian Random Variables, Expectations. Pairs of Random Variables: Joint Cumulative Distribution Function – Joint Probability Mass Function – Marginal Probability Mass Function – Joint Probability Density Function – Marginal Probability Density Function – Expected Values – Covariance – Correlation – Independent Random Variables. **(11)**

SUMS OF RANDOM VARIABLES

Expected Values of Sums – Probability Density Function of the Sum of Two Random Variables – Moment Generating Function for families of Random Variables – Central Limit Theorem –

Applications of Central Limit Theorem

(7)

STOCHASTIC PROCESSES

Types of Stochastic Processes – Poisson Process, Brownian Motion Process – Expected Value and Correlation – Stationary Processes – Wide Sense Stationary Stochastic Processes – Cross-Correlation – Gaussian Processes.

(8)

RANDOM SIGNAL PROCESSING

Linear Filtering of Continuous-Time Stochastic Process – Linear Filtering of a Random Sequence – Power Spectral Density of a Continuous -Time Process – Power Spectral Density of a Random Sequence. **(8)**

TOTAL: 45+15=60

TEXT BOOK

Roy D.Yates and David J Goodman, Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers, John Wiley & Sons, New Delhi, 2012.

REFERENCES

1. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.
2. Saeed Ghahramani, Fundamentals of Probability with Stochastic Processes, Prentice Hall, New Jersy, 2014.
3. Sheldon M. Ross, Stochastic Processes, Wiley India Pvt. Ltd, New Delhi, 2008.
4. Athanasios Papoulis and Unnikrishna Pillai S, Probability, Random Variables and Stochastic Processes, Tata McGraw Hill, New Delhi, 2006.
5. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, Wiley, Delhi, 2014.

19EC42 PRINCIPLES OF COMMUNICATION

L	T	P	C
3	1	0	4

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate ability to

1. Illustrate DSB-FC, DSB-SC, SSB-SC, VSB amplitude modulation techniques & their spectrum, explain the function of DSB-SC and SSB-SC modulators and compare their performances
2. Illustrate angle modulation techniques & their spectrum, compare their performances, and explain the operating principle of FM transmitter
3. Describe the operation of AM & FM receivers, compare & distinguish between their performance characteristics and parameters
4. Describe the operation of pulse analog modulation & pulse digital modulation techniques
5. Express narrow band noise using I & Q components & estimate the performance of DSB-SC, SSB & FM Receivers systems using Figure of Merit and to compute the SNR of PCM and DM systems

AMPLITUDE MODULATION

Elements of Communication System - Communication Channels - Need for Modulation - Frequency Translation – Types of Amplitude Modulation and their Spectrum – DSB-SC Modulators: Product Modulator, Balanced Modulator - SSB-SC Modulators: Filter Method, Phase Shift Method - AM Transmitters.

(9)

ANGLE MODULATION

Phase Modulation - Frequency Modulation - Narrow Band FM - Wide Band FM - Frequency Spectrum of FM – Transmission Bandwidth of FM Signals - Direct FM generation: Reactance Modulator - Narrowband FM generation- Indirect FM generation - Pre-Emphasis and De-Emphasis – Armstrong FM Transmitter.

(9)

AM & FM RECEIVERS

AM Demodulators: Envelope detector, Coherent Detection of DSB-SC, SSB-SC - Costas Receiver - AM Receivers: Super heterodyne.

FM Demodulators: Foster Seeley Discriminator, Ratio Detector, PLL Demodulator- FM Receivers.

(9)

PULSE MODULATION

Sampling Process - Pulse Amplitude Modulation - Pulse Width Modulation - Pulse Position Modulation - Quantization Process – Uniform and Non-Uniform Quantization - Pulse Code Modulation - Delta Modulation- Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation.

(9)

NOISE IN CW SYSTEMS

Noise - Narrow Band Noise and its properties - Representation of Narrow Band Noise: In-phase & Quadrature Components, Envelope & Phase Components - Sine Wave Plus Narrowband Noise - Receiver Model - Noise in DSB-SC, SSB & FM Receivers - SNR of PCM and DM systems.

(9)

TOTAL: 45+15=60

TEXT BOOKS

1. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition, 2004.
2. Herbert Taub and Donald L. Schilling, "Principles of communication", McGraw Hill International student Edition, 3rd Edition, 2008.

REFERENCES

1. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", Pearson Education, 5th Edition, 2009.
2. John G. Proakis and Masoud Salehi, "Fundamentals of Communication Systems", Pearson Education, 2nd Edition, 2015.
3. Kennedy G, "Electronic Communication Systems", Tata McGraw Hill, 4th Edition, 1999.
4. Lathi. B. P, "Communication Systems", BS Publications, 4th Edition, 2004.
5. Hwei P. Hsu,"Schaum's Outlines of Analog and Digital Communication", McGraw Hill, 3rd Edition, 2003.

19EC43 MICROCONTROLLER BASED SYSTEMS

L	T	P	C
3	1	0	4

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Interpret the architecture & instruction Set of 8051 microcontroller to developAssembly language programs.
2. Illustrate the application of 8051 microcontroller on chip peripherals to implement thefunctions of I/O port, timer/Counter, serial port & interrupts.
3. Exemplify the peripheral devices 8255 PPI and LCD display and traffic light controller,8279 for interfacing keyboard and 7 segment display and 8259 PIC for handlingmultiple interrupts I/O.
4. Integrate memory modules and the I/O devices ADC, DAC, Sensor & RTC with 8051microcontroller for an application and develop Assembly Language Programs.
5. Interpret the programming aspects of Arduino IDE to develop an Arduino based applications.

8051 MICROCONTROLLER

Architecture of 8051 microcontroller - Special Function Registers – I/O Pins, Ports and Circuits - Instruction Set - Addressing Modes - Assembly language Programming.

(9)

ON-CHIP PERIPHERALS

I/O Port Programming - Timer Registers - Timer Modes - Overflow Flags - Clocking Sources -Timer/ Counter Interrupts – Timer Programming - Baud Rate Generation - Serial Port Register -Modes of Operation – Serial Port Programming- Interrupt Organization - Processing Interrupts - Interrupt Programming.

(9)

PERIPHERAL DEVICES

Programmable Peripheral Interface (8255) – Keyboard / Display Controller (8279) - Programmable Interrupt Controller (8259) - Case Studies: Traffic Light Control, Interfacing Keyboard, Seven Segment and LCD display - Multiple Interrupt requests.

(9)

INTERFCAING MEMORY AND I/O DEVICES WITH 8051

External Memory Interface – Interfacing with MAX232 chip for RS232C Communication - ADC and DAC Interface – Measuring voltage, current and frequency - RTC Interfacing - DC Motor Control - Stepper Motor control.

(9)

ARDUINO BASED SYSTEM

Arduino functionality - Arduino Board - Arduino IDE – Digital Inputs, Outputs, and Pulse-Width Modulation - In Built functions and libraries for interfacing Sensors and Actuators - Case Studies: Interfacing Relays and Sensors – Temperature monitoring - Distance measurement – Smart home automation System.

(9)

TOTAL: 45+15=60

TEXT BOOKS

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems Using Assembly and C ", 2nd Edition, Pearson Education 2013.
2. Kenneth Kenneth J. Ayala, "The 8051 Microcontroller. Architecture, Programming and Applications", 3rd Edition, West publishing company 2014

REFERENCES

1. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086,8051, 8096", Prentice Hall of India, 2nd Edition, 2014.
2. Soumitra Kumar Mandal "Microprocessors and Microcontrollers Architecture Programming and Interfacing using 8085,8086 & 8051" Tata McGraw Hill Publishing Co Ltd, 1st Edition, 2011.
3. Myke Predko, "Programming and Customizing the 8051 Microcontroller", 1st Edition,2012.
4. Manish K Patel, "The 8051 Microcontroller Based Embedded Systems "Tata McGrawHill Publishing Co Ltd, Ist Edition,2014.
5. Jeremy Blum “Exploring Arduino: Tools and Techniques for Engineering Wizardry” John Wiley and sons , 2nd Edition,2019.

Website Reference:
https://www.coursera.org/learn/interface-with-arduino

19EC44-LINEAR INTEGRATED CIRCUITS

L T P C

3 0 0 3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate ability to

1. Interpret and analyze differential amplifiers with constant current sources, Interpret the characteristics of operational amplifier
2. design and analyze operational amplifier application circuits
3. design and analyze filters & oscillator circuits using operational amplifier
4. analyze and design multivibrators and data converters using linear ICs
5. apply the concepts of PLL to design frequency multiplier/divider, FSK demodulator and design voltage regulators using ICs

OPERATIONAL AMPLIFIERS

Differential amplifier - differential amplifier with constant current source - current mirror – Widlar current source- current repeaters -Wilson current source-Building blocks of operational amplifier-I/O stages, gain stage and level translator stage of op-amp -Characteristics of an Ideal Operational Amplifier-Op-amp parameters & characteristics- frequency response – stability - frequency compensation. **(9)**

OP-AMP APPLICATIONS

Linear applications: voltage follower - inverting, non inverting amplifiers-summing, scaling, averaging amplifiers-instrumentation amplifiers- V to I & I to V converters - difference amplifier-integrator-differentiator.

Nonlinear applications: Precision half wave & full wave rectifiers - clipper- clamper - peak detector-sample & hold circuit-log & anti-log amplifiers

Open loop applications: Comparator-zero crossing detector- Schmitt trigger-voltage li miters-window detectors.

(9)

ACTIVE FILTERS AND OSCILLATORS

Active filters - Sallen-Key filter structure- Design of Butterworth filters: Low pass filter- High pass filter- Band pass filter- Band reject filter - All pass filters - Switched capacitor filters-Design of Oscillators: RC phase shift oscillator- Wien bridge oscillator- LC Oscillators: Hartley oscillator - Colpitts oscillator - Clapp oscillator- Crystal oscillator.

(9)

MULTIVIBRATORS AND DATA CONVERTERS

Design of Astable Multivibrator & Monostable Multivibrator using Op.Amp -Triangular wave generator-Saw tooth wave generator - IC 555 timer: Functional block diagram and description of Astable & Monostable multivibrators using IC555 - Digital to Analog converters: Binary Weighted Network - R-2R Ladder Network- inverted R-2R ladder network - Analog to Digital converters: Successive Approximation - Counter Type - Dual slope - Flash type converters.

(9)

PLL AND VOLTAGE REGULATORS

Phased Locked Loop: operating principles-Basic building blocks - Applications: Frequency multiplier/divider - Frequency translator - Frequency synthesizer - FM demodulator - FSK demodulator - Monolithic PLL - Voltage regulators: Fixed voltage regulator-Adjustable voltage regulator - Dual tracking regulator - Switching regulator: self oscillating type switching regulator - IC voltage regulators.

(9)

TOTAL : 45

TEXT BOOKS

1. Gayakwad Ramakant A, "Op-amps and Linear Integrated Circuits", Pearson Education, 4th Edition, 2015.
2. Roy Choudhury and Shail Jain "Linear Integrated Circuits", New Age International Private Limited, 5th Edition, New Delhi, 2018.

REFERENCES

1. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Tata McGraw-Hill, 3rd Edition, 2007.
2. K.R.Botkar, "Integrated Circuits", Khanna Publishers, 2nd Edition, 2003.
3. B.Somanathan Nair, "Linear Integrated Circuits, Analysis, Design and Applications", Wiley India Publishers, 1st Edition, 2009.
4. Ron Mancini, "OP AMPs for Everyone", Newnes, An Imprint of Elsevier, 2nd Edition, 2003.
5. Robert F. Coughlin, Frederick F. Driscoll, " Operational Amplifiers and Linear Integrated Circuits", Prentice Hall ,6th Edition, 2001.

19EC45 ELECTROMAGNETIC FIELDS AND WAVEGUIDES

L	T	P	C
3	0	0	3

ASSESMENT: THEORY

COURSE OUTCOME

CO1. Describe the concepts of Electrostatic fields with the help of mathematics and apply them for practical applications

CO2. Describe the concepts of static Magnetic fields with the help of mathematics and apply them for practical engineering problems such as magnetic levitation

CO3. Interpret Maxwell's equations for time varying Electromagnetic fields, determine its parameters for different media, distinguish various polarizations of plane waves and evaluate reflection and transmission coefficients

CO4. Formulate general solutions for TE, TM & TEM modes of parallel plate and Rectangular waveguides and determine parameters such as frequency, phase constant, velocity, attenuation and associated characteristic impedance for the waveguides.

CO5. Formulate general solutions for TE, TM & TEM modes of Circular waveguide and determine parameters such as frequency, phase constant, velocity, attenuation and associated characteristic impedance for the waveguide and Q factor of Rectangular Cavity Resonators

ELECTROSTATIC FIELDS

Fundamentals of vector calculus-Introduction to three co-ordinate systems - Introduction to electrostatic fields - Coulomb's Law and field intensity - Electric Field due to Line, Surface and Volume charge distributions - Electric flux density - Gauss's law- Maxwell's equation - Application of Gauss's law - Electric potential - Relationship between E and V- Energy density – Boundary conditions in electrostatic fields - Capacitance of parallel plate-Capacitance of Coaxial cable - Laplace and Poisson's equations.

(10)

MAGNETIC FIELDS

Biot-Savart's Law - Ampere's circuital law - Applications - Magnetic flux density and Maxwell's equations - Magnetic -Scalar and Vector potential - Magnetic Torque and Moment - Magnetic Boundary conditions -Magnetic energy - Inductors and Inductances - Energy stored in magnetic field - Energy density.

(9)

ELECTROMAGNETIC WAVES

Maxwell's equation - Equation of continuity - Inconsistency of Ampere's law - Wave motion in free space -Uniform plane waves - wave equation for conducting medium - Sinusoidal time variations - Conductors and Dielectrics - Relation between E and H in a uniform plane waves - Reflection by a perfect conductor -Normal and Oblique incidence - Reflection by a Dielectric- Normal and Oblique incidence - Poynting Vector and Theorem.

(9)

WAVES AND RECTANGULAR GUIDES

Waves between parallel planes - Transverse Electric waves - Transverse Magnetic waves - characteristics of TM and TE waves - Transverse Electromagnetic waves - Velocities of propagation - Attenuation for TM,TE and TEM waves -Wave impedances. Rectangular guides: Transverse Electric waves in Rectangular guides- Transverse Magnetic waves in Rectangular guides - Impossibility of TEM waves in waveguide.

(9)

CIRCULAR GUIDES AND CAVITY RESONATORS

Circular guide: Transverse Electric waves and Transverse Magnetic waves in circular guides - Excitation of various modes - Wave impedances and characteristic impedances - Cavity Resonators - Rectangular cavity resonators - Q factor of rectangular cavity resonator for TE_{101} mode.

(8)

TOTAL : 45

TEXT BOOKS

1. Mathew.N.O.Sadiku, "Elements of Electromagnetics", Oxford University press, 6th Edition, 2015.
2. David K.Cheng , "Field and Wave Electromagnetics", Pearson Education, 2013.

REFERENCES

1. William H.Hayt, "Engineering Electromagnetics",Tata McGraw-Hill, 8th Edition, 2012.
2. Edward.C.Jordan & Keith.G.Balmain,, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2nd Edition, 1995.
3. Rajeev Bansal, " Fundamentals of Engineering Electromagnetics", Taylor & Francis, 2018
4. Joseph A.Edminister, "Schaum's Outline of Electromagnetics", Tata McGraw-Hill, Fifth Edition, 2018.
5. Nathan da, " Engineering Electromagnetics", Springer, third Edition, 2018

19ECL46 MICROCONTROLLERS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Develop an 8051 microcontroller Assembly Language Programs using Assembler, KEIL IDE & Proteus Simulator and interface ADC & DAC boards with microcontrollers.
2. Demonstrate real time applications using ARDUINO boards
3. Develop communication skills and capability to work in team

Developing 8051 Assembly Language Programs using Trainer Kits

- Arithmetic and Logical operations (Addition, Subtraction, Multiplication and Division)

- Data manipulating Operations and Delay Routines
- String handling, (Block Move, Searching, Sorting, Swapping and Reversal)
- Solving a Polynomial, Palindrome and Generating Fibonacci Series

Interfacing Experiments

- Interfacing ADC
- Interfacing DAC

8051 Programming using KEIL IDE and Proteus Simulator

- Input/Output Port Programming.
- Timer/Counter Programming.
- Serial Port Programming.
- Handling Interrupts

Embedded 'C' programs using ARDUINO boards

- Data Acquisition using sensors
- Vehicle Tracking

TOTAL: 30

REFERENCES

1. Microcontrollers Laboratory manual prepared by ECE department, CIT.
2. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051, 8096", Prentice Hall of India, Ist Edition, 2011.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems Using Assembly and C ", 2nd Edition, Pearson Education 2013.

Website Reference:

https://www.coursera.org/learn/interface-with-arduino

19ECL47 LINEAR INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon completion of the course, the students will be able to demonstrate an ability to,

1. Test and analyze the characteristics of operational amplifier and special purpose integrated circuits
2. Design, simulate and test active filters, oscillators, multivibrators, comparators, Schmitt Trigger, data

converters, PLL based frequency multiplier and voltage regulators

3. Develop communication skills and capability to work in team

LIST OF EXPERIMENTS

- Operational Amplifier Characteristics
- Operational Amplifier Applications
- Active Filters
- Oscillators & Multivibrators
- Comparator & Schmitt Trigger
- D/A & A/D Convertors
- Multivibrators using Timer IC
- PLL Characteristics and applications
- IC Voltage Regulators

TOTAL : 30

REFERENCES

1. Linear Integrated Circuits Laboratory Manual of ECE Department, CIT.
2. Gayakwad Ramakant A, " Lab Manual to Accompany Op-Amps and Linear Integrated Circuits ", Prentice Hall, 4th Edition, 1999.
3. David A.Bell, "Laboratory Manual for Operational Amplifiers and Linear ICs", Oxford University Press, 2nd Edition, 2006.

19EC51 CONTROL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

1. Ascertain the transfer function of Mechanical and Electrical systems using block diagram reduction and signal flow graph methods
2. Determine time domain response, specifications, and steady state errors of first and second order systems and explain the importance of P, PI & PID controllers in control systems design.
3. Sketch and estimate frequency domain specifications of all-pass & minimum phase systems using bode & polar plots.
4. Test the stability of system by applying Root locus, Nyquist stability criterion and Routh Hurwitz criterion for a system transfer function.

5. Draw state model of electrical systems, determine the solution of state equation using state space representation and test the controllability and observability of systems using Kalman's test.

CONTROL SYSTEM MODELLING

Linear control systems- Open loop and closed loop systems- Examples of control system- Transfer function- Mechanical systems: Translational & Rotational systems- Electrical systems -Analogous system- Block diagram reduction method- Signal flow graph-Mason's gain formula

(9)

TIME DOMAIN RESPONSE

Standard test signals - Type and order of systems –First order system -Step response analysis of second order feedback control systems - Time domain specifications - Steady state errors - Error constants- Introduction to P, PI and PID Controllers

(9)

FREQUENCY DOMAIN RESPONSE

Introduction to frequency response - Frequency domain specifications- Bode plot- Polar plot- All pass and minimum phase systems- Introduction to Lead, Lag and Lead-Lag compensators

(9)

STABILITY RESPONSE

Concepts of stability –S plane for stability - Necessary conditions for stability- Routh Hurwitz criterion- Root locus - Construction of root loci - Nyquist stability Criterion - Assessment of relative stability using Nyquist criterion

(9)

SYSTEM STATE VARIABLE

Concepts of State, State variable and state model- State space representation using physical, phase and canonical variables (Electrical Systems) - State transition matrix - Solution of state equations - Concepts of Controllability & Observability (Kalman's test only)

(9)

TOTAL: 45

TEXT BOOKS

1. Nagrath,I.J. and M.Gopal, "Control Systems Engineering", New age International Publishers, 6th Edition, 2018.
2. Ktsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Limited, 5th Edition, 2015.

REFERENCES

1. Norman S.Nise, "Control Systems Engineering", John Wiley, 6th edition, 2018.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison Wesley, 12th edition, 2013.

3. Farid Golnarghi and Benjamin C. Kuo, "Automatic control systems", Wiley student edition, 9th Edition, 2014.
4. A.Nagoor Kani, "Control Systems", RBA Publications, 2014.
5. W.Bolton, "Control Systems", Newnes, Elsevier Limited, 1st Edition, 2006.

19EC52 DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Compute the Discrete Fourier Transform (DFT) of a given discrete time sequence using Radix-2 Fast Fourier Transform algorithms and to compute the linear convolution of discrete time sequences using DFT.

CO2: Design IIR Butterworth and Chebyshev type I low pass and high pass digital filters for given specifications and realize IIR systems using direct, cascade and parallel form structures.

CO3: Design Linear phase low pass and high pass FIR digital filters using windowing & frequency sampling methods and realize FIR systems using linear phase structures.

CO4: Examine the effects of quantization error in digital filters.

CO5: Explain the Applications of Digital Signal Processing.

DISCRETE FOURIER TRANSFORM

Review of z Transform, Discrete Fourier Transform – Operations on Finite-Length Sequences – DFT Symmetry Relations - Discrete Fourier Transform Properties – Fourier Domain Filtering – Linear Convolution using the DFT - Radix-2 FFT Algorithms - Decimation-in-Time FFT algorithm, Decimation-in-Frequency FFT algorithm.

(12)

IIR DIGITAL FILTER DESIGN

Design of Discrete time IIR Butterworth and Chebyshev type I Low pass & High pass filters - Design of IIR Filter by Impulse Invariance and Bilinear Transformation - Structure of IIR Systems - Direct, Cascade and Parallel form structures.

(10)

FIR DIGITAL FILTER DESIGN

Symmetric and Antisymmetric FIR Filters - Design of Linear Phase low pass and high pass FIR Filters using Rectangular, Hamming & Hann Windows and Frequency Sampling Method - Design of FIR Differentiators - Structure of FIR Systems- linear phase structures.

(9)

FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS

Quantization Process and Errors - Quantization of Fixed point and Floating point numbers - A/D Conversion Noise Analysis - Dynamic range Scaling - Limit Cycles in IIR Digital Filter.

(6)

APPLICATIONS OF DIGITAL SIGNAL PROCESSING

Spectral Analysis of Sinusoidal Signals – Spectral Analysis of Nonstationary Signals – Noise Reduction and Two-Band Digital Crossover – Digital Music Synthesis - Signal Compression.

(8)

TOTAL: 45

TEXT BOOKS

1. John G Proakis and Dimitris G Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, 4th Edition, 2007.
2. Sanjit. K. Mitra "Digital Signal Processing - A computer based approach", Tata McGraw Hill, 4th Edition, 2011.

REFERENCES

1. V. Oppenheim, R. W. Shafer and J.R.Buck, "Discrete-Time Signal Processing", Pearson Education, 4th Edition, 2011.
2. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing", Wiley, 2009.
3. Ifeachor E.C. & Jervis B.W., "Digital Signal Processing: A Practical Approach", Pearson Education, 2nd Edition, 2002.
4. Monson H Hayes, "Schaum's Outlines of - Digital Signal Processing", Tata McGraw Hill, 2nd Edition, 2012.
5. Li Tan, "Digital Signal Processing Fundamentals and Applications", Academic Press, 2008.

L	T	P	C
3	0	0	3

19EC53 EMBEDDED SYSTEMS AND IoT

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1. Interpret the hardware/software components of an embedded system for an application and infer the architecture & programming model of ARM processor.
CO2. Infer the instruction set and exception types of ARM processor to develop Assembly language programs.
CO3. Understand the serial and parallel communication devices and protocols and develop application software for embedded systems.
CO4. Exemplify the key concepts in real time embedded application development using Real Time Operating System (RTOS).
CO5. Interpret the characteristics, functional blocks and architecture of IoT to develop an IoT based applications.

EMBEDDED COMPUTING AND ARM PROCESSOR

Embedded system overview and applications, features and architecture considerations - Embedded Systems vs General computing system– Classification of Embedded Systems -Typical embedded system: Core of the embedded system, Memory, Sensors & Actuators and Communication Interface ARM Embedded System - CISC and RISC Processors – ARM Cortex M4 Architecture - Programmer's model- Operating Modes- Program status registers

(9)

ARM CORTEX-M4 PROGRAMMING

ARM Instruction Set - ARM Instruction Types: Data Transfer, Data Processing, Control Flow, Data conversion, Bit field Processing and program flow control Instructions – Memory bit band operations - Interrupts – Exceptions types - NVIC Registers for interrupt control.

(9)

DEVICES AND BUSES FOR DEVICES NETWORK

I/O Devices: Types and Examples of I/O devices, Synchronous, ISO-synchronous and Asynchronous Communications - Internal Serial-Communication Devices: SPI, SCI, SI, UART, Parallel Port Devices - Serial Communication Buses: I2C, USB, CAN- Advanced I/O Serial high speed buses: ISA, PCI, PCI-X and advanced buses.

(9)

REAL TIME OPERATING SYSTEM

Foreground / Background systems - Critical section of code – Resource - Shared Resource - Tasks, Process and Threads, States - Types of Real-time tasks -Task Periodicity - Multiprocessing and Multitasking - RTOS Task scheduling models: Co-operative Round Robin Scheduling, Cyclic Scheduling with Time Slicing, RM and EDF -Priority Inheritance Protocol - Inter Process Communication : Semaphores , Message Queues , Mailboxes and Dead lock situations .

(9)

IoT AND ITS APPLICATIONS

IoT Definition – Characteristics - IoT Functional Blocks –IoT Architecture –Physical design of IoT – Logical design of IoT- Sensing & Actuation -Basics of Networking - Communication Protocols- Machine-to-Machine - Communication models & APIs.

Domain specific applications of IoT*:* Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture, Smart Traffic Control and Smart water management.

(9)

TOTAL: 45

TEXT BOOKS

1. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 processors", Elsevier - Newness publication, 3rd Edition, 2014.
2. Raj Kamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw Hill, 2nd Edition, 2009.

REFERENCES

1. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers, 1st Edition, 2004.
2. Shibu K.V, "Introduction to Embedded Systems", Tata Mc Graw Hill, 1st Edition, 2009.
3. Jean J.Labrosse, "Embedded Systems Building Blocks", CMP Books, 2nd Edition, 2010.
4. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
5. Ying Bai, “Practical Microcontroller Engineering with ARM Technology” IEEE Press & Wiley publishers, 2016.

19EC54 ANTENNAS AND WAVE PROPAGATION

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Understand the antenna fundamentals and parameters.
2. Analyze the radiation characteristics of antenna array.
3. Understand the radiation characteristics of special antennas.
4. Illustrate antenna parameter measurement methods and Understand the characteristics of radio wave propagation.
5. Interpret the physical significance of transmission line and impart knowledge in impedance transformation and matching using Smith chart.

FUNDAMENTALS OF ANTENNA

Types of antennas – Radiation mechanism – Antenna parameters – Friis Transmission formula – Duality of Antennas – Retarded potentials – Radiation fields of oscillating dipole – Monopole and Half wave Dipole: Power radiated and Radiation Resistance.

(8)

ANTENNA ARRAYS

Need for antenna arrays – Array of two point sources – Broad side array, End fire array, Pattern multiplication, N-element linear array, Binomial arrays – Log periodic dipole array – Phased array – Folded dipole – Yagi Uda antenna – Introduction to smart antennas.

(9)

SPECIAL ANTENNAS

Loop antenna: emf equation of loop antenna – Application in Radio direction finding – Huygens' principle, Babinet's principle – Slot antenna(Quantitative) – Horn antenna – Pyramidal Horn – Conical Horn – Reflector antennas and their feed systems – Micro strip antennas: Basic Characteristics – Feeding methods – Rectangular patch: Transmission line model – Circular patch.

(9)

ANTENNA MEASUREMENTS & WAVE PROPAGATION

Antenna Test Ranges: Elevated Ranges – Ground reflection ranges – Anechoic chambers & absorbing materials – Compact Antenna Test Ranges (CATRS) – Measurement of Gain – Radiation Pattern – Beam Width.

Wave propagation: Modes of propagation – Structure of atmosphere – Ground wave propagation – Sky wave propagation –Virtual height – Maximum usable frequency – Critical angle – Skip distance – Space wave propagation – Duct propagation.

(9)

TRANSMISSION LINE THEORY

General Transmission Line equations – Transmission Line analysis: Voltage, Current and Input Impedance in a line – Reflection coefficient – Lossless Transmission Line – Special Termination conditions – Sourced and Loaded Transmission Line - Standing Waves Ratio - Quarter Wave transformer – Smith Chart - Single Stub Matching using Smith Chart.

(10)

TOTAL:45

TEXT BOOKS

1. C.A.Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons Inc., 4th Edition, 2016.
2. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design - Theory and Applications", Prentice Hall, 2nd Edition, 2009.

REFERENCES

1. K.D.Prasad, "Antennas & Wave Propagation", Satya Prakashan, New Delhi, 3rd Edition , 2003.
2. John D.Kraus, Ronald J.Marhefka, Ahmad S Khan, "Antennas and Wave Propagation" Tata Mc Graw Hill, 4th Edition, 2010.
3. John.D.Ryder, "Networks, Lines and Fields", Prentice Hall of India, New Delhi, 2nd Edition, 1997.
4. Warren L. Stutzman, Gary A. Thiele, "Antenna theory and design", John Wiley and Sons Ltd., 3rd Edition, 2013.
5. A.R.Harish, M.Sachidananda, "Antennas and Wave Propagation", Oxford University Press, 1st Edition ,2007.

19ECL55 SIGNAL PROCESSING LABORATORY

L	T	P	C
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ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Analyze the Spectrum of Discrete time signals and frequency response of Linear Time Invariant systems.
CO2: Implement and test FIR/IIR Low pass & High pass filters and analyze the quantization effects.
CO3: Design and test the applications of Digital Signal Processing.

LIST OF EXPERIMENTS

The following experiments are implemented using open source software and Fixed / Floating point DSP Processors.

- Verification of Linear Convolution, Circular Convolution and Correlation
- Spectral Analysis using FFT
- Design and testing of IIR Low pass and High Pass filters and analyze the quantization effects
- Design and testing of FIR Low pass and High pass filters using Windowing technique and analyze the quantization effects
- Applications of Digital Signal Processing

Case Study:

Sub band coding of Speech signal, Identification of Voice/Unvoiced/Silence regions of Speech, Echo Cancellation using NLMS Adaptive Filter

TOTAL: 30

REFERENCES

1. Discrete Time Signal Processing Lab Manual, Department of ECE, CIT.
2. Sen M. Kuo, Bob H. Lee, and Wenshun Tian, "Real-Time Digital Signal Processing: Fundamentals, Implementations and Applications", Wiley, 3rd Edition, 2013.
3. Rulph Chassaing, Donald S. Reay, "Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416DSK", Wiley, 2nd Edition, 2011.
4. Donald Reay, "Digital Signal Processing and Applications with the OMAP - L138 Experimenter" Wiley, 2012.
5. Steven K Smith, "Digital Signal Processing-A Practical Guide for Engineers and Scientists", Newnes, 2003.

19ECL56 EMBEDDED SYSTEMS AND IoT LABORATORY

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ASSESMENT: PRACTICAL

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Develop an ARM Assembly Language Programs for Arithmetic & array operations, timer/counter operation and interrupts and interfacing hardware with ADC, Temperature sensor, I2C based Serial EEPROM.

2. Demonstrate applications of IoT using NODE MCU ESP 8266/ ARDUINO boards

3. Develop communication skills and capability to work in team.

Experiments using ARM CORTEX M4 LPC 4088 /STM32F446 Processor

- Searching and Sorting an Array
- Code Conversion Techniques
- LED brightness control using PWM signal
- Time Delay Generation using Timer / Counter
- Programming External Interrupts
- Programming Serial Port using UART communication between target board and PC
- Temperature sensor LM 35 ADC Interfacing
- Interfacing I2C based Serial EEPROM

Embedded 'C' programs using NODE MCU ESP 8266/ ARDUINO boards

- IoT based weather monitoring system to track temperature and humidity data over the internet using Arduino and ThingSpeak.
- Track a Vehicle on Google Maps using Arduino, ESP8266 & GPS
- Data acquisition and control using the MQTT based cloud server with the user interface as Mobile APP and web browser
- Develop a simple home security system using Wi-Fi module, HC-SR04 ultrasonic sensor and the IFTTT app

Case study:

Design an analog data acquisition system using sensors such as LDR, thermistor & LM35 , ADC, timer, interrupts and serial port.

TOTAL: 30

REFERENCES

1. Embedded Systems Laboratory manual prepared by ECE department, CIT.
2. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, Pearson Edition, 2012.
3. Pethuru Raj and Anupama C. Raman "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.
4. STM32F446 Processor manual Link: https://www.st.com/resource/en/datasheet/stm32f446mc.pdf

19EC61 VLSI DESIGN

L	T	P	C

4	0	0	4

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Examine the I-V and DC characteristics of MOS transistors and sketch the layout of CMOS Circuits
2. Design and compare the static and dynamic CMOS combinational circuits using different logic styles
3. Design the static and dynamic CMOS sequential circuits using different logic styles
4. Develop and design VLSI sub systems and memories
5. Explain FPGA architectures and VLSI Testing methods

MOS TRANSISTORS AND FABRICATION

CMOS Logic - VLSI Design flow – Ideal I-V Characteristics of MOS Transistors - Non-Ideal I-V Effects - DC Transfer characteristics - n-well CMOS Processing Technology - Stick Diagram and layout design rules - Layout of CMOS Circuits – Delay Estimation.

(12)

COMBINATIONAL CIRCUITS DESIGN

Circuit Families: Logical Effort and Transistor Sizing - Static CMOS – Ratioed Circuits – Cascode Voltage Switch Logic – Dynamic Circuits - Pass transistor Logic - Transmission gate logic – Differential Circuits.

(12)

SEQUENTIAL CIRCUITS DESIGN

Sequencing static circuits - Conventional CMOS Latches and flip-flops - Pulsed latches - Resettable latches and flip-flops - enabled latches and flip flops - Incorporating Logic into latches - TSPC Latches and flip-flops - Sequencing dynamic circuits.

(12)

VLSI SUBSYSTEMS AND MEMORY DESIGN

Single bit Addition - Ripple Carry Adder - Carry look-ahead adder – Carry skip adder - Subtractor - One/Zero detectors – Comparators - Unsigned array and 2's complement array multipliers - Booth encoding – 6T SRAM and DRAM cell design – Power Dissipation in Memories.

(12)

FPGA ARCHITECTURE AND VLSI TESTING

CPLD Architectures - FPGA Architectures: Organization – Programming Technologies – PLB Architectures - Programmable Interconnects – Programmable I/O Blocks.

Manufacturing Test Principles: Fault Models, Observability and Controllability, Fault Coverage and ATPG - Design for Testability: BIST and IDDQ Testing.

(12)

TOTAL : 60

TEXT BOOK

1. Neil H.E.Weste, David Harris "CMOS VLSI Design - A Circuits and Systems Perspective", Pearson Education, 4th Edition, 2015.

2. Charles H.Roth and Lizy Kurian John,"Digital System design using VHDL", John Wiley& Sons, 2nd Edition, 2013.

REFERENCES

1. V.S.V. Prabhakar K. Lal Kishore, “VLSI Design”, John Wiley and Sons, First Edition, 2019.
2. Debaprasad Das, “VLSI Design”, Oxford University Press, II Edition, 2015.
3. Kamran Eshraghian, Douglas A Pucknell, and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems”, Prentice Hall of India, First Edition, 2005.
4. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Prentice Hall of India, 2nd Edition, 2016.
5. John P.Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, 2009.

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19EC62 DIGITAL COMMUNICATION

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Calculate channel capacity based on entropy and mutual information using Shannon's Channel capacity theorem

CO2: Comprehend various error control encoding and decoding techniques

CO3: Discuss Inter Symbol Interference problem in baseband data transmission and derive the Nyquist criteria for distortion less transmission

CO4: Describe and analyze different Digital modulation techniques on the basis of their spectral occupancy

CO5: Discuss the design of optimal receiver for minimizing probability of error and analyze its performance

INFORMATION THEORY

Uncertainty Information and Entropy - Basic Properties of entropy - Information rate - Conditional entropy - Joint Entropy - Mutual Information - Channel capacity of a Gaussian channel - Channel models - BSC and BEC channels - Shannon's channel coding theorem **(9)**

MEMORYLESS FINITE SCHEMES FOR CHANNEL CODING

Linear block codes - Syndrome decoding - Cyclic codes: Generator polynomial - Parity check polynomial -Calculation of syndrome - Convolutional codes - Viterbi decoding- Introduction to Turbo codes

(9)

BASEBAND TRANSMISSION AND RECEPTION

Baseband Binary PAM systems –Baseband Pulse shaping: Intersymbol Interference , Nyquist Criteria for distortion less Baseband Binary Transmission- Pulse shaping by Digital Methods -Duobinary Baseband PAM System - Optimum filter Realization using Matched filter and Correlator - Eye Diagrams

(9)

DIGITAL MODULATION AND TRANSMISSION

Geometric Representation of signals - Generation and signal space representation of Binary Frequency Shift Keying - Binary Phase Shift Keying - DPSK, DEPSK, QPSK, M-ary PSK - Quadrature Amplitude modulation

(9)

OPTIMAL RECEPTION OF DIGITAL SIGNAL

Optimum receiver for Digital Modulation Scheme: BFSK, BPSK, DPSK, QPSK- Probability of Error: BFSK, BPSK, DPSK, QPSK, M-ary PSK - Comparison of Modulation Systems

(9)

TOTAL: 45

TEXT BOOKS

1. Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003.
2. Herbert Taub, Donald L Schilling and Gautam Saha, "Principles of Communication Systems", Tata McGraw Hill, 3rd Edition, 2008.

REFERENCES

1. Simon Haykins, "Digital Communications", 1st Edition, Wiley India edition, 2010.
2. K.Sam Shanmugam, "Digital and Analog Communication systems", John Wiley and sons,2008.
3. John G. Proakis and Masoud Salehi, "Digital Communications", McGraw-Hill Education, 5th Edition, 2008.
4. Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", Wiley India, 2nd Edition, 2013.
5. Todd K.Moon, "Error Correction Coding: Mathematical Methods and algorithms", John Wiley & Sons, 2005.
6. Robert G. Gallager, "Principles of Digital Communication," Cambridge University Press, 2008.

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3	0	0	3

19EC63 DATA COMMUNICATION NETWORKS

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Develop and Illustrate frame transmission for a given scenario. Estimate utilization percentage of data links in networks. Outline the concepts of computer networks, its layered architecture, and switching mechanisms.

CO2 : Evaluate throughput at MAC layer level. Analyze adaptability of given data for a given LAN standard. Categorize given address into one of standard addressing techniques and schemes.

CO3 : Design subnet masks, sub-blocks addressing scheme and identify routing mechanisms to fulfill networking requirements.

CO4 : Analyze given Transport layer header and extract its field data. Describe the essential principles of transport layer protocols. Identify the key factors to improve the performance and QoS parameters of data communication networks.

CO5 : Describe the features and operations of various application layer protocols like TELNET, SMTP,

FTP, HTTP, SNMP and to discuss the security issues in networks.

NETWORK ARCHITECTURE AND DATA LINK LAYER

Introduction: Building Blocks - Links, Nodes - Layering and Protocols - OSI Architecture - Internet Architecture - Circuit Switching vs Packet Switching - Datagram Networks - TCP/IP Reference Model - Logical Link Control Functions - Framing - Stop and Wait Protocol for Noisy And Noiseless Channels - Go-Back-N Protocol For Noisy Channel - Selective Repeat Protocol For Noisy Channel. **(9)**

MEDIUM ACCESS SUBLAYER

Medium Access Layer: Random Access - Controlled Access - Wired LAN - IEEE 802.3: Standard Ethernet, IEEE 802.4: Token Ring - IEEE 802.5: Token Bus - Connecting Devices: Repeaters, Hubs, Switches and Gateways - Virtual LANs. **(9)**

NETWORK LAYER

Addressing -Logical - Physical Address Mapping - IPv4 - IPv6 - Address Resolution Protocol (ARP) - Reverse Address Resolution Protocol (RARP) - Internet Control Message Protocol (ICMP) - Internet Group Management Protocol (IGMP) - Forwarding and Routing techniques - Distance Vector Routing - Link State Routing. **(9)**

TRANSPORT LAYER

Process-to-Process Delivery - User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) : Segments, Connection Establishment, Data Transfer, Termination , Flow Control, Error Control, Congestion Control - Stream Control Transmission Protocol (SCTP) - QoS - Flow classes - Queuing : FIFO, Priority and Weighted Fair Queuing - Traffic shaping: Leaky bucket and Token Bucket. **(9)**

APPLICATION LAYER & SECURITY

Teletype Network (TELNET) - Simple Mail Transfer Protocol (SMTP) - File Transfer Protocol (FTP) - Hyper Text Transfer Protocol (HTTP) - Simple Network Management Protocol (SNMP): SNMP Management Components, Structure, Information Base – Security: Symmetric Key, Asymmetric Key – Network Security: Message Confidentiality, Message Integrity, Message Authentication. **(9)**

TOTAL: 45

TEXT BOOKS

1. Behrouz.A. Forouzan, "Data Communication and Networking", Tata McGraw Hill, 5th Edition, 2013.
2. Stallings.W, "Data and Computer Communication", Pearson Education, 10th Edition, 2013.

REFERENCES

1. Larry L. Peterson, Bruce S. Davie , "Computer Networks: A Systems Approach", Elsevier Science 5th Edition, 2011.
2. J.F.Kurkose & K.W.Rose, "Computer Networking-A top down approach", Pearson Education, 7th Edition, 2012.
3. Ed Tittle, "Schaum's outlines - Computer Networking", McGraw Hill Professional, 2002.
4. Srinivasan Keshav, "An Engineering Approach to Computer Networking", Addision Wesley Professional, 2010.

5. Andrew S.Tanenbaum, David Wetherall, "Computer Networks", Pearson Education, 5th Edition, 2013.

19ECL64 VLSI DESIGN LABORATORY

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ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon the completion of the course, students will be able to demonstrate an ability to

1. Design and simulate CMOS logic combinational & sequential circuits using backend tool
2. Examine the power and stuck at faults in combinational circuits
3. Work in teams to achieve goals and communicate effectively

LIST OF EXPERIMENTS

- Characteristics of nMOS and pMOS transistors
- Design and Simulation of nMOS inverter, CMOS inverter and obtaining its transfer characteristics and Noise Margin
- Logic design using pass transistors, transmission gates and static CMOS logic
- Design and Simulation of dynamic CMOS circuits
- Design and Simulation of simple combinational circuits (encoder, multiplexer, code converters)
- Design and Simulation of ALU subsystem-Adders, Multipliers
- Design and Simulation of sequential circuits (counters, shift registers)
- Layout design of Digital logic circuits
- Design and Simulation of Memory cell
- Power analysis of Pseudo nMOS inverter and CMOS inverter
- Testing of Stuck at faults of combinational digital Circuits

TOTAL: 30

REFERENCES

1. VLSI Design Laboratory Manual prepared by ECE Department, CIT.
2. Neil H.E.Weste, David Harris "CMOS VLSI Design - A Circuits and Systems Perspective", Pearson Education, 4th Edition, 2015.

19ECL65 ANALOG AND DIGITAL COMMUNICATION LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Construct and test analog modulation, pulse amplitude modulation, pulse code modulation, digital modulation and demodulation circuits
2. Simulate and test Linear Block Coders, Cyclic Coders and Convolutional Coders
3. Develop communication skills and capability to work in team

LIST OF EXPERIMENTS

- Generation and demodulation of Analog Modulated signal
- Generation and demodulation of Frequency Modulated signal
- Verification of sampling theorem for low pass signals and testing of pulse analog modulation circuits
- Testing of Pulse Digital Modulation circuits
- Generation and detection of BFSK, BPSK, QPSK and QAM modulation scheme
- Implementation of Linear Block Coders, Cyclic Coders and Convolutional Coders
- Testing the performance of Digital Communication system under AWGN using Software Defined Radio

TOTAL: 30

REFERENCES

1. Robert W. Heath J., "Digital Communication Physical Layer Exploration Lab Using the NI USRP", National Technology & Science Press, 2012.
2. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2nd Edition, 2009.
3. Analog and Digital Communication Laboratory Manual, Department of ECE, CIT.

19EC71 DIGITAL IMAGE PROCESSING

L	T	P	C
4	0	0	4

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, students will be able to demonstrate an ability to

1. Describe the digital image formation process & its representation and compute forward and inverse transform for an image.
2. Apply image enhancement techniques in spatial and frequency domain for improving the visual perception of an image.
3. Describe noise models and apply restoration filters & morphological operators to an image.
4. Interpret image quality and describe image compression techniques.
5. Make use of image segmentation techniques to extract regions of interest from an image and construct descriptors to describe region in a form suitable for computer processing.

DIGITAL IMAGE FUNDAMENTALS & TRANSFORMS

Fundamentals of Image processing - Image sampling and Quantization - Basic relationship between pixels. Image Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Haar Transform and Karhunen Loeve Transform.

(12)

IMAGE ENHANCEMENT

Gray Level transformations – Histogram Processing - Smoothing Spatial filters - Sharpening Spatial filters - Frequency domain filters: Smoothing and Sharpening - Homomorphic Filtering - Color image fundamentals: RGB, HSI Models.

(12)

IMAGE RESTORATION

Model of image degradation - Noise Models – Mean filters - Order statistics filters - Adaptive filters: Local noise reduction filter and Median filter - Linear position invariant degradations - Inverse filtering -Wiener filtering - Constrained least square filtering - Morphological operators - Dilation, Erosion, Opening and Closing. (12**)**

IMAGE COMPRESSION

Coding redundancy - Spatial and temporal redundancy - Irrelevant information - Measuring image information - Fidelity criteria - Image compression models - Image formats - Huffman coding- Arithmetic coding - LZW coding – Run length coding - Bit plane coding - Predictive coding - Block transform coding - Wavelet Coding – JPEG Compression.

(12)

IMAGE SEGMENTATION AND DESCRIPTION

Point detection - line detection - Edge detection - Edge linking and boundary detection: Local processing, Global processing: Hough Transform - Thresholding: Global thresholding, Adaptive thresholding and Optimal thresholding - Region based segmentation – Image Representation: Chain codes, Skeletons - Boundary descriptors: Simple descriptors, Shape numbers - Regional Descriptors: Simple descriptors, Topological descriptors, Relational Descriptors.

(12)

TOTAL: 60

TEXT BOOK

Rafael C.Gonzalez & Richard E.Woods, "Digital Image Processing", 4th Edition, Pearson Education, 2018.

REFERENCES

1. Anil.K.Jain, "Fundamentals of Digital Image Processing", Pearson, 2015.
2. Sid Ahmed M.A., "Image Processing - Theory, Algorithm and Architecture", McGraw Hill, 2009.
3. William K.Pratt, "Digital Image Processing", John Wiley, 4th edition, 2007.
4. Jayaraman S, Esakkirajan S &Veerakumar T, "Digital image Processing", Tata McGraw Hill, reprint 2010.
5. Milan Sonka, Vaclav Hlavac & Roger Boyle, "Image processing, Analysis and Machine Vision", Thomson Asia Prt. Ltd, 4th Edition, 2015.

19EC72- MICROWAVE ENGINEERING & OPTICAL COMMUNICATION

L	T	P	C
4	0	0	4

ASSESSMENT: THEORY

COURSE OUTCOME:

Upon completion of this Course the students will be able to demonstrate an ability to

1. Analyze and characterize given system or networks based on their scattering parameters.
2. Analyze the generation of Microwave signals and understand its construction
3. Explain the operating principle of microwave semiconductor devices and measuring losses, VSWR, scattering and spectral parameters.
4. Explain the concepts of optical fibers communication systems and various signal degradation factors associated with optical fibers
5. Explain the various optical fiber measurements based on the transmission, optical and mechanical characteristics

MICROWAVE DEVICE CHARACTERIZATION

Frequency Spectrum - Scattering Matrix - Properties - Transmission (ABCD) Matrix - Two port, Three port and Four port Network Characterization - Lossless Divider - Resistive Divider – 90^{o} Quadrature Hybrid Coupler - 180^{o} Hybrid Junction

(11)

MICROWAVE GENERATION

High frequency limitations of conventional tubes - Principle of velocity modulation –Two cavity Klystron and Reflex klystron- Traveling wave tube amplifier- Magnetron oscillators - Gunn diode

(12)

SEMICONDUCTOR DEVICES & MICROWAVE MEASUREMENTS

IMPATT Diode- TRAPATT diode - PIN diode - Tunnel diodes - Spectrum analyzer - Network analyzer - Insertion Loss, Attenuation and VSWR measurements - Impedance measurement by Slotted line method - Dielectric constant measurement by waveguide method.

(12)

OPTICAL FIBER COMMUNICATION

Elements of an Optical Fiber Transmission link - Optical transmission basics - Light propagation in optical fiber- Optical Fiber Modes and Configurations - Optical Sources: LEDs, Laser Diodes - Detectors: PIN diode, APD- Signal Degradation in Optical Fibers: Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion.

(13)

OPTICAL FIBER MEASUREMENTS

Fiber attenuation measurements-Dispersion measurements-Fiber refractive index profile measurements- Fiber cut off wavelength Measurements – Fiber numerical aperture measurements – Fiber diameter measurements-Field measurements: Optical Time domain Reflectometry.

(12)

TOTAL: 60

TEXT BOOKS

1. David M. Pozar, “Microwave Engineering”, Wiley India (P) Ltd, New Delhi, 4th edition, 2012.

2. Samuel Y. Liao, "Microwave Devices and Circuits", Prentice Hall of International Ltd, 4th Edition, 2009.
3. Keiser G, “Optical Fiber Communications”, McGraw Hill, New Delhi, 4th edition, 2011.

REFERENCES

1. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications”, Pearson Education Inc., 2011.
2. Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2017
3. John M. Senior, “Optical Fiber Communications Principles and Practice”, PHI, New Delhi, 3rd edition, 2009
4. Robert E Colin, “Foundations for Microwave Engineering”, John Wiley & Sons, 2010
5. S. Rao, "Microwave Engineering", Prentice Hall of India, 2nd Edition, 2015.

19EC73 WIRELESS COMMUNICATION AND NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

4. Illustrate path loss, small scale and large scale fading in mobile channels
5. Describe the cellular concepts, Channel Assignment Strategies, Multiple access techniques and interpret the cellular capacity
6. Explain about the concept of different Digital Signaling for fading channels

7. Compare different linear equalization algorithms & diversity techniques and conclude their choice for wireless channels
8. Explain wireless network architecture with their standards

MOBILE RADIO PROPAGATION

Radio Wave Propagation - Free Space Propagation Model - Ground Reflection Model, Diffraction, Scattering - Practical link budget design - Small scale fading - Time dispersion parameters - Coherence bandwidth - Doppler spread & Coherence time, Fading due to Multipath time delay spread - Fading due to Doppler spread.

(9)

CELLULAR ARCHITECTURE

Frequency Reuse - Channel Assignment Strategies - Handoff Strategies - Interference and System Capacity - Trunking and Grade of Service - Capacity in Cellular Systems - Multiple access techniques: FDMA, TDMA, CDMA, OFDMA

(9)

DIGITAL SIGNALING FOR FADING CHANNELS

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, QAM Principle, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

(9)

MULTIPATH MITIGATION TECHNIQUES

Equalization – Adaptive equalization: Linear and Non-Linear equalization, Zero forcing and LMS Algorithms - Diversity – Micro and Macro diversity - Diversity combining techniques - Error probability in fading channels with diversity reception - Rake receiver.

(9)

WIRELESS NETWORKS

GSM – 3G – 4G (LTE) – LTE-A – 5G – NFC systems – WLAN technology – WLL – Hyper LAN – Ad hoc networks – Bluetooth – UWB.

(9)

TOTAL: 45

TEXT BOOKS

1. Rappaport.T.S, “Wireless communications”, Pearson Education, 2nd Edition, 2010
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2ndEdition 2012.

REFERENCES

1. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 1stEdition, 2005.
2. A.Goldsmith, Wireless Communications, Cambridge University Press, 2005.
3. Aditya K Jagannatham, “Principles of Modern Wireless Communication Systems Theory and Practice”, McGraw Hill Education (India) Private Limited, 1st Edition, 2017
4. William Stallings, "Wireless Communications and networks", Pearson Prentice Hall of India, 2ndEdition, 2009.

5. Clint Smith. P.E, and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.

19EC74 WIRELESS COMMUNICATION AND NETWORKING LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Implement the fading channel models, diversity & equalization techniques and multi carrier modulation techniques
2. Simulate and test the performance of wireless communication systems and networks
3. Develop communication skills and capability to work in team

LIST OF EXPERIMENTS

The following experiments are implemented using software and hardware

- Large Scale & Small-Scale Fading Channel Modelling
- Equalization Techniques
- Diversity Techniques
- Spread Spectrum systems
- Space Time Block Codes
- OFDM Transmitter & Receiver
- Wireless communication systems design using Software Defined Radio (SDR)
- Simulation of wireless networks and their performance analysis

TOTAL: 30

REFERENCES

1. Robert W. Heath J., "Digital Communication Physical Layer Exploration Lab Using the NI USRP", National Technology & Science Press, 2012.
2. Rappaport,T.S., "Wireless communications", Pearson Education, 2nd Edition, 2010.
3. Wireless Communication and Networking Laboratory Manual, Department of ECE, CIT.

19ECL75-HIGH FREQUENCY LABORATORY

L	T	P	C

0 0 2 1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of this Course, the students will acquire practical knowledge to:

1. Test and measure parameters, interpret and analyze measured data, record and present results of tests on passive microwave devices.
2. (i) Test and measure parameters, interpret and analyze measured data, record and present results of tests on passive antennae, fiber-optic cable and optic devices.
   (ii) Design, Simulate, observe results, interpret and analyze measured data, record and present results of simulations of antenna and micro-striplines.
3. Develop Communication Skills and capability to work in team and achieve goals.

LIST OF EXPERIMENTS

- Measurement and Characterization of Passive devices: Isolator, Circulator, Magic Tee and Directional coupler
- Mode characteristics of Reflex Klystron
- Measurement of VSWR, Frequency, Guide Wavelength and Unknown Impedance.
- Measurement of Dielectric constant of a dielectric material.
- Measurement of Radiation pattern of antenna of Horn and Dielectric.
- Design, simulation and analysis of Microstrip-lines and antenna using Antenna Simulation software
- Analysis the characteristics of microwave passive devices using HFSS.
- Analysis of Fiber Optic Analog link's characteristics.
- Test and characterize the optical telecommunication network using OTDR.
- Analysis of standing waves formation in transmission line using FDR method.
- Analysis of Electric, magnetic fields and radiation pattern of an antenna using C program / PYTHON/ SCILAB.
- Analysis of field pattern of various modes inside a rectangular waveguide and rectangular cavity resonator

TOTAL: 30

REFERENCES

1. David M. Pozar, "Microwave Engineering", Wiley India (P) Ltd, New Delhi, 4th edition, 2012.
2. Keiser G, "Optical Fiber Communications", McGraw Hill, New Delhi, 4th edition, 2011.
3. Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2017
4. S. Rao, "Microwave Engineering", Prentice Hall of India, 2nd Edition, 2015.

19ECE01 MULTIMEDIA COMPRESSION AND COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate ability to

CO1 Illustrate various multimedia components and its characteristics.
CO2 Determine the average length of text and image by various compression techniques, and calculate the compression ratio.
CO3 Interpret the various techniques for audio and video compression.
CO4 Illustrate the network architecture and various communication protocols for VoIP. Identify the challenges and key factors to improve the performance and QoS parameters of VoIP.
CO5 Analyze the various multimedia networking protocols to provide the best effort service for Real time interactive multimedia application.

MULTIMEDIA COMPONENTS

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

(9)

TEXT AND IMAGE COMPRESSION

Compression principles-Source encoders and destination encoders-Lossless and lossy compression-Entropy encoding -Source encoding- Text compression -Static Huffman coding , Dynamic Huffman coding - Arithmetic coding - Lempel Ziv-Welsh Compression - Image compression – Graphics interchange formate – Tagged image file format - JPEG

(9)

AUDIO AND VIDEO COMPRESSION

Audio compression-DPCM-Adaptive DPCM -Adaptive Predictive Coding-Linear Predictive Coding-Code Excited LPC- Perceptual coding - Video compression principles-H.261, H.263, MPEG 1, 2, 4.

(9)

VoIP TECHNOLOGY

Basics of IP transport, VoIP challenges, H.323/ SIP -Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service - CODEC Methods-VOIP applicability.

(9)

MULTIMEDIA NETWORKING

Multimedia networking- Applications- Streamed stored and audio-making - Best Effort service-Protocols for real time interactive applications- Distributing multimedia- Beyond best effort service-Secluding and policing Mechanisms- Integrated services, Differentiated Services-RSVP.

(9)

TOTAL:45

TEXT BOOKS

1. Fred Halshall,"Multimedia communication-Applications, Networks, Protocols and Standards", Pearson Education, 2013.
2. Tay Vaughan, "Multideai: Making It Work", 7/e, TMH, 2007.

REFERENCES

1. Kurose and W. Ross, "Computer networking ?A Top down Approach", Pearson education, 3rd Edition, 2010.
2. Marcus Goncalves, "Voice over IP Networks", McGraw Hill, 2nd Edition,1999.
3. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems : Techniques, Standards and Networks", Pearson Education,2007.
4. R.Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education,1st Edition, 1995.
5. Ranjan Parekh, "Principles of Multimedia", 3rd Edition, 2010.

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19ECE02 DIGITAL SWITCHING AND TRANSMISSION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Understand the fundamental building blocks of digital switching and their operating principles including signaling.
2. Explain the features and operation of time space switching mechanisms.
3. Analyze and determine traffic parameters related to call connect and gradeof service.
4. Describe the concepts and explain the operating principles of network synchronization and clock recovery.
5. Describe the structure of PDH SDH and Cross connect networks and their operation

EVOLUTION AND BUILDING BLOCKS OF SWITCHING SYSTEMS

Message switching and Circuit switching - Functions of switching systems - Distribution systems - Digital Switching Systems-Switching system hierarchy - Evolution of switching systems - Stored program control switching system - Basic Call processing- Call signaling - SS7 signalling.

(7)

DIGITAL SWITCHING TECHNOLOGIES

Space Division switching - Folded switches - Digital Time Division switching - Combinational Two dimensional switching : Space-Time and Time-Space switching - Three dimensional : Space-Time-Space and Time Space Time switching - Digital Cross Connect Systems - DCS hierarchy.

(8)

TELECOMMUNICATION TRAFFIC

Unit of traffic - congestion - traffic parameters - Busy Hours Call Attempt - Traffic Intensity - Call processing capacity- Call Completion Ratio - Call Blocking Probability - Grade of Service - Holding time distributions - Arrival time Distributions – Loss Systems - Erlang B-Formula - Delay Systems - Service Times - ErlangC Formula

(9)

NETWORK SYNCHRONISATION

Timing Recovery - Clock instability - Jitter - Slips - Asynchronous Multiplexing - Plesiochronous Network Synchronisation – Pulse stuffing -Mutual synchronization - Master Slave synchronization - Hierarchical synchronization

(8)

TRANSMISSION SYSTEMS

Network Structure - services - regulations - standards - Digital Transmission -PDH and SDH - SDH Features - Network evolution - Cross connect - Add-Drop Mux - SDH Frame structure.

(8)

TOTAL : 45

TEXT BOOKS

1. Flood J E, "Telecommunications Switching, Traffic and Networks" first Indian reprint, Pearson Education India, 2001.
2. ThiagarajanViswanathan, ManavBhatnagar"Telecommunication switching systems and networks" 2nd Edition, PHI Learning, 2015.

REFERENCES

1. John C Bellamy, "Digital Telephony" John Wiley and Sons, 3rd Edition, 2006.
2. Bosse J G van, Fabrizio U. Devetak "Signaling in Telecommunication Networks" John Wiley & Sons,2nd Edition, 2006.

19ECE03 INTRODUCTION TO MACHINE LEARNING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate ability to

1. understand and illustrate a wide variety of examples in supervised and unsupervised learning algorithms.
2. *a.*analyze uncertain probabilities and make rational decisions to minimize risk with associate rules from data.
   *b.*understand the parametric approach for classification and regression models.
3. design a function that learns from a labeled multivariate sample by fine tuning the complexity of the data.
4. explain various feature selection methods to extract subset of important features from original inputs.
5. *a.*apply clustering methods to learn the mixture of parameters from data to various class.
   *b.*understand learning algorithms that build decision tree for labeled training samples in classification and regression models.

LEARNING MODELS

Machine Learning - Learning Associations – Classification - Unsupervised Learning- Reinforcement Learning - Supervised Learning: Learning a Class from Examples - Vapnik - Chervonenkis (VC) Dimension -Probably Approximately Correct (PAC) Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm.

(9)

DECISION THEORY AND PARAMETRIC METHODS

Classification - Losses and Risks - Discriminant Functions - Association Rules - Parametric Methods: Introduction – Maximum Likelihood Estimation - Evaluating an Estimator: Bias and Variance - The Bayes' Estimator - Parametric Classification – Regression-Tuning model

complexity.

(9)

MULTIVARIATE METHODS

Multivariate Data - Parameter Estimation - Estimation of Missing Values - Multivariate Normal Distribution – Multivariate Classification - Tuning Complexity - Discrete Features - Multivariate Regression.

(9)

DIMENSIONALITY REDUCTION

Subset selection – Principal Component Analysis- Feature Embedding-Factor Analysis- Singular Value Decomposition and Matrix Factorization- Multidimensional Scaling- Linear Discriminant Analysis.

(9)

CLUSTERING AND DECISION TREES

Mixture Densities-k-means Clustering- Expectation Maximization Algorithm- Supervised Learning after Clustering- Decision Trees: Univariate Trees- Pruning- Rule Extraction from Trees-Learning rules from data-Multivariate trees.

(9)

TOTAL: 45

TEXT BOOK

Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, 3rd Edition, 2015, ISBN 978-0-262-02818-9.

REFERENCES

1. Tom M.Mitchell, "Machine Learning", McGraw-Hill Private Limited, Indian Edition, 2017.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman Hall/CRC 2nd Edition, 2015, ISBN 978-1-4200-6718-7.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2nd Edition, 2019, ISBN 978-0- 262-01825-8.

19ECE04 SIGNAL PROCESSING USING PYTHON

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the principles of Numerical Python Basics
CO2 : Apply Numpy to perform filtering and Convolution
CO3 : Perform spectral analysis in Python
CO4 : Design and develop FIR digital filters using window methods in Python
CO5 : Design and develop IIR Butterworth and Chebyshev digital filters in Python

INTRODUCTION TO PYTHON

Introduction – Numpy-Numpy arrays and Memory – Numpy matrices- Numpy broadcasting – Matplotlib – Alternatives to Matplotlib – Ipython – Ipython Notebook – Scipy–Computer Algebra – Interfacing with compiled libraries.

(9)

FILTERING AND CONVOLUTION

Smoothing – Convolution – Convolution theorem –Gaussian filter – Efficient convolution – Efficient autocorrelation – Differentiation – Integration – Cumulative sum – Integrating noise.

(9)

SPECTRAL ANALYSIS

Sampling theorem – Reconstruction – Fourier transform matrix – DFT – zero padding – Circular convolution –Spectral analysis using windows – Window metrics.

(9)

FINITE IMPULSE RESPONSE FILTER DESIGN

FIR Filters as Moving averages – Continuous frequency filter transfer function – Z- Transform – Causality – Symmetry and Anti- symmetry – Filter design using Rectangular, Hamming, Hanning and Blackman window methods.

(9)

INFINITE IMPULSE RESPONSE FILTER DESIGN

Design of Butterworth and Chebyshev filters- Frequency transformation - Properties of IIR filters - IIR filter design - Bilinear transformation and Impulse invariant transformation.

(9)

TOTAL:45

TEXT BOOK

Jose Unpingco, "Python for Signal Processing", Springer International Publishing Switzerland 2014.

REFERENCES

1. Allen B. Downey, "Digital Signal Processing in Python", Green tea press, 2014.
2. Ludeman L C, "Fundamentals of Digital Signal Processing", John Wiley, Singapore, 1992.
3. Oppenheim A.V., Schafer R.W. & Buck J.R., "Discrete - Time Signal Processing", Prentice Hall Signal Processing Series, 3rd Edition, 2010.
4. J.G. Proakis, D.G Manolakis, "Digital Signal Processing principles, algorithms and applications", Pearson Education, 4th Edition, 2013.
5. Mark Lutz, "Programming Python: Powerful Object-Oriented Programming", O'Reilly media Inc, 2011.

19ECE05 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Illustrate the characteristics of random processes
2. Estimate the frequency spectrum of random signal by using various power spectrum estimation techniques
3. Design a Wiener filter to produce minimum mean square estimate for linear prediction
   and Develop an adaptive filter algorithms for real time signal processing application
   4. Analyze the spectral characteristics of sample rate converted discrete time signals by using interpolation and decimation
   5. Design filter bank with different structure for computation complexity reduction

DISCRETE RANDOM SIGNAL PROCESSING

Discrete Random Processes – Ensemble averages, Gaussian process, Stationary processes, Autocorrelation and Autocovariance matrices, Ergodicity, Parseval's Theorem – Wiener–Khintchine Theorem – Power Spectrum, Filtering random processes, Spectral Factorization.

(9)

SPECTRUM ESTIMATION

Estimation of spectra from finite duration signals, Non-Parametric Methods –Periodogram, Modified Periodogram, Bartlett and Welch methods, Blackman–Tukey method – Parametric Methods – AR, MA, and ARMA model based spectral estimation – Frequency Estimation**.**

(

9)

LINEAR PREDICTION AND FILTERING

Linear prediction – Forward and backward predictions – Solutions of the Normal equations – Levinson – Durbin algorithms – Least Mean Squared error criterion –FIR Wiener filter– IIR Wiener filter – FIR adaptive filters–LMS Algorithm.

(9)

MULTIRATE SYSTEM

Review of Sampling theorem – Sub-Nyquist sampling–Basic Multirate operations – up sampling and down sampling – time domain and frequency domain analysis – Identities of Multirate operations; Interpolator and decimator design – Rate conversion.

(9)

FILTER BANKS

Multirate Filter Banks: Maximally decimated filter banks – Quadrature mirror filter (QMF) banks – Polyphase representation – Filter banks with tree structure – Filter banks with parallel structure – Polyphase structures: Fundamentals of Polyphase structures – Polyphase QMF Banks – Polyphase filter Banks.

(9)

TOTAL: 45

TEXT BOOKS

1. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and Sons, Singapore, 2009.
2. N.J.Fliege, “Multirate Digital Signal Processing”, John Wiley, 2000.

REFERENCES

1. Simon Haykin, “Adaptive Filter Theory”, 4th Edition, Pearson Education,2008
2. John G.Proakis et.al, “Algorithms for Statistical Signal Processing”, Pearson Education, 2003.
3. T.Adali and Simon Haykin, “Adaptive Signal Processing – Next Generation Solutions”, Wiley India Pvt. Ltd., 2010.
4. P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice Hall, PTR, 1993.
5. Fredric J Harris, “Multirate signal Processing For Communication Systems”, 1st Edition, Pearson Education ,2007

19ECE06 SPEECH SIGNAL PROCESSING

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate ability to

CO1. Describe the concepts of speech production
CO2. Analyze the time domain parameters for speech processing
CO3. Analyze the frequency domain methods for speech processing
CO4. Illustrate the Linear Predictive analysis with its parameters for speech processing
CO5. Infer the concepts of speech processing for real time applications

MECHANICS OF SPEECH

Speech production: Mechanism of speech production, Acoustic phonetics - Digital models for speech signals - Representations of speech waveform: Sampling speech signals, basics of quantization, delta modulation, and Differential PCM.

(9)

TIME DOMAIN METHODS FOR SPEECH PROCESSING

Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

(9)

FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING

Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems: Phase vocoder, Channel Vocoder - Homomorphic speech analysis: Cepstral analysis of Speech, Formant and Pitch Estimation, Homomorphic Vocoders.

(9)

LINEAR PREDICTIVE ANALYSIS OF SPEECH

Basic Principles of linear predictive analysis – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP.

(9)

APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING

Algorithms: Dynamic time warping, K-means clustering and Vector quantization, Gaussian mixture modeling, hidden Markov modeling - Automatic Speech Recognition: Command and Control application: Voice Repertory Dialer, Automated Call type Recognition, Call Distribution by Voice Commands, Credit Card Sales Validation**.**

(9)

TOTAL:45

TEXT BOOK

1. L. R. Rabiner and R. W. Schaffer, "Digital Processing of Speech signals", Prentice Hall, 2004.
2. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing", John Wiley and Sons Inc., 2006.

REFERENCES

1. Thomas F.Quatieri, "Discrete-time Speech Signal Processing-Principles and Practice", Pearson Education, 2004.
2. L.R. Rabiner and B. H. Juang , "Fundamentals of speech recognition", Pearson Education, 2003.
3. Owens, F.J. "Signal Processing of Speech", McGraw-Hill, 1993.
4. Claudi Becchetti and Lucio Prina Ricotti,"Speech Recognition", John Wiley and Sons, 1999.
5. John R Deller and John H L Hansen, John G Proakis,"Discrete Time Processing of Speech Signals",Wliey-IEEE Press,2000.

19ECE07 WEARABLE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT:THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

1. Categorize and explain the type of sensors used in wearable systems.
2. Analyze the wearability issues in signal processing.
3. Specify the types of energy harvesting methods for wearable devices.
4. Explain the techniques used in wireless health systems.
5. List out and explain the applications of wearable systems.

SENSORS

Need for wearable systems- Sensors for wearable systems-Inertia movement sensors- Respiration activity sensor- Inductive plethysmography- Impedance plethysmography- pneumography- Wearable ground reaction force sensor- GSR- Radiant thermal sensor- Wearable motion sensors- CMOS – Based Biosensors- E-Textiles- Bio compatibility.

(9)

SIGNAL PROCESSING

Wearability issues -physical shape and placement of sensor- Technical challenges - sensor design- signal acquisition- Constraint on sampling frequency for reduced energy consumption- light weight

signal processing- Rejection of irrelevant information- Data mining.

(9)

ENERGY HARVESTING FOR WEARABLE DEVICES

Solar cell- Vibration based- Thermal based- Human body as a heat source for power generation- Hybrid thermoelectric photovoltaic energy harvests- Thermopiles.

(9)

WIRELESS HEALTH SYSTEMS

Need for wireless monitoring- Definition of Body area network- BAN and Healthcare- Technical Challenges- System security and reliability- BAN Architecture – Introduction- Wireless communication techniques.

(9)

APPLICATIONS OF WEARABLE SYSTEMS

Medical Diagnostics- Medical Monitoring-Patients with chronic disease- Hospital patients- Elderly patients- Multi parameter monitoring- Neural recording- Gait analysis- Sports Medicine- Smart Fabrics

(9)

TOTAL: 45

TEXT BOOK

1. Annalisa Bonfiglio,DaniloDe Rossi , “Wearable Monitoring Systems”, Springer,2011.
2. Sandeep K.S. Gupta,TridibMukherjee,Krishna Kumar Venkatasubramanian, “Body Area Networks Safety,Security, and Sustainability”,Cambridge University Press,2013.

REFERENCES

1. Hang,Yuan-Ting, “Wearable Medical Sensors and Systems”,Springer,2013.
2. Mehmet R. Yuce,JamilY.Khan, “Wireless Body Area Networks Technology, Implementation and Applications”,Pan Stanford Publishing Pvt.Ltd, Singapore,2012.
3. Guang-Zhong Yang(Ed.), “Body Sensor Networks”, Springer,2007.
4. Andreas Lymberis, Danilo de Rossi , “Wearable eHealth systems for Personalised Health Management - State of the art and future challenges” ,IOS press, The Netherlands,2004.

19ECE08 ADAPTIVE SIGNAL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate ability to

CO1 ate the characteristics, applications and properties of Adaptive Systems.

CO2 Explain theory of adaptation with stationary signals.

CO3 Examine the concepts of gradient and mean square error performance in adaptive systems.

CO4 Exemplify LMS algorithms and constraints associated with it.

CO5 Describe the various applications of adaptive signal processing.

ADAPTIVE SYSTEMS

Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications. Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

(9)

THEORY OF ADAPTATION WITH STATIONARY SIGNALS

Properties of the Quadratic Performance Surface, Significance of Eigen values, Eigen vectors, correlation matrix. Searching the Performance Surface: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve.

(9)

GRADIENT ESTIMATION AND ITS EFFECTS ON ADAPTATION

Gradient component estimation by derivative measurement, performance penalty, Variances of the gradient estimate, effects on the weight – vector solution, Excess mean square error and time constants, misadjustments, total misadjustments and other practical considerations.

(9)

ADAPTIVE ALGORITHM AND STRUCTURE

LMS Algorithm, Derivation, Convergence of the weight vector, learning curve, noise vector in weight vector solution, misadjustment, Performance analysis

(9)

APPLICATIONS OF ADAPTIVE SIGNAL PROCESSING

Adaptive modeling of a multi-path communication channel, model in geophysical exploration, FIR digital filter synthesis.

(9)

TOTAL:45

TEXT BOOK

1. Bernard Widrow and Samuel D. Stearns, “Adaptive Signal Processing”, Person Education India, 2016.
2. Simon Haykin, Adaptive Filter Theory, Pearson Education, 2014.

REFERENCES

J. Benesty, Y. Huang, Adaptive Signal processing: Applications to Real World Problems, Springer , 2013

1. T. Adali and S. Haykin, ADAPTIVE SIGNAL PROCESSING: Next Generation Solutions, John Wiley & Sons Inc. , 2010
2. Sayed Ali, H., Fundamentals of Adaptive Filtering, John Wiley & Sons. 2003
3. John R. Treichler, C. Richard Johnson, Michael G. Larimore, Theory and Design of Adaptive Filters, Prentice-Hall of India, 2002.
4. D. G. Manolakis, V.K. Ingle, S.M. Kogon, Adaptive Signal Processing, McGraw-Hill , 2000.

19ECE09 INFORMATION THEORY AND CODING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Evaluate the information content in a discrete memoryless source through parameters such as entropy and mutual information.

CO2 : Estimate a channel's capacity based on Shannon's channel capacity theorem

CO3 : Construct efficient source coding schemes based on the entropy of source and probability of input variables

CO4 : Develop channel error control codes using BCH and RS algorithms

CO5 : Design of various coding techniques for AWGN and fading channels

CONCEPTS OF INFORMATION THEORY

Review of probability Theory - Random variables - Operations on single and multiple random variables-random process concept- Memoryless Finite Schemes- Self information measure - Entropy function - Conditional Entropies - Characteristics of Entropy function - Derivation of the noise characteristics of a channel - Mutual information - Redundancy - Efficiency and channel capacity - capacities of channels with symmetric noise structure. **(9)**

CONTINUOUS CHANNELS

Definitions of different entropies - Mutual information - Maximization of the entropy of a continuous random variable - Entropy maximization problems - Channel capacity under the influence of additive white Gaussian Noise- Hartley Shannon's Law – Trade-off between Bandwidth and SNR - Comparison of different modulation methods- Information Capacity Theorem - Rate Distortion Theory. **(9)**

ELEMENTS OF ENCODING

Separable binary codes - Shannon - Fano encoding - Necessary and sufficient conditions for noiseless coding - Shannon's binary coding - fundamental theorem of discrete noiseless coding - Huffman's code - Gilbert Moore coding - Fundamental theorem of discrete coding in presence of noise - Instantaneous Codes - Kraft Inequality and McMillan's Theorem - Average Length and Compact Codes - Geometric Representation - Arithmetic Coding

(9)

ERROR CONTROL CODES

Hamming's single error correcting code - BCH codes - Reed-Solomon codes - Decoding BCH and RS codes - finding the Error Locator Polynomial - Non-binary BCH and RS Decoding - Erasure decoding for Non binary BCH and RS codes -Turbo codes - Encoding Parallel Concatenated codes

- Turbo MAP decoding algorithm - BCJR algorithm - Log likelihood ratio decoding **(9)**

CODING OVER CHANNELS

AWGN channels-Coding gain-Encoding and decoding in AWGN channels-ML and MAP decoding for Repetition codes- Coding gain performances -Density Parity check (LDPC) codes, Gallager construction of LDPC codes-Tanner Graphs- Gallager decoding -Degree optimisation to achieve higher thresholds- Soft-decision Message Passing Decoder for AWGN channels-Density evolution for AWGN channels **(9)**

TOTAL: 45

TEXT BOOK

1. Reza F M, "An Introduction to Information theory", McGraw Hill, 2000.
2. Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 1st edition, 2021.

REFERENCES

1. Richard B.Wells, "Applied Coding and Information Theory for Engineers", Pearson Education, 1st edition Indian reprint, 2009. (updated)
2. Ranjan Bose, "Information Theory Coding and Cryptography", Tata McGraw Hill,2nd Edition 2008. (updated)
3. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2nd Edition, 2009. (updated)
4. Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003.
5. Simon Haykins, " Digital Communications Systems", 1st Edition, Wiley, 2013

19ECE10 COMMUNICATION SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Discuss the characteristics and properties of LTIV systems
2. Analyze the spectral characteristics of discrete time signals by using filters and analyze the sample rate converted discrete time signals by interpolation and decimation
3. Outline different bandpass modulation & demodulation techniques and compare their performance
4. Apply channel coding procedure and calculate coding efficiency
5. Analyze the performance of Spread Spectrum and OFDM system

INTRODUCTION

Basics of LabVIEW – LabVIEW Coding Guidelines - Generating Signals – Generating Channel Models - Generating Symbols - Examples of Time-Varying Systems- Models for LTIV Systems - Time Domain Description for LTIV System - Frequency Domain Description of LTIV Systems - Properties of LTIV Systems - Random Process Models – Channel Modeling and Simulation.

(9)

FFT AND DIGITAL FILTERS

Spectral Analysis using FFT, FIR Filters - Sampling – Quantization: Uniform Quantization, Non-uniform Quantization, Quantization Errors - FIR Filter Design by Windowing, Equi-ripple FIR Filters – Effects of Filter-Phase Response – Pulse-Shaping Filter – Upsampling – Down sampling – Resampling Filters: Half band Filters, Polyphase Filters.

(9)

BANDPASS DIGITAL TRANSMISSION AND RECEPTION

Frequency Shift Keying (FSK) - Phase Modulation - Phase Shift Keying (PSK) - Differential Phase Shift Keying (DPSK) - Quadrature Amplitude Modulation (QAM) – M-ary keying- Comparison of Various Signaling - Signal Detection and Recovery: Matched filter detection, Threshold decisions - Performance Measurements- Bit-error rate, Error vector magnitude.

(9)

CHANNEL CODING

Waveform Coding, Linear Block Coding, Cyclic Coding- Convolutional Coding and Viterbi Decoding - Trellis-Coded Modulation (TCM) - Turbo Coding -Low-Density Parity-Check (LDPC) Coding - Differential Space-Time Block Coding (DSTBC).

(9)

WIRELESS COMMUNICATION SYSTEM

Performance analysis Spread Spectrum System, OFDM System - Simulation and Modeling.

(9)

TOTAL: 45

TEXT BOOK

1. Cory L.Clark, "Digital Signal Processing and Digital Communication using Labview", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Robert W. Heath J., "Digital Communication Physical Layer Exploration Lab Using the NI USRP", National Technology & Science Press, 2012

REFERENCES:

1. Won Y. Yang, Yong S. Cho, Won G. Jeon, Jeong W. Lee, Jong H. Paik Jae K. Kim, Mi-Hyun Lee, Kyu I. Lee, Kyung W. Park, Kyung S. Woo, "MATLAB®/Simulink® for Digital Communication", A-Jin Publishing Co, 2009
2. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2nd Edition, 2009.
3. LabVIEW Basics-I Manual, National Instruments, 2009.
4. William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport and Kurt L. Kosbar Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.
5. K. C. Raveendranathan, "Communication Systems Modelling and Simulation: Using MATLAB and Simulink", Universities Press (India) Private Limited, Hyderabad (AP), 2011.
6. Michel C. Jeruchim, Philip Balaban and K. Sam Shanmugan, "Simulation of Communication Systems", Plenum Press, New York, 1992.

19ECE11-OVERVIEW OF INDUSTRY 4.0

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate ability to

1. Illustrate design principle scenarios, principles and strategies of automation and the basic elements of automated system and explain transfer mechanisms and cyber physical systems
2. Illustrate data acquisition systems objectives and Nyquist sampling theorem classification and types of filters and design of filters with their application
3. Compare and distinguish the industrial advantages of Nano electrical and electronic devices and the significance of Nanotech in industrial application.
4. Describe the machine to machine communication and their application over agriculture, health care and activity monitoring.
5. Express Robot Classification. Robotic System Components, Different Orientation Descriptions and Robot control architecture.

INTRODUCTION

Introduction to Industry 4.0 design principle scenarios, Automation in Production System, Principles and Strategies of Automation, BasicElements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines and cyber Physical systems. **(9)**

DATA ACQUISITION SYSTEMS

Data Acquisition Systems(DAS) - Objectives - General configurations - Transducers - Signal Conditioning - Instrumentation amplifiers - Noise Reduction Techniques in Signal Conditioning- Transmitters -Piezoelectric Couplers- Nyquist's Sampling Theorem classification and types of filters - Design of Filters- Butterworth Approximation-Narrow Bandpass and Notch Filters and their application in DAS **(9)**

NANOTECHNOLOGY

Industry Advantages of Nano electrical and electronic devices – Electronic circuit chips – Nano sensors and actuators, Optical switches – Diodes and Nano-wire transistors - Memory storage – Lighting and displays – Filters (IR blocking) – Quantum computers – 30 Energy devices – Medical diagnosis – Conductive additives - Lead-free solder – Nanocoating's –EMI shielding. **(9)**

INTRODUCTION TO IoT

Sensing, Actuation, Basics of Networking, Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring.

(9)

ROBOTIC SYSTEMS AND APPLICATION

Robot Definition, Robot Classification. Robotic System Components, Different Orientation Descriptions, Manipulator Kinematics and Mechanics of Robot Motion, Velocity Transformations, Static Forces Transformations, Manipulator Dynamics, Trajectory Planning, Inverse Dynamics Control, Robot Controller Architectures, Robot Sensing and Vision Systems, Introduction to Intelligent Robots, Robots In Manufacturing Automation. **(9)**

TOTAL: 45

TEXT BOOK

1. Hermann, Pentek, Otto, 2016: Design Principles for Industry 4.0 Scenarios
2. "Industrial Automation and Control System Security Principles" by Ronald.L.Krutz 2016 edition

REFERENCES

1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, by Pethuru Raj and Anupama C. Raman (CRC Press).
2. Introduction to Nanotechnology By Charles P. Poole, Jr., Frank J. Owens . A Wiley Interscience Publications 2003.
3. Robotics and Control by R K Mittal and IJ Nagarath TATA McGraw Hill Publications 2003.
4. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence
   By Jan Holler, VlasiosTsiatsis, Stamatis Karnouskos, Catherine Mulligan, Stefan Avesand, David Boyle · 2014

19ECE12 CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
3	0	0	3

ASSESSMENT THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

1. Describe the issues, scope and significance of various security mechanismsand services applicable to Communication networks.Explain and analyze, algorithms and techniques of Block andStream ciphers.
2. Describe the concepts and applications of Modern Symmetric Key Ciphers
3. Describe the concepts and applications of ASymmetric Key Encipherment
4. Explain about concepts and applications of Integrity Authentication and Key management
5. Discuss the concepts of security at application, transport and network layer,

NUMBER THEORETIC AND ALGEBRAIC ALGORITHMS

Significance of network and data security in todays communication scenario – Overall Classification - Integer Arithmetic Modular Arithmetic – matrices – Linear congruenceSubstitution ciphers – Transposition ciphers – Stream cipher- Block ciphers – Algebraic structures – GF(2n) fields.

(9)

MODERN SYMMETRIC KEY CIPHERS

Modern block ciphers – Modern stream ciphers – DES – AES – uses of modern block ciphers and stream cipher, Application Examples.

(9)

ASYMMETRIC KEY ENCIPHERMENT

Mathematics of cryptography – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm – RSA, Rabin – Elliptic curve, Application Examples.

(9)

INTEGRITY AUTHENTICATION AND KEY MANAGEMENT

Message integrity – random oracle model – message authentication – SHA-512 – WHIRL POOLDigital signature schemes Entity anthentication– password – challenge response – zero knowledge – Biometrics – Kerberos – symmetric key management – public key distribution – steganography, Application Examples. **(9)**

NETWORK SECURITY

Security at the Application Layer: E-mail – PGP – S/MIME – Security at the transport layer: SSL and TLS – Security at the network layer: IPsec, Two Security Protocol – Security Association – Internet Key Exchange – ISAKMP, Application Examples.

(9)

TOTAL: 45

TEXT BOOK

1. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw- Hill Education, 2011.
2. William Stallings,"Cryptography and Network security: Principles and practice", 7th Edition, Pearson Education,2016.

REFERENCES

1. Douglas R.Stlinson, "Cryptography Theory and Practice", CRC Press series on Discrete Mathematics and its application, 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security Private Communication in a Public World", Pearson Education, 2nd Edition, 2003.
3. Atul Kahate ," Cryptography and Network security", 3rd Edition, McGraw-Hill Education, 2013.
4. Christos Douligeris, Dimitrios N. Serpanos, "Network Security: Current Status and Future Directions", John Wiley, 2007.
5. R.K.Nichols, "Wireless Security" Tata Mc Graw Hill Education, 2006.

19ECE13 PARALLEL AND DISTRIBUTED PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

1. Describe the architecture of models of parallel computers
2. Illustrate the key concepts of advanced processor and memory hierarchy technology
3. Exemplify the types of pipelining methods for super scalar architecture
4. Interpret the models, languages and compilers for parallel programming
5. Infer the concepts of distributed systems.

PARALLEL ARCHITECTURE

Parallel Computer Models, Program and Network properties, Principles of scalable performance **(9)**

PROCESSORS AND MEMORY HIERARCHY, BUS

Advanced processor Technology, Super scalar and vector processor, Memory hierarchy technology, Virtual Memory Technology, Backplane Bus systems. **(9)**

PIPELINING AND SUPER SCALAR TECHNIQUES

Linear Pipeline, Nonlinear pipeline, Instruction pipeline, Arithmetic pipeline, Superscalar and super pipeline design, Parallel and scalable architectures- Multiprocessor and Multicomputers. **(9)**

SOFTWARE FOR PARALLEL PROGRAMMING

Parallel programming models, languages, compliers- Parallel Program Development and Environments. **(9)**

DISTRIBUTED SYSTEMS

Models, Hardware concepts, communication, synchronization mechanism, case study: MPI and PVM, Distributed file systems. **(9)**

TOTAL : 45

TEXT BOOK

1. Hwang. K, "Advanced computer Architecture‖, Parallelism, scalability, Programmability", Tata McGraw Hill, 1993.
2. Tanenbaum A.S, "Distributed Operating Systems", Pearson Education, Asia, 2002.

REFERENCES

1. Dezso Sima,Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures", Pearson Education, 2007.
2. Quinn, M.J., "Designing Efficient Algorithms for Parallel Computers", McGraw - Hill, 2003.
3. Harry F. Jordan Gita Alaghband, " Fundamentals of parallel Processing", Pearson Education , 2003

4. V.Rajaraman and C.Siva Ram Murthy, “Parallel Computers Architecture and Programming”, PHI, 2000.
5. Culler, D.E., “Parallel Computer Architecture‖, A Hardware – Software approach, Harcourt” , Asia Pvt.Ltd., 1999

19ECE14 OPTICAL COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the working of an Optical component based on its scattering parameters

CO2 : Explain the architecture and traffic flow of different client layer Optical networks.

CO3 : Analyze traffic models applicable for wavelength routing networks and determine the cost trade-off for

designing a ring network

CO4 : Illustrate the function of the Photonic packet switching network and explain different architecture of

access networks

CO5 : Identify, illustrate and compare the management and control aspects of optical networks

OPTICAL SYSTEM COMPONENTS

Optical transmission basics - Network evolution - Light propagation in optical fibers - Loss & bandwidth, System limitations, Non- Linear effects - Solitons - Optical Components: Couplers, Isolators, Circulators, Multiplexers & Filters - Optical Amplifiers - Switches - Wavelength Converters. **(9)**

OPTICAL NETWORK ARCHITECTURES

Introduction to Optical Networks - SONET/SDH –Optical Transport Network – Generic Framing Procedure-Ethernet –IP- Multiprotocol Label Switching – Resilient Packet Ring – Storage Area Networks **(9)**

WAVELENGTH ROUTING NETWORKS

WDM Network Elements-Optical Line Terminals, Optical Line Amplifiers, Optical Add/Drop Multiplexers, Optical Crossconnects-WDM Network Design - Cost Trade –offs-LTD and RWA problems –Dimensioning Wavelength –Routing Networks-Statistical Dimensioning Models-Maximum Load Dimensioning Models **(9)**

PACKET SWITCHING AND ACCESS NETWORKS

Photonic Packet Switching - OTDM - Multiplexing and Demultiplexing - Synchronization - Burst switching – Test beds -Access Networks - Network Architecture overview –Enhanced HFC –Fiber to the Curb **(9)**

NETWORK DESIGN AND MANAGEMENT SYSTEM

Transmission System Engineering - System model - Power penalty - Transmitter - Receiver - Optical amplifiers - Crosstalk - Dispersion - Wavelength stabilization - Overall design considerations - Control and management: Network management functions, Configuration management, Performance management, Fault management, Optical safety. **(9)**

TOTAL : 45

TEXT BOOK

1. Rajiv Ramaswami, Kumar N. Sivarajan and Galen H Sasaki "Optical Networks: A Practical Perspective", Elsevier/Morgan Kaufmann, 3rd Edition, 2010.
2. C.Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, 2002.

REFERENCES

1. Biswanath Mukherjee, "Optical WDM Networks", Springer Science, 2006.
2. Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks - Architecture, Design and control ", Cambridge University Press, 2nd Edition, 2009.
3. Govind P.Agrawal, "Fiber-Optic Communication Systems", John Wiley and Sons, 4th Edition, 2012.
4. P.E.Green, "Fiber Optic Networks", Prentice Hall, 1993.
5. Franz and Jain, "Optical communication systems", Narosa Publications, New Delhi, 1995.

19ECE15 SOFT COMPUTING AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to
CO1. Interpret the basic concepts of artificial neural networks and fuzzy logic
CO2. Analyze the various neural network algorithmsfor real time optimization problems
CO3.Infer the concepts and methods of fuzzy systems
CO4.Apply theGenetic algorithm for single objective and multiobjective optimization problems
CO5. Interpret the techniques of hybrid computing algorithms and to develop an applications

ARTIFICIAL NEURAL NETWORKS& FUZZY LOGIC

Artificial neural networks: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications.Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzy relations: cartesian product of relation - classical

relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.

(9)

NEURAL NETWORKS

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network.

(9)

FUZZY SYSTEMS

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

(9)

GENETIC ALGORITHM

Genetic algorithm and search space - general genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem-Multi-objective Optimization Problem Solving- Multi-Objective Evolutionary Algorithm (MOEA)- Non-Pareto approaches to solve MOOPs -Pareto-based approaches to solve MOOPs -Some applications with MOEAs.

(9)

HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

(9)

TOTAL: 45

TEXT BOOK

1. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
2. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education 2004.

REFERENCES

1. S.Rajasekaran and G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" , Prentice Hall, 1997.
3. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, " Neural Networks and Learning Machines", 3rd Edition,PHI Learning, 2011.

19ECE16 COGNITIVE RADIO COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. describe the evolution of software defined radio and cognitive radio
2. illustrate the architecture of cognitive radio communication system
3. analyze and explain different spectrum sensing techniques and dynamic spectrum access
4. explain the MAC and Network layer design for Cognitive Radio
5. illustrate the applications of Cognitive Radio

INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO

Evolution of Software Defined Radio and Cognitive radio – goals – benefits – definitions – architectures - enabling technologies - radio frequency spectrum and regulations.

(9)

COGNITIVE RADIO ARCHITECTURE

Cognition cycle – orient – plan - decide and act phases – organization of CR - SDR as a platform for Cognitive Radio – Hardware and Software Architectures - Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

(9)

SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS

Introduction – Primary user detection techniques – energy detection - feature detection - matched filtering - cooperative detection and other approaches - Fundamental Tradeoffs in spectrum sensing - Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing - Fundamental Limits of Cognitive Radio.

(9)

MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

(9)

APPLICATIONS OF COGNITIVE RADIO

Overview of security issues in cognitive radios, auction-based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

(9)

TOTAL: 45

TEXT BOOK

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, “Cognitive Radio Communications and Networks – Principles and Practice”, Academic Press, Elsevier, 2010
2. Huseyin Arslan, “Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems”, Springer, 2014.

REFERENCES

1. Bruce A.Fette, "Cognitive Radio Technology", 2nd Edition, Elsevier Science, 2009.
2. Kwang Cheng Chen, Ramjee Prasad, "Cognitive Radio Networks", John Wiley and Sons, 2009.
3. Ezio Biglieri, Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, "Principles of Cognitive Radio", Cambridge University Press, 2014.
4. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks – From Theory to Practice", Springer Series: Analog Circuits and Signal Processing, 2014.
5. Geetam Singh Tomar, Ashish Bagwari, Jyotshana Kanti, Introduction to Cognitive Radio Networks and Applications, CRC Press, Taylor & Francis Group,2016

19ECE17 NEXT GENERATION NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Explain the concepts of SDN network and integration with LTE.
2. Discuss the concepts of Traffic Transport and Network Management in SDMN
3. Explain the principles of Resource and Mobility Management in SDMN

4. Discuss the concepts of NGN architecture and service evolution
5. Explain the features of NGN management and standardization

SDMN-LTE INTEGRATION NETWORK

SDN Paradigm and Applications - SDN for Wireless Challenges - Leveraging SDN for 5G Networks Ubiquitous Connectivity - Mobile Cloud - Cooperative Cellular Network - Restructuring Mobile Networks to SDN - SDN/LTE Integration Benefits. **(9)**

NETWORK AND TRANSPORT LAYER MANAGEMENT IN SDMN

IPv6 – IPv6 PE – IPv6 VPN –Mobile IP–Mobile TCP- Mobile Network Function and Service Delivery Virtualization and Orchestration- NFV , SDN - Traffic Management in SDMNs – NFV & SDN in Packet Core. **(9)**

RESOURCE AND MOBILITY MANAGEMENT IN SDMN

QoE Framework Architecture - Quality Monitoring - QoE Enforcement - Software Defined Internet Mobility Management - Architecture of Mobile Virtual Network Operators - MVNO Developments in 3G, 4G, and LTE - Cognitive MVNO. **(9)**

NGN ARCHITECTURE

Evolution Towards NGN - Technology Requirements, NGN Functional Architecture - Transport Stratum, Service Stratum, Service/ Content Layer and Customer Terminal Equipment Function - NGN Entities, Network and Service Evolution - Fixed, Mobile, Cable and Internet Evolution Towards NGN. **(9)**

NGN MANAGEMENT AND STANDARDIZATION

NGN requirements on Management - Customer, Third Party, Configuration, Accounting, Performance, Device and Information Management. Service and control management - End-to-End QoS and security - ITU and GSI-NGN releases, ETSI-NGN concept and releases. **(9)**

TOTAL: 45

TEXT BOOK

1. Madhusanga Liyanage, Andrei Gurtov and Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015.
2. Jingming Li Salina and Pascal Salina, "Next Generation Networks-perspectives and potentials", Wiley, January 2008.

REFERENCES

1. Savo G Glisic, "Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
2. Thomas Plavyk, "Next generation Telecommunication Networks", Services and Management, Wiley & IEEE Press Publications, 2010.
3. Martin Sauter, "3G, 4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
4. Neill Wilkinson, "Next Generation Network Services", John Wiley Publications, 2002.
5. Monique J. Morrow, "Next Generation Networks", CISCO Press, 2007.

19ECE18 WIRELESS ADHOC AND SENSOR NETWORKS

L	T	P	C
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ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Outline the challenges & issues in the wireless Ad Hoc and sensor network and its subsystems and Interpret network architecture and its components
2. Describe the essential principles of the MAC protocols for Wireless Ad Hoc Networks
3. Explain the Routing & Transport protocols for Wireless Ad Hoc Networks
4. Discuss the features of MAC & Routing protocols for WSN
5. Explain the principles of localization tracking and infrastructure establishment in WSN

FUNDAMENTALS OF AD HOC & SENSOR NETWORKS

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Cellular and Ad Hoc Networks (MANETs) – issues in Ad hoc networks -

Wireless sensor networks (WSNs): Challenges and Constraints - Single node architecture – Hardware components, Energy consumption of sensor nodes - Applications of Ad Hoc and Sensor Networks.

(9)

MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols: A Media Access Protocol for Wireless LAN (MACAW), Busy Tone Multiple Access protocols - Contention based protocols with Reservation Mechanisms: Distributed Packet reservation Multiple Access Protocol (D-PRMA), Five Phase Reservation Protocol (FPRP) - Contention based protocols with Scheduling Mechanisms: Distributed Priority Scheduling and Medium Access in Ad Hoc Networks, Distributed Wireless Ordering protocol (DWOP).

(9)

ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS

Issues in Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) —Location–Aided Routing (LAR) –Zone Routing Protocol (ZRP).

(9)

MAC AND ROUTING FOR WIRELESS SENSOR NETWORKS

MAC Protocols for Wireless Sensor Networks, IEEE 802.15.4, Zigbee, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

(9)

LOCALIZATION TRACKING AND INFRASTRUCTURE ESTABLISHMENT

A Tracking Scenario – Problem formulation - Distributed representation and inference of states– Tracking multiple objects – Sensor models – Topology control – Clustering – Time synchronization – Localization and Localization Services

(9)

TOTAL: 45

TEXT BOOK

1. C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2012.
2. Kazem Sohraby, Daniel Minoli and TaiebZnati, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley Interscience A John Wiley & sons, Inc., Publication, 2007.

REFERENCES

1. Carlos de Morais Cordeiro, Dharma Prakash Agarwal, "Ad hoc and Sensor Network: Theory and Applications", 2nd Edition, World Scientific Publishing Co, 2011.
2. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

3. Feng Zhao and Leonidas Guibas, “Wireless Sensor Networks: An information processing Approach”, Elsevier 2004.
4. C.K.Toh, “Ad Hoc Mobile Wireless Networks”, Pearson Education, 2009.
5. Ian F. Akyildiz, Mehmet Can Vuran, “Wireless Sensor Networks” John Wiley, 2010
6. Yingshu Li, My T. Thai,Weili Wu, “ Wireless Sensor Networks and Applications” Springer 2008

19ECE19 WIRELESS NETWORKS AND STANDARDS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. (i) Outline the concepts of TDMA , GSM, CDMA in the Second generation wireless cellular networks
   (ii) Describe and compare the air interface techniques in the second generation systems.
   (iii) Summarize the UMTS Services, air interface techniques, WCDMA and CDMA in the third generation systems
2. Describe the working principles of various wireless standards and its operations
3. Describe the Function of Mobile IP and Outline the various wireless application protocols

4. Outline the various types wireless LANs and Summarize the Wireless LAN Standards
5. Describe the features and operations of various Wireless Personal Area Networks and its standards

SECOND AND THIRD GENERATION: ARCHITECTURE AND PROCESS FLOW

Second Generation TDMA – GSM : Architecture, Air Interface, Channels, Voice-call setup, Hand over - EDGE architecture– Second Generation CDMA: Forward and Reverse channel, Call Handoff – Third Generation systems – UMTS network architecture **(9)**

WIRELESS SYSTEM OPERATIONS AND STANDARDS

Cordless systems : Time Division Duplex, DECT Operation, ADPCM- Wireless Local Loop : Propagation considerations for WLL-OFDM –WiMAX and IEEE 802.16 : Long-Term Evolution : System Architecture, Transmission Techniques ,Channels in the radio interface, Radio Resource Management. 5G -Objectives and usage scenarios, New Radio Air interface, RAN architecture. **(9)**

MOBILE IP AND WIRELESS APPLICATION PROTOCOLS

Mobile IP : Operation of Mobile IP, Discovery using Agent Solicitation , Move Detection ,Co-located addresses – Registration : Securing the Registration Procedure –Tunneling : IP-within-IP Encapsulation, Minimal Encapsulation – Wireless Application Protocol : Architectural Overview, Wireless Markup Language, WML Script, Wireless Application Environment, Wireless Session Protocol, Wireless Transaction Protocol, Wireless Transport Layer Security, Wireless Datagram Protocol **(9)**

WIRELESS LANS

Introduction - Spread Spectrum LANs : Configuration, Transmission issues – Narrowband Microwave LANs : Licensed Narrow Band RF, Unlicensed narrowband RF – IEEE 802.11: Architecture and services , Wi-Fi alliance, Medium Access Control ,Reliable Data Delivery, IEEE 802.11a/b Physical Layer – Introduction to 802.11n – Infrared LANs : Strengths and Weakness, Transmission techniques **(9)**

WPAN

Introduction – Radio Specification – Baseband and Specification – Link Manager Specification – Logical Link Control and Adaptation Protocol – IEEE 802.15: IEEE 802.15.3/a, IEEE 802.15.4 – UWB – Optical Wireless Wavelength division Multiplexing (OWWDM). **(9)**

TOTAL : 45

TEXT BOOK

1. KavehPahlavan and Prashant Krishnamurthy, "Principles of Wireless networks – A unified Approach", Prentice Hall, 2013.
2. Clint Smith, P.E. and Daniel Collins, "3G Wireless Networks", Tata McGraw Hill, 2nd Edition, 2007.

REFERENCES

1. William Stallings, "Wireless Communications and Networks", Prentice Hall, 2nd Edition 2009.

2. Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kauffmann Publishers, 2007.
3. Dharma PrakashAgarwal and Qing-An Zeng, "Introduction to Wireless and Mobile Systems", Thomson India, 3rd edition, 2011.
4. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press, 2005.
5. Saad Z Asif, "5G Mobile Communication, Concepts and Challenges", CRC Press, 2019.

19ECE20 5G NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Describe about the fundamental concepts of 4G & 5G networks
2. Explain about 5G Modulation Schemes
3. Explain about Multiple Access techniques in 5G networks
4. Analyze the behaviour of different optimization for power control
5. Explain about Massive MIMO for 5G networks

EVOLUTION OF 4G AND 5G NETWORKS

OFDM principle - Modulation, Cyclic Prefix, Challenges in 4G- Windowing, PAPR, Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, Ultra-Dense Network Architecture and Technologies for 5G- Concept and Challenges of UDN, GPP HeNB Architecture, Key Technologies of UDN- Flexible Networking, Multi-RATs Coordination.

(9)

5G MODULATION SCHEMES

Introduction to Equalization- types - Filter-bank based multi-carrier (FBMC), Universal filtered multi carrier (UFMC), Generalized frequency division multicarrier (GFDM) - Principles, Transceiver Block diagram, Frame structure, Resource structure, allocation, mapping, MIMO-GFDM.

(9)

MULTIPLE ACCESS TECHNIQUES IN 5G

NOMA – Principle- Superposition Coding, Successive Interference Cancellation, Power Domain NOMA, Sparse Code NOMA- types, Power Domain Sparse Code NOMA and IDMA Relaying: Cooperative NOMA- Benefits and Challenges, Half duplex relaying, Full duplex relaying, Amplify and forward relaying, Decode and forward relaying, Decode and forward relaying with PLNC, BER Analysis, Capacity Analysis.

(9)

POWER OPTIMIZATION ALGORITHMS

Introduction to Power Optimization- One Dimensional-Multi dimensional, Multi- Objective Optimization- Geometric – Cone Programming - Convex Optimization- Ant Colony- Genetic Algorithms-Fuzzy Logic- Heuristic Algorithms.

(9)

MASSIVE MIMO FOR 5G

Introduction, MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: asic forms of massive MIMO implementation, Hybrid beamforming for interference clustering and user grouping, Channel models, Machine type communications, D2D communications and Coordinated Multipoint Transmissions.

(9)

TOTAL : 45

TEXT BOOK

1. Afif Osseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
2. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016

REFERENCES

1. Saad Z Asif, “5G Mobile Communication,Concepts and Challenges", CRC Press
2. Thomas L. Marzetta , Erik G. Larsson , Hong Yang , Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 2018
3. Fei Hu, “Opportunities in 5G Networks: A Research and Development Perspective”, CRC Press, Taylor & Francis Group, 2016.
4. Ashish Bagwari, Geetam Singh Tomar, JyotshanaBagwari , “Advanced Wireless Sensing Techniques for 5G Networks”, CRC Press, Taylor & Francis Group, 2018.
5. Ajay R. Mishra , “Fundamentals of Network Planning and Optimisation 2G/3G/4G: Evolution to 5G”, 2nd Edition, Wiley,2018.
6. Patrick Marsch, ÖmerBulakci, Olav Queseth, Mauro Boldi , “5G System Design: Architectural and Functional Considerations and Long Term Research”, Wiley, 2018.

19ECE21 NETWORK ROUTING AND INFRASTRUCTURE MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Understand fundamental networking concepts
2. Interpret concepts of switching, cable categories and connection tools.
3. Understand IP addressing- IPV4 and IPV6 2 Understand Domain and work group users
4. Analyze WAN technologies and connectivity options
5. Understand configuration of domain names, security issues and infrastructure management

NETWORK FUNDAMENTALS

OSI and TCP/IP models-Network Infrastructure based Components: Firewalls, Access points-Wireless controllers-Cloud resources on network architecture-Network topologies-Troubleshooting methodologies to resolve network problems.

(9)

LAN SWITCHING TECHNOLOGIES

Switching concepts-MAC learning and aging-Frame switching-Frame flooding-MAC address table-Troubleshoot interface and cable issues-Configure, verify, and troubleshoot VLANs multiple switches.

(9)

IPV4 AND IPV6 ROUTING TECHNOLOGIES

IPv4 addressing-Configure, verify, and troubleshoot IPv4 addressing and subnetting
IPv6 addressing-Configure, verify, and troubleshoot IPv6 addressing-routing concepts components of a routing table-static routing and dynamic routing. **(9)**

WAN TECHNOLOGIES

WAN topology options-WAN access connectivity options-Metro Ethernet-Broadband PPPoE-Internet VPN-QoS concepts-Congestion management **(9)**

INFRASTRUCTURE SERVICES, SECURITY AND MANAGEMENT

DNS lookup operation-Configure and verify DHCP on a router-port security-traffic filtering-Local authentication-device-monitoring protocols-device management. **(9)**

TOTAL : 45

TEXT BOOK

1. Wendell Odom, "CCNA Routing and Switching 200-125 Official Cert Guide Library" Cisco Press Publications, 2016
2. Todd Lammle, "CCNA Routing and Switching Complete Review Guide", 2nd Edition, Publisher(s): Sybex

REFERENCES

1. Richard McMohan,"Introduction to Networking" Tata McGraw Hill
2. Behrouz A. Forouzan,"Local Area Networks" McGraw Hill Edition, 2002
3. Michael J. Martin "Understanding the Network A Practical Guide to Internetworking" , New RidersPublishing.

4. Todd Lammle- CiscoCertified Network Associate 3/E Wiley India Pvt. Ltd/Sybex Jill Spealman,Planning, Implementing, and Maintaining a Windows Server, Microsoft Press
5. http://www.cisco.com/en/US/products/ps6642/products_white_paper0900aecd805ffde8.shtml .

19ECE22 RADAR AND NAVIGATIONAL AIDS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Define radar parameters and effects of various factors on radar
2. Compare MTI, Pulsed Doppler and CW radar systems and describe the principles of operation of delay line cancellers, filters and signal processing techniques and comprehend the effect of these on radar systems' performance.
3. Explain the principles and operation of Sequential lobbing , Conical Scanning and Mono-pulse tracking radars
4. Outline the principles and operation of radio navigation systems and landing systems
5. Explain the principles and operation of various satellite based navigation systems and analyze various navigations satellites.

RANGE EQUATION

Basic Radar - Radar Range equation - Radar parameters - Block diagram - Radar frequencies - Derivation of simple range equation - Effect of various factors : radar cross section, transmitted Power - Pulse repetition frequency - System losses - S/N ratio and propagation losses.

(9)

MTI, PULSE DOPPLER and CW RADAR SYSTEMS

Doppler effect - Pulsed radar - CW radar - MTI and Pulsed Doppler radar - Block diagrams and principles of working - Delay line cancellers and filters - Staggered PRFs - Doppler filter banks - Digital MTI processing - Range gates and filters used in MTI - Comparison of radar systems.

(9)

TRACKING RADARS

Basic principles of tracking in angle - sequential lobe switching - conical scanning - Monopulse tracking methods: Amplitude comparison and Phase comparison - Limitations to tracking accuracy - methods to reduce errors and inaccuracy -Low angle tracking - Tracking in range - Tracking in Doppler - Comparison of tracking radars.

(9)

RADIO NAVIGATION AND LANDING AIDS

General principles - Radio compass Non Directional Beacon (NDB) – Automatic Direction Finding (ADF), VHF Omnidirectional Radio (VOR), Distance Measuring Equipment (DME) - Hyperbolic Navigation DECCA, OMEGA, LORAN - Mechanics of Landing: Instrument Landing System - Microwave Landing System.

(9)

SATELLITE NAVIGATION SYSTEM

Basics of Satellite Navigation - Global Positioning System (GPS) - Basic principles - Position, velocity determination– Differential-GPS (DGPS)-Navigation Satellites of different countries such as GLONAS and COMPASS, IRNSS, NAVIC Receiver and applications.

(9)

TOTAL : 45

TEXT BOOK

1. M.I.Skolnik ,"Introduction to Radar Systems", Tata McGraw Hill , 3rd Edition, 2017.
2. Myron Kyton and W.R.Fried "Avionics Navigation Systems" John Wiley & Sons 1997.

REFERENCES

1. Nagaraja "Elements of Electronic Navigation", Tata McGraw Hill, 2nd Edition, 1996.
2. Nathansan, "Radar design principles-Signal processing and environment", Scitech Publishing, 2nd Edition, 1999.
3. Hofmann-Wellenhof, Hlichlinegger and J.Collins, "GPS Theory and Practice", 5th Revised Edition, Springer Verlag , 2012
4. B. Bhatta "Global Navigation Satellite Systems Insights into GPS, GLONASS, Galileo, Compass, and others", BS Publications, 2010.
5. www.gsa.europa.eu

19ECE23 - SATELLITE COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : outline the elements and types of satellite orbits, determine the orbital parameters

CO2 : describe the subsystems of satellite communication systems and earth station systems

CO3 : apply the link design for signal to noise ratio calculations

CO4 : explain different multiplexing techniques for satellite systems

CO5 : describe the use of satellite systems for various applications

SATELLITE ORBITS AND TRAJECTORIES

Orbital Mechanics: Orbit Equations, Kepler's Laws, Orbital Period, Orbit types - Look angle determination - Orbital effects on communication system performance - Satellite Launch. **(8)**

SATELLITE AND EARTH STATION SUBSYSTEMS

Satellite Subsystems: Power, Transponders, Antennas - AOCS, TTC&M – Earth station systems : Transmit-Receive Earth stations - Effects of earth- Perturbation, sun transit outage , moon transit outage - Satellite power design, Reliability **(8)**

LINK DESIGN

Basic transmission theory – System noise temperature and G/T Ratio- Noise figure and noise temperature- Calculation of system noise temperature – G/T ratio for earth stations - Link budgets - Uplink and downlink budget calculations - Error control for digital satellite links - Prediction of rain attenuation and propagation impairment counter measures. **(10)**

MULTIPLE ACCESS FOR SATELLITE COMMUNICATION

Frequency division Multiple Access (FDMA), Single Channel per Carrier systems (SCPC), Multiple Channel per Carrier systems (MCPC), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Space Domain Multiple Access (SDMA) **(9)**

APPLICATIONS

Communication Satellites- Frequency Bands, Payloads, Satellite Telephony, Satellite Television- Direct –to-Home satellite television, VSAT, Remote Sensing Satellites: Classification of remote Sensing systems, orbits, Payloads, Weather Forecasting Satellites: Fundamentals, Images, Orbits, Payloads, Navigation Satellites: Development of Satellite Navigation Systems, GPS system and its working principles.

(10)

TOTAL : 45

TEXT BOOK

1. Dennis Roddy, "Satellite Communications", Mc Graw Hill, 4th Edition, 2006.
2. T.Pratt, C. Bostian and J.Allnutt, "Satellite Communications", John Wiley and Sons, 2nd Edition, 2014.

REFERENCES

1. W.L.Pritchard, H G Suyderhoud and R A Nelson, "Satellite Communication System Engineering", 2nd Edition, Prentice Hall, 1993.
2. Anil K. Maini, Varsha Agrawal," Satellite technology: principles and applications, Wiley India Pvt. Ltd., 2nd edition, 2015.
3. Tri. T. Ha, "Digital Satellite Communications", McGraw Hill, 2nd Edition, 1990.
4. Manojit Mithra ,"Satellite Communication", Prentice Hall,2005.
5. B.N.Agarwal, "Design of Geosynchronous Space craft", Prentice Hall, 1986.
6. M. Richharia, "Satellite systems for Personal Applications", John Wiley, 2010.

19ECE24 DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Describe algorithm, its notations and its complexity
CO2: Analyze the algorithms with the knowledge of basic data structures such as arrays, stacks and queues
with implementations
CO3: Use the concept of linked lists with different possible operations and applications and apply the concept of trees in data structures
CO4: Apply the suitable graph algorithm for given applications
CO5: Analyze sorting and searching algorithms for given applications

INTRODUCTION TO DATA STRUCTURES

Data Vs Information - Representation of numbers: Integer, Real, Representation of Characters - Definition of an algorithm - Basic steps in development of an algorithm - Algorithm notations - Sparks - Algorithm complexity - Space and Time complexity - Order notations

(9)

ARRAYS, STACKS AND QUEUES

Data structures - Abstract Data Types - Basic data structures: Representation of arrays, Array operations- Fundamentals of Stacks, Queues, Priority queues- Dequeues - Application of stacks: Recursion - Evaluation of expressions - Application of Queue-Job Scheduling-ALGORITHMS: Introduction-Analysis of algorithms -Best, worst and average case time complexities-notations.

(9)

LINKED LISTS AND TREES

Lists: Operations - Singly linked lists, doubly linked lists, Circularly linked lists-Applications: Linked Stacks-Linked queues-Linked Priority queues- Application of Linked lists: Polynomial manipulation

Trees:Terminologies – Binary trees: Sequential and linked representation -operations -Traversals, Binary search tree--Expression trees -Infix, Postfix and Prefix expressions – Heaps-Max heap-Min heap. **(9)**

GRAPHS

Graphs: Definition – representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Graph search methods (Breadth first and depth first traversals)-Connected components-spanning trees-Shortest path: Warshall algorithm, Dijkstra's Algorithm -Transitive closure - Activity networks -Topological sort.

(9)

SORTING AND SEARCHING TECHNIQUES

Sorting algorithms: Selection sort- Bubble sort- Insertion sort - Shell sort - Quick sort - Heap sort - Merge sort-Searching: Linear search, Binary search, - Hashing Techniques

(9)

TOTAL : 45

TEXT BOOK

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures in C", Galgotia Publications, 2008.
2. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications" McGraw Hill, 2nd Edition, 2008

REFERENCES

1. A. Chitra, P. T. Rajan, “Data Structures", Tata McGraw Hill Education, 2008.
2. Thomes H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein “Introduction to Algorithms”, The MIT Press, 2009.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education, 1997
4. Seymour Lipschutz, “Data Structures”, Schaum’s Outline, McGraw Hill, 2011.
5. Balagurusamy, “Data Structures using C”, McGraw Hill, 2013.

19ECE25 OPERATING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Outline the basic functionalities of operating systems, operating system components, various types of operating system and system software, and features of Macro-processors, linkers and loaders.
CO2 : Demonstrate process control and apply scheduling algorithms.
CO3 :Apply principles of mutual exclusion and synchronization techniques to demonstrate process execution.
CO4 : Examine various memory management schemes and find suitable technique to design a system.
CO5 : Describe disk scheduling algorithms, Secondary storage management techniques, file organization and access methods.

OPERATING SYSTEM OVERVIEW
Objectives and functions of OS - Evolution of OS - Distributed System - Real-Time systems - Operating system components - Interrupts - System call - Virtual Machines - Symmetric Multiprocessing - Microkernel. Macro processor.
(9)

PROCESS DESCRIPTION AND CONTROL
Process - Process states - Process description - Process control -Processes and Threads - Uniprocessor Scheduling: Types of Processor Scheduling - Scheduling Algorithms - Overview of Multiprocessor Scheduling and Real time scheduling.
(9)

MUTUAL EXCLUSION AND SYNCHRONIZATION

Principles of concurrency - Mutual exclusion: Software and hardware approaches - Semaphores - Monitors - Message Passing - Readers/ Writers problem. Deadlock and Starvation: Principles of deadlock - Deadlock Prevention - Deadlock Detection - Deadlock Avoidance.

(9)

MEMORY MANAGEMENT

Memory management requirements - Memory partitioning - Loading and Linking - Paging - Segmentation. Virtual Memory: Hardware and control structures - Operating Systems software: Fetch Policy, Placement policy, Replacement policy, Resident set management, Cleaning policy, Load control.

(9)

I/O MANAGEMENT AND FILE MANAGEMENT

I/O devices - Organization of I/O function - OS design issues - I/O buffering - Disk scheduling. File management: Overview - File organization and access - File directories - File sharing - Record blocking-Secondary storage management. Casestudy: Linux

(9)

TOTAL : 45

TEXT BOOK

1. William Stallings, "Operating Systems Internals and Design Principles", Pearson Education, 9th Edition, 2019.
2. Silberchatz, Galvin, Gagne, "Operating System Concepts", John Wiley, 9th Edition, 2018.

REFERENCES

1. Harvey M. Deitel, Paul J. Deitel, David R. Choffnes, "Operating Systems", Pearson Education, 3rd Edition, 2007.
2. Gary Nutt, "Operating System", Addison Wesley, USA, 2009.
3. Andrew S Tanenbaum and Herbert Bos, "Modern Operating Systems", Prentice Hall of India, New Delhi, 2015.

19ECE26 REAL TIME APPLICATIONS USING PYTHON

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Infer the programming concepts of Python to develop simple computational programs.
CO2 Implement Python programs with conditionals & loops and functions.
:
CO3: Use Python lists**,** tuples & dictionaries for representing compound data and perform input/output with files.
CO4: Implement Python programs using OOPs concepts.

CO5 : Develop real time applications of Raspberry Pi3 using LEDs , Sensors, LCD Display & Servo motor control and web server.

INTRODUCTION TO PYTHON

Basic Syntax Variable and Data Types Operator: int, float, boolean, string, and list -Variables, expressions, statements, tuple assignment, precedence of operators, comments -Modules and functions, function definition and use, flow of execution, parameters and arguments - ***Illustrative programs:*** Exchange the values of two variables - Circulate the values of n variables - Distance between two points. **(9)**

CONTROL FLOW & FUNCTIONS

Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else) - Iteration: state, while, for, break, continue, pass - Fruitful functions: return values, parameters, local and global scope, function composition, recursion - Strings: string slices, immutability, string functions and methods, string module - Lists as array s- Lists, Tuples, Dictionaries- ***Illustrative programs*:** Square root – GCD – Exponentiation - Sum an array of numbers - Linear search - Binary search **(9)**

LISTS, TUPLES, DICTIONARIES & FILE HANDLING

Lists - List Operations – Mutation – Aliasing - Cloning – Tuple assignment - Tuple as return value - Dictionaries: Operations and methods - Advanced list processing - List comprehension – Variables - ***Illustrative programs:*** Selection sort - Insertion sort - Mergesort, Histogram.

Files and exception Handling : text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; ***Illustrative programs:*** Word count - Copy file.

(9)

CLASSES AND INHERITANCE

Object Oriented Programming - Class Instances - Class and object- Attributes -Inheritance – Overloading - Overriding - Data hiding- ***An Extended Example***: Building a Class - Visualizing the Hierarchy - Adding another Class - Using Inherited Methods – Grade book – Generators.

(9)

PROGRAMMING THE RASPBERRY PI 3 USING PYTHON

Programming General Purpose Input / Output (GPIO) port pins -Interfacing seven segment LED and LCD Display , servomotor - Real time Monitoring & Data logging System using I2C protocol - Email notifier using Gmail SMTP server -Data Acquisition and control for Industrial/ Home Automation using MQTT Protocol.

(9)

TOTAL: 45

TEXT BOOK

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd Edition, Shroff/O'Reilly Publishers, 2016.
2. Sai Yamanoor& Srihari Yamanoor, "Python Programming with Raspberry Pi" Packt Publishing, 1st Edition, 2017.

REFERENCES

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

2. John V Guttag, “Introduction to Computation and Programming Using Python’’, 1st Edition, MIT Press, 2013.
3. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python” 1st Edition, Network Theory Ltd., 2011.
4. Robert Sedgewick, Kevin Wayne and Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016.
5. Simon Monk, “Programming the Raspberry Pi: Getting Started with Python” McGraw-Hill, 1st Edition, 2013

19ECE27 DESIGN FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

6. Students will acquire the knowledge about electric vehicle components, efficiency and vehicle dynamics.
7. Illustrate about electric and hybrid vehicle architecture and power train components.
8. Describe the concepts of battery fundamentals and fuel cell, super capacitor energy storage.
9. Design the different types of power electronics converters and electrical machines.
10. Describe the concepts of hybrid vehicle control strategy.

INTRODUCTION TO ALTERNATIVE VEHICLE AND VEHICLE MECHANICS:
Electric Vehicles-Hybrid Electric Vehicles- Electric and Hybrid Vehicle Components-Vehicle Mass and Performance-Well to wheel analysis- EV/ICE Comparison: Efficiency comparison,Pollution comparison-capital and operating cost comparison - Electric Vehicle Market-Road way fundamentals-Vehicle kinetics-Dynamics of vehicle motion-Propulsion power-Velocity and acceleration-Tire road force mechanics

(9)

ALTERNATIVE VEHICLE ARCHITECTURE
Electric Vehicles-Hybrid series and parallel architecture-Plug in Hybrid Electric Vehicle- Power train component sizing: EV Power train component sizing, HEV Power train component sizing, HEV Power train component sizing example-Mass analysis and packaging- Vehicle simulation.

(9)

ENERGY STORAGE
Batteries in Electric Vehicle- Battery basics-Battery parameters- Electro chemical fundamentals-Battery Modeling: Circuit Model, Empirical Model-Traction Batteries-Battery pack management-Fuel Cell based energy storage, Super Capacitor and Flywheel based energy storage.

(9)

POWER ELECTRONICS CONVERTERS AND ELECTRIC MACHINES
Power Electronic Switches- DC / DC converter: Non isolated and isolated converters-Cell balancing converters- Fundamentals of Electric Machines-Simple DC Machine-Three phase AC Machines-Types of AC Machines: Induction Machine, Permanent Magnet Synchronous Machine (PMSM)-Switched Reluctance Machine.

(9)

HYBRID VEHICLE CONTROL STRATEGY
Vehicle supervisory Controller-Mode selection strategy: Mechanical Power split hybrid model- Series and parallel Hybrid 2 X 2 modes- Series, parallel, Series and parallel control Strategies-Energy storage system Control-Regeneration control.

(9)

TOTAL: 45

TEXT BOOK

1. IqbalHussain, "Electric & Hybrid Vehicles - Design Fundamentals", Second Edition, CRC Press,2011
2.Ali Emadi, MehrdadEhsani, "Vehicular Electric Power Systems" Marcel Dekker, Inc., New York, 2014.

REFERENCE BOOKS

1. SandeepDhameja, "Electric Vehicle Battery Systems" Newnes, an imprint of Elsevier, 2013.
2. J.M.Miller, "Propulsion Systems for Hybrid Vehicles", Institution of Electrical Engineers (IEE),
   London, UK, 2004
3. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.
4. ndian vehicle emission standards: https://www.dieselnet.com/standards/in/2wheel.php

19ECE28 AUTOMOTIVE ELECTRONICS

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Design modules for hybrid vehicle using automotive system components.
2. Modify the automobile Electronic Engine Control to improve fuel economy, safety and comfort in Automobiles as per the government test procedures.
3. Design control system in automotives by appropriate choice of Sensors and actuators.
4. Determine the vehicle parameters to control engine functioning and interpret vehicle's self-diagnostic codes.
5. Examine internal communication network that interconnects the components inside a vehicle to reduce the fatal accidents and delays

AUTOMOTIVE VEHICLE SYSTEMS

Basics of the gasoline (SI) engine - Method of operation, Fuel supply - Fuel delivery with manifold injection, Fuel delivery with gasoline direct injection - Inductive ignition system – Design, Function and method of operation - Spark plugs - Function, usage, electrode - Transmission System: Manual, Automatic Transmission - Differential - Braking system - Steering system – Rack and pinion, power steering - Electronic systems: Starting system, Charging system - Hybrid Electric Vehicle Power train Control. **(9)**

ELECTRONICS IN AUTOMOTIVE SYSTEMS

Need for Electronic Engine Control - Exhaust Emissions - Fuel Economy - Federal Government Test Procedures - Concept of an Electronic Engine Control System - Exhaust Catalytic Converters - Electronic Fuel Control System - Open-Loop Control, closed-Loop Control - Analysis of Intake Manifold Pressure - Idle Speed Control - Electronic Ignition System - Electronic Suspension System - Electronic Steering Control - Antilock Braking System - Safety & Comfort systems: Night Vision, Airbags and Seatbelt pre-tensioner.

(9)

AUTOMOTIVE SENSORS & ACTUATORS

Automotive engine control sensors: Air Flow Rate Sensor, Engine Crankshaft and Camshaft Position Sensor - Throttle Angle Sensor - Intake & Exhaust Temperature - Rail Pressure - Cylinder Pressure & boost pressure Sensors - Sensors for Feedback Control: lambda sensor, Knock Sensors - Automotive Engine Control Actuators: Throttle actuator - Exhaust Gas Recirculation (EGR) - Oil pump - VVT valve.

(9)

AUTOMOTIVE INSTRUMENTATION AND DIAGNOSTICS

Modern Automotive Instrumentation - Display Devices – LED, LCD, Transmissive LCD, VFD, Flat Panel Display. Measurements: Fuel Quantity, Coolant Temperature, Oil Pressure, Vehicle Speed - Trip Information Computer – Telematics - Diagnostics: Onboard Diagnostics Model - Diagnostic Fault Codes - Onboard Diagnosis (OBD II).

(9)

VEHICLE COMMUNICATION PROTOCOLS

Vehicle Communication Protocols: CAN, LIN, FLEXRAY, MOST

(9)

TOTAL:45

TEXT BOOK

William B. Ribbens, Ph.D, "Understanding Automotive Electronics", Elsevier Publications, 7th Edition, 2012.

REFERENCES

1. William B. Ribbens, Ph.D, "Understanding Automotive Electronics", Elsevier Publications, 6th Edition, 2003.
2. BOSCH Automotive Handbook, 8th Edition
3. Konard Reif,"Gasolin Engine Management",Systems and Components, Springer FachmedienWiesbaden 2015
4. Denton. T, "Automobile Electrical and Electronics Systems", 3rd Edition, SAE (Society for Automobile Engineers) International, 2004.
5. Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009
6. Barry Hollembeak, "Today's Technician: Automotive Electricity and Electronics (Classroom manual)", Delmar Cengage Learning, 4th Edition, 2006.

19ECE29 ADVANCED PROCESSOR ARCHITECTURES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

CO1:Exemplify the architecture, trends and applications of parallel processing and memory systems.
CO2: Elaborate the principles and classification of pipelining concepts.
CO3: Develop clear idea about the networking concepts and algorithms for array processors.
CO4: Illustrate the architectural principles & programming of multiprocessor and concepts on system deadlocks.
CO5: Describe architecture, features and applications of MSP430 Microcontroller and TMS320C6713 DSP processor.

PARALLEL PROCESSING, MEMORY AND INPUT-OUTPUT SUBSYSTEMS
Trends towards Parallel Processing – ParallelComputer Structures – Architectural Classification Schemes - Parallel Processing Applications. Hierarchical Memory Structure -Virtual Memory

System – Cache Memories – Input-Output Subsystems .

(9)

PRINCIPLES OF PIPELINING AND VECTOR PROCESSING

Principles of Linear Pipelining- Classification of PipelineProcessors-General Pipelines and Reservation Tables- Interleaved Memory Organizations- Principles of Designing PipelinedProcessors- Characteristics of Vector Processing-Pipelined Vector Processing Methods – Architecture of Cray-I Vector Processor.

(9)

STRUCTURES AND ALGORITHMS FOR ARRAY PROCESSORS

SIMD Array Processors: SIMD Computer Organization, Makingthe data routing mechanism. SIMD Interconnection Networks: Static Vs Dynamic Networks, Mesh-Connected IlliacNetwork, CubeInterconnection Networks, Barrel Shifter and Data Manipulator- ParallelAlgorithms for Array Processors: SIMD Matrix Multiplication,Parallel Storing on Array Processors and SIMD Fast Fourier Transform.

(9)

MULTIPROCESSOR ARCHITECTURE, PROGRAMMING, CONTROL AND ALGORITHMS

Loosely Coupled Multiprocessors-Tightly Coupled Multiprocessors-Processor Characteristics for Multiprocessing. Interconnection Networks: Time shared or CommonBuses- Crossbar Switch and Multiport Memories-Inter-process Communication Mechanisms: Process Synchronization Mechanisms,Synchronization with Semaphores, Conditional Critical Sections and Monitors. System Deadlocks and Protection:System Deadlocks and Protection, Deadlock Prevention and Avoidance- Deadlock Detection and Recovery and ProtectionSchemes.

(9)

MSP430 MICROCONTROLLER AND TMS320C6713 DSP PROCESSOR

Introduction- - MSP 430 Architecture –Features – DigitalI/O : Input Registers , Output Registers , Direction Registers , Pull Up and Pull down Enable Registers Function Select Registers ,Configuring Unused Port Pins Digital I/O Registers -TMS320C6000 family overview- Typical Applications – TMS320C67x DSPfeatures and Options – Architecture – CPU-CPU Data Paths – Functional Units – On-chip Peripherals: DMA, EDMA, HPI,McBSP and Timers.

(9)

TOTAL : 45

TEXT BOOK

1. Venkataramani B, Bhaskar M, "Digital Signal Processors: Architecture, Programming & Applications", Tata McGraw HillPublishing Company Ltd., New Delhi, 2011.
2. MSP 430X2xx Family User's Guide", Texas Instruments

REFERENCES

1. Hesham El-Rewini, Mostafa Abd-El-Barr, "Advanced Computer Architecture and Parallel Processing" Wiley, 2005.
2. SPRU197d.pdf (TMS320C6000 Technical Brief), Texas Instruments

3. SPRU733A.pdf (TMS320C67x/67x+ DSP CPU and Instruction Set Reference Guide, Texas Instruments.

19ECE30 IoT BASED SYSTEM DESIGN

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Interpret architecture for IoT and system management based of IoT.
CO2: Examine the communication technologies and protocols of IoT.
CO3: Familiarize with the physical devices and logical design of IoT.
CO4: Design simple IoT systems comprising sensors, edge devices, wireless network connections,
data analytics capabilities and cloud storage.
CO5.Describe IoT based applications for Home, Industry Automation, agriculture and productivity
applications

IoT ARCHITECTURE

Defining Internet of Tings- Realization of IoT Ecosystem using Wireless Technologies: Architecture for IoT using Mobile devices- Mobile Technologies for supporting IoT ecosystem- Layered architecture for IoT- Protocol architecture of IoT-Infrastructure Protocols- IoT and M2M- Software defined networking - Network function virtualization-IoT System Management with NETCONF-YANG, SNMP, NETOPEER

(9)

COMMUNICATION TECHOLOGIES AND PROTOCOLS OF IoT

IoT point to point communication technologies- IoT Communication Pattern- IoT protocol Architecture- Selection of Wireless technologies: 6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi, Widi- IoT protocols and softwares: MQTT – UDP -MQTT brokers – Publish & subscribe modes – HTTP – COAP -XMPP and gateway protocols.

(9)

PHYSICAL DEVICES & LOGICAL DESIGN

Basic building blocks of a loT Device- Python packages of interest for loT, Python web application framework. Programming Inputs and outputs, Serial, SPI and I2C - Sensors and sensor Node and interfacing using any Embedded target boards: Raspberry Pi- **OPEN SOURCE HARDWARE:** Raspberry PI physical devices, Raspberry Pi Interfaces, Pi Programming APIs/Packages, Web services.

CASESTUDIES: Real time applications of IoT- Connecting IoT to cloud.

(9)

INTRODUCTION TO CLOUD COMPUTATION AND BIG DATA ANALYTICS

Cloud Computing: Grid/SOA and Cloud Computing-Cloud Middleware- Mobile cloud computing-Big data analytics tools and technology

Cloud Support : Cloud Storage models and communication APIs Webserver – Web server for IoT - Cloud for IoT - Designing a RESTful web API - Amazon Web services for IoT - Data Analytics for IoT : Apache Hadoop - Using map reduce for batch data analytic.

(9)

IoT APPLICATION AND ITS VARIANTS

Envisioning Futuristic Smart Airports using IoT Integration- Envisioning Smart Health care systems in a connected world- Smart use cases of IoT: Strategic Governance framework for the implementation of Smart cities, Smart Industrial use cases of IoT, Smart lighting for energy conservation, Smart transportation systems, Connected cars.

(9)

TOTAL : 45

TEXT BOOK

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016
2. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March,2008.

REFERENCES

1. Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally, "Internet of Things A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014.
2. Pethuru Raj, Anupama C. Raman, "The Internet of Things Enabling Technologies, Platforms, and Use Cases", CRC Press(Taylor & Francis Group), 2017.

3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.
4. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly Media Press, I[st] Edition, 2012.
5. Honbo Zhou, "Internet of Things in the cloud:A middleware perspective", CRC press, 2012.

19ECE31 REAL TIME OPERATING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 :Determine the concepts of Real time operatingsystems.
CO2 :Illustrate the concepts of scheduling and implement the algorithm to develop Real time operating systems
CO3: Explain and summarize the concepts of multiprocessor system.
CO4 : Determine the concepts of distributedin Real time systems
CO5 : Exemplify the performance and benchmarking of RTOS

INTRODUCTION TO REAL TIME OPERATING SYSTEMS

Introduction-Producing quality software-modeling the software-the importance of time and timing-handling multiple jobs-handling complex multiple jobs-using interrupts as the execution engine-simple quasi –concurrency-basic features of real time operating systems

(9)

SCHEDULING CONCEPTS AND IMPLEMENTATIONS

Introduction-simple cyclic, timed cyclic and cooperative scheduling- task priorities-priority pre-emptive scheduling-using queues-implementing queues-the processor descriptor-tick-priority and

system responsiveness-By passing the scheduler-code sharing and reentrancy

(9)

MULTI PROCESSOR SYSTEMS

Processor structures-multi core processors-multi computer structures-software issues-structuring software as a set of functions-structuring software as a set of data processing operations-software control and execution issues-scheduling and execution of AMP, SMP, BMP system

(9)

DISTRIBUTED SYSTEMS

Software structuring in distributed systems-communication and timing aspects of distributed systems-mapping software onto hardware in distributed systems

(9)

PERFORMANCE AND BENCHMARKING OF RTOS

Introduction-measuring computer performance-computation performance benchmarking-OS performance-Time overhead in processor system-OS performance and representative bench mark-basic requirements-test categories-test stressing methods

(9)

TOTAL:45

TEXT BOOK

Dr.Jim Cooling, "Real time operating systems",Lindentree Associates, 2018.

REFERENCES

1. K.C.Wang, "Embedded and Real time operating systems",Springer International Publishing,2017.
2. Qing li, "Real time concepts for embedded systems"3rd edition,Taylor and francis limited,2017.
3. ChowdaryVenkateswaraPenumuchu"Simple Real-time Operating System: A Kernel Inside View for a Beginner" Trafford Publishing, 2007
4. Rajib mall,"Real-Time Systems: Theory and Practice"Pearson Education India, 2009

19ECE32- ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

CO1 : Describe the concepts of robotics, safety measures and homogeneous transformation.
CO2 : Formulate the concepts of mechanical drives and sensors in robotics.
CO3 : Exemplify the concepts of artificial intelligence and problem solving by searching.
CO4 : Develop robotics programming, classifications and its applications.
CO5 : Illustrate the methodologies in robot task planning and problem solving techniques.

ROBOT KINEMATICS

Introduction - Robotics and programmable automation - Historical background - Laws of Robotics - Robot definitions - Robotics system and Robot anatomy - Specifications of Robots - Safety measures in Robotics. Robot kinematics - forward and reverse kinematics of three and four degrees of freedom robot arm-Homogeneous transformation - Kinematics equations using homogeneous transformation.

(10)

ROBOTIC DRIVERS, CONTROLS AND SENSING SYSTEMS

Robot drives, actuators and control - Functions of drive systems - General types of fluids - Pump classification - Pneumatic systems - Electrical drives - DC motors - Stepper motors - Drive mechanism- Need for sensing systems - Sensory device - Types of sensors - Robot vision systems - Low level vision and high-level vision.

(9)

ARTIFICIAL INTELLIGENCE AND ROBOTICS

Artificial intelligence and automated manufacturing - AI and robotics –Solving problems by searching- Problem solving agents: Search problems and solutions, Formulating problems- Search algorithms- Uninformed search strategies: Breadth-first search, Dijkstra's algorithm, Depth-first search, iterative deepening search, Bidirectional search- Informed search strategies: Greedy best-first search, A* search, Search contours, satisficing search, Memory-bounded search, Bidirectional heuristic search

(9)

ROBOTIC LANGUAGE AND PROGRAMMING

Robot language and programming. Robot language - Classification of Robot languages - Computer control and robot software - VAL system and language.Application of Robots: Capabilities of Robots - Robotics applications - Obstacle avoidance.

(8)

ANALYSIS AND TASK PLANNING

Robot intelligence and task planning - Use of predicate logic - Means and Ends analysis - Problem solving - Robot learning - Robot task planning - Basic problems intask planning- Expert systems and Knowledge engineering.

(9)

TOTAL:45

TEXT BOOK

1. Satya Ranjan Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 2nd Edition, 2012.
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2014.
3. K.S. Fu, R.C. Gonzalez, C.S.G. Lee,"Robotics: Control, Sensing, Vision and Intelligence", Tata McGraw-Hill, Eleventh reprint, 2013.

REFERENCES

1. Robin.R.Murphy, "Introduction to AI Robotics", The MIT Press, Canbridge, Massachusetts, London,

England, Second edition, 2019.

2. Jadran Lenarcic, Jean-Pierre Merlet, "Advances in Robot Kinematics 2016", Springer International Publishing AG, 2018.

3. Peter McKinnon, "Robotics", CreateSpace Independent Publishing Platform, 2016.

4. Ritu Tiwari, Anupam Shukla, Rahul Kala, "Intelligent Planning for Mobile Robotics: Algorithmic Approaches", Information science reference, United states of America, 2013.

5. David. L. Pool and Alan. K. Mackworth, "Artificial Intelligence: Foundations of Computational agents", Cambridge University,2011.

19ECE33 REAL TIME CONTROLLERS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Interpret the concepts and compare the characteristics of real - time systems to choose the architecture of a Real time Controller for an application.
2. Infer the architecture and Instruction set of C2000 Processor to develop Assembly language programs
3. Appraise the data format, Addressing modes, Pipelining and Interrupt handler of C2000 processor for real time constraints
4. Determine the concepts of Energy estimation techniques in Real time Systems
5. Examine the communication protocols for real time applications

REAL TIME ENVIORMENT

Real Time Systems -Types of Real Time systems - Hard and Soft, Real Time Event Characteristics, Challenges in Real Time System Design - Distributed and Multi-processor Architecture - Embedded systems and its characteristics. **(9)**

ARCHITECTURE OF TI C2000

Software Development and the Process - Assembler Directives - C2000 Architecture - Central Processing Unit - Program Control - Programming and System Issues - Phase Locked Loop Application.

(9)

DEPLOYMENT CONSIDERATIONS

Data Representation and Arithmetic - Fixed Point vs Floating Point Format - Finite Word Length Effects - Addressing Modes - Pipeline - Instruction Cache - Interrupts - Hardware and Software - Real Time Implementation Considerations. **(9)**

ENERGY EFFICIENT REAL TIME SYSTEMS

Basic Concepts of Energy Efficiency and its Estimates - Thermal Effects - Reliability - Hardware Techniques - Power Reduction - Low Power Design - Power Gating - Real Time - Execution Time - Software Techniques- Software Tools - Energy Sources - Batteries - Energy Harvesting.

(**9)**

REAL TIME COMMUNICATION

Communication Requirements - Timeliness - Dependability - Design Issues - Flow Control and Thrashing - Event Triggered Communication - Ethernet - Controller Area Network - User Datagram Protocol - Token Protocol - Time triggered communication - Flexray - Control Law Accelerators - Fixed Point Libraries (iQMath).

(9)

TOTAL : 45

TEXT BOOK

1. Hermann Kopetz , "Real Time Systems: Design Principles for Distributed Embedded Applications", Springer publications, 2nd Edition, 2011

REFERENCES

1. Robert Oshana,"DSP Software Development Techniques for Embedded and Real-Time Systems",Newnes publication,1st edition, 2006.
2. Sen M Kuo and WoongSenGan, "Digital Signal Processors, Architecture, Implementations and Applications", Prentice Hall,1st edition , 2004.
3. C2000 Teaching CD ROM from Texas Instruments.
4. TMS320C28x CPU and Instruction Set Reference Guide, TI Literature Number: SPRU 430E, Revised January 2009.
5. TMS320x28xx, 28xxx DSP Peripheral Reference Guide, TI Literature Number: SPRU566J, Revised April 2011.

19ECE34 REAL TIME MICROCOMPUTER SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to
CO1 : Illustrate the concepts of Real time systems and choose scheduling algorithms to develop Real
time systems
CO2 : Interpret the programming languages and tools to develop application software for Real time
systems
CO3 : Determine the concepts of database techniques in Real time systems
CO4 : Examine the fault tolerance techniques for Real time applications
CO5 : Exemplify the evaluation techniques for fault tolerance in Real time systems

REAL TIME SYSTEMS
Introduction- Issues in Real Time Computing - Structure of a Real Time System - Task classes - Performance measures for Real TimeSystems - Estimating program run times - Task assignment and scheduling - Classical uniprocessor scheduling algorithms -Uniprocessor scheduling of IRIS tasks - Task assignment - Mode changes and Fault Tolerant Scheduling
(9)

PROGRAMMING LANGUAGES AND TOOLS
Introduction - Desired language characteristics - Data typing - Control structures - Facilitating Hierarchicaldecomposition - Packages - Run time error handling - Overloading and Generics - Multitasking - Low level programming – TaskScheduling - Timing Specifications - Programming Environments - Run - time support
(9)

REAL TIME DATABASES
Basic Definitions - Real time Vs General Purpose Databases - Main Memory Databases – Transactionpriorities- Transaction Aborts - Concurrency control issues - Disk Scheduling Algorithms - Two - phase Approach to improvePredictability - Maintaining Serialization Consistency - Databases for Hard Real Time Systems.
(9)

REAL TIME COMMUNICATION
- Communications media - Network Topologies - Protocols - Fault Tolerant Routing - Fault ToleranceTechniques - Fault Types - Fault Detection - Fault Error containment Redundancy - Data Diversity - Reversal Checks – Integrated failure handling
(9)

RELIABILTY EVALUATION TECHNIQUES
–Introduction-Obtaining parameter values, Reliability models for Hardware Redundancy - Software errormodels- Clock Synchronization - Clocks, -A Nonfault - Tolerant Synchronization Algorithm - Impact of faults - Fault TolerantSynchronization in Hardware & software.
(9)

TOTAL : 45

TEXT BOOK

1. C.M. Krishna, Kang G. Shin, "Real - Time Systems", Tata McGraw Hill International Editions, 1st Edition, 2010.

2. Rajib Mall, "Real-time systems: theory and practice", Pearson Education, 1st Edition, 2008.

REFERENCES

1. Peter D.Lawrence, "Real Time Micro Computer System Design - An Introduction", McGraw Hill, 1st Edition 1988.
2. Stuart Bennett, "Real Time Computer Control - An Introduction", Prentice Hall of India, 1st Edition, 1998.
3. S.T. Allworth and R.N.Zobel, "Introduction to real time software design", Macmillan, 2nd Edition,1987.
4. R.J.A Buhur, D.L Bailey, "An Introduction to Real - Time Systems", Prentice - Hall International, 1st Edition 1999.
5. Philip.A.Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 4th Edition, April 2012

19ECE35 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate ability to

1. explain the Physiological signals and transducers used in biomedical engineering.
2. infer the physiological parameters using specific types of meters and analyzers.
3. categorize the different types of electrode systems and find suitable application for the bio electric events.
4. describe the equipment used in medical imaging.
5. determine the type of life assisting devices , explain the different diagnostics and therapeutic techniques for medical applications.

FUNDAMENTALS OF BIOMEDICAL ENGINEERING

Cell and its structure – Resting and Action Potential – Basic components of a biomedical system- - Physiological signals and transducers – Transducers – selection criteria – Piezo electric, ultrasonic transducers – Temperature measurements – Fibre optic temperature sensors**.**

(9)

NON ELECTRICAL PARAMETERS MEASUREMENT

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analyzers, pH of blood –measurement of blood pCO_2, pO_2, finger-tip oximeter – ESR, GSR measurements.

(9)

ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes – Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier – ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms – Electrical safety in medical environment, shock hazards – leakage current- Instruments for checking safety parameters of biomedical equipments.

(9)

IMAGING MODALITIES AND ANALYSIS

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems – Retinal Imaging – Imaging application in Biometric systems – Analysis of digital images.

(9)

LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine –Dialyzers – Lithotripsy – ICCU patient monitoring system – Nano Robots – Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

(9)

TOTAL : 45

TEXT BOOK

1. Joseph J.carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and sons, New York, 4th Edition, 2015.

2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 3rd Edition, 2014.

REFERENCES

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice hall of India, New Delhi, 2nd Edition, 2018.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 4th Edition, 2015.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and Techniques", Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", Boca Raton, CRC Press LLC, 3rd Edition, 2006.
5. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2006.

19ECE36 POWER ELECTRONICS

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME:

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Illustrate the static and dynamic characteristics of power semiconductor devices.
CO2 : Analyze the performance of phase controlled rectifiers.
CO3 : Explain the operation and switching techniques of DC-DC converters
CO4 :Apply voltage control and harmonic elimination methods to inverters.

CO5 : Explain the operation of AC voltage controllers and cycloconverters.

POWER SEMICONDUCTOR DEVICES

Power Diodes - Power Transistors–SCR – TRIAC - GTO- Power MOSFET - IGBT - IGCT - Static and Dynamic Characteristics.

(9)

PHASE CONTROLLED RECTIFIERS

Single Phase Half Controlled Rectifier with R and RL load – Single Phase Full Controlled Rectifier with RL load - Effect of free-wheeling diode - Continuous and Discontinuous Mode of operation – Three phase full converters – Dual converters - Light Dimmer - Excitation system - Solar PV systems. **(10)**

DC TO DC CONVERTERS

Step-down and step-up choppers -Types of choppers-A, B, C, D and E –Switching Mode Regulators – Buck Regulator – BoostRegulator - Buck-Boost Regulator–SMPS- Battery operated vehicles.

(9)

INVERTERS

Single phase voltage source inverters – Voltage control - Single PWM - Multiple PWM - Sinusoidal PWM – Space Vector Modulation in Three phase inverters – Harmonic reduction - Single phase current source inverters -Induction heating - UPS.

(9)

AC TO AC CONVERTERS:

Single phase and Three phase AC voltage controllers– Integral cycle Control – Sequence control - Single phase cycloconverters – Matrix converters.

(8)

TOTAL : 45

TEXT BOOK

1. Muhammad Harunur Rashid, "Power Electronics Devices, Circuits, and Applications"Pearson, Fourth Edition, 2014.
2. P. S. Bimbhra, "Power Electronics"Khanna Publishers, Fifth Edition, 2012.

REFERENCES

1. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, Second Edition, 2014.
2. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications, and Design" John Wiley & Sons,Third Edition, 2003.
3. VedamSubramanyam, "Power Electronics" New Age International, Second Edition, 2006.
4. M.D.Singh and K.B.Khanchandani, "Power Electronics" Tata McGraw Hills, Second Edition, 2008.

19EC37 SENSORS AND TRANSDUCERS

ASSESSMENT: THEORY.

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Interpret the working principles and applications of strain and pressure sensors.
2. Categorize the type of motion sensors used for different applications
3. Exemplify the working of different types of light radiation sensors .
4. Illustrate the key concepts of heat and temperature sensors used to measure the temperature parameters. .
5. Explain the construction and working of Electronic sensors.

STRAIN AND PRESSURE SENSORS

Resistance strain gauge, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometry, Fiber optic methods. Pressure gauges: Aneroid capacitance pressure gauge, Ionization gauge, Using the transducers for applications

(9)

MOTION SENSORS

Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, Rotation sensors drag cup devices, piezoelectric devices. Rotary encoders.

(9)

LIGHT RADIATION SENSORS

Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber optic applications, light transducer, solid state, transducers liquid crystal devices.

(9)

HEAT AND TEMPERATURE SENSORS

Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector.

(9)

ELECTRONIC SENSORS

Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

(9)

TOTAL: 45

TEXT BOOKS

1. Ernest O Doebelin, Dhanesh N Manik, "Measurement Systems, Application and Design", McGraw Hill, 6th Edition, 2007
2. R Sinclair, "Sensors and Transducers, 3rd Edition, Newnes publishers, 2001.

REFERENCES

1. Jack P Holman,"Experimental Methods for Engineers", 7th Edition, McGraw Hill, USA, 2001.
2. Robert G Seippel, "Transducers, Sensors and Detectors", Reston Publishing Company, USA, 1983.

3. Jacob Fraden," Handbook of modern sensors: physics, designs, and applications", 5th Edition, Springer, 2016.
4. John P. Bentley," Principles of Measurement systems", 3rd Edition, Pearson Education Asia Pvt. Ltd, 2009.
5. D. Patranabis," Sensors and Transducers", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2006.

19ECE38 BIOMEDICAL TRANSDUCERS AND BIOSENSORS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : explain the principles of resistive transducers , blood pressure transducers , Capacitive transducers , inductive transducers and their applications.
CO2 : explain the principles of temperature transducers and Piezoelectric transducers and their applications.
CO3 : explain the principles of different types of pressure transducers.
CO4 : explain the principle of biopotential electrodes.
CO5 : explain the principle of Biosensors and their applications

RESISTIVE AND DISPLACEMENT TRANSDUCERS:

Principle of resistive Strain Gauge, Type and construction of metal wire and Metal foil strain gauges, Strain gauge materials, Gauge factor, Semiconductor strain gauge, Signal Conditioning circuit, Temperature compensation, Bridgebalance circuit, Strain Gauge type Blood pressure transducers. Potentiometric Transducers: L.V.D.T, Inductive displacement transducer, Capacitive displacement transducers, Ultrasonic methods, Diaphragm displacement transducer, Applications.

(10)

TEMPERATURE AND PIEZOELECTRIC TRANSDUCERS:

Measurement Principle, characteristics, Design and Applications: Thermosensitive- Resistance Temperature Detectors (RTDs), Thermistor. Thermoelectric -Thermocouple, PN junction diode. Non-contact type temperaturemeasurements techniques: Radiation thermography, Infrared radiation, pyrometer, Infrared temperature probe, Optical Pyrometer.

Piezoelectric phenomena and materials, Output voltage expression of Piezocrystal, Piezoelectric Force transducer, Piezoelectric acceleration transducer ,Equivalent circuit of Piezoelectric transducers and Dynamic characteristics.Merits and demerits of Piezoelectric Transducers.Piezoelectric UltrasonicTransducer: Construction and design, Electrical excitation, piezoelectric semiconductor and Applications.

(10)

PRESSURE TRANSDUCERS:

Occlusive cuff methods- Force balance methods- Direct hydraulically CoupledCatheter transducer system, Diaphragm pressure transducers.-Piezoelectric Pressure transducer-Electrical transduction methods for Catheter tip transducer-Optical transducers.-Implantable pressure transducer, Micro pressure transducer.

(8)

BIOPOTENTIAL ELECTRODES

Electrode theory: the electrode / Electrolyte interface, Polarizable and nonpolarizable electrodes, Liquid junction potential, Electrode potential, Application of Biopotential electrodes. ECG electrodes: Surface electrodes, Silver- silver chloride electrodes, stainless steel electrodes, Electrode impedance and Electrode equivalentcircuit. EMG electrodes: Surface electrodes, Needle and Wire electrodes. EEGelectrodes: Micro and suction electrodes- Glass microelectrodes, Metalmicroelectrodes, Suction electrodes, Microelectrode equivalent circuit.

(9)

BIOSENSORS

Definition of biosensor, Application and origin of biosensor, Transduction mechanism of biosensor, Blood gas and pH sensors, Bio-Analytical Sensor, Enzymatic biosensors, Optical Biosensors, PO_2 and PCO_2 sensor .

(8)

TOTAL : 45

TEXT BOOK

1. Medical Instrumentation: Application and Design, 5th Edition, John G. Webster (Editor), Amit J. Nimunkar (Editor),ISBN: 978-1-119-45733-6 August 2020.

2. Biomedical Sensors: Fundamentals and Applications April 1982, Harry N. Norton

REFERENCE BOOKS

1.Biomedical Transducers and Instruments by Tatsuo Togawa, Toshiyo Tamura, P. Ake Oberg.

2.Transducers for Biomedical Measurements: Principles and Applications , Richard Cobbold (S. C.) Wiley,
1974 .

3. Earnest O.Doeblin, Measurement System Application and Design , McGraw Hill Newyork 1990.

4.Principles of Applied Biomedical Instrumentation, 3rd Edition, ,L. A. Geddes, L. E. Baker, Wiley , 1991.

19ECE39 NANO ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Interpret the concepts of diverse Electron microscopes based on their construction techniques.
2. Infer the formation and properties of nanotube and identify the appropriate structure of nanotubes for memory application.
3. Infer the concepts of Quantum physics, Quantum electronic devices and apply them in Quantum computers.
4. Illustrate the features of diverse Logic devices and reconstruct the single electron device for logic applications.
5. Use nanobio sensors and develop sensor based medical devices

BACKGROUND TO NANOTECHNOLOGY

Types of nanotechnology and nano machines - Periodic table - Atomic structure - Molecules and phases - energy - Molecular and atomic size - Surface and dimensional space - Top down and bottom up - Molecular nanotechnology: Electron microscope - scanning electron microscope - Atomic force microscope - Scanning tunnelling microscope-Nano materials - Preparation - Plasma arcing - Chemical vapour deposition - sol-gels - Electro deposition - Ball milling -Applications of nanomaterials.

(9)

CARBON NANOTUBES

New forms of carbon-Fullerenes - Types of nanotubes - Formation of nanotubes – Assemblies -Electronic properties - Synthesis of carbon nanotubes - Carbon nanotube FETs - Nanotube for memory applications - Prospects of carbon nanotube in Nano electronics.

(9)

FUNDAMENTALS OF NANO ELECTRONICS

The tool of Micro and nano fabrication-From classical to Quantum physics- Quantum electronic devices-Quantum information and Quantum computers-Experimental Implementations of Quantum Computers.

(9)

LOGIC DEVICES

Silicon MOSFETS novel materials and alternate concepts-Fundamentals of MOSFET Devices- Nano Electromechanical Logic gates-Single electron devices for Logic applications-Electron wave guide devices-Super conductor Digital electronics.

(9)

EVOLVING INTERFACES OF NANO

Applications of Nano in Biology: Nano Sensors: Nano scale organization for sensors, Nano Bio Sensors – Nano Medicine: Nano Technology in diagnostic applications, approach to Developing Nano Medicines.

(9)

TOTAL: 45

TEXT BOOK

1. Michael Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons and BurkhardRaguse, "Nanotechnology: Basic Science and Emerging Technologies", Chapman & Hall / CRC, 2002

REFERENCES

1. Rainer Waser (Ed.), "Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices", 3rd edition, Wiley-VCH, 2012
2. T. Pradeep, "NANO: The Essentials - Understanding Nanoscience and Nanotechnology", McGraw Hill, 2007.
3. George W. Hanson, "Fundamentals of Nano electronics", 1st edition, Pearson Educationl, 2008

4. Shunrioda, David Ferry, "Silicon Nano electronics", Taylor and Francis group, CRC 2005.

5. Karl Goser, Peter Glosekotter, Jan Dienstuhl, "Nano electronics and Nano system: From transistors to molecular and quantum Devices", Springer 2004 .

19ECE40 NANO SENSORS AND DEVICES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Illustrate the concepts of characteristics and the classification of nano sensor.
CO2: Infer the material properties and the classification of nanostructured materials.
CO3: Describe the different types of biosensors based on nanostructured materials.
CO4: Describe the different types of chemical based nano sensors.
CO5: Discuss about the microscopic techniques to view nanomaterials and future trends of nano sensors.

NANO SENSORS

Nanoscience and Nanotechnology Definition of Sensor Parameters and Characteristics Evolution of Semiconductor-Based Micro sensors Definition and Classification of Nano sensors, Examples of Nano sensors.

(9)

MATERIALS FOR NANO SENSORS

One-dimensional, Two-dimensional and Three-dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties.

(9)

NANO BIOSENSORS

Introduction, Nanoparticle -Based Electrochemical Biosensors, CNT-Based Electrochemical Biosensors Functionalization of CNTs for Biosensor, Nanotube and Nanowire-Based FET Nano biosensors Fabrication Cantilever- Based Nano biosensors.

(9)

CHEMICAL NANO SENSORS

Introduction, Gas Sensors-Based on Nanomaterials, Metallic Nanoparticle-Based Gas Sensors, Metal Oxide Gas Sensors, CNT- Nanowire and Opto - chemical Nano sensors, Carbon Nanotube Gas Sensors.

(9)

FUTURE TRENDS OF NANO SENSORS

Scanning Tunnelling Microscope, Atomic Force Microscope, Mechanical Nano sensors, Thermal Nano sensors, Optical Nano sensors, Magnetic Nano sensors.

(9)

TOTAL: 45

TEXT BOOK

1. Pradeep T, ―Nano: The Essentials Understanding Nanoscience and Nanotechnology‖, Tata Mc-Graw Hill, New Delhi, 2012.
2. Ramachandra Rao M S and Shubra Singh, ―Nanoscience and Nanotechnology: Fundamentals to Frontiers‖, Wiley, Delhi, 2014.

REFERENCES

1. Nanosensors: Physical, Chemical, and Biological,1st Edition,Vinod Kumar Khanna, Published October 26, 2011.
2. Chemical Sensors and Biosensors; Brian, R Eggins; Wiley; New York, Chichester, 2002.
3. Masaru Kuno, ―Introductory Nanoscience: Physical and Chemical Concepts‖, Taylor And Francis, New York, 2012.
4. Hornyak G L, Tibbals H F and Dutta J, ―Introduction to Nanoscience and Nanotechnology‖, CRC Press, London, 2009.

19ECE41 VERILOG HDL

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Understand about the design methodologies in Verilog HDL
CO2: Design various combinational circuits using gate level modeling
CO3: Design combinational circuits using data flow level modeling
CO4: Understand about the design of combinational circuits using behavioral modeling
CO5: Verify and design the digital circuits using switch level modeling

OVERVIEW OF DIGITAL DESIGN WITH VERILOG HDL

Evolution of Computer Aided Digital Design and Emergence of HDLs - Typical Design flow - Importance of HDLs - Popularity of Verilog HDL - Hierarchical Modeling Concepts: Design Methodologies - 4 bit Ripple Carry Counter - Modules - Instances - Components of a Simulation.

(9)

GATE LEVEL MODELING

Basic Concepts: Lexical Conventions - Data types - System Tasks and Compiler - Modules - Ports - Gate Types: AND Gate, OR Gate, Buffer, Not Gate - Multiplexer - 4 bit Full Adder - Gate Delays: Rise, Fall, Turn off Delays, Minimum, Typical, Maximum Delays - Delay Examples. **(9)**

DATA FLOW MODELING

Continuous Assignments: Implicit Continuous Assignment - Delays: Regular Assignment Delay, Implicit Continuous Assignment Delay, Net Declaration Delay - Expressions, Operators and Operands - Operator Types - Operator Precedence - 4 to1 Multiplexer - 4 bit Full Adder - Ripple Counter. **(9)**

BEHAVIOURAL MODELING

Structured Procedures - Procedural Assignments - Timing Controls - Conditional Statements - Multiway Branching - Loops - Sequential and Parallel Blocks - 4 to 1 Multiplexer - 4 bit Counters - Traffic Signal Controller. **(9)**

TASKS, FUNCTIONS AND SWITCH LEVEL MODELING

Tasks - Functions - Differences between Tasks and Functions - Switch Level Modeling: Switch Level Modeling Elements - MOS Switches - CMOS Switches - Bidirectional Switches - Power and Ground - Resistive Switches - Delay Specification on Switches - CMOS NOR gate - 2 to 1 Multiplexer - Simple CMOS Flip Flop. **(9)**

TOTAL : 45

TEXTBOOK

1.Samir Palnitkar "VERILOG HDL - A Guide to Digital Design and Synthesis", Pearson Education, 2nd Edition, 2011

REFERENCES

1. Stephen D. M. Brown, Zvonko G. Vranesic," Fundamentals of Digital Logic with Verilog Design", McGraw Hill Higher Education, 2nd Edition, 2008

2. T.R. Padmanabhan, B.Bala Tripura Sundari," Design Through Verilog HDL", John Wiley & Sons, 2009

3. Donald E. Thomas, Philip R. Moorby, ―The Verilog Hardware Description Language‖, Springer Science+Business Media, LLC, 5th edition,2002.

19ECE42 HDL BASED SYSTEM DESIGN

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. design basic combinational and sequential circuits using VHDL
2. design and write VHDL code for carry look ahead adder, binary multiplier and dividers using state graphs
3. design and develop VHDL codes for digital circuits using State Machine charts
4. understand the representation of floating-point number, perform floating point addition and multiplication
5. design and write VHDL code for static RAM memory and a RISC microprocessor

DESIGN OF BASIC COMBINATIONAL AND SEQUENTIAL CIRCUITS

Design of adder, subtractor, multiplexer, de-multiplexer, encoder, decoder, flip-flops, counters using VHDL.

(9)

DESIGN OF SUBSYSTEMS FOR ARITHMETIC OPERATIONS

Design of Carry look ahead adder - State graphs for control networks- Design of a binary multiplier- Multiplication of signed binary numbers-Design of a binary divider.

(9)

DIGITAL DESIGN WITH SM CHARTS

State machine charts- Derivation of SM Charts- Realization of SM Charts-Implementation of the dice game-Alternative Realizations for SM Charts using microprogramming- Linked State Machines.

(9)

FLOATING POINT ARITHMETIC

Representation of Floating-Point Numbers - Floating Point Multiplication - Floating Point Addition.

(9)

DESIGN OF MEMORIES AND RISC MICROPROCESSOR

Static RAM Memory- MIPS ISA: Arithmetic Instructions, Logical Instructions, Memory access Instructions, Control Transfer Instructions – Design of Data Path – Instruction Execution Flow – VHDL model for register file, memory, CPU Processor, Complete MIPS.

(9)

TOTAL:45

TEXT BOOK

1. Charles H.Roth, Lizy Kurian John "Digital Systems Design using VHDL", 2nd Edition Cengage Learning, 2013.
2. Charles H. Roth, Lizy Kurian John," Principles of Digital Systems Design using VHDL", Cenage Learning India Pvt Ltd, 2010.

REFERENCES

1. Douglas L. Perry, "VHDL Programming by example", 4th Edition, McGraw-Hill Education, 2002.
2. Stephen Brown, Zvonko Vranesic, "Digital system Design Using VHDL",3rd Edition, Tata Mc Graw Hill, 2009.
3. J.Basker, "A VHDL Primer", Addison Wesley, New Delhi, 3rd Edition, 2015.
4. Zainalabedin Navabi, "VHDL: Modular Design and Synthesis of Cores and Systems", 3rd Edition, McGraw Hill Education, 2010.
5. Volnei A. Pedroni, "Circuit Design with VHDL", MIT Press, 2004.

19ECE43 INTRODUCTION TO MINIATURIZATION TECHNOLOGIES

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Interpret the concepts of micro electro mechanical systems and the working principle of MEMS systems.

CO2: Infer the material properties and the fabrication process of microsystems.

CO3: Infer the properties and the classification of nanostructure devices.

CO4: Describe the different methods of synthesis and the characterization of nanomaterials.

CO5: Describe CAD tools and micro, nano based applications for medicine, agriculture and bio-technology and robotics.

MEMS SYSTEMS

MEMS and Microsystems, Miniaturization, Scaling Laws in Miniaturization , Typical products, MEMS Process, , MEMS materials, Working principle: Micro sensors, MEMS with micro actuators, Micro accelerometers and Micro fluidics.

(9)

MICROSYSTEM DESIGN MECHANICS, MATERIAL AND FABRICATION PROCESS

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Microsystem Materials, Microsystem Fabrication Process.

(9)

NANO SCIENCE AND NANOTECHNOLOGY

Nano science concepts, size effects, surface area, surface to volume ratio, top down and bottom up approach, properties of nanomaterials, Classification of nanostructures: Classification based on dimensionality, Carbon nanotubes and graphene Quantum dots , wells and wires, Carbon-based Nano materials – fullerenes and buck balls

(9)

SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS

Synthesis of nanomaterials, Chemical Methods: Sol – gel- Chemical Vapour deposition(CVD) – Metal Oxide Chemical Vapour Deposition (MOCVD), Physical Methods: Ball Milling - spray Pyrolysis - Sputtering - Molecular Beam Epitaxy-Characterization of nanostructures : structural characterization, Scanning Electron Microscopy (SEM)- Transmission Electron Microscope(TEM) – Scanning Tunnelling Microscope (STM) - Atomic force microscopy (AFM).

(9)

MICRO,NANO TOOLS AND APPLICATIONS

CAD TOOLS,BIO-MEMS, MOEMS, Magnetic MEMS, RF Mems, case study – Capacitive RF MEMS switch performance issues, Nanotechnology in agriculture, Nano medicine and Nano biotechnology, nanomaterials for data storage, Case study on Nanorobotics in surgery.

(9)

TOTAL:45

TEXT BOOK

1. Tai Ran Hsu, ―MEMS and Microsystems, Design, Manufacture and Nanoscale Engineering, John Wiley & Sons, New Jersey. 2008.
2. Stephen Santuria," Microsystems Design", Kluwer publishers, 2000.

REFERENCES

1. James J Allen, ―Micro Electro Mechanical System Design CRC Press-Taylor & Francis‖, New York, 2005.
2. A Textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.
3. Introduction to Nanotechnology, Charles P.Poole, Frank J. Owens, Wiley Interscience(2003).

19ECE44 MEMS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1. Develop the MEMS and Microsystems using fabrication, sensing and actuation mechanisms.

CO2. Design the MEMS goods by using elasticity, stress ,strain and material properties.

CO3. Analyze the characteristics of electrostatic and electromagnetic for designing actuators and motors.

CO4. Examine the concepts of issues in MEMS circuits and systems and to model and devise the CAD for MEMS

CO5. Determine the design conceptions for RF and optical MEMS applications

INTRODUCTION TO MEMS

MEMS and Micro systems - Miniaturization - Typical products - Micro sensors - Micro actuation- MEMS with micro actuators- Micro accelerometers - Micro Fluidics - MEMS materials - Micro fabrication

(9)

MECHANICS FOR MEMS DESIGN

Elasticity: Stress, Strain and material properties - Bending of thin plates - Spring configurations - Torsional deflection - Mechanical Vibration: Resonance - Thermo mechanics - Actuators - Force and response time - Fracture and thin film mechanics.

(9)

ELECTROSTATIC AND ELECTROMAGNETIC DESIGN AND SYSTEM ISSUES

Electrostatics : Basic theory, Electro Static Instability - Surface Tension-Gap and finger pull up - Electro static actuators - Comb generators - Gap closer - Rotary motors - Inch worms - Electromagnetic actuators - Bistable actuators - Electronic interfaces - Feedback system - Noise -

Circuit and system issues.

(9)

MEMS APPLICATION

Case studies - Capacitive accelerometer - Piezo Electric pressure sensor - Micro fluidics application - Modeling of MEMS Systems - CAD for MEMS.

(9)

INTRODUCTION TO OPTICAL AND RF MEMS

Optical MEMS - System design basics: Gaussian optics, Matrix operations, Resolution - Case studies - MEMS Scanners and Retinal Scanning display - Digital Micro Mirror Devices - Optical switches - RF MEMS: Design basics, Case study, capacitive RF MEMS switch, Performance issues.

(9)

TOTAL: 45

TEXT BOOK

1. Stephen Santeria, "Micro systems design", Kluwer publishers, 2001.
2. N.P. Mahalik, "MEMS", Tata McGraw Hill, 2007.

REFERENCES

1. Vijay K. Varadan, K.J. Vinoy, K.A.Jose, "RF MEMS" and their Application" Published by John Wiley & sons Ltd, England, reprinted April 2003.
2. NadimMaluf and Kirt William, "An introduction to Micro Electromechanical system Engineering", 2nd Edition, Artech House, 2004.
3. Mohamed Gad-el-Hak, "The MEMS Hand book-Application", CRC press, 2nd Edition,2006
4. Tai Ran Hsu, "MEMS & Micro systems Design, Manufacture and Nano scale Engineering" John Wiley and sons, New Jersey, 2nd Edition, 2008.
5. Jan G. Korvink, Oliver Paul, "MEMS a practical guide of design, analysis and applications", William Andrew, 2006.

19ECE45 VLSI PROCESS TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Understand the physics of Crystal growth, wafer fabrication and basic properties of silicon wafer.
CO2: Infer the concepts of various lithography and etching techniques.
CO3: Describe the different process of wafer exposure system.
CO4: Describe the process of IC fabrication technology.
CO5: Discuss about the analytical, assembly and packaging techniques of VLSI devices.

CRYSTAL GROWTH, WAFER PREPARATION, EPITAXY AND OXIDATION

Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing considerations, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Oxidation Techniques and Systems. **(9)**

LITHOGRAPHY AND RELATIVE PLASMA ETCHING

Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, reactive Plasma Etching techniques and equipments. **(9)**

DEPOSITION, DIFFUSION, ION IMPLEMENTATION AND METALLIZATION

Deposition process, Poly silicon, plasma assisted Deposition, CVD-Diffusion-Models of Diffusion in Solids, Fick's one dimensional Diffusion Equations – Atomic Diffusion Mechanism – Measurement techniques -Van der-pauw technique -Ion implantation – Physical vapor deposition – deposition methods. **(9)**

PROCESS SIMULATION AND VLSI PROCESS INTEGRATION

CMOS IC process Technology - Diffusion and oxidation – Epitaxy – Lithography – Etching and Deposition- NMOS IC process Technology — MOS Memory IC technology - Bipolar IC Technology – IC Fabrication.

(9)

ANALYTICAL, ASSEMBLY TECHNIQUES AND PACKAGING OF VLSI DEVICES

Analytical Beams - Chemical methods – Package types – packaging design considerations – VLSI assembly technology – Package fabrication technology.

(9)

TOTAL:45

TEXT BOOK

1. S.M.Sze, "VLSI Technology", McGraw Hill Education; 2nd edition, 2017.

REFERENCES

1. Gary S. May and Costas J. Spanos," Fundamentals of semiconductor manufacturing and process control", John Wiley and Sons, 2006.
2. Wai Kai Chen, "VLSI Technology" CRC Press, 2003.
3. Hong Xiao, "Introduction to Semiconductor Manufacturing Technology",PHI,2001.
4. James D Plummer, Michael D. Deal, Peter B. Griffin, "Silicon VLSI Technology: Fundamentals Practice and Modeling", Prentice Hall India.2000.
5. Amar Mukherjee, "Introduction to NMOS and CMOS VLSI System design:Prentice Hall India.2000.

19ECE46 LOW POWER VLSI DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

CO1: Explain the sources of power dissipation in CMOS
CO2: Summarize the power optimization and trade-off techniques in digital circuits

CO3: Learn how to design low power memories and special techniques
CO4: Illustrate the power estimation at logic and circuit level
C05: Explain the software design for low power in various level

POWER DISSIPATION IN CMOS

Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design

(9)

POWER OPTIMIZATION

Logical level power optimization – Circuit level low power design – Circuit techniques for reducing power consumption in Adders and Multipliers

(9)

DESIGN OF LOW POWER CMOS CIRCUITS

Computer Arithmetic techniques for low power systems – Reducing power consumption in memories – Low power clock– Interconnect and layout design – Advanced techniques – Special techniques

(9)

POWER ESTIMATION

Power estimation techniques – Logic level power estimation – Simulation power analysis – Probabilistic power analysis

(9)

SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER

Synthesis for low power –Behavioral level transforms – Software design for low power **(9)**

TOTAL:45

TEXTBOOK

1. K.Roy and S.C. Prasad, "Low power CMOS VLSI circuit design", Wiley 2014.
2. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998

REFERENCES

1. Kiat-send Yeo, Kaushik Roy "Low-Voltage, Low-power VLSI Subsystem", Tata McGrawHill, 2009.
2. Abdellatif Bellaouar, Mohamed. I. and Elmasry, "Low power digital VLSI design", Kluwer, 2008
3. Dimitrios Soudris, Chirstian Pignet and Costas Goutis, "Designing CMOS circuits For Low Power", Kluwer, 2002.
4. James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", John Wiley and sons, inc. 2001
5. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design",Kluwer,1995

19ECE47 IC FABRICATION TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESMENT: THEORY

COURSE OUTCOMES

Upon completion of the course, students will be able to demonstrate an ability to

1. Explain the basic IC fabrication, cleaning and etching process.
2. Explain the different methods of epitaxy and oxidation
3. Explain metal and non-metal deposition and plasma, RIE & RTP etching techniques
4. Analyze the different methods of lithography and diffusion
5. Explain implantation equipment, annealing & shallow junctions and NMOS, CMOS technologies

IC TECHNOLOGY FUNDAMENTALS : Basic Fabrication Steps and their Importance - Clean Room and Safety Requirements - Wafer Cleaning Processes - Wet Chemical Etching Techniques - Electronic Grade Silicon - Czochralski Crystal Growing - Silicon Shaping - Processing Considerations. **(9)**

EPITAXY AND OXIDATION : Epitaxy: Vapor Phase Epitaxy - Molecular Beam Epitaxy - Silicon on Insulators - Epitaxial evaluation - Oxidation: Growth mechanism and Kinetics - Thin Oxides - Oxidation technologies in VLSI and ULSI - Characterization of Oxide Films - Oxide Properties - Redistribution of Dopants at Interface - Oxidation of Polysilicon - Oxidation Induced Defects **(9)**

DEPOSITION AND ETCHING : Chemical Vapour Deposition Techniques for deposition of Polysilicon, Silicon Dioxide, Silicon Nitride and Metal Films - Metal Film Deposition - Evaporation and Sputtering techniques - Failure mechanisms in Metal Interconnects - Multi-level Metallization schemes - Plasma and Rapid Thermal Processing - PECVD - Plasma Etching and RIE techniques - RTP techniques for Annealing, Growth and Deposition of various films for use in ULSI. **(9)**

LITHOGRAPHY AND DIFFUSION : Photolithography - E-Beam Lithography - X-Ray Lithography - Ion Lithography - Mask Generation - Models of Diffusion in Solids - Fick's One Dimensional Diffusion Equations - Atomic Diffusion Mechanisms - Diffusivities of B, P, As and Sb - Measurement techniques - Diffusion in Polysilicon, SiO_2 - Diffusion Enhancements and Retardations. **(9)**

ION IMPLANTATION AND VLSI PROCESS INTEGRATION : Ion implantation: Range theory, implantation equipment, annealing, shallow junctions, high energy implantation. VLSI process integration of NMOS, CMOS and Bipolar Circuits - Advanced MOS technology **(9)**

TOTAL :45

TEXT BOOK

1. S.M.Sze, "VLSI Technology", 2nd Edition, Tata McGraw-Hill, 2003.
2. C.Y. Chang and S.M.Sze, "ULSI Technology", McGraw-Hill, 1996.

REFERENCES

1. Stephen A. Campbell, “The Science and Engineering of Microelectronic Fabrication”, Second Edition, Oxford University Press, 2001.
2. James D. Plummer, Michael D. Deal, Peter D.Griffin, ”Silicon VLSI Technology: Fundamentals, Practice and Modeling”, 1st Edition, Pearson Education, 2009.
3. Sorab K. Ghandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide", 2nd Edition, John & Wiley Sons, 1994.
4. Peter R.Shepherd, "Integrated Circuit: Design, Fabrication and Test", McGraw-Hill, 1996.

19ECE48 CMOS ANALOG IC DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Realize the concepts of single stage amplifiers and design
CO2 : Analyze the modes of operation of differential amplifiers and current mirrors
CO3 : Understand the frequency response and noise characteristics of single stage amplifiers and differential amplifiers followed by loading effect in feedback networks
CO4 : Explain single stage and two stage operational amplifiers and its compensation techniques
CO5 : Discuss about the switched capacitor filters, oscillators and PLL

SINGLE STAGE AMPLIFIERS

Importance of Analog Integrated CMOS Circuits-General consideration of MOS devices: MOSFET as a switch, MOSFET structure, I/V Characteristics - Second Order Effects - MOS Device Models- Single Stage Amplifiers: Common source stage with different loads, Source Followers, Common gate stage & Cascode Stage.

(9)

DIFFERENTIAL AMPLIFIERS AND CURRENT MIRRORS

Single Ended and Differential operation- Qualitative and Quantitive analysis of Differential pair-Common mode response-Differential Pair with MOS loads- Gilbert Cell. Basic current mirrors-Cascode current mirrors- Active current mirrors- Large signal and small signal analysis -Common mode operation. **(9)**

FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE

General Considerations- Miller Effect-Association of poles with nodes- Frequency response of Common source stage with different loads-Source Followers-Common gate stage-Cascode Stage-Differential Pair. Noise- Types of noise- Noise in single stage amplifiers- Noise in differential pairs-Effect of feedback on noise- Effect of loading in feedback networks

(9)

OPERATIONAL AMPLIFIERS

General Considerations- Performance parameters-One stage and two stage opamps- Gain boosting-Comparison-Common mode feedback-Input range limitations - Slew rate-Power supply rejection-Noise in Opamps. Stability and frequency compensation

(9)

SWITCHED CAPACITOR CIRCUITS AND PLL

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor common mode feedback. Oscillatory system - Ring oscillators –cross coupled LC oscillators - Voltage Controlled Oscillators (VCO) –Phase Locked Loops-Simple PLL-Charge pump PLL – Non ideal effects-Delay locked loops –Applications of PLL.

(9)

TOTAL : 45

TEXT BOOK

BehzadRazavi "Design of Analog CMOS Integrated Circuits", 2nd Edition, McGraw-Hill Education, 2017

REFERENCES

1. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design", 2nd Edition, Oxford
University Press, 2016.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, " Analysis and Design of Analog Integrated Circuits", 5th Edition, John Wiley & Sons Inc, 2009

3. David A. Johns, Ken Martin, “Analog Integrated Circuit Design”, Wiley Student Edition, 2013
4. Alan B.Grebene, “Bipolar and MOS Analog Integrated circuit design”, John Wiley & sons, Inc.,Wiley Classics Library Edition, 2002.
5. Neil H.E Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design: A System Perspective", Addison Wesley, NewDelhi, 2nd Edition, 2009.

19ECE49 ELECTROMAGNETIC RADIATION HAZARDS AND SAFETY

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Interpret the sources of extremely low frequency and radio frequency radiation.
CO2: Explain the biological interaction of Electromagnetic Radiation on human cells and threat to Cancer.
CO3: Analyze the Dosimetry effects of Electromagnetic Radiation using Specific Absorption Rate.
CO4: Describe the safety standards and International Regulations framed for radiation protection.
CO5: Infer the radio frequency survey on Mobile phones, Microwave ovens and Medical devices.

SOURCES OF ELECTROMAGNETIC RADIATION

Sources of Extremely Low frequency Fields: DC Sources and AC Sources – Electric Utility System - Extremely Low frequency Fields in the Environment -Elements of Radio Frequency Radiation System – Radio and Television Transmitters – Radar Systems – Satellite Earth Stations – Microwave

Communications – Mobile Radio Equipment – Cellular Communication – Nano communication Sources. **(9)**

BIOLOGICAL EFFECTS

Interaction Mechanisms - Extremely Low frequency Fields and Cancer – Cellular Studies – Animal Studies – Human Studies – Epidemiological studies of Cancer and Nano cancer – Thermal Effects – Athermal and Nonthermal Effects – Genetic Effects – Cell Proliferation – Cell Transformation.

(9)

INCIDENT AND INTERNAL FIELD DOSIMETRY

Radio Frequency Radiation Modeling – Measurement Techniques - Time Averaging – Spatial Averaging – Mitigation in Public and Occupational Environments – Specific Absorption Rate – Types – parameters – Estimation of Specific Absorption rate – Theoretical Dosimetry – Experimental Dosimetry – Phantom Models – Dosimetric Studies of Cellular Phones.

(9)

SAFETY AND REGULATION

Safety Standards - Extremely Low frequency Standards in Europe – Regulations in United States – ANSI/IEEE C95.1 – National Council on Radiation Protection and Measurement – National Institute for Occupational Safety and Health – Regulations in Asia Pacific – International Regulatory Activities: International Radiation Protection Association – International Commission on Non-Ionizing Radiation Protection.

(10)

RADIO FREQUENCY SITE SURVEYS

Survey on Mobile Systems – Survey of Broadcast Stations – Survey of Traffic Radar Devices – Survey of Radio Frequency Heating Equipment – Microwave Ovens – Survey of Radio Frequency Interference on Medical Devices.

(8)

TOTAL: 45

TEXT BOOK

1. Riadh W.Y. Habash," Electromagnetic Fields and Radiation: Human Bioeffects and Safety"CRC Press, 1st Edition, 2018

REFERENCES

1. Patrick Staebler," Human Exposure to Electromagnetic Fields: From Extremely Low Frequency (ELF) to Radiofrequency", John Wiley & Sons, 2017.
2. Andrew W. Wood, Ken Karipidis, "Non-ionizing Radiation Protection: Summary of Research and Policy Options", John Wiley & Sons, 2017.
3. Colin J. Martin, David G. Sutton, "Practical Radiation Protection in Healthcare", Oxford University Press, 2015.
4. Martin Roosli "Epidemiology of Electromagnetic Fields" CRC Press, 1st Edition, 2014.
5. Peter Stavroulakis, "Biological Effects of Electromagnetic Fields: Mechanisms, Modeling, Biological Effects, Therapeutic Effects, International Standards, Exposure Criteria" Springer Science & Business Media, 2014.

19ECE50 MODERN ANTENNAS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1. Explain the concept and applications of PIFA, Helical & Ceramic chip antennas and

Illustrate SAR value measurement & minimization methods for mobile handset.

CO2. Categorize Fractal structuresand determine the radiation parameters of simple Fractal antenna.

CO3. Categorize antennas for millimeter wave and sub-millimeter wave applications based on their operating frequency and Explain the concept and radiation parameters of Substrate integrated waveguide,Dielectric resonator,Reflector antennas.

CO4. Explain the techniques for broad impedance bandwidth & enhanced radiation performance and applications in high speed wireless communication

CO5. Derive and describe narrowband beam processing techniques for smart antenna such as Conventional, Null steering & Optimal beam former and Optimal beam space processor.

MOBILE HANDESET ANTENNAS

Review of antenna basic parameters – Frequency bands for commercial applications – Cellular handset antenna design issues – Helical wire antennas and variants – Evolution of the PIFA – Ceramic chip and resonator antennas – SAR measurement and minimization – Provision for GPS and Bluetooth. **(9)**

FRACTAL ANTENNAS

Fractal antenna geometries – Iterated function systems – Fractal antenna elements – Radiation characteristics - Fractal antenna arrays – Antenna arrays based on aperiodic tilings – Hybrid Fractal antenna – Fractal MIMO structures.

(9)

MILLIMETER WAVE ANTENNAS

Millimeter wave and Terahertz applications – Waveguide antennas – Printed planar antennas – On-chip antennas – Sub millimeter wave antennas – Vivaldi antenna & long slot array for ultra-wideband characteristics – Dielectric resonating antennas –Substrate integrated waveguide antennas –Reflector antennas.

(9)

BROADBAND PLANAR ANTENNA

Suspended plate antennas – Techniques for broad impedance bandwidth – Techniques for enhanced radiation performance – Planar monopole antennas – Applications in high speed wireless communications. **(9)**

SMART ANTENNAS

Beam steering – Degree of freedom – Key benefits of smart antennas technology – Narrow band processing: Signal model-Conventional beam former-Null steering beam former-Optimal beam former-Optimization using reference signal-Optimal beam space processor.

(9)

TOTAL: 45

TEXT BOOK

John.L.Volakis, “Antenna Engineering Handbook”, Tata McGraw Hill, 4th Edition, 2007.

REFERENCES

1. Constantine A.Balanis, “Modern Antenna Handbook”, John Wiley and Sons, 2008.
2. S.Drabowitch, A.Papiernik ,et.al, “Modern Antennas”, Springer, 2nd Edition,2005.
3. Zhi Ning Chen, “Antennas for Portable Devices”, John Wiley & Sons, 2007.
4. Lal Chand Godara, “Smart Antennas”, C.R.C Press, 2004.
5. John D Kraus, Ronald J Marhefka, Ahmad S Khan,“Antennas for all applications”, John Wiley and Sons, 3rd Edition, New York, 2002.

19ECE51 ADVANCED ANTENNA TECHNOLOGY

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate an ability to

1. Comprehensive knowledge of various antennas design and performance parameters of antenna.
2. Ability to understand design constraints of smart antennas for different application.
3. Understand the basic concept of mobile satellite antennas in Satellite Communication.
4. Describe the different design techniques for mobile-phone antennas and implementation of different techniques used for SAR reduction.
5. Explain the concept and applications of Spiral antenna, flagpote & ILS antennas and different advance antennas presently in practice.

LENS ANTENNA

Artificial dielectric lens antenna - Luneburg & Einstein lenses - electrically & physically small antenna - ground plane antenna - sleeve antenna - turnstile antenna - submerged antenna, surface wave & leaky wave antenna - weather-vane antenna

(9)

SMART ANTENNAS

Antenna arrays - Antenna classification - Diversity techniques - Introduction - Need for smart antennas - Overview - Smart antenna configurations - Space Division Multiple Access - Architecture of a smart antenna system - Mutual coupling effects.

(9)

MOBILE SATELLITE ANTENNAS

Introduction - system requirements for vehicle antennas - omnidirectional antennas for mobile satellite communication - directional antennas for mobile satellite communication - antenna systems for GPS - Multiband antennas for future GPS/ITS services - Satellite constellation systems and antenna requirements.

(9)

MOBILE HANDESET ANTENNAS

Review of antenna basic parameters - Frequency bands for commercial applications - Cellular handset antenna design issues -Helical wire antennas and variants - Evolution of the PIFA - Ceramic chip and resonator antennas - SAR measurement and minimization - Provision for GPS and Bluetooth.

(9)

SPECIAL ANTENNAS

Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic-Reconfigurable antenna, Active antenna, Dielectric antennas - flagpote antenna - chimney antenna - ILS antenna - sugar-scoop antenna - asteroid detection antenna - embedded antenna - plasma antenna.

(9)

TOTAL: 45

TEXT BOOK

1. P. J. B. Clarricoats ,"Advanced Antenna Technology", Microwave Exhibitions and Publishers, 2nd Edition,1987.
2. Constantine A. Balanis, Panayiotis I. Ioannides, "Introduction to Smart Antennas" Morgan & Claypool Publishers, 1st Edition,2007.
3. Kyohei Fujimoto, "Mobile Antenna Systems Handbook", Artech House, 3rd Edition,2008

REFERENCES

1. Zhi Ning Chen, "Antennas for Portable Devices", John Wiley & Sons, 1st Edition 2007.
2. Lal Chand Godara, "Smart Antennas", C.R.C Press, 1st Edition 2004.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for all applications", John Wiley and Sons, 3rd Edition, New York, 2002.
4. Frank Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 1st Edition 2005.
5. Girish Kumar, K. P. Ray, "Broadband Microstrip Antennas", Artech house Inc., Boston, 2003.

19ECE52 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will demonstrate ability to

1. Explain EMI/EMC concepts and its sources
2. Explain the various coupling principles and standards
3. Describe the various EMI measurement methods and its control techniques
4. Describe the performance of EMC design for PCBs.
5. Explain the Measurement techniques for emission and about EMC standards.

EMI ENVIRONMENT

EMI/ EMC concepts and definitions - Electromagnetic environment- Natural and Nuclear sources of EMI: Celestial Electromagnetic Noise, Lightning Discharge, Electrostatic Discharge, Electromagnetic Pulse-EMI from apparatus and circuits: Noise from Relays and Switches.

(9)

EMI COUPLING PRINCIPLES AND STANDARDS

Conducted, radiated and transient coupling- Common ground impedance coupling – Common mode and ground loop coupling - Differential mode coupling – Near field cable to cable coupling - Field to cable coupling – Power mains and Power supply coupling-Cross talk in transmission lines.

(9)

EMI CONTROL TECHNIQUES

Shielding- Filtering- Grounding- Electrical Bonding- Isolation Transformer - EMI Suppression Cables- EMC connectors- Transient suppressors and Surge Suppression Devices.

(9)

EMC DESIGN OF PCBS

Component selection and mounting; Choice of capacitors, inductors, transformers and resistors, Power Distribution Decoupling – Zoning - Motherboard Designs and Propagation Delay Performance Models.

(9)

EMI MEASUREMENTS AND STANDARDS

Open area test site Measurements-Measurement Precautions-Anechoic Chamber- TEM cell- Reverberating Chamber, GTEM cell- Comparison of test facilities- Civilian standards: CISPR, FCC, EN- Military standards: MIL 461/462.

(9)

TO TAL:45

TEXT BOOK

1. V.P.Kodali, "Engineering EMC principles, Measurements and Technology", IEEE Press, Newyork, Wiley-Blackwell, Second Edition,2016.
2. Clayton R. Paul, "Introduction to Electromagnetic Compatibility "John Wiley & Sons,2014.

REFERNCES

1. Christos Christopoulos, "Principles and Techniques of Electromagnetic Compatibility", Second Edition, CRC Press, 2018
2. Bogdan Adamczyk , ' Foundations of Electromagnetic Compatibility: with Practical, Wiley, 2017
3. David A. Weston, "Electromagnetic compability: Methods, Analysis, Circuits and Measurments'' Third Edition, CRC Press,2016.
4. Henry W.Ott,, "Noise Reduction Techniques in Electronics System", John Wiley and Sons,Newyork,1998.
5. Bernhard Keiser, "Principles of Electomagnetic Compatibility", Artech house,3rd Ed,1994.

19ECE53 RF MICROELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Examine transceiver architecture and analyses RF components for effective transmission and Reception
2. Analyze impedance matching issues in Low Noise Amplifiers, mixers and Gilbert Cells.
3. Categorize and explain oscillators for RF Signal generation

4. Describe Phase detectors, charge pumps and synthesizers and infer stability issues
5. Assess the impedance matching issues in power amplifier during large signal power amplification.

TRANSCEIVER ARCHITECTURES

Heterodyne and Homodyne architectures – Direct conversion Transceiver-Low IF receiver - Discrete and CMOS realization of passive components for RF - Distortion - IP3 – Blockers and Blocker Filtering - Friis Formula for cascaded blocks**.**

(9)

CMOS LNAS AND MIXERS

Noise Figure and impedance matching issues –Common Source Amplifier – Common Gate Amplifier and differential LNAs - Passive mixers - Active mixers - Gilbert cells - linearity and Noise Figure of mixers.

(9)

OSCILLATORS

LC Resonator- Analysis of Oscillator as Feedback System-Negative Resistance generated by amplifier – Basic differential oscillator topologies – Modified Common-Collector Colpitts' Oscillator with Buffering-Phase Noise.

(9)

FREQUENCY SYNTHESIS

PLL Components-Continuous Time Analysis for PLL Synthesizers-Discrete Time Analysis for PLL Synthesizers-Transient Behavior of PLLs-Fractional-N PLL Frequency Synthesizers**.**

(9)

POWER AMPLIFIERS

Class A, B , C , D , E ,F and AB power amplifiers – Summary of Amplifier classes for RF Integrated Circuits -Matching to achieve desired power- Effects and Implication of Non- Linearity.

(9)

TOTAL: 45

TEXT BOOK

1. John Rogers and Calvin Plett, "Radio Frequency Integrated Circuit Design", Artech House, 2nd edition ,2010.
2. B. Razavi - "RF Microelectronics" - Pearson Education, 2nd edition , 2013.
3. Thomas H.Lee - "The Design of CMOS Radio Frequency Integrated Circuits"-,Cambridge University Press, 2nd Edition,2004.

REFERENCES

1. Ken Kuang, Franklin Kim, Sean S. Cahill, "RF and Microwave Microelectronics Packaging", Springer New York, 2009.

2. Serge Luryi, Jimmy Xu, Alex Zaslavsky, "Future Trends in Microelectronics: Up the Nano Creek", John Wiley & sons, 3rd Edition, 2007.
3. Marian K. Kazimierczuk ,"RF power amplifiers" Wiley, 2nd edition ,2014.
4. Carlos Quemada, Guillermo Bistue, Inigo Adin, "Design Methodology for RF CMOS phase locked loops", Artech house, 2008.
5. Ferri Losee, "RF Systems, Components and Circuits handbook", Artech house, 2nd edition 2005.

LIST OF OPEN ELECTIVES

CODE	COURSE NAME	L	T	P	Credits
19ECEOE01	SIGNAL PROCESSING AND ITS APPLICATIONS	3	0	0	3
19ECEOE02	SMART SENSORS AND IOT	3	0	0	3
19ECEOE03	CONSUMER ELECTRONICS	3	0	0	3
19ECEOE04	ROBOTICS	3	0	0	3
19ECEOE05	INFORMATION THEORY AND CODING TECHNIQUES	3	0	0	3
19ECEOE06	WIRELESS SENSOR NETWORKS	3	0	0	3
19ECEOE07	AUTOMOTIVE EMBEDDED SYSTEMS	3	0	0	3
19ECEOE08	5G TECHNOLOGIES AND APPLICATIONS	3	0	0	3
19ECEOE09	VEHICULAR COMMUNICATION	3	0	0	3

19ECEOE010	SENSING FOR AUTOMOTIVE SYSTEMS	3	0	0	3

19ECEOE01 SIGNAL PROCESSING AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Compute the Discrete Fourier Transform (DFT) of a given discrete time sequence using Radix-2 Fast Fourier Transform algorithms and design FIR/IIR Filters
2. Apply source coding procedure to calculate coding efficiency based on entropy & mutual information and outline different pulse analog modulation techniques
3. Analyze various equalization techniques and compare its performance
4. Calculate channel capacity using Shannon's channel capacity theorem and develop channel error control codes
5. Analyze speech processing methods in time and frequency domain and design codec methods for speech compression techniques

ORTHOGONAL TRANSFORMS AND DIGITAL FILTER STRUCTURES

DFT-DCT-Properties of DFT- Computation of DFT, FFT and structures-Decimation in time-Decimation in frequency - Linear convolution using DFT

Basic FIR/IIR filter structures-FIR/IIR Cascaded lattice structures-Parallel allpass realization of IIR transfer functions- Sine cosine generator - Computational complexity of filter structures

(10)

DATA COMPRESSION

Information entropy-Source coding-Huffman algorithm-Delta Modulation-Adaptive Delta Modulation- Continuously Variable Slope Delta Modulation-Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation.

(8)

SIGNAL PROCESSING IN COMMUNICATION RECEIVER

Temporal Equalization-Space Time Equalization-Frequency Domain Equalization-Symbol Timing Recovery- Channel Quality Estimation- Automatic Frequency Control-Overall Receiver Block.

(9)

ERROR CORRECTING CODES & CHANNEL CODING

Error Correcting codes-Error Correction-Linear Blocks Codes-Cyclic Codes- Bose, Chaudhari and Hocquenghem Codes-Convolution Codes-Viterbi Decoding-Interleaving Codes-Concatenated Codes-Turbo Codes.

(9)

SPEECH CODING

Speech Coding-Adaptive Predictive Coding-Sub Band Coding,-Vocoders-Liner Predictive Coding-Image Coding-Joint Photo Graphic Expert Group (JPEG)-Moving Pictures Expert Group (MPEG), the layer-3 of MPEG-1 Algorithms(MP3),Lempel- ZIV Algorithms - Recognition techniques:Speech Recognition and Image recognition.

(9)

TOTAL:45

TEXT BOOK

1. V. Oppenheim, R. W. Shafer and J.R.Buck, "Discrete-Time Signal Processing", Pearson Education, 3rd Edition,2011.
2. Simon Haykin, "Digital Communications Systems", 1st Edition, Wiley, 2013.

REFERENCES

1. Sanjit. K. Mitra and Sanjit Kumar Mitra, "Digital Signal Processing - A computer based approach", Tata McGraw Hill, 4th Edition, 2011.
2. Todd K Moon, "Error Correction Coding – Mathematical methods and Algorithms", John Wiley & Sons, 2005.
3. Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003
4. L.R.Rabiner and R.W.Schaffer "Digital Processing of Speech signals" Prentice Hall 1978
5. Nirmal K. Bose, Calyampudi Radhakrishna Rao, "Signal Processing and Its Applications" North-Holland, 1993

19ECEOE2 SMART SENSORS AND IoT

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY.

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

1. Explain the classification ,types,packaging and testing of smart sensors
2. Interpret the construction and working principles of Electronic sensors
3. Exemplify the working of different types of light radiation sensors .
4. Illustrate the key concepts of temperature ,gas and airquality sensors used to measure the parameters.
5. Interpret the characteristics, functional blocks and architecture of IoT to develop an IoT based applications.

SMART SENSORS BASICS

Sensor Classification, Performance and Types, Error Analysis characteristics- Semiconductor Packaging- Hybrid Packaging- Packaging for Monolithic Sensors- Reliability Implications-Testing Smart Sensors- HVAC Sensor Chip- Amplification and Signal Conditioning- Integrated Signal Conditioning- Digital conversion- MCU Control-MCUs for Sensor Interface- Techniques and System Considerations- Sensor Integration.

(9)

ELECTRONIC SENSORS

Resistance strain gauge - piezoelectric pressure gauge - characteristics- load cells-torque sensor- Piezo-resistive and capacitive pressure sensor- optoelectronic pressure sensors- vacuum sensors- Capacitor plate sensor, Inductive sensors, LVDT- Hall effect- Doppler detectors- liquid level detectors, flow sensors - ultrasonic sensor- flow sensors.

(9)

GHT RADIATION SENSORS

Electronic and Optical properties of semiconductor as sensors – LED - Semiconductor lasers- Fiber optic sensors- Thermal detectors - Photo multipliers- photoconductive detectors- Photo diodes- Avalanche photodiodes – CCDs - Intensity sensor – Interferometers-Phase sensor: Phase detection,

Polarization maintaining fibers.

(9)

TEMPERATURE, GAS AND AIR QUALITY SENSORS

Bimetallic strip- Bourdon temperature gauge- thermocouples- Resistance thermometers- thermistors- bolometer- Pyroelectric detector-Engine combustion process- Catalytic exhaust after treatment, Emission limits- Exhaust sensors and Engine control - Exhaust sensors for OBD- Hydro-Carbon Sensors- NOx-Sensors-Oxygen Sensors- Measurement of oxides of sulphur,oxides of nitrogen unburnt hydrocarbons,carbonmonoxide, dust mist and fog- smoke sensors.

(9)

IoT AND ITS APPLICATIONS

IoT Definition – Characteristics - IoT Functional Blocks –IoT Architecture –Physical design of IoT – Logical design of IoT- Sensing & Actuation -Basics of Networking - Communication Protocols- Machine-to-Machine - Communication models & APIs.

Domain specific applications of IoT*:* Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture, Smart Traffic Control and Smart water management.

(9)

TOTAL: 45

TEXT BOOK

1. Jacob Fraden," Handbook of modern sensors: physics, designs, and applications", 5th Edition, Springer, 2016.
2. Randy Frank, "Understanding Smart Sensors", Artech House, 2nd Edition, Boston, 2011.

REFERENCES

6. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
7. Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier, 1st edition, Netherland,2011.
8. John G Webster, "Measurement, Instrumentation and sensor Handbook", CRC Press, 2nd edition, Florida,2017.
9. John P. Bentley," Principles of Measurement systems", 3rd Edition, Pearson Education Asia Pvt. Ltd, 2009.
10. D. Patranabis," Sensors and Transducers", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2006.
11. Ernest O Doebelin, Dhanesh N Manik, "Measurement Systems, Application and Design", McGraw Hill, 6th Edition, 2007

19ECEOE03 - CONSUMER ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, students will be able to demonstrate an ability to

CO1: Understand the various types of microphones and loudspeaker.
CO2: Explain the principle and working of Monochrome TV.
CO3: Describe the Colour TV scanning process and camera tube.
CO4: Illustrate LCD, LED TV, working of cable TV and DTH.
CO5: Interpret the significant technical considerations using a broad systems perspective.

AUDIO SYSTEMS

Microphones Carbon, moving coil, wireless microphone; Loudspeakers – Direct radiating Electrostatic and horn loudspeaker; Multi-speaker system; Sound Recording - Magnetic Recording, Digital Recording, Optical Recording (CD system and DVD).

(9)

MONOCHROME TV

Elements of TV communication system, Scanning process, Scanning methods and Aspect Ratio, Need of synchronizing and blanking pulses, Composite Video Signal, Camera Tube: Vidicon.

(9)

COLOUR TELEVISION

Primary, secondary colours, Concept of Mixing, Colour Triangle, Camera tube, PAL TV Receiver, Concept of Compatibility with Monochrome Receiver, NTSC, PAL, SECAM.

(9)

LCD AND LED TELEVISION

Basic principle and working of LCD & LED TV, Cable Television: Working of Cable TV, DTH.

(9)

DOMESTIC & CONSUMER APPLIANCES

Operation of Microwave Oven, Automatic Washing Machine, Photostat Machine, Digital Camera, Vacuum cleaner, Food Processors, Scanner.

(9)

TOTAL: 45

TEXT BOOK

1. Bali S.P., “Consumer Electronics” Pearson Education, 2017.
2. Bali R and Bali S.P. “Audio video systems: principle practices & troubleshooting”, Khanna Book Publishing Co. (P) Ltd., 2010.

REFERENCES

1. Gulati R.R., “Modern Television practices” New Age International Publication (P) Ltd.2011.
2. Gupta R.G, “Audio video systems” Tata Mc graw Hill, 2010, 2nd Edition.
3. Whitaker Jerry & Benson Blair, “Standard Handbook of Audio engineering” McGraw-Hill Professional, 2010, 3rd Edition.
4. Amit Dhir, “The Digital Consumer Technology Handbook”, Elsevier Science, 2004.

19ECEOE04- ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, students will be able to demonstrate an ability to

CO1 : Describe the concepts of robotics, safety measures and homogeneous transformation.
CO2 : Formulate the concepts of mechanical drives and sensors in robotics.
CO3 : Describe the types of sensors and Robotic Vision
CO4 : Develop robotics programming, classifications and its applications.
CO5 : Exemplify the concepts of artificial intelligence.

ROBOT KINEMATICS

Introduction - Robotics and programmable automation - Historical background - Laws of Robotics - Robot definitions - Robotics system and Robot anatomy - Specifications of Robots - Safety measures in Robotics.

(**10)**

ROBOTIC DRIVERS AND CONTROLS

Robot drives, actuators and control - Functions of drive systems - General types of fluids - Pump classification - Pneumatic systems - Electrical drives - DC motors - Stepper motors - Drive mechanism. **(9)**

SENSORS AND MACHINE VISION

Need for sensing systems- Principles and Applications of the following types of sensors- Position and displacement sensors – Potentiometers, Encoders, Linear Variable Differential Transformer, Force and Torque sensors- Wrist sensor, Joint sensor, Tactile array sensor, Slip sensors- Proximity sensors- Range finders- Imaging sensors- Inductive Proximity switch- Acoustic sensors- Opto-electronic sensors- Lighting Techniques, Robot Vision- Sensing and Digitizing, Image Processing and analysis- Preprocessing, Segmentation, Description, Recognition, Interpretation and Applications of robot vision system **(9)**

ROBOTIC LANGUAGE AND PROGRAMMING

Robot language and programming. Robot language - Classification of Robot languages - Computer control and robot software - VAL system and language. Applications of Robots: Capabilities of Robots - Robotics applications - Obstacle avoidance.

(8)

ARTIFICIAL INTELLIGENCE IN ROBOTICS

The history of Artificial Intelligence- Artificial and Natural Intelligence- Artificial Intelligence and Automated manufacturing- The application domains of Artificial Algorithms- Risks and Benefits of AI- Agents and Environments- Knowledge representation.

(9)

TOTAL: 45

TEXT BOOK

1. Satya Ranjan Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 2nd Edition, 2012.
2. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2014.

REFERENCES

1. Robin.R.Murphy, "Introduction to AI Robotics", The MIT Press, Canbridge, Massachusetts, London, England, Second edition, 2019.

2. Jadran Lenarcic, Jean-Pierre Merlet, "Advances in Robot Kinematics 2016", Springer International Publishing AG, 2018.

3. Peter McKinnon, "Robotics", CreateSpace Independent Publishing Platform, 2016.

4. Ritu Tiwari, Anupam Shukla, Rahul Kala, "Intelligent Planning for Mobile Robotics: Algorithmic Approaches", Information science reference, United states of America, 2013.

5. David. L. Pool and Alan. K. Mackworth, "Artificial Intelligence: Foundations of Computational agents", Cambridge University,2011.

19ECEOE05 INFORMATION THEORY AND CODING TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the information content in a discrete memoryless source through parameters such as entropy and mutual information.

CO2 : Estimate a channel's capacity based on Shannon's channel capacity theorem

CO3 : Analyze various channel encoding and decoding methods

CO4 : Design and develop an error control coding methods for random error and burst error detection and correction techniques

CO5 : Understand different applications in coding techniques

INFORMATION THEORY AND SCHEMES FOR SOURCE CODING

Uncertainty Information and Entropy - Basic Properties of entropy - Information rate - Conditional entropy - Joint Entropy - Mutual Information - Channel capacity of a Gaussian channel

SOURCE CODING : Prefix codes - Necessary conditions for source coding - Kraft Mcmillan Inequality- Huffman Coding- Shannon Fano Coding Efficiency calculations. **(9)**

MEMORYLESS FINITE SCHEMES FOR CHANNEL CODING

Discrete Memoryless Channel - Channel models - BSC and BEC channels - Cascaded channels - Channel capacity of discrete and analog channels - Channel capacity of a Gaussian channel- Bandwidth-S/N trade-off-Channel coding theorem - Information capacity theorem - Code rate and redundancy-Parity check codes - Rate Distortion Theory.

(9)

LINEAR BLOCK CODES AND CYCLIC CODES

Rationale for coding - Types of codes - Matrix description of linear block codes - Syndrome decoding - Minimum distance considerations -Repetition codes - Dual codes- Cyclic codes :Generator polynomial - Parity check polynomial - Encoder of cyclic codes - Calculation of syndrome - Cyclic codes for error correction.

(10)

CONVOLUTIONAL CODES

Convolutional codes : Tree codes- Trellis codes- Viterbi decoding of convolutional codes - Catastrophic Error Propagation in Convolutional Codes -Performance Bounds for Convolutional Codes - Coding Gain - Convolutional Code Trade off - Soft Decision Viterbi Decoding -Feedback Decoding - Sequential Decoding

(9)

CODING TECHNIQUES IN DATA COMPRESSION

Static and Dynamic Huffman coding - Arithmetic coding – Run length encoding- Lempel-Ziv coding –Image compression techniques –JPEG standard for Lossy and Lossless compression- Video compression standards.

(8)

TOTAL : 45

TEXT BOOK

1. Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003..
2. Ranjan Bose, "Information Theory Coding and Cryptography", Tata McGraw Hill,3rd Edition 2016.

REFERENCES

1. Richard B.Wells, "Applied Coding and Information Theory for Engineers", Pearson Education, 1st edition Indian reprint, 2009.
2. Khalid Sayood, "Introduction to Data Compression", Fourth Edition, Elsevier, 2012.
3. Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2nd Edition, 2009.
4. Thomas M. Cover and Joy A. Thomas, “Elements of Information Theory”, John Wiley & Sons, 2nd Edition, 2006.
5. Reza F M, "An Introduction to Information theory", McGraw Hill, 2000.
6. Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 1st edition, 2021.

19ECEOE06 - WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

ASSESMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Outline the challenges & issues in the wireless sensor network and its subsystems and interpret network architecture and its components

CO2 : Describe the essential principles of the MAC protocols for Wireless Sensor Networks

CO3 : Elucidate the Routing & localization tracking inWireless Sensor Networks

CO4 : Discuss the features of WSN Operating systems

CO5 : Illustrate the methodologies to provide WSN based solution for various critical issues.

SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES

Challenges for Wireless Sensor Networks-Enabling Technologies for Wireless Sensor Networks-Characteristic requirements for WSN – WSN architecture – Commercially available sensor nodes – Imote, IRIS, Sunspot -Physical layer and transceiver design considerations in WSNs-Single Node Architecture –Energy Consumption of Sensor Nodes– Sensor Network Scenarios- Optimization Goals

and Figures of Merit.

(9)

DATA LINK LAYER

Fundamentals of MAC protocols- Issues in designing a MAC Protocol for WSN - Low duty cycle protocols and wakeup concepts – Contention based protocols:PAMAS - Schedule-based protocols:LEACH – Sensor MAC – Berkeley MAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4- Link Layer protocols – fundamentals task and requirements, error control, framing, link management, Address and Name Management, Assignment of MAC Addresses, Unique,Content-based and geographical addressing.

(10)

ROUTING AND TRACKING

Routing Challenges and Design Issues in Wireless Sensor Networks- Taxonomy :Data-centric routing SPIN - Energy aware routing, Gradient-based routing -Hierarchical Routing LEACH –Location Based Routing GAF, Data aggregation – Various aggregation techniques

A Tracking Scenario - Problem formulation - Distributed representation and inference of states- Tracking multiple objects - Sensor models - Topology control - Clustering - Time synchronization - Localization and Localization Services

(10)

EMBEDDED OPERATING SYSTEMS FOR WSNs

Embedded Operating Systems: Operating Systems for WSNs – Introduction - Operating System Design Issues– Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

(7)

APPLICATIONS OF WSN

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling

(9)

TOTAL : 45

TEXT BOOKS

1.Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, First Edition,2007.

2.Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

REFERENCES

1. Anna Hac, "Wireless Sensor Network Design", John Wiley & Sons, First Edition,2003.

2. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "Wireless Sensor Networks", Springer Publication, 2004.

3. Paolo Santi, "Topology Control in Wireless Adhoc and Sensor Networks", John Wiley & Sons, 2005.

4. Philip Levis, David Gay,"TinyOS Programming", Cambridge University Press, 2009 Contiki - Open Source Operating System for IOT - http://www.contiki-os.org/

19ECEOE07 AUTOMOTIVE EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Design modules for hybrid vehicle using automotive system components.
CO2: Design control system in automotives by appropriate choice of Microcontrollers, Sensors and actuators.
CO3: Examine the communication protocols for real time applications
CO4: Understand the safety and comfort in Automobiles as per the government test procedures.
CO5: Understand the communication and diagnostic protocols

AUTOMOTIVE SYSTEMS
Overview of Automotive industry - Tools and Processes - Introduction to modern automotive systems -Spark and Compression Ignition Engines - Automotive Transmissions - Vehicle braking fundamentals -Steering Control - Overview of Hybrid Vehicles - Analog and Digital Systems - Basic measurements systems. **(9)**

SENSORS AND ACTUATORS
Sensors: Characteristics, response and modeling - Actuators - Microcontroller and Digital Signal Processors used for automotive applications.
(9)

EMBEDDED COMMUNICATION
Embedded Automotive Protocols: CAN, LIN, FLEXRAY, MOST
(9)

SAFETY SYSTEMS
Active Safety Systems: ABS, TCS, ESP, brake assist - Passive Safety Systems: Airbag systems, Advance Driver Assistance system (ADAS) –Computer vision techniques - Connected cars technology - Trends towards Autonomous vehicles. **(9)**

FUNDAMENTALS OF DIAGNOSTICS

Basic wiring system and Multiplex wiring system, Self-Diagnostic system – various On board and off board diagnostics in Automobiles - Diagnostics tools - Diagnostics Protocols: KWP20000 and UDS.

(9)

TOTAL : 45

TEXT BOOK

Ronald K Jurgen, "Automotive Electronics Hand Book", McGraw- Hill, 2nd Edition 1999.

REFERENCES

6. William B. Ribbens, Ph.D, "Understanding Automotive Electronics", Elsevier Publications, 7th Edition, 2012.
7. Tom Denton, "Advance Automotive Diagnosis", 2nd Edition, Elsevier 2006.
8. BOSCH Automotive Handbook, 8th Edition
9. Denton. T, "Automobile Electrical and Electronics Systems", SAE (Society for Automobile Engineers) International, 3rd Edition 2004.
10. Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009.

19ECEOE08 5G TECHNOLOGIES AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course, the students will be able to demonstrate ability to

1. describe the evolution of cellular systems from 2G to 4G
2. explain the motivation, targets of 5G technology and its standardization
3. elaborate the 3GPP releases and 5G radio access network architecture
4. discuss the services offered by 5G deployment and its design approaches
5. understand the role between 5G and emerging next generation wireless technologies

EVOLUTION OF CELLULAR SYSTEMS

Evolution from 2G to 3G and 3G to 4G - Circuit Switch to Packet Switch - ITU Standardization Process- - Evolution of LTE and releases.

(9)

INTRODUCTION TO 5G

Motivation for 5G - 5G targets – Technology components - Spectrum – capabilities - The role of 3GPP in standardization - use cases – 5GPPP (Public-Private Partnership)

(9)

5G RADIO ACCESS NETWORK

Radio access – 3GPP Releases – 5G New Radio (NR) – Requirements – 3GPP phases for IMT-2020 - NR air interface – 5G RAN architecture

(9)

5G SERVICES

Enhanced Mobile Broadband (eMBB) systems - Massive Machine Type Communication (MMTC) system - Ultra Reliable and Low Latency Communication (URLLC) systems – Design approaches

(9)

EMERGING TECHNOLOGIES IN 5G

Massive MIMO – Network Function Virtualization – Software Defined Networking - Cognitive radio –Millimetre Wave - Heterogeneous network – Internet of Things

(9)

TOTAL : 45

TEXT BOOK

1. Saad Asif, "5G mobile Communications Concepts and Technologies", CRC Press,2018
2. Biljana Badic, Christian Drewes, Ingolf karls, Markus Mueck, "Rolling out 5G Use cases, Applications and Technology Solutions", Apress, 2016

REFERENCES

1. Antti Toskala, Harri Holma, Takehiro Nakamura, "5G Technology 3GPP New Radio", Wiley & Sons Ltd. 2020.
2. Devaki Chandramouli, Juho Pirskanen, Rainer Liebhart, "5G for the Connected World", Wiley,2019
3. Haesik Kim, "Design and Optimization for 5G Wireless Communications", Wiley, 2020
4. Ramjee Prasad , "5G Outlook Innovations and Applications", River Publications, 2016
5. Anwer Al-Dulaimi , "5G Networks Fundamental Requirements, Enabling Technologies, and Operations Management", Wiley, 2018
6. Mauro Boldi, Olav Queseth, Patrick Marsch, Ömer Bulakci, "5G System Design Architectural and Functional Considerations and Long Term Research", Wiley,2018

19ECEOE09-VEHICULAR COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

1. Understand basic principles, technologies, and system architecture of vehicular ad-hoc networks (VANET)
2. Analyze Physical Layer and MAC Layer for signal propagation for vehicular communication
3. Describe the various routing mechanisms and protocols to fulfill vehicular networking requirements.
4. Explain the challenges and issues in establishing cellular V2X connection and mobility management.
5. outline vehicular communication platforms for various emerging applications

INTRODUCTION TO VEHICULAR RADIO NETWORKS

Basic principles and challenges-Mobile Wireless Communications and Networks-Need for Vehicular Communications-VANET activities- Network Architecture for Vehicular Communications.

(9)

PHYSICAL LAYER AND MAC LAYER

Signal Propagation-Doppler spread and its impact on OFDM Systems-Proposed MAC approaches and standards, Intelligent Transportation Systems: IEEE 802.11p-ITS-IVC

(10)

VANET ROUTING PROTOCOLS

Opportunistic packet forwarding-topology based routing- geographic routing

(8)

VEHICULAR MOBILITY MANAGEMENT

Connected Vehicles& Connected Autonomous Vehicles- Dedicated Short Range Communication-flow and traffic models-Standards and Regulations- DSRC Protocol Stack, Cellular V2X

(9)

EMERGING VANET APPLICATIONS

Vehicle to Infrastructure Safety Applications-communication paradigms-message coding and composition-data aggregation- Security and Privacy

(9)

TOTAL:45

TEXT BOOK

1. H. Hartenstein and K. P. Laberteaux, VANET: Vehicular Applications and Inter-Networking Technologies, John Wiley & Sons Ltd., 1st Edition 2010.
2. Luca Delgrossi, Tao Zhang, "Vehicle Safety Communications: Protocols, Security, and Privacy", John Wiley & Sons Ltd1st Edition 2012.

REFERENCES

1. P. H.-J. Chong, I. W.-H. Ho, Vehicular Networks: Applications, Performance Analysis and Challenges, Nova Science Publishers, 2019.
2. C. Sommer, F. Dressler, Vehicular Networking, Cambridge University Press, 2015.
3. Popescu-Zeletin R, Radusch I and Rigani M.A, "Vehicular-2-X Communication",Springer,2010.
4. M. Watfa, Advances in Vehicular Ad-Hoc Networks: Development and Challenges, Information Science Reference, 2010.
5. H. Moustafa, Y. Zhang, Vehicular Networks: Techniques, Standards, and Applications, CRC Press, 2009.
6. Xiang W, "Wireless Access in Vehicular Environments Technology", Springer, 2015

19ECEOE10 SENSING FOR AUTOMOTIVE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

Upon completion of this course the students will be able to demonstrate an ability to

CO1: Acquaint with the basic automotive system components and need for automotive sensors.
CO2: Discuss the fundamentals of various Power train sensors in automotive systems.
CO3: Comprehend various sensors for chassis management.
CO4: Understand the sensors for vehicle management & security systems in Automobiles.
CO5: Examine the vehicle communication protocols standards in automotive applications.

AUTOMOTIVE SYSTEMS
Introduction to Modern Automotive Systems- Electronics in Automobiles - Combustion Engines- Power-train- braking systems – Transmission- Applications and Challenges in the automotive.
(9)

POWERTRAIN AUTOMOTIVE SENSORS
Exhaust temperature sensor - λ sensors - PM sensor - NOx sensor - fuel quality sensor- level sensor- torque sensor-speed sensor- manifold pressure sensor - mass flow sensor.
(9)

CHASSSIS SENSORS
Wheel speed sensors/direction sensors- steering position sensor (multi turn)- acceleration sensor (inertia measurement)- brake pneumatic pressure sensor- ABS sensor- electronic stability sensor.
(9)

SENSORS FOR VEHICLE MANAGEMENT & SECURITY SYSTEMS
Gas sensors (CO2)- Temperature/humidity sensor- air bag sensor- key less entering sensor- radar sensors. Tire pressure monitoring systems- Two wheeler and Four wheeler security systems. **(9)**

VEHICLE COMMUNICATION STANDARDS
Automotive Protocols: CAN, LIN, FLEXRAY, MOST
(9)

TOTAL : 45

TEXT BOOK

John Turner, Automotive Sensors, 2010, Momentum Press, 1st Edition, New York.

REFERENCES

1. Automotive Electrics, Automotive Electronics: Systems & Components, 2014, 5th Edition, BOSCH.
2. Ronald K Jurgen, "Automotive Electronics Hand Book", McGraw- Hill, 2nd Edition 1999.
3. Automotive Sensors Handbook, 8th Edition, 2011, BOSCH

4. Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, Iwao Yokomori, “Sensors for Automotive Technology”, 4th Edition, Wiley, New York, 2010.
5. Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009.

LIST OF ONE CREDIT COURSES

S.No	Subject Code	TITLE OF THE COURSE	GROUP
1	19ECOC01	BASICS OF PYTHON	I
2	19ECOC02	QUANTITATIVE APTITUDE FOR ENGINEERS/ VERBAL APTITUDE FOR ENGINEERS	III
3	19ECOC03	PROBLEM SOLVING WITH ALGORITHMS AND DATA STRUCTURES	I
4	19ECOC04	PROGRAMMING IN C: A PRACTICAL APPROACH	I
5	19ECOC05	PROGRAMMING IN C++	I
6	19ECOC06	WEB DESIGNING AND JAVA	I
7	19ECOC07	VIRTUAL INSTRUMENTATION	I
8	19ECOC08	INTERNET OF THINGS: A HANDS-ON APPROACH	I
9	19ECOC09	MACHINE LEARNING ALGORITHMS USING PYTHON	I
10	19ECOC10	PROGRAMMING IN SCILAB	I
11	19ECOC11	PCB DESIGN AND FABRICATION	II
12	19ECOC12	DRONE – DESIGN& DEVELOPMENT	II
13	19ECOC13	LORA TECHNOLOGY	II
14	19ECOC14	APPLICATION DESIGN USING RASPBERRY PI & PYTHON	II
15	19ECOC15	INTERNET OF THINGS (IOT) COMMUNICATION PROTOCOLS	II
16	19ECOC16	COMMUNICATION SKILLS FOR ENGINEERING PROFESSIONALS	III
17	19ECOC17	ENTREPRENEURSHIP AND MANAGEMENT FUNCTIONS	III
18	19ECOC18	PROFESSIONAL SKILLS FOR ENGINEERING PROFESSIONALS	III
19	19ECOC19	LEADERSHIP AND MANAGEMENT SKILLS FOR ENGINEERING PROFESSIONALS	III
20	19ECOC20	INNOVATION MANAGEMENT	III
21	19ECOC21	PROJECT MANAGEMENT	III
22	NPTEL COURSES		IV

GROUP	GROUP NAME
I	PROGRAMMING COURSES
II	INDUSTRY COLLABORATED COURSES

III	SOFT SKILLS DEVELOPMENT COURSES
IV	NPTEL COURSES

19ECOC01 BASICS OF PYTHON

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain basic concepts and illustrate data types, operators, and I/O functions forwriting Python Programming

CO2 : Write Python programs using conditional statements and list and interpret results

INTRODUCTION

Conceptual introduction, topics in computer science, algorithms,modern computer systems, hardware architecture, data representation in computers, software and operating system,installing Python: basic syntax, interactive shell, editing, saving, and running a script,The concept of data types; variables, assignments, immutable variables,numerical types, arithmetic operators and expressions, comments in the program, understanding error messages. **(7)**

CONTROL STATEMENTS AND LIST

Conditions, boolean logic, logical operators,rangesControl statements: if-else, loops (for, while) String manipulations: subscript operator, indexing, slicing a stringstrings and number system: converting strings to numbers and vice versa , Binary, octal, hexadecimal numbersLists, tuples, and dictionaries basic list operators, replacing, inserting, removing an element- searching and sorting listsDictionary literals, adding and removing keys, accessing and replacing values-Traversing dictionaries-Case Study. **(8)**

TOTAL:15

TEXTBOOK

Fundamentals of Python, First Programs Author, Kenneth Lambert Publisher, Course Technology, Cengage Learning, 2012 ISBN-13: 978-1-111-82270-5.

19ECOC02 QUANTITATIVE APTITUDE FOR ENGINEERS/ VERBAL APTITUDE FOR ENGINEERS

APTITUDE SYLLABUS:

QUANTITATIVE:

- Time And Work
- Time, Speed, Distance
- Averages
- Ratios & Proportions
- Sequence, Series And Progressions
- Co-Ordinate Geometry
- Statistics
- Combinatorics
- Percentage
- Trigonometry
- Set Theory
- Theory Of Equation
- Logarithm
- Functions And Graph
- Data Interpretation On Multiple Charts
- Profit And Loss
- Simple Equation
- Algebra
- Geometry
- Data Interpretion
- Alligations And Mixtures
- Simple Interest & Compound Interest
- Pipes And Cisterns
- Problems On Hcf And Lcm
- Linear Algebra
- Probability
- Percentages
- Permutations & Combinations
- Numbers
- Functions
- Mensuration
- Sudoku
- Areas, Shapes, Perimeter
- Height And Distance
- Partnership

- Races And Games
- Simplification
- Clocks & Calendars
- Problems On Ages
- Surds & Indices
- Data Sufficiency
- Logarithms
- Problems On Trains
- Cryptarithmetic
- Divisibility
- Numbers And Decimal Fractions
- Spatial Ability
- Chain Rule

VERBAL

- Paragraph Formation
- Sentence Completion
- Reading Comprehensions
- Sentence Correction
- Spotting Errors
- Sentence Selection
- Antonyms
- Synonyms
- Theme Detection
- Parts Of Speech
- Jumbled Sentences
- Selecting Words
- Sentence Improvement
- Odd Words
- Sentence Formation
- Fact - Inference - Judgement
- Fill In The Blanks
- One Word Substitution
- Idioms And Phrases
- Spellings

19ECOC03 PROBLEM SOLVING WITH ALGORITHMS AND DATA STRUCTURES
(ONE CREDIT COURSE- LABORATORY)

ASSESSMENT: PRACTICAL

LIST OF EXPERIMENTS

- Sparse and Dense Matrix operations using arrays
- Implementation and Applications of Linked List- Singly linked, Doubly linked and Circular lists
- Implementation and applications of stacks
- Implementation and application of queues
- Binary search trees and Minimum cost spanning tree
- Graphs - Depth First Search and Breadth First Search
- Sorting algorithms

REFERENCES

1. Jean Paul Tremblay and Sorenson, ―An Introduction to Data Structures with Applications, McGraw Hill Publishing Company, New Delhi, 2012.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, ―Introduction to Algorithms, MIT Press, England, 2009.
3. Venkatesan R and Lovelyn Rose S, ―Data Structures‖, Wiley India Pvt Ltd, New Delhi, 2015.
4. Laboratory Manual , Prepared by Department , CIT

19ECOC04 PROGRAMMING IN C: A PRACTICAL APPROACH

- Data Types, Variables and Constants
- Operators & Expressions
- Input Output statements
- Conditional statements
- Loops
- Arrays
- Pointers with Arrays
- Concepts of Arrays and Pointers. Debugging concepts. Examples.
- Pointers with functions and call types
- Concepts of Functions. Debugging examples.

TOTAL: 15

REFERENCES

1. Byron S.Gottfried and Jitender Kumar Chhabra, ―Programming with C, Tata McGraw Hill Publishing Company, 4th Edition, New Delhi, 2018.
2. Brian W.Kernigham and Dennis M.Ritchie, ―C programming Language (ANSI C), Pearson India, 2nd Edition, 2015.
3. Herbert Schildt, ―C-The Complete Reference, Tata McGraw Hill Publishing Company, 4th Edition, New Delhi, 2010.
4. PradipDey and ManasGhosh, ―Programming in C, Oxford University Press, New Delhi, 2nd edition, 2011.
5. Deitel and Deitel, ―C How to Program, Pearson Education, 7th Edition, New Delhi, 2013.

6. E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill, 8th Edition, New Delhi, 2019.

19ECOC05 PROGRAMMING IN C++

BASICS OF C++ & ABSTRACT DATA TYPE IN C++

Introduction to C++ - Programming Paradigms - Procedural Programming - Conquering Complexity - Built-in Types - Arrays and Pointers - Comments, Keywords & I/O Streams- Built-in Operators and Control Constructs - Structures, References and Functions

Encapsulation: Data Members, Member Functions, Private and Public - Constructors and Destructors: Default Arguments, Storage Allocation and Deallocation, this Pointer, Copy Constructors. **(7)**

OPERATOR OVERLOADING & POLYMORPHIC PROGRAMMING

Operator functions - Binary and unary operators - Member and non-member operators - Friend functions - Initialization vs. Assignment - Stream Input and Output

Inheritance: Public Inheritance and Subtyping, Base and Derived Classes, Constructors and Destructors, Base Class Initialization, Using Protected keyword- ***Virtual Functions***: Base Class Pointers and References - Dynamic Binding: Abstract Base Classes, Pure Virtual Functions & Virtual Destructors –***Exceptions:*** try, catch & throw -Exception Hierarchies - File streams.

(8)

TOTAL: 15

REFERENCES

1. BjarneStroustrup, "The C++ Programming Language", 3rd edition, Pearson Education, 2000.
2. Stanley B Lippman, Jove Lajoie, and Barbara Moo "C++ Primer", 5th Edition, Addison Wesley, 2012.

19ECOC06 WEB DESIGNING AND JAVA

SCRIPTING

Web page Designing using HTML, Scripting basics- Client side and server side scripting. Java Script- Object, names, literals, operators and expressions- statements and features- events - windows - documents - frames - data types - built-in functions- Browser object model - Verifying forms.- HTML5- CSS3- HTML 5 canvas - Web site creation using tools.

(5)

JDBC

JDBC Overview – JDBC implementation – Connection class – Statements - Catching Database Results, handling database Queries. Networking– InetAddress class – URL class- TCP sockets - UDP sockets, Java Beans –RMI.

(3)

APPLETS

Java applets- Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. Event Handling. Introducing AWT: Working with Windows Graphics and Text. Using AWT Controls, Layout Managers and Menus. Servlet – life cycle of a servlet. The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction to JSP. **(4)**

WEB BASED APPLICATIONS AND ITS TECHNOLOGIES

Rails: Overview of Rails - Document request - Processing forms - Rails application with databases - Layouts - e-Business Models - e-Marketing - online payments and Security.

(3)

TOTAL:15

REFERENCES

1. Deital&Deital, "Internet and World Wide Web-How to Program", Pearson Education Fifth Edition, 2011.
2. RashimMogha, Preetham. V.V. "Java Web Services Programming", Wiley Dreamtech, New Delhi, Java 2 Enterprise Edition, 2003. (Server Side Technologies)
3. Robert W.Sebesta, "Programming with World Wide Web", Pearson Education, Eighth Edition, 2015.

19ECOC07 VIRTUAL INSTRUMENTATION

INTRODUCTION TO LABVIEW

Introduction to Virtual Instrumentation - Basics of LabVIEW – Loops – Structures - Arrays and Clusters - Graphs and Charts - State Machines - File Input/Output - String Handling.

(4)

DATA ACQUISITION

Signals Handling and Classification – Signal Conditioning - Analog Interfacing (I/O) -Data Acquisition with LabVIEW DAQ Vis –Interfacing with Assistants - Interfacing Instruments.

(3)

COMMON INSTRUMENT INTERFACES

GPIB-RS232-Handshaking- RS232/RS485 interfacing, VISA – IVI - PCMCIA – SCXI – VXI - Networking basics for office & Industrial applications.

(4)

APPLICATIONS

Motion Control - Virtual Instrumentation and CAD Tool, Remote Front Panel LabVIEW Applications, Timed Loop Applications Client–Server Applications.

(3)

TOTAL:15

REFERENCES

1. S. Gupta and J. John, "Virtual Instrumentation using LabVIEW", Tata McGraw-Hill Publishing Company Limited New Delhi, 2010.
2. Jovitha Jerome, "Virtual Instrumentation Using Labview", Prentice Hall of India, 2010
3. Bruce Mihura, "LabVIEW for Data Acquisition", Prentice Hall of India, 2013

19ECOC08 INTERNET OF THINGS: A HANDS-ON APPROACH

PREREQUISITES

Basic programming knowledge

Embedded 'C' programs using Arduino uno boards

1. Introduction to Arduino IDE
2. Display LED Brightness on a 16x2 LCD
3. Sensor Interfacing with Arduino (DHT11,PIR,Relay & Motor)

4. Google Assistant Based Voice Controlled Home Automation using DIY Arduino Wi-Fi Shield
5. IoT based weather monitoring system to track temperature and humidity data over the internet using Arduino and ThingSpeak.

Embedded 'C' programs using NODE MCU ESP 8266 boards

1. IoT Controlled LED using Google Firebase Console
2. Track a Vehicle on Google Maps using Arduino, ESP8266 & GPS
3. IoT Based Air Pollution Monitoring System to monitor the Air Quality over a webserver using internet
4. Develop an Android application using called MIT App Inventor 2 to control the colour of an RGB LED with a smart phone via Bluetooth module.
5. Develop a simple home security system using Wi-Fi module, HC-SR04 ultrasonic sensor and the IFTTT app

Python Programming using Raspberry Pi boards

1. Getting started with Raspberry Pi – OS Installation, library dependencies, Internet Connectivity.
2. Interfacing XBee Module with Raspberry Pi
3. Data acquisition and control using the MQTT based cloud server with the user interface as Mobile APP and web browser
4. Real Time Face Recognition with Raspberry Pi and OpenCV
5. Optical Character Recognition (OCR) using Tesseract on Raspberry Pi

TOTAL:15

REFERENCES

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press) Research papers
3. "Arduino Projects and Tutorials" by Rui Santos of the RandomNerd Tutorials.com Blog.

19ECOC09 MACHINE LEARNING ALGORITHMS USING PYTHON

Module 1 - Introduction to Machine Learning

Applications of Machine Learning
Supervised vs Unsupervised Learning
Python libraries suitable for Machine Learning

Module 2 - Regression

Linear Regressions
Non-linear Regression
Model evaluation methods

Module 3 - Classification
K-Nearest Neighbour
Decision Trees
Logistic Regression
Support Vector Machines
Model Evaluation

Module 4 - Unsupervised Learning
K-Means Clustering
Hierarchical Clustering
Density-Based Clustering

Module 5 - Recommender Systems
Content-based recommender systems
Collaborative Filtering

REFERENCES:

1. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, 2016.
2. Jason Brownlee, "Machine Learning Algorithms From Scratch with Python", Machine Learning Mastery, 2016.
3. Dipanjan Sarkar, Raghav Bali, Tushar Sharma, "Practical Machine Learning with Python", Apress, 2017.
4. Sebastian Raschka, "Python Machine Learning", Packt Publishing, 2015.
5. Rudolph Russell, "Machine Learning -Step-By-Step Guide to Implement Machine Learning Algorithms with Python", CreateSpace Independent Publishing Platform, 2018.

19ECOC10 PROGRAMMING IN SCILAB

- Scilab environment
- Scilab workspace and working directory
- Scalars and Vectors
- Matrices
- Polynomials
- Plotting graphs
- Scilab programming language
- Statistics

- Script files and function files

REFERENCES:

1. Hema Ramachandran, Achuthsankar S. Nair, “Scilab A Free Software to MATLAB”, S. Chand Limited, 2012.
2. Rachna Verma , Arvind Verma, “Introduction to Scilab”, 2018
3. Sandeep Nagar, “Introduction to Scilab”, Apress, 2017.
4. Vandana Bagla, “Computational Programming Using Scilab”, KDP, 2019.
5. Perrine Mathieu, Philippe Roux, “Scilab : I. Fundamentals”, Scilab Enterprises, 2016.

19ECOC11 PCB DESIGN AND FABRICATION

INTRODUCTION& SCHEMATIC CAPTURE

Basics of PCB- History of PCB- Different types of materials : FR-4 , PTFE , Metal - Types of PCB : Single sided , Double sided , Multi-Layer , Rigid , Flex , Rigid-Flex - Packages: Through Hole , Surface Mount , Flat , Small outline , Solder pads , Vias , Solder Mask , Silk Screen , Fabrication Process : Screening , printing , Etching , Drilling , Masking.

Installation process of Altium - Project Creation - Adding sheets - Panels - Compoents-Types of components - Adding components to schematic sheets - Net lanels- Wires - Ports - Connecting components - ERC - Validating schematics - Debugging the errors . **(7)**

LIBRARY CREATION& PCB LAYOUT

Adding integrated library file - Introduction to Symboyl wizard - Creation of Componentsymboyl - Getting data from data sheet - Introduction to footprint wizard -Measurments- Creating footprint - Validating integrated library.

Adding PCB file - Setting the orgin- Shaping the PCB - Updating schematic components to PCB- Components Placement - Routing : Auto-Routing , Manual Routing- Layer stack , Design Rule Check - Debugging errors - Generating fabrication outputs .

(8)

TOTAL: 15 HOURS

TEXT BOOK

Roger Hu, “PCB Design and Layout Fundamentals” First Edition, 2019

WEB URLs:

Fundamentals of PCB designing - Altium Academy: https://resources.altium.com/

19ECOC12 DRONE – DESIGN & DEVELOPMENT

INTRODUCTION

Understanding the aerodynamics behind drone - Parts of drone - Construction of drone -Propeller basic - Relation between weight and thrust - Motions in drone- Drone pitch - Rolling motion - Yaw motion - Throttle – Hovering - Factors to be considered while selecting the Motors - Calculation behind parts selection.

(7)

EXAMINING, ASSEMBLING AND FLYING

Motors - Electronic speed controller – Propellers- Understanding flight controller - RF transmitter and receiver - Assembling all parts to frame - Calibrating the ESC & flight controller - Possible errors and mistake & rectification - Operating condition -Flying drone.

(8)

TOTAL: 15 HOURS

TEXT BOOK:

John Baichtal , “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, 1st Edition,Pearson Education, 2015.

WEB URLs:

- https://www.thecasefarm.co.uk/how-to-build-your-own-drone/
- https://travelbydrone.com/important-things-to-know-before-buying-your-first-drone/
- https://www.wired.com/story/guide-drones/
- https://www.ctia.org/news/up-up-and-away-how-do-drones-work

19ECOC13 LoRA TECHNOLOGY

INTRODUCTION TO LoRa AND LoRaWAN:

LoRa specifications–LoRa Modulation techniques-Chirp Spread Spectrum - Spreading Factor -LoRa Spread Spectrum Modulation -LoRaapplications -Network Coverage - Low-Power Wide Area Networks

LoRaWAN specifications- Packet Forwarders -Hardware for End Devices -Hardware for Gateways - LoRaWAN Frequencies -LoRa End Node - MAC Configuration-RFM9x LoRa Radio Transceiver Breakouts –Sensor Integration with Arduino based LoRaWAN Wireless Modules – GPS break out board -LoRa Gateway Configuration.

(7)

INTEGRATION OF IoT SERVERS WITH A LoRa WIRELESS NETWORKS

Building a low-cost single-channel LoRa gateway based on the Raspberry Pi – Application creation on the Things Network - Connecting with IoT Servers Using a RESTful API –Connecting IoT server using the MQTT protocol with a LoRa wireless network - Upstream/Downstream Data-Local LoRa Server Port- Create /Update Application Server to Data base.

(8)

Case studies : Design and development GPS tracking system.

TOTAL: 15 HOURS

TEXT BOOKS:

1. Seneviratne P., Introduction to LoRa and LoRaWAN. In: Beginning LoRa Radio Networks with Arduino. Apress, Berkeley, CA (2019). https://doi.org/10.1007/978-1-4842-4357-2_1
2. Daniel Minoli Building the Internet of Things With IPv6 and MIPv6 , The Evolving World of M2M Communications John Wiely ,First Edition. 2013
3. David Boswarthick, Omar Elloumi and Olivier_Hersent, M2M Communications, A systematic Approach John Wiely,First Edition. 2012

WEB URLs:

1. www.semtech.com/lora/what-is-lora
2. www.os.mbed.com/docs/mbed-os/v5.15/tutorials/LoRa-tutorial.html

19ECOC14 APPLICATION DESIGN USING RASPBERRY PI & PYTHON

INTRODUCTION TO PYTHON & EMBEDDED SYSTEMS

Basic Python Syntax - Data Types - Numbers and Math functions -Variables & Names –Strings - Conditional statements - For and while Loop - List, Tuple and Dictionary -Python Functions – Modules - Exceptions, File Handling

Embedded Systems - Open source hardware (Raspberry pi) - LED and Switch Interfacing- Digital Sensor Interfacing applications - Actuator Interfacing - Application Development using Digital sensors. **(7)**

IoT DESIGN USING RASPBERRY PI

Introduction to SPI -Analog Sensor Interfacing applications -Data collection and visualization for real-time systems - Open source IoT cloud and end device -Real time data monitoring application development - Bluetooth Communication using RFCOMM & L2CAP - Sensor Data transmission - Sensor Data transmission through Bluetooth to Cloud -UDP Communication of Devices using WiFi without using Internet - Device Control & application design using UDP - Transmit and Receive Text using UART Communication between two devices - Device Control & Application Design using UART Communication - MQTT based application development - Device Control using Mobile & Web application. **(8)**

TOTAL:15

TEXT BOOKS:

1. Gary Mitnick ,"Raspberry Pi 3: Learn to Use Raspberry Pi 3! An Introduction to Using With Python, Scratch, Javascript and More", Createspace Independent Publication, First Edition, 2017
2. Tim Cox & Steven Lawrence Fernandes, "Getting Started with Python for the Internet of Things", Packt Publishing; 1st edition ,2019
3. Gareth Halfacree&Eben Upton, "Raspberry Pi User Guide" John Wiley & sons, First Edition, 2016.

19ECOC15 INTERNET OF THINGS (IOT) COMMUNICATION PROTOCOLS

Introduction to IoT&IoT Communication Protocols

- Introduction to IoT
- Overview of IoT Communication Protocol
- Wireless Development Module

Hardware Implementation on Bluetooth, BLE, Zigbee, Wi-Fi & MQTT protocols

Introduction to Bluetooth & BLE Architecture, Zigbee, Wi-Fi & MQTT protocols
Demo1: Bluetooth Communication with Wireless Development Module

- Demo2 : BLE Communication with Wireless Development Module
- Demo 3: Zigbee Communication Protocol with Wireless Development Module
- Demo 4: HTTP Protocol with Wireless Development Module
- Demo5: MQTT Communication with Wireless Development Module

Introduction to Long Range Communication Protocol

- Introduction to Long Range Communication Protocols
- LoRa, Sigfox, NB-IoT
- Introduction to 4 Layer & 3 Layer Architecture Model

Three Layer Architecture Model for Long Range Communication

- Hybrid of LoRa with MQTT
- Hybrid of LoRa with TCP

Hardware Implementation on Long Range Communication Protocol

- Demo6: Gateway Registration
- Demo7: Network Server Registration
- Demo8: Application Server Registration
- Demo9: Long Range Communication using Wireless Development Module

TOTAL: 15

REFERENCES

1. J.-P. Vasseur& A. Dunkels. "Interconnecting Smart Objects with IP: The Next Internet". Morgan Kaufmann, 2010
2. Olivier Hersent, David Boswarthick&Omar Elloumi ," The Internet of Things: Key Applications and Protocols, Wiley, First Edition, 2011

19ECOC16 COMMUNICATION SKILLS FOR ENGINEERING PROFESSIONALS

Introduction to Communication: Need for effective communication, Functions of Communication and Induction to the students, Communication Cycle, Levels of communication; Flow of communication; Communication networks; General and Technical Communication.

Non-verbal Communication and Body Language: Forms of Non-verbal communication; Kinesics; Proxemics; Chronemics and Effective use of body language.

Presentation Skills: 4Ps (Planning, Preparation, Practice, Presentation), Outlining; Effective use of A/V aids and Modes of Delivery

Listening Skills: Hearing Vs listening, process of listening, types, Barriers to Listening, Qualities of a Good Listener and Active Vs Passive Listening

Speaking Skills: Introducing yourself, Describing a person, place, situation and event, Giving instruction, Making inquiries – at a bank, post-office, air-port, hospital, reservation counter and role play

Writing Skills: Basics of Writing, Paragraph Writing, Precise Writing, Memos, Advertisements, Paraphrasing and Summarizing.

Letter Writing: Informal Letter, (Formal) Business Letters: Essential and Occasional Parts of a letter, layout, Characteristic and Letter of Inquiry, Complaint and Adjustments, orders and replies of it

Report Writing: Format, Structure and Types, Technical Reports, Description and Proposal

Reading Skills: Skimming and Scanning, Intensive and Extensive Reading, Poor habits of reading and The SQ3R Method

Grammar and Vocabulary: Tenses, Determiners, prepositions, conjunctions, Model Auxiliaries, concord, active and passive voice, Homonyms, Homophones, Acronyms.

REFERENCES:

1. Muralikrishna C., Sunita Mishra "Communication Skills for Engineers" 2nd edition, Pearson, New Delhi 2010
2. Vyas Manish A., Yogesh L. Patel, "Tasks for the English Classroom", MacMillan, New Delhi, 2012.
3. Michael vince, 'Advanced Language Practice', Macmillan Education, Oxford,2003
4. Iris, "English for Materials Science and Engineering", Springer Fachmedien Wiesbaden GmbH 2011
5. Lougheed Lin, "Business Correspondence: A Guide to Everyday Writing', Longman, Pearson Education, Inc,2003

19ECOC17 ENTREPRENEURSHIP AND MANAGEMENT FUNCTIONS

ENTREPRENEUR: Definition, Functions of an Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship -Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.

MANAGEMENT: Introduction -Meaning -nature and characteristics of Management, Scope and functional areas of Management -Management as a Science, Art or Profession Management & Administration -Roles of Management, Levels of Management, Development of Management Thought- Early Management Approaches-Modern Management Approaches.

PLANNING: Nature, importance and purpose of planning process -Objectives -Types of plans (Meaning only) -Decision making -Importance of planning -steps in planning & planning premises -Hierarchy of plans.

ORGANISING AND STAFFING: Nature and purpose of organization -Principles of organization Types of organization -Departmentation -Committees – Centralisation Vs Decentralisation of authority and responsibility -Span of control -MBO and MBE Nature and importance of Staffing Process of Selection & Recruitment.

DIRECTING & CONTROLLING: Meaning and nature of directing -Leadership styles, Motivation Theories, Communication -Meaning and importance – Coordination, meaning and importance and Techniques of Co -ordination. Meaning and steps in controlling -Essentials of a sound control system Methods of establishing control.

REFERENCES:

1. P. C. Tripathi, P. N. Reddy, "Principles of Management", Tata McGraw Hill, 4th Edition, 2010.

2. Vasant Desai, "Dynamics of Entrepreneurial Development & Management" Himalaya Publishing House, 2010.
3. Donald F.Kuratko, "Entrepreneurship: Theory, Process, Practice", South-Western College Publishing, 2019.
4. Prasanna Chandra, "Projects- Planning, Analysis, Financing, Implementation and review", Tata McGraw Hill, 2012.
5. Manjunath V.S., "Entrepreneurship & Management", Pearson Education, 2010.

19ECOC18 PROFESSIONAL SKILLS FOR ENGINEERING PROFESSIONALS

Engineer as a Professional, Time Management and Organisational Skills
• Reflective practice for self-development
• Benefits of self-awareness and emotional management
• Personal style and the impact it has in a collaborative environment
• Managing Time: Setting SMART goals and establishing objectives; setting priorities and scheduling time
• Organisational Skills
• Professional Ethics for Engineers
Complex and Creative Problem Solving
• Model Based Problem Solving
• Fault Finding individual issues – SWAT and Taskforce
• Problem Solving Tools – 5 Whys , 5 E + 1 H , Direct Observation Techniques , KT Analysis
• Mental Models
• Critical Thinking with Team Exercise
• Socratic Questioning

Coaching, Mentoring & Team Leadership Skills
• Characteristics of Effective Teams
• Developing Relationships for Effective Teams
• Constructive Feedback, Delivering and Receiving Feedback
• RAPID decision making model
• Key elements of effective meetings
• Key elements of a team charter
Project Management Fundamentals
• The Nature of Projects – background to project management and how it delivers value
• Managing Scope – managing project requirements and developing project work tasks
• Detailed Planning – Preparing Schedules and Budgets
• Project Control – Addressing uncertainty and reporting performance.
Technical Writing Skills
• Structure of reports and proposals; standard practices in presentation of scientific and engineering information
• Standard writing practices, terminology and formatting
• Structure of sentences and paragraphs: clarity, organization, continuity and emphasis
• Organizing and communicating the experimental and technical details

• Standards in the use of graphs and tables for data presentation; schematics, micrographs and pictures
• Quantitative analysis and mathematical descriptions
• Grammatical issues in technical writing

Communication & Presentation Skills

• The Nature of Projects
• Managing Scope
• Detailed Planning
• Project Control

REFERENCES:

1. Kevin Retz, "The Professional Skills Handbook For Engineers And Technical Professionals", CRC Press, 2019.
2. Raymond Greenlaw, "Technical Writing, Presentational Skills, and Online Communication", Information Science Reference, 2012.
3. Christee Gabour Atwood , "Presentation Skills Training", American Society for Training & Development, 2017.
4. Donald J. Treffinger, Scott G. Isaksen, K. Brian Stead-Dorval, "Creative Problem Solving", Prufrock Press,2006.
5. David Allred Whetten, "Developing Management Skills", Pearson Education, 2011.

19ECOC19 LEADERSHIP AND MANAGEMENT SKILLS FOR ENGINEERING PROFESSIONALS

- Internal and external organisational environments
- Effects of culture on organisations
- Motivation and leadership of project teams
- Diversity and multi-cultural appreciation and management
- Stakeholder management
- Contractual relationships
- Supply chain management
- Nature of professionalism
- Morality, negligence, integrity, responsibility

REFERENCES:

1. Dennis W. Hess, "Leadership by Engineers and Scientists", Wiley, 2018.
2. Pamela McCauley, "Essentials of Engineering Leadership and Innovation", CRC Press, 2017.
3. Michael K. Badawy , "Developing Managerial Skills in Engineers and Scientists", Wiley, 1995.

19ECOC20 INNOVATION MANAGEMENT

EXPLORING INNOVATIONS

- Processes used to explore innovations along the technology, market and strategy dimensions as the innovation moves from idea to market.
- Introduction to concepts such as Blue Ocean Strategy, Value Network, Disruptive Innovation, Open Innovation

(3)

EXECUTING INNOVATIONS

- Structures and incentives to effectively allow talented individuals from different functions to execute innovation processes
- Roles such as Chief Innovation or Technology Officer or Technology Evangelist **(4)**

EXPLOITING INNOVATIONS

- Strategies to effectively exploit the value of innovation, including innovation platforms that include multiple products, portfolios, standards and business models

(4)

RENEWING INNOVATIONS

- Processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their innovation foundations in the face of potentially disruptive innovations

(4)

TOTAL: 15

REFERENCES

1. Paul Trott, "Innovation Management and New Product Development", Pearson, Fifth Edition, 2011, ISBN:9781447916079
2. Joe Tidd and John Bessant, "Managing Innovation: Integrating Technological, Market andorganizational change", Wiley, 2009, ISBN:978-1-118-53859-3.
3. Burgelman R. Christensen C., Maidique M., Wheelwright S., "Strategic Management ofTechnology and Innovation", McGraw Hill, 2007, ISBN: 9780071232302

19ECOC21 PROJECT MANAGEMENT

Project management – Concept of a Project – Categories of Project - Project life cycle-Definition of project management - The project as a conversion Process - project environment - complexity of projects - the relationship between project Management and line management - current issues in project management- system approach to project management - Roles and responsibilities of project manager.

Project planning - project planning as a value adding activity - process of project planning - managing the planning process - communicating project plans - Computerized Project Management - planning with standards.

Project implementation - stages - Bottlenecks in project implementation -Guidelines for effective implementation - Management techniques for project management - project monitoring - essentials - roles - tools and techniques - project management environment - management reporting - report designing - project evaluation - project review.

REFERENCES:

1. Project Management - Harvey Maylor - Macmillan India Ltd, 1999.

2. Project Management - S. Choudhury - Tata McGraw Hill publishing, 2017.

3. Project Management Principles & Techniques - B.B. Goel- Deep & Deep publications

Pvt Ltd., 2002.

4. Project Planning, Analysis, Selection, implementation and Review – Prasanna Chandra -

Tata McGraw Hill Publishing Company Ltd., 2017.

5. Project Management A systems Approach to Planning Scheduling and Controlling-

Harold Kerzner, CBs Publishers & Distributors, 2003.

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M.E. APPLIED ELECTRONICS

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2019 - 2020 and onwards)

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2	Vision and Mission of the Department	2
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COIMBATORE INSTITUTE OF TECHNOLOGY

(APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
Government Aided Autonomous Institution
Avinashi Road, Civil Aerodrome Post,
Coimbatore – 641 014.

DIAMOND JUBILEE

(1956 -2016)

DEPARTMENT OF MANAGEMENT STUDIES

MBA DEGREE PROGRAMME

2021-22 Regulations

Curriculum & Syllabi

Under Choice Based Credit System

(For the students admitted during 2021-22 onwards)

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to "inculcate a sound knowledge in engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena".

MISSION

The mission of CIT is to "impart high quality education and training to its students to make them world - class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large".

DEPARTMENT OF MANAGEMENT STUDIES (MBA)

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF DEPARTMENT OF MANAGEMENT STUDIES (MBA)

Vision	**Department of Management Studies at Coimbatore Institute of Technology endeavors to be a School of Management with Global Mindset and bring out highly capable, engaged and ethical leaders who will create positive changes in the world of Business & Society.**
Mission	**The Mission of Department of Management studies is to:** • **Develop MBA graduates with Self- Awareness, Self-Reflection and Responsible Leadership.** • **Empower the MBA graduates with Techno- Managerial skills to choose their individual career paths with confidence**
Objective	**To teach the foundations of General Management and develop skills in Problem Solving, and using Analytical Tools for Decision making in a competitive business environment.**

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF MANAGEMENT STUDIES (MBA)

MASTER OF BUSINESS ADMINISTRATION REGULATIONS – 2021

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

MBA programme curriculum is designed to prepare the post graduate students

I. To have a thorough understanding of the core aspects of the business.
II. To provide the learners with the management tools to identify, analyze and create business opportunities as well as solve business problems.
III. To prepare them to have a holistic approach towards management functions.
IV. To motivate them for continuous learning.
V. To inspire and make them practice ethical standards in business.

PROGRAMME OUTCOMES (POs):

On successful completion of the programme, MBA graduates develop the:

1. Ability to apply the business acumen gained in practice.
2. Ability to understand and solve managerial issues.
3. Ability to communicate and negotiate effectively, to achieve organizational and individual goals.
4. Ability to upgrade their professional and managerial skills in their workplace.
5. Ability to explore and reflect about managerial challenges, develop informed managerial decisions in a dynamically unstable environment.
6. Ability to take up challenging assignments.
7. Ability to understand one's own ability to set achievable targets and complete them.
8. Ability to pursue lifelong learning.
9. Ability to have a fulfilling business career.
10. Ability to have financial literacy.
11. Ability to fulfill social outreach
12. Ability to understand business analytics

MAPPING OF PEOS WITH POS:

Programme Educational Objectives	Programme Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
I	3	3	2	1	3	3	1	2	1	1	1	3
II	1	3	1	2	3	1	3	2	1	3	1	3
III	3	3	2	3	3	2	3	3	3	1	2	3
IV	2	1	2	3	3	1	3	3	3	1	2	1
V	1	3	3	2	2	3	1	2	3	1	3	1

Year	Sem.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
YEAR 1	SEM 1	Statistics for Management		.							
		Management Concepts and Organizational Behavior	.		.	.					
		Managerial Economics	.				.	.			
		Accounting for Decision Making		.							
		Legal Aspects of Business	.	.	.						
		Information Management	.		.	.				.	.
		Marketing Management	.			.					.
		Indian Ethos and Business Ethics Seminar				.	.				.
		Business Communications (Laboratory)			.	.				.	.
	SEM 2	Quantitative Techniques for Decision Making		.		.					
		Financial Management		.		.		.			.
		Human Resource Management	.		.	.		.		.	.
		Operations Management	.	.		.			.		
		Business Research Methods		.		.			.		
		Business Analytics				.					.
		Non-Functional Elective									
		Data Analysis and Business Modelling (Laboratory)		.				.	.		.
		Rural Community Engagement	.		.		.			.	.
YEAR2	SEM 3	Strategic Management	.		.	.		.		.	.
		International Business	.		.		.				.
		Creativity and Innovation Laboratory	.	.		.		.			.
		Elective I	Given below for each stream/Specialization								
		Elective II									
		Elective III									
		Elective IV									
		Elective V									
		Elective VI									
		Summer Internship	.	.	.	.	.	.	.	.	.
	SEM 4	Project work – 16 weeks Project Work + Maximum 4 weeks for report writing	.	.	.	.	.	.	.	.	.

NON FUNCTIONAL ELECTIVES

SL. NO.	SUBJECT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
1.	Entrepreneurship Development	▪			▪					
2.	Corporate Governance	▪		▪	▪				▪	
3.	Event Management				▪				▪	
4.	Micro and Small Business Management	▪			▪				▪	
5.	Fuzzy logic for Management Decision Making		▪			▪	▪	▪		
6.	Intellectual Property Rights				▪				▪	
7.	Sustainable Management	▪		▪	▪				▪	

Sl. No.	SUBJECT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Stream/ Specialization : **Financial Management**										
1.	Security Analysis and Portfolio Management						▪		▪	▪
2.	Financial markets						▪		▪	
3.	Banking and Financial Services						▪		▪	
4.	Financial Derivatives						▪		▪	
5.	Financial Modelling			▪			▪	▪	▪	▪
6.	Business Analysis and Valuation			▪	▪		▪	▪	▪	
7.	International Finance						▪		▪	
8.	Behavioral Finance	▪					▪		▪	▪
9.	Fintech and Block chain Applications in Finance			▪			▪	▪	▪	▪
Stream/ Specialization : **Operations Management**										
10.	Supply Chain Management		▪		▪	▪				▪
11.	Quality Management	▪			▪				▪	▪
12.	Materials Management				▪					
13.	Services Operations Management	▪	▪	▪	▪	▪				▪
14.	Process Management	▪	▪		▪					
15.	Supply Chain Analytics		▪		▪	▪	▪	▪	▪	
16.	Project Management	▪	▪		▪					▪
17.	Product design				▪					▪
18.	Lean Six Sigma		▪		▪	▪	▪		▪	
19.	Robust Design	▪			▪				▪	▪

Stream/ Specialization : **Marketing Management**										
20.	Retail Marketing				▪					▪
21.	Consumer Behavior	▪		▪	▪				▪	▪
22.	Integrated Marketing Communications				▪	▪				
23.	Services Marketing	▪		▪	▪					▪
24.	Sales and Distribution Management				▪					▪
25.	Product and Brand Management				▪					
26.	Digital Marketing		▪		▪	▪	▪	▪		
27.	International Marketing	▪			▪		▪			▪
28.	Marketing Analytics		▪		▪	▪	▪	▪	▪	
Stream/ Specialization : **Human Resource Management**										
29.	Strategic Human Resource Management	▪			▪		▪		▪	▪
30.	Industrial Relations and Labour Legislations	▪			▪					▪
31.	Social Psychology	▪		▪	▪	▪			▪	
32.	Organizational, Design, Change and Development				▪		▪			▪
33.	Managerial Behavior and Effectiveness	▪		▪	▪	▪			▪	▪
34.	Negotiation and Conflict Management	▪		▪	▪	▪				▪
35.	Reward and Compensation Management				▪	▪			▪	
36.	Personal Effectiveness	▪		▪	▪	▪		▪	▪	▪
37.	International Human Resources Management				▪		▪		▪	
38.	Human Resource Analytics		▪		▪		▪	▪		
Stream/ Specialization : **Systems Management**										
39.	e-business			▪	▪				▪	▪
40.	Internet of Things				▪		▪		▪	▪
41.	Cloud computing				▪	▪			▪	
42.	Enterprise Resource Planning	▪			▪				▪	▪
43.	Software Project and quality management				▪	▪				
44.	Data Mining for Business Intelligence		▪		▪				▪	▪
45.	Big Data Analytics		▪		▪	▪	▪	▪		
46.	Deep Learning & Artificial Intelligence			▪	▪	▪	▪	▪	▪	
47.	R Programming		▪			▪	▪	▪		
48.	Python Programming		▪			▪	▪	▪		

Stream/ Specialization : **Business Analytics**										
49.	Block Chain Technology				▪	▪	▪			
50.	Social media web Analytics		▪		▪	▪	▪	▪		▪
51.	Stochastic Modelling		▪			▪	▪	▪		
52.	Time Series Analysis		▪			▪	▪	▪		
53.	Multivariate data analysis		▪			▪	▪	▪		
54.	Data Mining for Business Intelligence		▪		▪				▪	▪
55.	Big Data Analytics		▪		▪	▪	▪	▪		
56.	Deep Learning & Artificial Intelligence			▪	▪	▪	▪	▪	▪	
57.	R Programming		▪			▪	▪	▪		
58.	Python Programming		▪			▪	▪	▪		

Coimbatore Institute of Technology

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

Department of Management Studies (MBA)

REGULATIONS – 2021

CHOICE BASED CREDIT SYSTEM

MASTER OF BUSINESS ADMINISTRATION (FULL – TIME)

CURRICULA AND SYLLABI FOR I TO IV SEMESTERS

SEMESTER - I

SL. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	21MBA11	Statistics for Management	PCC	3	0	0	3	3
2.	21MBA12	Management Concepts and Organizational Behavior	PCC	3	0	0	3	3
3.	21MBA13	Managerial Economics	PCC	3	0	0	3	3
4.	21MBA14	Accounting for Decision Making	PCC	3	0	0	3	3
5.	21MBA15	Legal Aspects of Business	PCC	3	0	0	3	3
6.	21MBA16	Information Management	PCC	3	0	0	3	3
7.	21MBA17	Marketing Management	PCC	3	0	0	3	3
PRACTICALS								
8.	21MBAL18	Indian Ethos and Business Ethics (Seminar)	EEC	0	0	4	4	2
9.	21MBAL19	Business Communications (Laboratory)	EEC	0	0	4	4	2
TOTAL				**21**	**0**	**8**	**29**	**25**

SEMESTER – II

SL. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	21MBA21	Quantitative Techniques for Decision Making	PCC	3	0	0	3	3
2.	21MBA22	Financial Management	PCC	3	0	0	3	3
3.	21MBA23	Human Resource Management	PCC	3	0	0	3	3
4.	21MBA24	Operations Management	PCC	3	0	0	3	3
5.	21MBA25	Business Research Methods	PCC	3	0	0	3	3
6.	21MBA26	Business Analytics	PCC	3	0	0	3	3
7.		Non-Functional Elective	PEC	3	0	0	3	3

PRACTICALS								
8.	21MBAL27	Data analysis and Business Modeling (Laboratory)	PCC	0	0	4	4	2
9.	21MBAL28	Rural Community Engagement	EEC	0	0	4	4	2
TOTAL				**21**	**0**	**8**	**29**	**25**

NOTE: In the second semester Students need to choose one elective from the Non-Functional stream

Summer internship – minimum 4 weeks of internship Training diary has to be submitted

SEMESTER - III

SL. NO.	COURSE CODE	COURSETITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	21MBA31	Strategic Management	PCC	3	0	0	3	3
2.	21MBA32	International Business	PCC	3	0	0	3	3
3.		Elective I	PEC	3	0	0	3	3
4.		Elective II	PEC	3	0	0	3	3
5.		Elective III	PEC	3	0	0	3	3
6.		Elective IV	PEC	3	0	0	3	3
7.		Elective V	PEC	3	0	0	3	3
8.		Elective VI	PEC	3	0	0	3	3
PRACTICALS								
9.	21MBAL33	Creativity and Innovation Laboratory	EEC	0	0	4	4	2
10.	21MBAL34	Summer Internship	EEC	0	0	4	4	2
TOTAL				**24**	**0**	**4**	**32**	**28**

NOTE: In the third semester Students need to choose -Three electives from 2 functional streams for Dual Specialization

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SEMESTER - IV

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	21MBA41	Project Work	EEC	0	0	24	24	12
TOTAL				**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 90

21MBA11- STATISTICS FOR MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVE:

- To learn the applications of statistics in business decision-making.

UNITI INTRODUCTION 9

Basic definitions and rules for probability, conditional probability independence of events, Baye_s theorem, and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNITII SAMPLING DISTRIBUTIONANDESTIMATION 9

Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

UNITIII TESTING OF HYPOTHESIS –PARAMETRICTESTS 9

Hypothesis testing: one sample and two sample tests for means and proportions of large samples (z-test), one sample and two sample tests for means of small samples (t-test), F-test for two sample standard deviations. ANOVA one and two way

UNITIV NON-PARAMETRIC TESTS 9

Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Kolmogorov-Smirnov – test for goodness of fit, comparing two populations. Mann – Whitney U test and Kruskal Wallis test. One sample run test.

UNITV CORRELATIONAND REGRESSION 9

Correlation – Coefficient of Determination – Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.

TOTAL: 45 PERIODS

OUTCOMES:

- To facilitate objective solutions in business decision-making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:

1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition,2017.
2. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition,2015.
3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition, 2017.
4. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition,2012.
5. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.
6. N. D. Vohra, Business Statistics, Tata McGraw Hill,2017.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	2	2	1	1	2	1	1	3
CO2	3	3	1	3	2	3	1	2	2	1	1	3
CO3	3	2	1	2	2	2	1	1	1	1	1	3
CO4	3	2	1	3	2	3	1	2	2	1	1	2
CO5	3	3	1	3	2	3	1	2	2	1	1	2

21MBA12 - MANAGEMENT CONCEPTS AND ORGANIZATIONAL BEHAVIOR

L	T	P	C
3	0	0	3

OBJECTIVES:

- To familiarize the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.
- To acquaint the students with the fundamentals of managing business and to understand individual and group behaviour at work place so as to improve the effectiveness of an organization. The course will use and focus on Indian experiences, approaches and cases.

UNITI NATURE AND THEORIESOFMANAGEMENT 9

Evolution of management Thought-Classical, Behavioral and Management Science Approaches Management- meaning, levels, management as an art or science, Managerial functions and Roles, Evolution of Management Theory- Classical era- Contribution of F.W.Taylor, Henri Fayol, Neo-Classical-Mayo & Hawthorne Experiments. Modern era – system & contingency approach Managerial Skills.

UNITII PLANNING AND ORGANISING 9

Planning - Steps in Planning Process - Scope and Limitations - Forecasting and types of Planning - Characteristics of a sound Plan - Management by Objectives (MBO) - Policies and Strategies - Scope and Formulation - Decision Making - Types, Techniques and Processes.

Organisation Structure and Design - Authority and Responsibility Relationships - Delegation of Authority and Decentralisation - Interdepartmental Coordination - - Impact of Technology on Organisational design - Mechanistic Vs Adoptive Structures - Formal and Informal Organisation. Control: meaning, function, Process and types of Control.

UNITIII INDIVIDUAL BEHAVIOUR 9

Meaning of Organizational behavior, contributing disciplines, importance of organizational behavior, Perception and Learning - Personality and Individual Differences - Motivation theories and Job Performance - Values, Attitudes and Beliefs - Communication Types- Process - Barriers - Making Communication Effective.

UNITIV GROUP BEHAVIOUR 9

Groups and Teams: Definition, Difference between groups and teams, Stages of Group Development, Group Cohesiveness, Types of teams, Group Dynamics-Leadership-Styles
- Approaches - Power and Politics - Organisational Structure - Organisational Climate and Culture, Conflict: concept, sources, Types, Stages of conflict, Management of conflict Organisational Change and Development.

UNITV EMERGING ASPECTS OFORGANIZATIONALBEHAVIOUR 9

Comparative Management Styles and approaches - Japanese Management Practices Organisational Creativity and Innovation - Organizational behavior across cultures - Conditions affecting cross cultural organizational operations, Managing International Workforce, Productivity and cultural contingencies, Cross cultural communication, Management of Diversity.

TOTAL: 45 PERIODS

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COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to "inculcate a sound knowledge in engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena".

MISSION

The mission of CIT is to "impart high quality education and training to its students to make them world - class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large".

DEPARTMENT OF COMPUTING
COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF DEPARTMENT OF COMPUTING

VISION

Department of Computing endeavors to make the students, world class software engineers, data scientists and decision makers with prudence of pioneering the solutions to the challenges of the nation and the world.

MISSION

The Mission of Department of Computing is

M1 : To impart sound conceptual knowledge along with intensive practical training and real time industry/ research project exposure to the students.

M2 : To provide a learning ambience to enhance innovations, problem solving skills, leadership qualities, team-spirit and ethical responsibilities.

M3 : To establish Industry Institute Interaction program to provide exposure of latest tools and technologies used in the IT organizations and enhance the entrepreneurship skills.

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF COMPUTING

M.Sc. DECISION AND COMPUTING SCIENCES

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1 **Expertise in Decision Making :** Evolve as decision scientists with an in-depth knowledge of multiple business domains across all functional areas.

PEO2 **Expertise in Software Development :** Be competent to develop software products by strategic blending of computing technology and management expertise that facilitate informed decision making.

PEO3 **Leadership and Lifelong Learning :** Demonstrate leadership qualities through acquisition of intrapreneurship and entrepreneurship traits and engage in active contribution to society through innovative solutions of global impact.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF COMPUTING

M.Sc. DECISION AND COMPUTING SCIENCES

PROGRAMME OUTCOMES

PO1 : Apply mathematical and statistical modelling for analysis of business problems that aid management to make data driven decisions.

PO2 : Perform quantitative and qualitative data analytics in functional areas of business like marketing, human resource management, finance, etc.

PO3 : Visualize and infer meaningful insights to facilitate strategic and operational decisions.

PO4 : Apply foundations of business management blended with computing science to address issues in decision-making.

PO5 : Develop smart enterprise applications applying software engineering principles and business domain knowledge.

PO6 : Design and develop software products and services for strategic decision making, business analytics and intelligence.

PO7 : Align and utilize information technology infrastructure, analytics and decision-making skills effectively to realize the organization's goals.

PO8 : Contribute and collaborate effectively in any role in multi-disciplinary teams.

PO9 : Recognize professional, social and ethical values imbibed in the business and technical environments.

PO10 : Engage in lifelong learning to be empowered with management expertise and by structured adoption of technological advancements.

PO11 : Aspire to be an intrapreneur/entrepreneur by transforming the idea into successful business venture with due consideration to financial, technical and management aspects.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF COMPUTING

M.Sc. DECISION AND COMPUTING SCIENCES

Curriculum from the Academic Year 2017 - 2018 onwards

Semester I

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC11	Technical English	3	0	0	3	HS
17MDC12	Applied Algebra and Calculus	3	2	0	4	BS
17MDC13	Basic Statistical Methods	3	2	0	4	BS
17MDC14	Human Behavior	3	0	0	3	PC
17MDC15	Programming in C	3	0	0	3	PC
	PRACTICALS					
17MDC16	Computing Laboratory I (Algebra, Calculus and Statistics in SciLab and Excel)	0	0	4	2	PC
17MDC17	Programming Laboratory in C	0	0	4	2	PC
17MDC18	English Language Laboratory	0	0	2	1	EEC / HS
	Total Credits				**22**	

Semester II

Course Code	Course Name	L	T	P	C	Category
	THEORY					
	Language Elective	3	0	0	3	HS
17MDC21	Probability and Applications	3	2	0	4	BS
17MDC22	Principles of Management	4	0	0	4	PC
17MDC23	Web Technology	3	0	0	3	PC
17MDC24	Data Structures and Algorithms	3	0	0	3	PC
	PRACTICALS					
17MDC25	Computing Laboratory II (Probability in Excel and SciLab)	0	0	4	2	PC
17MDC26	Web Technology Laboratory	0	0	4	2	PC
17MDC27	Data Structures Laboratory using Python	0	0	4	2	PC
	Total Credits				**23**	

Semester III

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC31	Applied Statistics for Business Decisions	3	2	0	4	BS
17MDC32	Financial Analysis and Reporting	4	0	0	4	PC
17MDC33	Computer Systems	3	0	0	3	PC
17MDC34	Database Management Systems	3	0	0	3	PC
17MDC35	Object Oriented Programming	3	0	0	3	PC
	PRACTICALS					
17MDC36	Business Statistics Laboratory using R	0	0	4	2	PC
17MDC37	Business Database Design Laboratory	0	0	4	2	PC
17MDC38	Object Oriented Programming Laboratory using Java	0	0	4	2	PC
	Total Credits				**23**	

Semester IV

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC41	Predictive Analytics	3	0	0	3	BS
17MDC42	Operations Research for Business	3	2	0	4	BS
17MDC43	Corporate Finance	3	0	0	3	PC
17MDC44	Production and Operations Management	3	0	0	3	PC
17MDC45	Computer Networks	3	0	0	3	PC
	PRACTICALS					
17MDC46	Predictive Analytics Laboratory	0	0	4	2	PC
17MDC47	Business Process Optimization Laboratory (OR & POM)	0	0	4	2	PC
17MDC48	Financial Analysis Laboratory (Spreadsheets and Python)	0	0	4	2	PC
17MDC49	Managerial Communication Skills*					EEC
	Total Credits				**22**	

Semester V

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC51	Organisational Behavior	3	0	0	3	PC
17MDC52	Digital Marketing	3	0	0	3	PC
17MDC53	Software Engineering	3	0	0	3	PC
17MDC54	Enterprise Resource Planning	3	0	0	3	PC
	Elective I	3	0	0	3	PE
	PRACTICALS					
17MDC55	Human Resources System Development Laboratory (Python,R studio)	0	0	4	2	PC
17MDC56	Digital Marketing Design Laboratory (R Studio, Visualisation, Graphical)	0	0	4	2	PC
17MDC57	Enterprise Application Development Laboratory (J2EE)	0	0	4	2	PC
17MDC58	Personality Development*					EEC
	Total Credits				**21**	

Semester VI

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC61	Economic Foundations of Business	3	0	0	3	PC
17MDC62	Computational Intelligence	3	0	0	3	PC
17MDC63	Mobile and Cloud Computing	3	0	0	3	PC
17MDC64	Data Warehousing and Mining	3	0	0	3	PC
	Elective - II	3	0	0	3	PE
	PRACTICALS					
17MDC65	Mobile and Cloud Application Development Laboratory	0	0	4	2	PC
17MDC66	Data Mining Laboratory	0	0	4	2	PC
	Elective Laboratory - I	0	0	4	2	EEC
	Total Credits				**21**	

Semester VII

Course Code	Course Name	L	T	P	C	Category
17MDC71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC81	Modeling and Simulation	3	0	0	3	PC
17MDC82	Decision Support Systems	3	0	0	3	PC
17MDC83	Game Theory and Decision Analysis	3	0	0	3	PC
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
	PRACTICALS					
17MDC84	Business Intelligence Laboratory	0	0	4	2	PC
17MDC85	Decision Analysis Laboratory (Game Theory)	0	0	4	2	EEC
17MDC86	Entrepreneurship Development*					EEC
	Elective - Laboratory II	0	0	4	2	PC
	Total Credits				**21**	

Semester IX

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC91	Principles of Information Security	3	0	0	3	PC
17MDC92	Project Management	3	0	0	3	PC
17MDC93	Human Computer Interface and Interaction	3	0	0	3	PC
	Elective - V	3	0	0	3	PE
	Elective - VI	3	0	0	3	PE
	PRACTICALS					
17MDC94	Human Computer Interface and Interaction Laboratory	0	0	4	2	PC
17MDC95	Minor Project - Decision Tool Development	0	0	8	4	EEC
17MDC96	Business Ethics *					EEC
	Total Credits				**21**	

Semester X

Course Code	Course Name	L	T	P	C	Category
17MDC101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
	Grand Total of Credits				**210**	

*Pass is required

PROFESSIONAL ELECTIVES - THEORY COURSES

Course Code	Course Name	L	T	P	C	Category
	MANAGEMENT STREAM					
	Finance					
17MDCE01	Security Analysis and Portfolio Management	3	0	0	3	PE
17MDCE02	Equity Valuation	3	0	0	3	PE
17MDCE03	Derivatives and Risk Management	3	0	0	3	PE
17MDCE04	Credit Risk Analytics and Management	3	0	0	3	PE
	Marketing					
17MDCE11	Consumer Behavior	3	0	0	3	PE
17MDCE12	Services Marketing	3	0	0	3	PE
17MDCE13	Customer Relationship Management	3	0	0	3	PE
17MDCE14	Brand Management	3	0	0	3	PE
	Human Resources					
17MDCE21	Strategic Human Resource Management	3	0	0	3	PE
17MDCE22	Organisational Development	3	0	0	3	PE
17MDCE23	Performance Management	3	0	0	3	PE
17MDCE24	Compensation Management	3	0	0	3	PE
	Operations & Logistics					
17MDCE31	Total Quality Management	3	0	0	3	PE
17MDCE32	Logistics Strategy and Planning	3	0	0	3	PE
17MDCE33	Supply Chain Management	3	0	0	3	PE
17MDCE34	Warehouse and Distribution Management	3	0	0	3	PE
	General Management					
17MDCE41	Business Environment	3	0	0	3	PE
17MDCE42	Legal Aspects of Business	3	0	0	3	PE
17MDCE43	Information Technology for Managers	3	0	0	3	PE
17MDCE44	Direct and Indirect Tax	3	0	0	3	PE
17MDCE45	Technology and Innovation Management	3	0	0	3	PE
17MDCE46	Business Process Management	3	0	0	3	PE
	COMPUTER SCIENCE STREAM					
	Data Analytics					
15MSSE34	Machine Learning	3	0	0	3	PE
16MDSE53	Big Data Architecture	3	0	0	3	PE
16MDSE2	Web Mining	3	0	0	3	PE
16MDS83	Data Visualization	3	0	0	3	PE
16MDSE6	Information Security Analytics	3	0	0	3	PE
16MDSE20	Data Centric Computing	3	0	0	3	PE
16MDSE8	Bio-Informatics	3	0	0	3	PE
16MDSE3	Social Network Analysis	3	0	0	3	PE

PROFESSIONAL ELECTIVES - THEORY COURSES

Course Code	Course Name	L	T	P	C	Category
16MDSE4	Geographical Information Analysis	3	0	0	3	PE
16MDSE11	Econometric Analysis	3	0	0	3	PE
16MDS92	Deep Learning	3	0	0	3	PE
	Distributed and Network Systems					
15MSSE19	SOA and Web Services	3	0	0	3	PE
15MSSE35	BlockChain Technology	3	0	0	3	PE
15MSSE17	Internetworking Protocols	3	0	0	3	PE
17MDCE51	Distributed Systems	3	0	0	3	PE
	Software Systems					
15MSSE09	Graphics and Multimedia Technologies	3	0	0	3	PE
15MSS63	Software Testing and Quality Assurance	3	0	0	3	PE
16MDSE7	Image Processing	3	0	0	3	PE
15MSSE06	Software Requirements Engineering	3	0	0	3	PE
15MSSE07	Software Reliability	3	0	0	3	PE
15MSSE08	Open Source Software Development	3	0	0	3	PE
16MDSE25	Software Architecture and Design Patterns	3	0	0	3	PE
15MSSE24	Real Time Systems	3	0	0	3	PE
15MSSE25	Analysis and Design of Real Time Systems	3	0	0	3	PE
15MSSE27	Computer vision	3	0	0	3	PE
15MSSE14	Design Thinking	3	0	0	3	PE
15MSSE36	Advanced Web Technology	3	0	0	3	PE

PROFESSIONAL ELECTIVES - LABORATORY COURSES

Course Code	Course Name	L	T	P	C	Category
17MDCEL1	Minor Project in Business / Data Analytics	0	0	4	2	PE
17MDCEL2	Modeling and Simulation Laboratory	0	0	4	2	PE
15MSSL08	Image Processing Laboratory	0	0	4	2	PE
15MSSL03	Graphics and Multimedia Laboratory	0	0	4	2	PE
15MSSL13	Advanced Web Technology Laboratory	0	0	4	2	PE
16MDS55	Machine Learning Laboratory	0	0	4	2	PE
16MDS56	Big Data Modeling Laboratory	0	0	4	2	PE
16MDS85	Data Visualization Laboratory	0	0	4	2	PE
16MDS94	Deep Learning Laboratory	0	0	4	2	PE
15MSS65	Software Testing Laboratory	0	0	4	2	PE
16MDSEL2	Web Mining Laboratory	0	0	4	2	PE

LANGUAGE ELECTIVE

Course Code	Course Name	L	T	P	C	Category
16MDSLE01	Professional English	3	0	0	3	HS
16FY22F	Basic French	3	0	0	3	HS
16FY22G	Basic German	3	0	0	3	HS

* Pass is required

\# FC - Foundation Course, PC - Professional Core, PE - Professional Elective, EEC - Employability Enhancement Course.

NOTE :

- Equal weightage for Decision Science and Computer Science is given in the design of the curriculum, which complement each other to address the industry needs.
- Students of this Programme can specialize in Decision Science and/or Computing Science by choosing interested elective courses given under different streams.

17MDC11 - TECHNICAL ENGLISH

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Given a technical paragraph identify the topic sentence, infer meanings, lexical and contextual items, and find the supporting points and transitional tags*
- *Given a communication context, specify the barriers to listening and deduce solutions to overcome the barriers. Given short conversations and monologues for listening, specify appropriate responses and construct a summary.*
- *For a given topic, introduce ideas, give opinions and justify your stance. For a given topic, argue for or against the topic for 5 minutes. Plan and prepare a 15 minute presentation using visual aids and deliver a power point presentation for a given technical topic.*
- *For a given topic, write an argumentative, descriptive, biographical or autobiographical essay. Interpret the given technical graphical representation and compose passage. Summarize and paraphrase technical texts in about 200 to 300 words.*
- *Apply the rules of grammar viz, tenses prepositions, subject-verb agreement, adjectives, direct indirect speech and use appropriate patterns in a given sentence.*

FOCUS ON LANGUAGE

Synonyms - Antonyms - Forms of Words - One Word Substitutes - Word Formation - Contextual Meanings - Tenses - Prepositions - Subject-verb Agreement - Adjectives - Sequence Words - Wh-Questions - Direct Indirect Speech- Adverbs - Abbreviations and Acronyms. **(9)**

READING

Predicting the Content - Skimming the Text - Understanding the Gist -Topic Sentence and its Role - Scanning - Inferring Meanings: Lexical and Contextual - Note-Making - Interpreting Graphics in Technical Writing - Sequencing of Sentences - Reading Comprehension - Dictionary Skills - Itinerary. **(9)**

WRITING

Filling Forms - Descriptive Writing - Autobiographical & Biographical Writing - Paragraph Writing - Academic Writing - Tweets - Paraphrasing - Channel Conversion - Essay Writing: Argumentative Writing - Poster Making - Instructions - Dialogue Writing - Informal Letters. **(9)**

LISTENING

Importance of Listening & Empathy in Communication - Reasons for Poor Listening - Traits of a Good Listener - Listening Mode - Note Taking - Listening to Short Dialogues - Listening to Long Conversations. **(8)**

SPEAKING

Describing Places - Giving Opinions - Narration - Introducing Ideas - Justifying Opinions - Formal Conversations - Telephonic Skill - Debating - Apologizing - Extempore - Effective Presentation Strategies - Planning - Outlining & Structuring - Nuances of Delivery - Controlling Nervousness & Stage Fright - Visual Aids in Presentation - Applications of MS Power Point. **(10)**

TOTAL: 45

TEXT BOOK

1. *Dr.K.Elango, "Resonance", Cambridge University Press, New Delhi, 2013.*

EXTENSIVE READING

1. *Dr.A.P.J.Abdul Kalam "India 2020" - Vision for the Millennium - Brooks/Cole Publishing Company, 2002. (Only Essay Questions)*

REFERENCE BOOKS

1. *Meenakshi Raman, Sangeeta Sharma, "Technical Communication - English Skills for Engineers", Oxford University Press, New Delhi, 2012.*
2. *Simon Sweeney, "English for Business Communication", Cambridge University Press, 2010.*
3. *Nagaraj Geetha, "A Course in Grammar and Composition", Cambridge University Press, 2012.*
4. *Samson T, "Innovate with English", Cambridge University Press, 2012.*
5. *Mark Ibbotson. "Cambridge English for Engineering" Cambridge University Press, 2012.*
6. *B. Sai Lakshmi. "Poly Skills- A Course in Communication and Life Skills" Cambridge University Press, 2012.*

17MDC12- APPLIED ALGEBRA AND CALCULUS

L	T	P	C
3	2	0	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Familiar with the basic concepts in financial mathematics and application of numerical methods in solving equations occurring in business modeling.*
- *Able to understand and apply matrix methods to solve real world problems.*
- *Able to understand and apply differential calculus to solve optimization problems in Economics and Business.*
- *Able to understand and apply integral calculus to solve real world problems in economics and finance.*
- *Having good understanding of empirical modeling.*

ALGEBRA

SEQUENCES AND SERIES : Arithmetic, geometric and harmonic sequences-Finite and infinite series. Convergence and divergence of infinite series-Simple examples-nthterm test for divergence and p-series convergence. Applications of series in financial mathematics: Simple and Compound Interest-Nominal and Effective Interest Rates-Continuous Compounding -Future Value and Present Value-Annuities- Ordinary Annuity: Future and Present Value, Annuity Payment, Principal Sum, Period and Interest Rate, Annuity Due, Deferred Annuity and Perpetuity. **(6)**

SOLUTION OF EQUATIONS : Algebraic and transcendental equations - Bisection Method and Newton Raphson method-Real World Applications of Newton Raphson Method: Finding the Break Even Point of a Firm and finding the interest rates of Annuities. **(4)**

MATRICES AND VECTOR SPACES: MATRICES: The Inverse of a Matrix-Properties and Algorithm to find the Inverse of a Matrix: Gauss Jordan Method- Solving a system of Linear Equations Using Matrix Inverse. Eigen values and Eigen vectors - Cayley Hamilton theorem (without proof)- Application to find the inverse and higher powers of a matrix - Diagonalization - Quadratic forms - Orthogonal reduction to Canonical form. Applications of Matrices: The Leontief Input Output Model in Economics, Leslie's Population Growth Model, Homogeneous Coordinates and their applications to Computer Graphics.

VECTOR SPACES: Vector spaces and Subspaces Linear dependence and independence of vectors- Linear transformations-Linearly independent sets and Bases-Dimension of a vector space **(14)**

CALCULUS

Differential Calculus : Definition of limit and derivative of a function. Applications to marginal analysis in Business and Economics, Relative Rate of Change and Elasticity of Demand- Maxima and Minima of function of single variables -Applications to Optimization of area and perimeter, Relation between Average Cost and Marginal Cost, Maximizing Revenue and Profit and Inventory Control. Functions of Several Variables-Partial Derivatives- Homogeneous functions and Euler's Theorem-Optimization of functions of two variables-Constrained Optimization using Lagrange Multipliers

Integral Calculus : Integration as a process of Summation-Application of Area between two curves to find the Net Excess Profit-Application to study Lorenz Curves in Economics-Calculation of present value of an income stream using definite integrals. **Special Functions:** Beta and Gamma Functions- Double and triple integrals - Applications: Area - Volume. **(13)**

EXPERIMENTAL DATA ANALYSIS : Curve fitting: Least Square Method. Interpolation: Newton's method - Lagrange's method. **Numerical Differentiation:** Application to Maxima and Minima of functions. **Numerical Integration:** Trapezoidal rule- Simpson's 1/3rd rule. Applications to real world problems and finding area, volume and Numerical Solutions of Ordinary Differential Equations: Taylor's Series - Runge Kutta Fourth order methods - Milne's Predictor - Corrector Method. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Ahmad Nazri Wahidudin, "Financial Mathematics and Its Applications", Ventus Publishing ApS, ISBN 978-87-7681-928-6, 2011.*
2. *David C Lay "Linear Algebra and its Applications", Fourth edition Pearson 2012.*
3. *R.A.Barnett, M.R.Ziegler and K.E.Bylen, Calculus for Business, Economics, Life Sciences and Social Sciences, 12th Edition, Prentice Hall, 2011.*
4. *L.D.Hoffman and G.L.Bradley, Calculus for Business, Economics and the Social and Life Sciences, 10th Edition, McGraw Hill, Higher Education, 2010.*

REFERENCE BOOKS

1. *Kandasamy, P.et al., "Engineering Mathematics", Volume - I & II (8th Fully Revised Edition), "S. Chand & Co, 2008. Kandasamy .P et al., "Numerical Methods", (for first year), (First Revised Edition) Tata McGraw Hill Publishing company Ltd., 2008.(para 5)*
2. *Veerarajan T, "Engineering Mathematics (For First Year)", (first revised edition), Tata McGraw Hill Publishing company Ltd, 2008.*
3. *Venkataraman. M.K., "Engineering Mathematics", (First year), The National Publishing Company, 2008.*

17MDC13 - BASIC STATISTICAL METHODS

L	T	P	C
3	2	0	4

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Achieve good skills in presentation and summarization of data using statistical tool*
- *Apply basic concepts in probability theory to data and derive useful measures for easy interpretation of the probability structure of data*
- *Gain knowledge in sampling and various methods of sampling from population data*
- *Understand the meaning of association between two variables and use regression analysis in prediction.*

DEFINITION OF STATISTICS

Data -Qualitative and quantitative - Measurement of data -Nominal and Ordinal - Raw data and grouped data - Primary and secondary data - Methods of collection -Classification of data - Tabulation -frequency distribution and various diagrammatic and graphical representations of data. **(7)**

SUMMARY STATISTICS

Measures of Central Tendency-arithmetic mean, median, mode, geometric mean and harmonic mean Merits and demerits-Relationship between mean, median and mode-Relationship AM, GM and HM, computation of the measures for grouped and ungrouped data-weighted arithmetic Measures of dispersion-range, mean deviation and standard deviation - coefficient of variation and its use- quartiles and inter quartile range-quintiles deciles and percentiles- moving averages -Skewness and Kurtosis and their uses. **(8)**

PROBABILITY

Deterministic and random experiments -Definition of sample space and events- classical and axiomatic definitions- Properties of probability- addition theorem- conditional probability and multiplication theorem of probability- Definition of independent events - Random variables and their probability distributions-Discrete and continuous random variables Probability mass function and cumulative distribution functions -definition - Mathematical expectation-mean and variance - Mean and variances of linear combination of random variables - Chebyshev's theorem- -Important discrete distributions-Discrete Uniform Distribution, Binomial, Poisson, -Continuous distributions: probability density functions and cumulative probability distributions-Normal distribution and its properties and applications. **(15)**

SAMPLING

Population and sample- sampling and its need -sampling vs complete enumeration -parameter and statistics-Probability sampling and -random sampling- simple random sampling, lottery method and random number table method- stratified random sampling-sampling distribution and standard error of a statistic. **(7)**

CORRELATION AND REGRESSION

Definition of correlation - Scatter plot -Karl Pearson's correlation coefficient its properties- Definition of Regression - Simple regression-Regression of x on y and y on x-Rank Correlation-Spearman's Rank Correlation Coefficient **(8)**

TOTAL : 45

TEXT BOOK

1. *S.C. Gupta, " Fundamentals of Statistics", 7th and Enlarged Edition, Himalaya publishing, Delhi, 2014.*

REFERENCE BOOK

1. *D M Levine T C Krehbiel and M L Berensen, "Business Statistics: A First Course", Pearson Education, Delhi, India, 2003.*
2. *Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists. (2002), 7th Edition, Pearson Education, Inc., Delhi, India*

17MDC14 - HUMAN BEHAVIOUR

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOME

- *Given an organizational environment, identify the importance of Human Behaviour and its impact.*
- *Engage in a comprehensive review of major theories and traits used in human personality psychology and apply them for given problem scenarios.*
- *Understand the role played by values and attitude in the workplace and analyze individual human behaviour in the workplace as influenced by Perception.*
- *Evaluate the role of motivation in determining employee behaviour in the organization, and apply the techniques to suggest tools of motivation for a given business environment.*
- *With solid understanding of human behaviour in the workplace from an individual, group and organizational. perspective, evaluate problem scenarios and suggest solutions to problems relating to motivation, personality, perception, values and attitude.*

UNDERSTANDING HHUMAN BEHAVIOUR

Understanding Human Behaviour - Classification of Human Behaviour - Nature of people in organization - Models of Human Behaviour : Psychoanalytic Model, Existential Model, Behavioristic Model,Cognitive Model - Implications of Human Behaviour on the organization - Case Study **(9)**

PERSONALITY

Personality - Determinants: Heredity and environmental linkage - Development Approach: Argyris's Maturity-Immaturity Continuum - Personality Traits: Social Traits, Personal Conception Traits, Emotional Adjustment Traits - Personality Theories : Erikson's eight life stages, Passages Theory, Maturation Theory - Case Study **(9)**

VALUES AND ATTITUDES

Values: Sources - Types of Values - Allport's six value categories - Patterns and trends in values. Attitudes: Cognitive Component - Affective Component - Behaviour Component -Attitudes and Behaviour - Attitudes and Cognitive consistency. Socialisation influence on Personality Values and Attitudes - Case Study **(9)**

PERCEPTION

Perception - Perception Process - Factors influencing perception process - Stages of the Perceptual Process - Response to Perceptual Process - Perceptual distortion: Stereotypes or Prototypes, Halo Effects, Selective Perception, Projection, Contrast Effects, Self-fulfilling Prophecy - Managing perceptual process - Attribution theory - Case Study **(9)**

MOTIVATION

Motivation - Reinforcement, Content and Process Theories- - Classical and Operant conditioning - Reinforcement Strategies - Theories of Motivation : Hierarchy of Need theory, ERG theory, Acquired Needs theory, Two Factor Theory, Equity Theory, Expectation Theory - Case Study **(9)**

TOTAL : 45

TEXT BOOK

1. *John .R. Schermerhorn, James. G. Hunt and Richard. N. Osorn, 'Organizational Behaviour', Wiley Publication, 7th Edition.*

REFERENCE BOOKS

1. *B. Narayan and Bharati Sharma, "Behavioral Science in Management" Omsons Publications, New Delhi, 1993.*
2. *Harlow/Hamke, Behaviour in Organizations Text, Readings and Cases, Little, Brown and Company, 1975.*

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to "inculcate a sound knowledge in engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena".

MISSION

The mission of CIT is to "impart high quality education and training to its students to make them world - class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large".

COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION AND MISSON OF THE DEPARTMENT

VISION

To empower the graduates with "Capabilities of Academic, Technical and Professional competence and to nurture them in the emerging fields of research, and innovative product development".

MISSION

The mission of the Electrical and Electronics Engineering program is to :

1. Make the students more active in using basic engineering and technology of the course by deep teaching learning method.
2. Train the students to create new product development procedures by agile based learning and master the operation of systems engineering.
3. Inculcate the ethics on realizing the importance of engineering, technology development and research on society and their future

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

1. To offer thematic oriented teaching through practical engineering operation and make the students to learn from practice to be successful in their career.
2. To promote creative thinking to inspire the real world engineering design based on demand through research and development
3. To make the students to realize the importance of becoming entrepreneurs by promoting project design considering the product R&D, production, marketing, service aspects and product life cycle
4. To foster teamwork, communication, leadership and cultivate techno-commercial-socio-economic problem solving capabilities

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

(POs & PSOs)

At the end of the programme, Electrical and Electronics Engineering Graduates will be able to :

PO1 : Engineering knowledge : Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialisation for the solution of complex engineering problems.

Competency		Indicators	
1.1	Demonstrate competence in mathematical modelling	1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
		1.1.2	Apply advanced mathematical techniques to model and solve electrical engineering problems
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural science to an engineering problem
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply fundamental engineering concepts to solve engineering problems
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	Apply electrical engineering concepts to solve engineering problems.

PO 2 : Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Competency		Indicators	
2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1	Articulate problem statements and identify objectives
		2.1.2	Identify engineering systems, variables, and parameters to solve the problems
		2.1.3	Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1	Reframe complex problems into interconnected sub-problems

		2.2.2	Identify, assemble and evaluate information and resources.
		2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
		2.2.4	Compare and contrast alternative solution processes to select the best process.
2.3	Demonstrate an ability to formulate and interpret a model	2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
		2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required
2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1	Apply engineering mathematics and computations to solve mathematical models
		2.4.2	Produce and validate results through skilful use of contemporary engineering tools and models
		2.4.3	Identify sources of error in the solution process, and limitations of the solution.
		2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

PO3 : Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competency		**Indicators**	
3.1	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.1	Recognize that need analysis is key to good problem definition
		3.1.2	Elicit and document, engineering requirements from stakeholders
		3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
		3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE.

	3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues 3.1.6 Determine design objectives, functional requirements and arrive at specifications
3.2 Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions 3.2.2 Build models/prototypes to develop a diverse set of design solutions 3.2.3 Identify suitable criteria for the evaluation of alternate design solutions
3.3 Demonstrate an ability to select an optimal design scheme for further development	3.3.1 Apply formal decision-making tools to select optimal engineering design solutions for further development 3.3.2 Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4 Demonstrate an ability to advance an engineering design to defined end state	3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources) 3.4.2 Generate information through appropriate tests to improve or revise the design

PO4 : Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Competency	**Indicators**
4.1 Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities 4.1.4 Establish a relationship between measured data and underlying physical principles.

4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures
		4.2.2	Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data
		4.3.2	Analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5 : Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency		**Indicators**	
5.1	Demonstrate an ability to identify / create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities
		5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.2.2	Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1	Discuss limitations and validate tools, techniques and resources
		5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

PO 6 : The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Competency		Indicators	
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7 : Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

Competency		Indicators	
7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management techniques for sustainable development
		7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

PO 8 : Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Competency		Indicators	
8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
8.2	Demonstrate an ability to apply the Code of Ethics	8.2.1	Identify tenets of the ASME professional code of ethics
		8.2.2	Examine and apply moral & ethical principles to known case studies

PO 9 : Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Competency		Indicators	
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		9.1.2	Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations-- communication, problem solving, conflict resolution and leadership skills	9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
		9.2.2	Treat other team members respectfully
		9.2.3	Listen to other members
		9.2.4	Maintain composure in difficult situations
9.3	Demonstrate success in a team-based project	9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts

PO 10 : Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Competency		Indicators	
10.1	Demonstrate an ability to comprehend technical literature and document project work	10.1.1	Read, understand and interpret technical and non-technical information
		10.1.2	Produce clear, well-constructed, and well-supported written engineering documents
		10.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2	Demonstrate competence in listening, speaking, and presentation	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others
		10.2.2	Deliver effective oral presentations to technical and non-technical audiences
10.3	Demonstrate the ability to integrate different modes of communication	10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
		10.3.2	Use a variety of media effectively to convey a message in a document or a presentation

PO 11 : Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Competency		Indicators	
11.1	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1	Describe various economic and financial costs/benefits of an engineering activity
		11.1.2	Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1	Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3	Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.
		11.3.2	Use project management tools to schedule an engineering project, so it is completed on time and on budget.

PO 12 : Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Competency		Indicators	
12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1	Describe the rationale for the requirement for continuing professional development
		12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
		12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3	Demonstrate an ability to identify and access sources for new information	12.3.1	Source and comprehend technical literature and other credible sources of information
		12.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

PSO1 : MODELING AND ANALYSIS : An ability to mathematically model and analyze the performance of Electrical machines, Control systems, Instrumentation systems, Power systems and Power Electronic systems.

PSO2 : DESIGN AND DEVELOPMENT : An ability to design the hardware and software requirements for the development of Electric drives, Automation systems and Embedded systems.

COIMBATORE INSTITUTE OF TECHNOLOGY

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B.E. ELECTRICAL AND ELECTRONICS ENGINEERING (FULL TIME)

CHOICE BASED CREDIT SYSTEM

Curriculum from the Academic Year 2019 - 2020 and onwards

SUBJECTS OF STUDY

Semester III

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EEM31	Transforms, Probability and Random Variables	3	0	0	3	BS
2	19EE31	Electric Circuit Analysis	2	1	0	3	PCC
3	19EE32	Electromagnetic Fields	2	1	0	3	PCC
4	19EE33	DC Machines and Transformers	3	0	0	3	PCC
5	19EE34	Analog Electronics	3	0	0	3	PCC
6	19EE35	Digital Electronics	3	0	0	3	PCC
7	19HSS01	Science of Creativity and Professional Ethics	1	0	0	1	HS
8	19EEL36	DC Machines and Transformers Laboratory	0	0	2	1	PCC
9	19EEL37	Analog and Digital Electronics Laboratory	0	0	2	1	PCC
10		One Credit Course 1				1	OCC
11	19HOC31	Communication Skills For Engineers I*	0	0	2	1	EEC
(BS - 3, HS - 1, PCC - 17, OCC - 1, EEC - 1)		**TOTAL CREDITS**				**23**	
* Not to be counted for GPA. Pass is required							

Semester IV

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EE41	AC Rotating Machines	3	0	0	3	PCC
2	19EE42	Networks and Systems	3	0	0	3	PCC
3	19EE43	Measurements and Instrumentation	3	0	0	3	PCC
4	19EE44	Linear Integrated Circuits	3	0	0	3	PCC
5	19EE45	Transmission and Distribution	3	0	0	3	PCC
6	19EE46	OOPS and C++ for Electrical Engineers	3	0	0	3	PCC
7	19EEL47	AC Rotating Machines Laboratory	0	0	2	1	PCC
8	19EEL48	Linear Integrated Circuits Laboratory	0	0	2	1	PCC
9		One Credit Course 2				1	OCC
10	19HOC41	Communication Skills For Engineers II*	0	0	2	1	EEC
(PCC - 20, OCC - 1, EEC - 1)		**TOTAL CREDITS**				**22**	
* Not to be counted for GPA. Pass is required							

Semester V

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EE51	Control Systems	3	0	0	3	PCC
2	19EE52	Power System Analysis	3	0	0	3	PCC
3	19EE53	Data Structures and Algorithms	3	0	0	3	PCC
4	19EE54	Embedded System Design	3	0	0	3	PCC
5		Elective Course 1	3	0	0	3	EC
6		Elective Course 2	3	0	0	3	EC
7	19EEL55	Control systems Laboratory	0	0	2	1	PCC
8	19EEL56	Embedded System Design Laboratory	0	0	2	1	PCC
9		One Credit Course 3				1	OCC
10	19EEL66	Mini Project	-	-	2	-	EEC
11	19INT51	Internship I	-	-	-	1	EEC
12	19HOC51	Employability and Personality Development Skills - I *	0	0	2	1	EEC
(PCC - 14, EC - 6, OCC - 1, EEC - 2)		**TOTAL CREDITS**				**23**	
* Not to be counted for GPA. Pass is required							

Semester VI

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EE61	Power Electronics	3	0	0	3	PCC
2	19EE62	Digital Protection of Power Systems	3	0	0	3	PCC
3	19EE63	Digital Signal Processing	3	1	0	4	PCC
4		Elective Course 3	3	0	0	3	EC
5		Elective Course 4	3	0	0	3	EC
6	19EEL64	Power Electronics Laboratory	0	0	2	1	PCC
7	19EEL65	Power Systems Laboratory	0	0	2	1	PCC
8		One Credit Course 4				1	OCC
9	19EEL66	Mini Project	0	0	6	3	EEC
10	19INT61	Internship II	-	-	-	1	EEC
11	19HOC61	Employability and Personality Development Skills - II*	0	0	2	1	EEC
(PCC - 12, EC - 6, OCC - 1, EEC - 5)		**TOTAL CREDITS**				**24**	
* Not to be counted for GPA. Pass is required							

Semester VII

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EE71	Solid State Drives and Control	3	0	0	3	PCC
2	19EE72	Generation of Electrical Energy	3	1	0	4	PCC
3	19EE73	Smart Grid	3	0	0	3	PCC
4		Elective Course 5	3	0	0	3	EC
5		Elective Course 6	3	0	0	3	EC
6	19EEL74	Electrical Drives Laboratory	0	0	2	1	PCC
7	19EEL75	Professional Competency	0	0	4	2	PCC
8	19EEL71	Project Phase 1	0	0	6	3	EEC
(PCC - 13, EC - 6, EEC - 3)		**TOTAL CREDITS**				**22**	

Semester VIII

S. No.	Course Code	Course Name	L	T	P	C	Category
1		Elective Course 7	3	0	0	3	EC
2		Elective Course 8	3	0	0	3	EC
3	19EEL81	Project Phase 2	0	0	10	5	EEC
(EC - 6, EEC - 5)		**TOTAL CREDITS**				**11**	

TOTAL CREDITS : 164 *

* Including First Year Credits

Category : **BS** - Basic Sciences, **HS** - Humanities and Social Sciences, **ES** - Engineering Sciences, **PCC** - Professional Core Course, **EC** - Elective Course, **EEC** - Employability Enhancement Course, **OCC** - One Credit Course.

ELECTIVE COURSES

PROFESSIONAL ELECTIVE COURSE : STREAM

I. ELECTRICAL MACHINES AND CONTROL (EMC)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EEE01	Design of Electrical Machines	3	0	0	3	EC
2	19EEE02	Special Electrical Machines	3	0	0	3	EC
3	19EEE03	Modeling and Analysis of Electrical Machines	3	0	0	3	EC
4	19EEE04	Digital Control Systems	3	0	0	3	EC
5	19EEE05	Systems Theory	3	0	0	3	EC
6	19EEE06	Embedded control of electric drives	3	0	0	3	EC
7	19EEE07	Robust Control	3	0	0	3	EC

II. POWER AND ENERGY (PE)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EEE08	Power Quality	3	0	0	3	EC
2	19EEE09	Advanced Power Electronics	3	0	0	3	EC
3	19EEE10	Power and Energy Management	3	0	0	3	EC
4	19EEE11	Energy Storage Technology	3	0	0	3	EC
5	19EEE12	Utilization and conservation of electrical energy	3	0	0	3	EC
6	19EEE13	Electrical Safety	3	0	0	3	EC
7	19EEE14	Energy Efficient Lighting System	3	0	0	3	EC
8	19EEE15	Power system design	3	0	0	3	EC
9	19EEE16	High Voltage Transmission Systems	3	0	0	3	EC
10	19EEE17	Deregulated Power System	3	0	0	3	EC
11	19EEE18	Electric Vehicles	3	0	0	3	EC
12	19EEE19	Energy Efficiency in Thermal & Electrical Utilities	3	0	0	3	EC
13	19EEE41	Switched Mode Power Conversion	3	0	0	3	EC
14	19EEE42	Utilization of Solar Energy	3	0	0	3	EC

III. ELECTRONIC DESIGN (ED)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EEE20	Real Time Embedded Systems	3	0	0	3	EC
2	19EEE21	VLSI Design	3	0	0	3	EC
3	19EEE22	FPGA based System Design	3	0	0	3	EC
4	19EEE23	Robotics and Control	3	0	0	3	EC
5	19EEE24	Digital Consumer technology	3	0	0	3	EC
6	19EEE25	Electronic Product Design	3	0	0	3	EC
7	19EEE26	Medical Electronics	3	0	0	3	EC
8	19EEE27	Analog and Digital Communication	3	0	0	3	EC
9	19EEE28	Multimedia system	3	0	0	3	EC
10	19EEE29	Automation, Renewable Energy & FPGA Laboratory	3	0	0	3	EC
11	19EEE43	Wearable Sensors	3	0	0	3	EC

IV. COMPUTER AND COMMUNICATION (CC)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EEE30	Computer architecture and parallel processing	3	0	0	3	EC
2	19EEE31	Multi core architecture	3	0	0	3	EC
3	19EEE32	Data Communication networks	3	0	0	3	EC
4	19EEE33	Fog computing	3	0	0	3	EC
5	19EEE34	Internet of Things	3	0	0	3	EC
6	19EEE35	Data Analytics	3	0	0	3	EC
7	19EEE36	Virtual instrumentation	3	0	0	3	EC
8	19EEE37	Cyber Physical systems	3	0	0	3	EC
9	19EEE38	Intelligent Techniques for Electrical Engineering	3	0	0	3	EC
10	19EEE39	Industrial Automation	3	0	0	3	EC
11	19EEE40	Deep Learning	3	0	0	3	EC

BS - BASIC SCIENCES

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19FYM12	Calculus and Numerical Methods	3	1	0	4	BS
2	19FYP13	Engineering Physics	3	0	0	3	BS
3	19FYC11	Engineering Chemistry	3	0	0	3	BS
4	19PL11	Physics Laboratory-I	0	0	1	0.5	BS
5	19CL11	Chemistry Laboratory-I	0	0	1	0.5	BS
6	19FYM22	Vector Calculus, Linear Algebra and Partial Differential Equations	3	1	0	4	BS
7	19PL21	Physics Laboratory-II	0	0	1	0.5	BS
8	19CL21	Chemistry Laboratory-II	0	0	1	0.5	BS
9	19MEL12	Engineering Practices Laboratory	0	0	2	1	BS
10	19EEM31	Transforms, Probability and Random Variables	3	0	0	3	BS
		TOTAL CREDITS				**20**	

HS - HUMANITIES AND SOCIAL SCIENCES

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19FYE11	Technical English	1	0	2	2	HS
2	19FYE21	Language Elective	1	0	2	2	HS
3	19FYC21	Environmental Science and Engineering	1	0	0	1	HS
4	19HSS01	Science of Creativity and Professional Ethics	1	1	0	1	HS
		TOTAL CREDITS				**6**	

ES - ENGINEERING SCIENCES

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19CM11	Basic Civil and Mechanical Engineering	3	0	0	3	ES
2	19MEL11	Engineering Graphics	1	0	4	3	ES
3	19FYP23	Electron Devices	3	0	0	3	ES
4	19EE22	Electric and Magnetic Circuits	3	0	0	3	ES
5	19CSL21	C Programming and Data Bases	0	0	4	2	ES
		TOTAL CREDITS				**14**	

PCC - PROFESSIONAL CORE COURSE

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19EE31	Electric Circuit Analysis	2	1	0	3	PCC
2	19EE32	Electromagnetic Fields	2	1	0	3	PCC
3	19EE33	DC Machines and Transformers	3	0	0	3	PCC
4	19EE34	Analog Electronics	3	0	0	3	PCC
5	19EE35	Digital Electronics	3	0	0	3	PCC
6	19EEL36	DC Machines and Transformers Laboratory	0	0	2	1	PCC
7	19EEL37	Analog and Digital Electronics Laboratory	0	0	2	1	PCC
8	19EE41	AC Rotating Machines	3	0	0	3	PCC
9	19EE42	Networks and Systems	3	0	0	3	PCC
10	19EE43	Measurements and Instrumentation	3	0	0	3	PCC
11	19EE44	Linear Integrated Circuits	3	0	0	3	PCC
12	19EE45	Transmission and Distribution	3	0	0	3	PCC
13	19EE46	OOPS and C++ for Electrical Engineers	3	0	0	3	PCC
14	19EEL47	AC Rotating Machines Laboratory	0	0	2	1	PCC
15	19EEL48	Linear Integrated Circuits Laboratory	0	0	2	1	PCC
16	19EE51	Control Systems	3	0	0	3	PCC
17	19EE52	Power System Analysis	3	0	0	3	PCC
18	19EE53	Data Structures and Algorithms	3	0	0	3	PCC
19	19EE54	Embedded System Design	3	0	0	3	PCC
20	19EEL55	Control systems Laboratory	0	0	2	1	PCC
21	19EEL56	Embedded System Design Laboratory	0	0	2	1	PCC
22	19EE61	Power Electronics	3	0	0	3	PCC
23	19EE62	Digital Protection of Power Systems	3	0	0	3	PCC
24	19EE63	Digital Signal Processing	3	1	0	4	PCC
25	19EEL64	Power Electronics Laboratory	0	0	2	1	PCC
26	19EEL65	Power Systems Laboratory	0	0	2	1	PCC
27	19EE71	Solid State Drives and Control	3	0	0	3	PCC
28	19EE72	Generation of Electrical Energy	3	1	0	4	PCC
29	19EE73	Smart Grid	3	0	0	3	PCC
30	19EEL74	Electrical Drives Laboratory	0	0	2	1	PCC
31	19EEL75	Professional Competency	0	0	2	1	PCC
		TOTAL CREDITS				**75**	

EEC - EMPLOYABILITY ENHANCEMENT COURSE

S. No.	Course Code	Course Name	L	T	P	C	Category
1	19FYEL11	Employability Skills	0	0	2	1	EEC
2	19FYEL21	English for Employability	0	0	2	1	EEC
3	19HOC31	Communication Skills For Engineers I*	0	0	2	1	EEC
4	19HOC41	Communication Skills For Engineers II*	0	0	2	1	EEC
5	19HOC51	Employability and Personality Development Skills - I *	0	0	2	1	EEC
6	19HOC61	Employability and Personality Development Skills - II *	0	0	2	1	EEC
7	19INT51	Internship 1	-	-	-	2	EEC
8	19EEL66	Mini Project	0	0	6	3	EEC
9	19INT61	Internship 2	-	-	-	2	EEC
10	19EEL71	Project Phase 1	0	0	6	3	EEC
11	19EEL81	Project Phase 2	0	0	10	5	EEC
		TOTAL CREDITS				**21**	

LIST OF ONE CREDIT COURSES *

1. DEPARTMENT BASED ONE CREDIT COURSES

S. No.	Course Code	Course Name	Credit	Category
1	19EEOC06	Electrical safety standards and practices	1	OCC
2	19EEOC07	Scilab Programming	1	OCC

2. INDUSTRY BASED ONE CREDIT COURSES

S. No.	Course Code	Course Name	Credit	Category
1	19EEOC08	Machine Vision	1	OCC
2	19EEOC09	Cyber Security in Manufacturing and Smart Grid	1	OCC
3	19EEOC10	Robotics and automation	1	OCC
4	19EEOC12	AWS Cloud Practitioner Essentials	1	OCC
5	19EEOC13	Introduction to IoT	1	OCC
6	19EEOC14	TCS ION Career Edge Young Professional	1	OCC

* One credit courses could be opted from Department/Industry/NPTEL

19EEM31 - TRANSFORMS, PROBABILITY AND RANDOM VARIABLES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon successfully completing of this course the students will be able to demonstrate ability to

CO1 *: Analyze the Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.*

CO2 *: Use the effective mathematical tools for the solutions of difference equations by using Z transform techniques for discrete time systems.*

CO3 *: Solve the physical problems of engineering by using the mathematical principles on transforms.*

CO4 *: Apply the basics of probability and random variables to solve engineering problems*

CO5 *: Apply moments, probability density functions, correlation & regression to analyze and solve problems.*

LAPLACE TRANSFORM

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems -Transforms of derivatives and integrals - Initial and final value theorems - Inverse transforms - Convolution theorem - Transform of periodic functions - Application to solution of linear second order ordinary differential equations with constant coefficients. **9**

Z TRANSFORMS AND DIFFERENCE EQUATIONS

Z-transforms - Elementary properties - Inverse Z-transform - Convolution theorem - Solution of difference equations using Z-transform. **9**

FOURIER SERIES AND FOURIER TRANSFORMS

Introduction to Fourier Series-Dirichlet's conditions-Trigonometric Fourier Series-Exponential form of Fourier Series-Fourier integral theorem (without proof)-Infinite Fourier transform-Infinite Fourier sine and cosine transforms properties and problems-Convolution theorem-Parseval's identity. **9**

PROBABILITY AND RANDOM VARIABLES

Probability-Axioms of Probability-Conditional Probability-Baye's theorem -Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Normal,Uniform and Exponential distributions. **9**

TWO DIMENSIONAL RANDOM VARIABLES

Probability mass function - Probability distribution function - Cumulative distribution function-Marginal probability functions - Conditional distribution - Expectation of two dimensional random variables - Covariance - Correlation. **9**

TOTAL: 45

TEXTBOOKS

1. *Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.*
2. *Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, New Delhi, 2017.*

REFERENCE BOOKS

1. *B.V.Ramana," Higher Engineering Mathematics", 6th Edition (2014), Tata MC Graw-Hill Publishing Company Limited, New Delhi.*
2. *Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.*
3. *William W Hines, Douglas C Montgomery, David M Goldsman and Connie M Borror, "Probability and Statistics in Engineering", John Wiley, 2008.*

19EE31- ELECTRIC CIRCUIT ANALYSIS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Apprehend the fundamentals of sinusoids, phasor and apply & analyse the sinusoidal excitation of R, L, C under steady state and associated power relations*

CO2 *: Realize the concept of linearity and apply the circuit theorems to solve complex electric circuits.*

CO3 *: Comprehend the frequency response of a resonant circuit and analyse the impact of quality factor, bandwidth on the frequency response.*

CO4 *: Recognize and interpret the dot convention of mutually coupled coils in a circuit and solve complex electromagnetic circuits. Also understand nature of the waveform and its impact on the electrical systems*

CO5 *: Describe the significance of three phase systems with star & delta connected circuits to solve the three phase circuits for both domestics and industrial applications*

SINUSOIDAL STEADY STATE ANALYSIS

Sinusoidal voltage and current -Peak, Average and RMS values - Peak (Crest) and Form factors for sinusoidal and non - sinusoidal periodic waveforms - R, L and C elements and their voltage - current relationships - concept of phasor - transforming a circuit into a phasor equivalent circuit- complex impedance and admittance - phasor diagrams - analysis of simple, single phase ac series and parallel circuits - apparent power, active power, reactive power, power factor - concept of complex power - impedance and power triangle **9**

CIRCUIT THEOREMS

Mesh and Nodal analysis in AC circuits - Linearity of a circuit and Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem - Reciprocity theorem - Tellegen's theorem - Millman's theorem-Concept of duality and dual networks. **9**

RESONANCE

Series and Parallel Resonance - resonant frequency for a tank circuit -impedance and phase angle of a resonant circuit - bandwidth and quality factor - voltage and current in a resonant circuit - variation of impedance with frequency **9**

COUPLED CIRCUITS AND WAVEFORM ANALYSIS (FOURIER METHOD)

Analysis of coupled circuits - conductively coupled circuits - single tuned and double tuned coupled circuit. Periodic waveforms in circuit analysis- exponential Fourier series -Trigonometric Fourier series- - waveform symmetry-line spectrum- RMS values-average power and power cube- true power factor - circuit applications. **9**

THREE PHASE CIRCUITS

Advantages of three phase system - generation of three - phase voltages - phase sequence - inter connection of three - phase sources and loads - star and delta connections and their transformation - line and phase quantities - analysis of three phase circuits with star and delta connected balanced and unbalanced loads - symmetrical components- phasor diagram representation - power measurement in three - phase circuits. **9**

Note: 1. A term paper on "Computer Simulation of Electric Circuits" to be submitted during the course work for internal assessment using MATLAB/PSIM/pSpice/Multisim.

2. Design Problems and Practical Applications to be discussed for all the units and team activity may be given on the specific design tasks for internal assessment.

TEXT BOOKS

1. *Charles K. Alexander and Matthew N.O.Sadiku, "Fundamentals of Electric Circuits" McGraw Hill Education (India) Private Limited, 6th Edition, 2019.*
2. *Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Series, McGraw Hill Education (India) Private Limited, 6th Edition, 2013.*

REFERENCES

1. *Allan H.Robbins, Wilheim C.Miller, "Circuit Analysis - Theory and Practice" Cengage Learning, 5th Edition, 2013.*
2. *William H. Hayt Jr, Jack E. Kemmerly, and Steven M.Durbin, "Engineering Circuit Analysis", McGraw Hill Education (India) Private Limited, 8th Edition, 2013.*
3. *K.S.Suresh Kumar, "Electric Circuits and Networks" Pearson, Dorling Kindersley (India) Private Limited, 2014.*
4. *James W.Nilsson,Susan A.Riedel, "Electric Circuits" Pearson, 11th edition, 2018.*
5. *Richard Dorf, James A.Svoboda, "Introduction to Electric Circuits" Wiley-India, John Wiley & Sons, 6th Edition 2004.*
6. *Robert.L.Boylestad, "Introductory Circuit Analysis" Pearson, Dorling Kindersley (India) Private Limited, 12th Edition, 2014.*
7. *Sudhakar A. and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", McGraw Hill Education (India) Private Limited, 2015.*

19EE32 - ELECTROMAGNETIC FIELDS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Solve electromagnetic field problems by using vector calculus concepts.*

CO2 *: Illustrate Coulomb's law, Gauss law, Poisson and Laplace equation concepts to solve electrostatic problems.*

CO3 *: Apply ampere's circuital law and Biot - Savart's law to determine magnetic field intensity and magnetic flux density in magneto static problems..*

CO4 *: Determine the capacitance and inductance for various configurations in electrostatic and magnetostatic fields.*

CO5 *: Analyze Maxwell's equations in different forms (differential and integral) and apply them to diverse engineering problems.*

VECTOR ANALYSIS

Vector algebra - Co - ordinate systems - Vector calculus: Dot product of vectors, Cross product of vectors, Transformation of vectors - Types of integral related to electromagnetic theory - Gradient, Divergence and Curl - Divergence theorem - Stoke's theorem. **9**

ELECTROSTATIC FIELDS

Coulomb's law - Electric field intensity of point, line and sheet of charges - Electric flux density - Gauss's law and its applications - Poisson's and Laplace equations - Electric potential - Potential gradient. **9**

ELECTRIC FIELD IN MATERIALS AND CAPACITANCE

Properties of Conductors and dielectric materials - Polarization in dielectrics - Boundary conditions for perfect dielectric materials - Electric dipole - Potential and field due to an electric dipole - Capacitance of parallel plate capacitor, spherical capacitor and cables with single dielectric - Electrostatic energy storage and Energy density. **9**

MAGNETOSTATICS AND INDUCTANCE

Applications of Biot - Savart's law - Applications of Ampere's circuital law - Scalar and Vector magnetic potentials - Magnetization - Magnetic boundary conditions - Inductance of Transmission lines - Magneto static energy and energy density - Lifting force of a magnet. **9**

ELECTRODYNAMIC FIELDS AND ELECTROMAGNETIC WAVES

Conduction and displacement current densities - Maxwell's equations in differential and integral forms - Maxwell's equation for harmonically varying fields - Electromagnetic waves: Electromagnetic wave equations - Intrinsic impedance and Skin depth - Electromagnetic waves in good conductors, lossy and lossless dielectrics - Poynting vector and Poynting's theorem. **9**

TOTAL : 45

TEXT BOOKS

1. *Matthew N.O.Sadiku, "Elements of Electromagnetics", Oxford University Press, 6th edition, 2015.*
2. *Gangadhar K.A. and Ramanathan P.M, "Electromagnetic Field Theory", Khanna Publishers, Delhi, 2011.*

REFERENCES

1. *W.H.Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, New Delhi, 6th edition, 2011.*
2. *John D. Kraus and Daniel A. Fleisch, "Electromagnetics with Applications", Tata McGraw Hill, 4th Edition, 2010.*
3. *Ophelia burgess, "Principles of Electromagnetism", Larsen & Keller Education, 2019.*
4. *Steven W. Ellingson, “Electromagnetics", Volume 2, Virginia tech publishing, 2019*

19EE33 - DC MACHINES AND TRANSFORMERS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Elucidate the constructional details and analyze the operation of DC machines*

CO2 : *Illustrate the speed control methods, braking and testing of DC machines for industrial application*

CO3 : *Explain the construction of transformer and to compute the equivalent circuit parameters to evaluate its performance under various conditions.*

CO4 : *Erudite the basic concept of three phase connections, principle of autotransformers and special purpose transformers.*

CO5 : *Design of overall transformers and inductors for specific application.*

DC MOTOR AND GENERATOR

D.C. Machines - Construction - Principle of operation - Methods of excitation- Armature Windings- Armature reaction - DC motor: Torque equation and characteristics - DC Generator: characteristics - EMF equation - commutation. **10**

SPEED CONTROL AND TESTING OF DC MOTORS

Speed control methods - Electric braking - Losses and Efficiency- Testing: Direct, Indirect and Regenerative methods to test the DC machines. **8**

TRANSFORMERS

Construction and operation of single phase transformers - EMF equation- Phasor diagram-equivalent circuit - voltage regulation- losses and efficiency - All day efficiency- Parallel operation. Predetermination of performance from open circuit and short circuit tests. **9**

THREE PHASE TRANSFORMERS AND AUTOTRANSFORMERS

Three-phase transformer: types of connection and their comparative features-Autotransformers: Construction- Principle- saving in copper - Applications -Special Purpose Transformers: Pulse, welding, rectifier, high frequency transformers. **8**

DESIGN OF TRANSFORMESR

Output equation - Design of core - Optimum Design for weight, volume, cost and losses - Overall Dimensions - Design of windings - No load current and losses calculations - Temperature rise and Regulation from design data - Design of inductors: Requirements - Fundamental Consideration with examples - Design of Tank and Cooling tubes (qualitative treatment only) - **10**

TOTAL: 45

TEXT BOOKS

1. *Kothari D.P., Nagrath, I.J. "Electrical Machines", McGraw Hill Publishing Company Ltd., Fourth Edition, New Delhi .2017.*
2. *Smarajit Ghosh., "Electrical Machines I," Pearson Education, First Edition 2011.*

REFERENCE BOOKS

1. *Bhattacharya, S.K., "Electrical Machines", Tata McGraw Hill, 2017.*
2. *A. E. Fitzgerald, Kingsley, Stephen D, "Electric Machinery", International Edition, Sixth Edition, the McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, 2003. ISBN 0-07- 112193-5*
3. *Colonel Wm. T. Mclyman, "Inductor Design Handbook", Third Edition, Marcel Dekker, Inc. 270 Madison Avenue, New York, NY 10016, U.S.A, 2004. ISBN: 0-8247-5393-3*
4. *M.G. Say, "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors, New Delhi, 2002.*

19EE34 - ANALOG ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 : *Illustrate the rectifiers, filters and regulators of a DC power supply.*

CO2 : *Analyze BJT and FET amplifiers using small signal models and to plot the frequency response of the amplifiers.*

CO3 : *Design and evaluate different classes of power amplifiers used for audio and radio applications.*

CO4 : *Utilize the concepts of negative feedback amplifiers to improve the stability of the amplifiers..*

CO5 : *Apply the concepts of positive feedback amplifiers to generate sustained oscillations and to design clippers and clampers.*

DC POWER SUPPLIES

Single Phase Rectifiers : Half wave, Full wave and Bridge rectifiers - Ripple factor - Rectification efficiency - TUF - PIV - Regulation - Filters: Inductor, Capacitor, L section and Π section filters - Ripple factor - Regulators: Series and Shunt type - Protection circuits. **9**

BJT AND FET SMALL SIGNAL AMPLIFIERS

BJT Amplifier : Small signal low frequency parameters and equivalent circuit - Small signal analysis of CE, CB and CC amplifiers with voltage divider bias using h - parameters. Multistage amplifier: RC Coupled - Transformer coupled amplifiers - Frequency response. FET Amplifier: Small signal model and analysis of CS, CD and CG amplifier. **12**

LARGE SIGNAL AMPLIFIERS

Classification : Class A power amplifier - Harmonic distortion - Class B amplifier - Push - pull amplifier - Complementary symmetry operation - Class AB amplifier, Class C amplifier and Class D amplifier. **6**

FEEDBACK AMPLIFIERS

Feedback concepts - Ideal feedback topologies - Advantages and Disadvantages of negative feedback - Analysis of voltage and current: Series and Shunt feedback amplifier circuits. **9**

WAVE SHAPING CIRCUITS AND OSCILLATORS

Clippers - Clampers. Oscillators: Barkhausen criterion - RC phase shift oscillator - Hartley Oscillator - Colpitts Oscillator - Frequency Stability - Crystal Oscillator. **9**

TOTAL : 45

TEXT BOOKS

1. *Jacob Millman, Christos C Halkias and Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw - Hill, 4th Edition, 2015.*
2. *Jacob Millman, Christos Halkias and Chetan D Parikh, "Millman's Integrated Circuits", Tata McGraw - Hill, 2nd Edition, 2008.*
3. *Allen Mottershead, "Electronic Devices and Circuits - An Introduction", PHI learning, 2011.*

REFERENCE BOOKS

1. *Jacob Millman and Herbert Taub, "Pulse, Digital and switching Waveforms", Tata McGraw - Hill, 2nd Edition, New Delhi, 2008.*
2. *Robert L. Boylstead and Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice - Hall of India, 11th Edition, New Delhi, 2012.*
3. *Salivahanan, "Electron Devices and Electronic Circuits", Tata McGraw - Hill, 3rd Edition New Delhi, 2012.*

19EE35 - DIGITAL ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Solve basic arithmetic calculations in binary, decimal and hexadecimal and illustrate reduction of logical expressions using boolean algebra, k-map and tabulation method and implement the functions using logic gates.*

CO2 *: Realize combinational circuits for given application and design using logic gates*

CO3 *: Design and analyze synchronous and asynchronous sequential circuits using flip-flops, able to develop Mealy and Moore Models and formulate the programming table for implementing the logic functions using PLA and PAL.*

CO4 *: Compare different types of logic families which are the basic unit of different types of logic gates in terms of efficiency.*

CO5 *: Develop Verilog coding for combinational and sequential logic circuits.*

BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES

Review of binary number systems - binary codes - Error detection and correction codes - Boolean postulates and theorems - Minimization of Boolean functions using basic laws - logic gates - Switching functions - Representation of logic functions - Canonical forms - SOP and POS - Simplification of logic functions using Karnaugh maps and Quine McCluskey method - NAND and NOR implementation. **9**

COMBINATIONAL LOGIC CIRCUITS

Binary adder and subtractor - BCD adder - Code converters - Decoders and Encoders - Multiplexers and Demultiplexers - Parity generators and checkers - Magnitude Comparator - Design of combinational logic circuits using logic gates, decoders and multiplexers - Implementation of combinational logic circuits using PROM, PAL and PLA. **9**

SEQUENTIAL LOGIC CIRCUITS

Flip Flops - counters - asynchronous and synchronous types - Modulo counters - Shift registers - Ring counter and twisted ring counter - Mealy and Moore Models - State table - excitation table - State diagram - State reduction - State assignment -Analysis and Design of synchronous sequential circuits - Design of sequence detectors, sequence generators and counters using flip-flops - Introduction to asynchronous sequential circuits. **10**

DIGITAL IC FAMILIES

Input and output characteristics of logic gates - TTL: Standard TTL - Three state output TTL - Schottky TTL - CMOS Logic: Inverter, NAND, and NOR gates - Interfacing TTL and CMOS families- ECL OR/NOR gate - comparison of TTL, ECL, and CMOS families. **9**

DIGITAL SYSTEM DESIGN USING VERILOG

Introduction to hardware description languages and verilog - Module declaration - HDL models of combinational circuits - Gate-level modeling - Dataflow modeling - Behavioral modeling - HDL for registers and counters. **8**

TOTAL : 45

TEXT BOOK

1. *Morris Mano M, Michael D. Ciletti, "Digital Design: with an Introduction to the Verilog HDL", Prentice Hall of India Ltd, 6th Edition, 2019.*

REFERENCE BOOKS

1. *John M. Yarbrough, "Digital Logic Applications and Design", PWS, 2001.*
2. *Richard F. Tinder, "Engineering Digital Systems Design", Harcourt India Pvt. Ltd., New Delhi, 2001.*
3. *John P.Uyemura, "A First Course in Digital Systems Design - An Integrated Approach", Brooks/Cole Publishing Company, 2000.*

19HSS01 - SCIENCE OF CREATIVITY AND PROFESSIONAL ETHICS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of course, students will be able to

CO1 : *Understand the principles of karma yoga, duty consciousness and evolution of the universe.*

CO2 : *Analyze the benefits of yoga and meditation.*

CO3 : *Understand the benefits of harmony, introspection and examine human values for sustained growth in career and life*

LIFE FORCE, CONCIOUSNESS AND EVOLUTION OF UNIVERSE

Science of Creativity and Personality Development - Principles of Karma Yoga - Duty Consciousness - Law of Nature - Life Force -Potentiality of the Life Force - Consciousness - Pancha Thanmatras - Biomagnetism. Evolution of the Universe: Creation Theory - Evolution Theory - Evolution of Living Beings: Absolute Space and Force - Seven Constituent Layers in the Body. **(6)**

YOGA AND ITS BENEFITS

Simple and Safe yoga - Upa yoga Practices : Yoga for peace, health, joy, love, well-being and success. Physical exercise - Meditation - Seven centers of meditation - benefits - effect of good vibrations - cause and effect system. **(3)**

HARMONY IN LIFE, INTROSPECTION AND HUMAN VALUES

Harmony in Life : Self, family, society and nature - Introspection : Analysis of thought, Moralization of desire, Neutralization of anger, Eradication of worries and Self realization.

Morals, Values and Ethics - Integrity - Work ethics - Service learning - Virtues - Respect for others - Valuing time - Co-operation -Commitment - Empathy - Self confidence - Challenges in work place - impact of cyber space on individual. **(6)**

TOTAL: 15

TEXT BOOKS

1. *Yogiraj Vethathri Maharishi, "Karma Yoga - The Holistic Unity", Vethathri Publications 4th Edition, 2009.*
2. *R.S.Naagarazan, "A Textbook on Professional Ethics and Human Values", New Age International Publishers, New Delhi, 2011.*

REFERENCES

1. *Sadhguru, "Body the Greatest Gadget and Mind is your Business", Diamond Pocket Books Pvt. Ltd, Isha Foundations, 2013.*
2. *Swami Vivekananda and Swami Nikhilananda, "Karma Yoga and Bhakti Yoga", 2nd Edition, Ramakrishna Vivekananda Publications, 2008.*

3. *Mike W. Martin and Roland Schinzinger,"Ethics in Engineering", 4th Edition McGraw Hill, NewYork, 2005.*
4. *M. Govindarajan, S. Natarajan, V.S. Senthilkumar, "Engineering Ethics", 1st Edition, Prentice Hall of India, 2009.*

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos)

Cos	Program Outcomes/Program Specific Outcomes (Pos/PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2	1					
CO2									2					
CO3								3	2					

(1: Slight, 2: Moderate 3: Substantial)

19EEL36 - DC MACHINES AND TRANSFORMERS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Analyze the performance of DC motors/generators by conducting direct load test experimentally.*

CO2 *: Analyze the performance of transformer by conducting direct load test experimentally.*

CO3 *: Predetermine the performance of DC machines by conducting Swinburne's test.*

CO4 *: Compare the performance characteristics obtained experimentally on various DC machines and select suitable DC machines for industrial applications.*

CO5 *: Draw the equivalent circuit and predetermine the performance of transformers by conducting open circuit and short circuit tests.*

LIST OF EXPERIMENTS

1. OCC and Critical Speed of DC Shunt Generator.
2. No Load Speed Control of DC Shunt Motor.
3. Swinburne's Test.
4. Load Test on DC Shunt Motor.
5. Load Test on DC Shunt Generator.
6. Load Test on DC Series Generator.
7. Load Test on DC Series Motor.
8. Load Test on DC Compound Motor.
9. OC and SC Test on Single - Phase Transformer.
10. Predetermination of performance characteristics of Single phase transformer.
11. Load Test on Single - Phase Transformer (R,L,C Loads).
12. IoT Based Motor Monitoring System.
13. Speed Control of PMDC Motor.
14. Design of transformer rating for inductive and non-inductive loads.

19EEL37 - ANALOG AND DIGITAL ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Design and construct simple electronic circuits to accomplish specific functions.*

CO2 *: Observe the amplitude and frequency responses of common amplification circuits*

CO3 *: Construct basic combinational circuits and verify their functionalities*

CO4 *: Design and simulate the combinational and sequential circuits*

CO5 *: Design and analyze the operation of counters and shift registers*

LIST OF EXPERIMENTS

1. Half-wave and Full-wave rectifiers
2. BJT and MOSFET Amplifiers
3. Frequency response of RC coupled amplifier
4. Testing of class B push-pull power amplifier
5. Code converters
6. Multiplexer and Demultiplexer
7. Encoder and Decoder
8. Error Detection and Correction circuits
9. Registers and PRBS Generators
10. Asynchronous and Synchronous Counters

Note: Simulate and verify digital IC experiments using Verilog.

19EE41 - AC ROTATING MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 : *Elucidate and illustrate constructional features, winding details, induced EMF of Synchronous Machines.*

CO2 : *Analyze the performance of the three phase Synchronous motors and develop phasor diagram to examine steady state performance and determination of X_d and X_q.*

CO3 : *Illustrate the operation and speed control characteristics PMSM and BLDC motors.*

CO4 : *Acquire knowledge about the construction, torque slip characteristics and compute equivalent circuit parameters to evaluate the performance of three phase induction motors.*

CO5 : *Interpret the double field revolving theory, analyze the performance and starting methods of single-phase induction motor.*

SYNCHRONOUS GENERATOR

Constructional features- EMF equation-Phasor diagram-Armature reaction-Synchronous impedance-Predetermination of voltage regulation - EMF, MMF, and Potier methods - Parallel operation of Alternators. **10**

SYNCHRONOUS MOTOR

Principle of operation -Starting methods - Phasor diagram-Effect of load on a synchronous motor -V-curves and Inverted V- curves-Two reaction theory of salient pole alternators - Determination of X_d & X_q. **9**

PMSM and BLDC MOTOR

PMSM: Construction - Principle of operation - EMF equation - Torque Equation - Phasor Diagram - Comparison of conventional synchronous motor with PMSM.

BLDC Motor: Construction - Principle of operation - Electronic Commutation - Types of BLDC Motor-EMF equation - Voltage and Torque equation - Speed Torque Characteristics - Comparison of DC motor and BLDC motor. **9**

THREE PHASE INDUCTION MOTOR

Constructional features- production of rotating magnetic field - torque equation -Phasor diagram - Performance analysis - Torque-slip characteristics- No load and blocked rotor tests-Load test- equivalent circuit- Circle diagram-starting methods - conventional speed control of induction motors. **10**

SINGLE PHASE INDUCTION MOTOR

Principle of operation- Double revolving field theory - Equivalent circuit and Performance characteristics -Methods of starting - Capacitor start, Shaded pole and Repulsion motors. **7**

TOTAL : 45

TEXT BOOKS

1. *M.G.Say, "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors, New Delhi, 2002.*
2. *Kothari D.P., Nagrath, I.J. "Electrical Machines", McGraw Hill Publishing Company Ltd., Fourth Edition, New Delhi. 2017.*

REFERENCE BOOKS

1. *Bhattacharya, S.K., "Electrical Machines", Tata McGraw Hill, 2017.*
2. *P.K.Mukherjee and S.Chakravorti, "Electrical Machines", DhanpatRai Publications, New Delhi, 2011.*
3. *P.S. Bhimbra, "Electrical Machinery", Khanna Publishers, 2003.*
4. *Cyrill. G. Veinott, "Fractional and Subfractional Horse Power Electric motors", TMH Publishers, 1996.*

19EE42 - NETWORKS AND SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to:

CO1 : *Solve circuit theory problems using graph theory concepts.*

CO2 : *Appreciate the transient response of electric circuits with DC and AC excitation and solve transient circuits using Laplace Transform techniques.*

CO3 : *Apply the concept of complex frequency in studying network functions and analyze two-port network parameters using various models.*

CO4 : *Identify the given function for positive realness and synthesize LC, RC, and RL one-port networks using Foster and Cauer forms.*

CO5 : *Apprehend the frequency response of active and passive filters.*

NETWORK TOPOLOGY

Linear oriented graphs - incidence matrix of a linear oriented graph -Kirchhoff's laws in incidence matrix formulation - circuit matrix of a linear oriented graph - tree and its properties - Kirchhoff's laws in fundamental circuit matrix formulation - Loop analysis of electric networks - cut sets - cut set matrix of a linear oriented graph - Kirchhoff's laws in fundamental cutest formulation - Node-pair analysis of networks - Analysis using generalized branch model. **9**

CIRCUIT TRANSIENTS

Transient concepts - differential equations and initial conditions in RLC networks - transient response of simple RL, RC, and RLC series and parallel circuits to step and sinusoidal inputs using Laplace transform method. **9**

NETWORK FUNCTIONS AND TWO PORT NETWORKS

Concept of complex frequency - Network functions - Driving point and transfer functions and their properties - Poles and Zeros and their significance - Time domain behavior from pole - zero plot - Impulse response of network functions - Two port networks - Z, Y, ABCD and h parameters - Condition for reciprocity and symmetry - Parameter conversion - Interconnection of two port networks - Analysis of typical two port networks - Input and Output impedances of terminated two port networks - Image impedances. **11**

ELEMENTS OF REALIZABILITY AND SYNTHESIS OF ONE-PORT NETWORKS

Hurwitz polynomials - Positive real functions - Frequency response of reactive one port network - Synthesis of reactive one port networks by Foster method and Cauer method - Synthesis of RL and RC networks by Foster method and Cauer method. **8**

FILTERS

The decibel scale - bode plots - passive filters: low pass, high pass, band pass, and band reject filters - Active filters: first order low pass, high pass, band pass, and band reject (or Notch) filter - Scaling: magnitude scaling - frequency scaling - magnitude and frequency scaling - applications. **8**

TOTAL : 45

TEXT BOOKS

1. *Ravish R. Singh, "Network Analysis and Synthesis", TMH, New Delhi, 1st Edition, 2017.*
2. *Roy D.Choudhury, "Networks and Systems", New Age Publications, New Delhi, 4th Edition, 2010.*

REFERENCE BOOKS

1. *Charles K. Alexander and Mathew N.O. Sadiku, "Fundamentals of Electric Circuits" McGraw Hill Education (India) Pvt Ltd, VI Edition, 2019.*
2. *Franklin F. Kuo, "Network Analysis and Synthesis" Wiley India Pvt. Ltd., New Delhi, 2nd Edition, 2012*
3. *Sudhakar A. and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", TMH, New Delhi, 2011.*
4. *Ramesh Babu P. and Anandanatarajan, R., "Signals and Systems", SciTech Publications (India) Pvt Ltd, 5th Edition, 2011.*

19EE43 - MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 : *Interpret statistical data measurement and evaluate static and dynamic characteristics for electrical and Non-electrical parameters measurement.*

CO2 : *Illustrate the functioning of different electro-mechanical and digital measuring instruments along with their application domains.*

CO3 : *Analyse and recommend suitable sensors and transducers for measuring non-electrical physical quantities and measurement techniques used in process industries.*

CO4 : *Integrate the electronic display and recording devices for the appropriate type of measurement or data recording and logging.*

CO5 : *Erudite about the intelligent sensors and data acquisition system in industry for effective measurement, control and data storage.*

MEASUREMENT CONCEPTS

Functional Elements of measurement and instrumentation system-Accuracy, Precision, types of errors, calibration and standards in measurement- Factors influencing the selection of Transducers - Classification - Introduction to Intelligent Sensors -MEMS sensors - Nano sensors - System on chip. **9**

ELECTRICAL MEASUREMENTS

Analog meters: PMMC and Moving Iron Instruments: Working, comparison and measurement of DC and AC Voltage and Current - Electrodynamometer type watt meter - Insulation resistance test, Earth resistance: Fall of potential method- Instrument Transformers: CT and PT - Applications

Digital meters: Block diagram and functioning of Multi-Meter, Principles of Net metering- Bi- directional single phase energy meter -Frequency Meter - Wheatstone, Kelvin, Maxwell, Schering and Wein bridges. **10**

NON-ELECTRICAL MEASUREMENTS

Transducers: Linear and Angular displacement: Resistive (Potentiometer), inductive (LVDT) - Liquid Level: Capacitive - piezoelectric, Hall Effect transducers - Flow meters: electromagnetic, ultrasonic types- Air velocity, pressure: Anemometer- Temperature: Thermocouple, RTD (3/4 wire), thermistor- principle of Thermography and thermal imaging and applications. Optical sensors: photo-diode, light dependent resistor and photo voltaic cell. **9**

DISPLAY AND RECORDING INSTRUMENTS

Working of Analog CRO - Dual Trace and Dual Beam CROs - Digital Storage Oscilloscopes(DSO) - Signal Analyser- Spectrum Analyzer- Harmonic Analyzer - Mixed signal oscilloscopes(MSO) - Signal Generator - Function Generator - Recorders: X-t recorder- X-Y recorder **8**

INTELLIGENT INDUSTRIAL INSTRUMENTATION

Telemetry Principles : Land Line Telemetry, RF Telemetry - Multiplexing - TDM,FDM and CDM - Functional elements of Data Acquisition System, control - Communication architecture in DAS-SCADA principles and application-Introduction to Intelligent Instrumentation using HART Protocol and communication layers. **9**

TOTAL : 45

TEXT BOOKS

1. *Sawhney A.K., "A Course in Electrical and Electronic Measurements", Dhanpat Rai & Sons, New Delhi,19th Edition, 2019.*
2. *Syed Akhtar.I and Vibhav Kumar.S, "Electronic Measurement and Instrumentation" I K International publishing House, 2018.*

REFERENCE BOOKS

1. *Ernest O.Doeblin "Measurement Systems - Applications and Design", McGraw Hill, 2nd Edition 2010.*
2. *Kalsi H.S.,"Electronic Instrumentation", Tata McGraw Hill Co, 3rd Edition, 2010.*
3. *A.D.Cooper and A.D.Helfrik, "Modern Electronic Instrumentation and Measurement Techniques", 2nd edition, Prentice Hall of India, New Delhi, 2008.*
4. *E. W. Golding & F. C. Widdis, "Electrical Measurement & Measuring Instrument", 5th edition, A.H.Wheeler& co., India, 2011.*

19EE44- LINEAR INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Examine the DC/AC characteristics of Op-amp and design an appropriate compensation for Op-amp.*

CO2 *: Design of various linear applications using op-amp IC741.*

CO3 *: Design of various non - linear applications using op-amp IC741.*

CO4 *: Design of analog circuits such as voltage regulator, VCO and multi - vibrators using other linear IC's.*

CO5 *: Design of analog computation and signal conditioning circuits using op-amps.*

OVERVIEW OF INTEGRATED CIRCUIT TECHNOLOGY VIDEO/ANIMATION TO BE DISPLAYED AND DISCUSSED

Silicon Semiconductor Technology - Wafer processing, Oxidation, Epitaxy, Deposition, Ion implantation Diffusion and Metallization - Basic CMOS processing technology - N-well, P-well process - Twin tub process and Silicon on insulator - Circuit Elements - Resistors, Capacitors and Thin film transistors. **3**

OPERATIONAL AMPLIFIER CHARACTERISTICS

Functional block diagram - Analysis of typical op-amp - Equivalent circuit - Open loop gain - CMRR - Input bias and off set currents - Input and Output off set voltages - Off set compensation techniques - Frequency response - Noise - Stability - Limitation - Frequency compensation techniques - Slew rate. **9**

OPERATIONAL AMPLIFIER APPLICATIONS

DC and AC Amplifier - Inverting and Non-inverting amplifier - Summing, Scaling and Averaging amplifier - Voltage follower - Differential amplifier - Instrumentation amplifier - Voltage to Current and Current to Voltage converters - Integrator and Differentiator - Practical considerations - Active filters and Oscillators.**9**

COMPARATORS AND CONVERTERS

Comparator- Zero crossing detector - Schmitt trigger - Voltage to Frequency and Frequency to Voltage converters - Sample and Hold circuit - D/A converters - A/D converters - Precision rectifiers - Peak detectors - Clipper and Clamper - Log and Antilog amplifier - Multiplier and Divider - Wave form generators. **9**

OTHER LINEAR IC APPLICATIONS

Voltage regulators - IC 7805 - IC 723 - Current limiting and Current boosting - Fixed and Adjustable three terminal regulators - SMPS ICs - PLL - Applications - IC 566 Voltage controlled oscillators - IC 555 timer - Monostable and Astable mode of operations - Applications. **9**

ANALOG COMPUTATION AND SIGNAL CONDITIONING

Solution to integro-differential equations, Signal conditioning of low magnitude signals from sensors - instrumentation amplifier design, filter design, analog buffers, analog interfacing circuits for microcontrollers. **6**

TOTAL : 45

TEXT BOOKS

1. *RamakantA.Gayakward, "Op-Amps and Linear Integrated Circuits", 4th Edition, Prentice Hall of India, New Delhi, 2015.*
2. *Coughlin F.R. and Driscoll F.F., "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, Prentice Hall of India, New Delhi, 2009.*

REFERENCES

1. *Roy Choudhury D and Shail Jain., "Linear Integrated Circuits", 5th Edition, New Age Science Ltd., 2018.*
2. *Sergio Franco, "Design with Operational Amplifiers and Analog and Integrated Circuits", 3rd Edition Tata McGraw Hill Publishing Co., New Delhi, 2012.*
3. *Michael Jacob J., "Analog Integrated Circuit Applications", 1st Edition, Prentice Hall of India, New Delhi, 2007.*
4. *Sidney Soclof, "Design & Application of Analog Integrated Circuits", Prentice Hall of India, 1997.*
5. *David A. Bell, "Operational Amplifiers and Linear ICs", 3rd Edition, Oxford University Press, 2011.*

19EE45 - TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, students will be able to,

CO1 : *Analyze HVAC and HVDC transmission, Overhead and underground transmission schemes, skin effect and earth capacitance, Compute the line parameters in single phase lines, three phase lines, bundled conductor lines and double circuit 3-ph lines.*

CO2 : *Model the short, medium and long transmission lines by various methods and determine the performance under different loading conditions, Analyze about Ferranti effect, Corona effect, Tuned power lines and Critical voltages on transmission lines.*

CO3 : *Understand the mechanical supports for transmission lines and types of insulators, Choose the number of insulators to improve the string efficiency of transmission lines, Compute sag and Tension in various types of transmission lines.*

CO4 : *Illustrate the types of cables and Grading of cables, Compute the capacitance in single and three core cables, Locate the cable fault using loop tests.*

CO5 : *Describe the types of substation and AC distribution system, Solve the AC distribution system problems and Tariff calculations for AC distribution systems.*

INTRODUCTION

Layout of AC power supply scheme by single line diagram - Introduction to EHV AC and HVDC transmission - Comparison between HVAC and HVDC - Overhead and underground transmission scheme - HVDC systems - Comparison of conductor materials in overhead systems. Line Parameters : Resistance of conductors - Skin effect - Inductance of a conductor due to internal and external flux - Inductance and capacitance of single-phase two-wire line, three phase lines with symmetrical and unsymmetrical spacing, Bundled conductor lines and Double circuit three phase lines - Effect of earth on line capacitance. **10**

LINE PERFORMANCE AND CORONA

Regulation and Efficiency of short lines - Medium lines represented by nominal T and Π methods - Long lines - Rigorous solution - ABCD constants - Ferranti effect - Tuned power lines. Phenomenon of corona- Disruptive critical voltage - Visual critical voltage - Corona loss - Radio frequency interference. **9**

MECHANICAL DESIGN OF OVERHEAD LINES

Insulator materials - Insulator types - Voltage distribution over insulator string - Methods of improving string efficiency - Insulator failure - Testing of insulators - Line supports - Types of steel towers - Cross arms - Span, Conductor configuration, spacing and clearances - Sag and Tension calculations- Effect of wind, temperature and ice - Support at different levels - String chart - Conductor vibration. **9**

UNDERGROUND CABLES

Comparison between overhead line and underground cable for transmission - Types of cables - Types of insulating materials - Insulation resistance - Potential gradient - Grading of cables - Capacitance of single and three core cables - Faults and fault location by loop test - Sheath effect - Cable installation - Current rating of cables -Operating problems with underground cables. **9**

DISTRIBUTION SYSTEMS AND SUBSTATIONS

Introduction to Grid system - AC distribution - Radial and Ring main systems - Ring main distributors with interconnectors - Methods of solving AC distribution systems - Tariff calculations- Wheeling Charges -

Substation - Types of substations - Layout and location of substations - Busbar arrangements - Introduction to substation automation protocols - Introduction to Indian Power System - Genco, Transco and Disco. **8**

TOTAL : 45

TEXT BOOK

1. *C.L.Wadhwa, "Electrical Power Systems", New Age International, 2017.*

REFERENCES

1. *Luces M.FualKeribeery and Watter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 2007.*
2. *V. K. Mehta and Rohit Mehta, "Principles of Power system", S. Chand and Company Ltd., New Delhi, 2011.*
3. *J.Nagrath and D.P.Kothari, "Power Systems Engineering", Tata McGraw Hill, 2019.*
4. *Dr. S.L.Uppal, "Electrical Power", Khanna Publishers, 1988.*
5. *M.L. Sony, P.V.Gupta, V.S Bhatnagar and A.Chakraborti, "A Text Book on Power Systems Engineering", DhanpatRai and Co., Delhi, 1997-98.*
6. *TorenGonen, "Electrical Power Distribution", CBC, 2010.*

19EE46 - OOP AND C++ FOR ELECTRICAL ENGINEERS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 *: Distinguish object oriented Programming and traditional programming techniques*

CO2 *: Develop, compile and debug programs*

CO3 *: Illustrate key concepts such as encapsulation and polymorphism*

CO4 *: Use files for reading and writing data*

CO5 *: Write C++ program for practical electrical applications*

PRINCIPLES OF OBJECT ORIENTED PROGRAMMING

Programming Paradigms - Object Oriented Technology - Basic concepts and benefits of OOP - Application of OOP - OOP languages. Introduction to C++: Basic data types - Derived data types - Symbolic constants - Scope resolution operator - Type modifiers - Type casting -Operators and control statements - Input and output statements - Function Prototyping - Inline function - Overloaded function - Introduction to friend function **9**

CLASSES AND OBJECTS

Class specification - Member function - Static data members - Instance creation - Array of objects - Dynamic objects - Static Objects. Constructors - Parameterized constructors - Overloaded Constructors - Constructors with default arguments - Copy constructors - Dynamic constructors - Dynamic initialization using constructors - Destructors. **9**

OPERATOR OVERLOADING AND INHERITANCE

Operator function - Overloading unary and binary operator - Overloading the operator using friend function - Stream operator overloading - Data Conversion.

Defining derived classes - Single Inheritance - Protected Data with private inheritance - Multiple Inheritance Multilevel inheritance - Hierarchical Inheritance - Hybrid Inheritance - Multipath inheritance- Abstract classes - Virtual function and dynamic polymorphism - Virtual Destructor - Nested Classes. **9**

I/O STREAMS

I/O STREAMS - Unformatted I/O operations - Formatted I/O operations - Manipulators - Hierarchy of file stream classes - Opening and closing of files - File pointers and Manipulation - Sequential access file - Random access file. **9**

APPLICATIONS IN ELECTRICAL ENGINEERING

Series RLC circuit transient analysis- Synthesis of typical wave forms-FFT Analysis-Mesh and Nodal analysis-Mason's gain formula-Calculation of efficiency and voltage regulation in transmission lines using T and Π model-Tariff Calculations Power System Analysis: Y- Bus formation, Z- Bus formation, Load flow analysis **9**

TOTAL - 45

TEXT BOOKS

1. *D.S.Malik, "C++ Programming: From Problem Analysis to Program Design", 8th Edition, Cengage Learning, 2018.*
2. *Larry Nyhoff,"Programming in C++ for Engineering and Science", CRC Press, Taylor and Francis Group, 2012. (For Electrical Engineering Applications)*

REFERENCE BOOKS

1. *Stanley B. Lippman and Josée Lajoie, "C++ Primer", 5th Edition, Addison-Wesley, 2015.*
2. *Stephen Prata, "C++ Primer plus", 6th Edition, Addison-Wesley, USA, 2015.*
3. *Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Pearson Education Inc,2015.*
4. *Joseph Valacich and Joey. G, "Essentials of Systems Analysis and Design", 6th Edition,Pearson Education Inc., 2014.*

19EEL47 - AC ROTATING MACHINES LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Analyze the performance of three phase and single-phase induction machines experimentally by direct and indirect methods.*

CO 2 : *Select suitable AC machines for an industrial application by experimentally verifying the performance characteristics.*

CO3 : *Predetermine the voltage regulation of alternator by EMF, MMF, Potier methods and Slip test experimentally.*

CO4 : *Draw the V - curves and Inverted V - curves of synchronous motor*

CO5 : *Draw the speed torque characteristics of BLDC motor and IoT based motor monitoring system*

LIST OF EXPERIMENTS

1. Performance characteristics of three phase squirrel - cage induction motor by direct load test.
2. Performance characteristics of three phase slip - ring induction motor by direct load test.
3. Predetermination of performance characteristics of three phase squirrel cage induction motor by equivalent circuit and circle diagram methods.
4. Separation of No - load losses of three phase induction motor.
5. Performance characteristics of Single phase induction motor by direct load test.
6. Predetermination of performance characteristics of Single phase induction motor by equivalent circuit method.
7. Predetermination of voltage regulation of three phase non - salient pole alternator by EMF and MMF methods.
8. Predetermination of voltage regulation of three phase Salient pole alternator by slip test.
9. Determination of “V” and “inverted - V” curves of synchronous motor.
10. Load test on cascaded induction motors.
11. Load test on Induction generator.
12. Speed Control of BLDC motor
13. Speed Control of PMSM Motor
14. IoT Based Motor Monitoring System

19EEL48 LINEAR INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 : *Design and test waveform generators and various analog circuits for arithmetic operations using IC741 for the given specifications.*

CO2 : *Design second order filters using IC741 and test their frequency response.*

CO3 : *Design and test regulated power supply for the given specifications using IC723, IC7805.*

CO4 : *Design and test ADC and DAC circuits for the given specifications using IC741 and arduino*

CO5 : *Construct astable and monostable multivibrator using IC555 timer for the given specification.*

LIST OF EXPERIMENTS

DESIGN AND TESTING OF THE FOLLOWING CIRCUITS

1. Linear applications of Operational Amplifier
2. Second order Low Pass and High Pass Filters
3. Astable and Monostable Multivibrator using IC 555
4. Precision Rectifier and Zero Crossing Detector
5. Instrumentation Amplifier
6. Square, Triangle and Ramp Waveform Generators
7. Analog to Digital Converters
8. Digital to Analog Converters
9. Voltage Regulator using IC 723
10. Wien bridge oscillator.

SIMULTION USING MULTISIM

1. Voltage Controlled Oscillator using IC 566
2. RC Phase Shift Oscillator
3. Clippers and Clampers
4. Schmitt Trigger Circuit

19EE51 - CONTROL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Appreciate the needs and effects of feedback in a control system; obtain the mathematical models of electrical and mechanical systems, and find transfer function through block diagram reduction and SFG.*

CO2 *: Analyze the response of I order and II order systems using time-domain techniques.*

CO3 *: Learn the stability concepts and finding the range of open loop gain for stability through various techniques.*

CO4 *: Analyze the response of systems using frequency domain techniques.*

CO5 *: Design compensators for the given system satisfying the given specifications.*

MATHEMATICAL REPRESENTATION OF SYSTEMS

Open loop and Closed loop systems - Physical system - Linear and Non - linear systems - Transfer function - Mathematical modeling of electrical and mechanical systems - Analogous systems - Effect of feedback on system sensitivity - Block diagram representation - Signal flow graphs and their properties - Mason's gain formula. Control system components: Potentiometer, Tachogenerator, Synchro, AC and DC servomotors. **9**

TIME RESPONSE ANALYSIS

Standard test signals - Time response of first order and second order feedback control systems to step input - Time domain specifications - Steady state error - Static error constants - Response with P, PI, PD, PID controllers - System response with additional poles and zeros. **9**

STABILITY AND ROOT LOCUS

Concept of Stability - Necessary conditions for stability - Routh Hurwitz criterion - Relative Stability Analysis. Root locus: concepts of root - locus - Construction of root locus - Determination of open loop gain for a specified damping of the dominant roots **9**

FREQUENCY RESPONSE ANALYSIS

Correlation between time domain and frequency domain specifications - Bode plot - Nyquist stability criterion - Relative stability - Gain margin and Phase margin - Polar plot. **9**

LINEAR SYSTEM DESIGN

Design of lag, lead and lag - lead compensators in frequency domain and time domain. **9**

TOTAL : 45

TEXT BOOKS

1. *Nagrath and M.Gopal, "Control Systems Engineering", New Age International Publishers, 6th Edition, New Delhi, 2011.*
2. *Norman S. Nise, "Control Systems Engineering", John Wiley and Sons Ltd, 6th Edition, Singapore, 2013.*
3. *A.AnandKumar,"Control Systems", PHI Learning Pvt. Ltd, 2nd Edition, Delhi, 2014.*

REFERENCE BOOKS

1 *Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Ltd., New Delhi, 2013.*

2 *M.Gopal, "Control Systems - Principles and Design", Tata McGraw Hill Publishing Company Limited, 4th Edition, New Delhi, 2012.*

3 *Benjamin C. Kuo "Automatic Control Systems", Prentice Hall of India, 8th Edition, New Delhi, 2010.*

4 *Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Prentice Hall, 10th Edition, NJ, 2008.*

5 *M.N.Bandyopadhayay,"Control Engineering and Practice", Prentice Hall of India Private Ltd., New Delhi, 2004.*

19EE52 - POWER SYSTEM ANALYSIS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Mathematically model and assess the power system network under healthy and faulty conditions.*

CO2 : *Apply mathematical methods to solve the load flow problems and interpret active and reactive power flows.*

CO3 : *Identify the fault and assess the fault conditions using symmetrical components.*

CO4 : *Illustrate the transient behavior of the power system network under open circuit and short circuited conditions.*

CO5 : *Derive the equation to analyze the dynamics of power systems and examine the reliability of electric power systems.*

POWER SYSTEM COMPONENTS AND NETWORK MODELING

Single line diagram - per unit quantities - per unit impedance / reactance diagrams - Complex Power - Representation of Loads - Π equivalent circuit of transformer with off nominal tap ratio - Bus admittance matrix - Formulation of Y bus-Formation of Z bus using step-by- step building algorithm. **9**

LOAD FLOW STUDIES

Load flow equations and methods of solutions - Gauss-Seidel method for load flow studies - Newton Raphson method for load flow studies - Introduction to Bus Voltage Control Methods using STATCOM and UPFC Devices-FDLF method. **9**

FAULT CALCULATIONS **9**

Balanced and unbalanced faults - Types of faults - Symmetrical faults - Consideration of prefault load current - Symmetrical components - Sequence impedances and sequence networks for synchronous machines, transmission lines, transformers - formation of sequence networks - Unsymmetrical fault analysis - single line to ground fault, line to line fault, double line to ground fault. **9**

POWER SYSTEM TRANSIENTS

Travelling waves on transmission lines - Wave equations - Surge impedance - Equivalent circuit for travelling wave studies -Reflection-Refraction - Forked line - Arcing grounds -Switching Transients-Capacitance switching. **9**

POWER SYSTEM STABILITY

Steady state and transient state stability of power systems - Stability limits - Swing equation for single machine infinite bus system - Solution of swing equation by equal area criterion - Methods of improving transient stability - Automatic Voltage Regulators - Load Frequency Control. **9**

TOTAL : 45

TEXT BOOKS

1. *D.P. Kothari, I.J.Nagrath, "Modern Power System Analysis", 4th edition, Tata McGraw Hill, 2011.*
2. *John J. Grainger, W.D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill, 2011.*

REFERENCE BOOKS

1. *C.L.Wadhwa, "Electrical Power Systems", New Age International (P) Ltd., 2017.*
2. *B.R.Gupta, "Power System Analysis and Design", 3rd Edition, Wheeler Publishers, 2003.*
3. *Hadi Saadat, "Power System Analysis", Tata McGraw Hill, 3rd Edition, reprint, 2008.*
4. *T.K. Nagsarkar, M.S. Sukhija, "Power System Analysis", Oxford University Press, 2007.*
5. *B.M. Weedy, "Electric Power Systems", John Wiley, New York, 2012.*

19EE53 - DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Examine data and define structures to organize large data*

CO2 *: Use graphs and trees to support search applications*

CO3 *: Describe how to analyze an algorithm, growth rate and decision making*

CO4 *: Design new algorithms or modify existing ones for new applications and reason about the efficiency of the result*

CO5 *: Develop the skills necessary to analyze algorithms that are used in a program.*

BASIC DATA STRUCTURES

Arrays - Array of structures - Polynomial representation - Multidimensional Arrays - Sparse Matrices - Transpose and Multiplication of Sparse Matrices - Stacks and Queues: Implementation and Applications. **9**

ADVANCED DATA STRUCTURES

Trees: Binary Tree - Tree Traversals - Binary Search Trees - AVL Trees - Splay Trees - B Trees - Red Black Trees **9**

GRAPHS ALGORITHMS

Elementary Graph Algorithms - Minimum Spanning Trees - Topological Sorting - Single source Shortest Paths - All Pairs Shortest Paths. **9**

SORTING AND HASHING

Insertion Sort - Shell Sort - Heap Sort - Merge Sort - Quick Sort - Radix Sort - External Sort - Analysis of Sorting Algorithms Hashing - Hash Functions - Separate Chaining - Open Addressing - Rehashing - Extendible Hashing. **9**

ALGORITHM DESIGN TECHNIQUES (QUALITATIVE TREATMENT ONLY)

The role of Algorithms in computing - Growth of functions. Introduction to algorithms design:

Divide and Conquer - Dynamic Programming - Greedy Algorithm - Backtracking - Branch and Bound - Randomized Algorithms. **9**

TOTAL : 45

TEXT BOOKS

1. *Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, PHI, 2013.*
2. *Thomas H Cormen, Charles E Leiserson and Ronald L Rivest, "Introduction to Algorithms", 3rd Edition, MIT Press, Cambridge, Massachusetts, 2009.*

REFERENCE BOOKS

1. *R G Dromey, "How to Solve it by Computers", Pearson Education Asia, 2007.*
2. *Robert Kruse, C. L. Tando, Bruce Leung and Shashi Mogalia, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2006.*
3. *Jean Paul Tremblay and Paul G Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, Tata McGraw Hill, 2007.*

19EE54 -EMBEDDED SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Interpret the register functionalities and architectural features of PIC18Fxxx microcontroller and ARM processor*

CO2 : *Develop an assembly language program to process data and access on-chip hardware units using appropriate instructions and addressing modes.*

CO3 : *Outline the organizational aspects of three stage pipeline execution process*

CO4 : *Illustrate the processor operations by citing examples of pre-conditions and post- conditions, describing registers and memory before and after the instruction execution.*

CO5 : *Develop an application software to interface various peripherals for the given design requirements*

PIC ARCHITECTURE

PIC Architecture - RISC Architecture -PIC18F458 Pin connection-PIC 18 Configuration registers -WREG register -PIC File Register- Status register-PIC Data format and Directives - Intel Hex format. **9**

PIC PROGRAMMING

Introduction to Assembly language programming -Assembling and Linking a PIC program- viewing register and memory with Simulator-Branch Instructions and Looping-Call instructions and stack-PIC 18 time delay and Instruction Pipelining-I/O Port programming-I/O Bit manipulation programming-Arithmetic and Logic Instructions-Timer and counter programming. **9**

ARM ARCHITECTURE

ARM programmer's model-Load Store Architecture- - Data path and control logic - ARM development tools-3 stage pipeline ARM organization - 5 stage pipeline ARM organization- ARM instruction execution-ARM implementation- Adder Design-Barrel shifter-Multiplier Design-Exception and Interrupt Handling. **9**

ARM PROGRAMMING

ARM Assembly Language Programming- Data processing instructions-Data transfer instructions- Control flow instructions-ARM Instruction set-Conditional execution-Branch and Branch with link-Data processing instructions-multiply instructions-multiple register transfer instructions. **9**

SYSTEM DESIGN

Stand-alone data acquisition system -Keypad interfacing - LCD Interfacing - Stepper Motor interfacing-Speed control of DC Motor - Internet Communication and Control - Serial Communication - Wireless communication. **9**

TOTAL : 45

TEXT BOOKS

1. *Steve Furber, "ARM System-on-Chip Architecture" Pearson Education Limited, 2012.*
2. *Muhammad Ali Mazidi, "PIC Microcontroller and Embedded Systems" 1st edition, Pearson Education, 2008.*

REFERENCE BOOKS

1. *John Crisp "Introduction to Microprocessors and Microcontrollers" 2nd edition,Elsevier Inc.,2004*
2. *Andrew N. Sloss, Dominic Symes, Chris Wright "ARM System Developer's Guide Designing and Optimizing System Software" Elsevier Inc., 2004*
3. *William Hohl and Christopher Hinds "ARM Assembly Language: Fundamentals and Techniques", 2nd Edition, CRC Press, 2014.*
4. *JohnIovine, "PIC Microcontroller Project Book", McGraw Hill 2000.*
5. *John. B. Peatman, "Design with PIC Microcontroller", Pearson Education, 2003.*
6. *ARM Architecture, Reference Manual, ARM Ltd.*
7. *Rob Toulson, Tim Wilmshurst "Fast and Effective Embedded Systems Design. Applying the ARM mbed" 2nd Edition , Elsevier Inc., 2017.*

19EEL55 - CONTROL SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Derive the transfer function of a given system experimentally.*

CO2 *: Design and verify the performance of lag/lead compensators in frequency/time domain.*

CO3 *: Choose and design a suitable controller to meet the given specifications of an electrical system.*

CO4 *: Analyze the system response in frequency/time domain using MATLAB software.*

CO5 *: Design PID controller for second order systems and implement it using simulation software (Matlab/ LabView).*

LIST OF EXPERIMENTS

1. Modeling and analysis of physical systems using SIMULINK
2. Mathematical modeling of self-excited DC motor and study of characteristics using SIMULINK
3. Mathematical modeling of separately excited DC motor and study of characteristics using SIMULINK
4. Determination of Transfer function constants for armature controlled DC Motor.
5. Determination of Transfer function constants for field controlled DC Motor.
6. Transfer function of 2 phase AC Servo Motor and stability analysis using Matlab.
7. Transfer function of magnetic levitation system under open loop uncompensated and closed compensated system
8. Stability analysis of given LTI system using frequency and time domain methods in SCILAB
9. Design of compensators using bode plots and Matlab.
10. Modeling and analysis of Level control system in SCILAB
11. Modeling and analysis of rotational systems in SCILAB
12. PID controller design for second order system using LabVIEW and Matlab SIMULINK.
13. PWM generation using CRIO and labVIEW simulation software.
14. Analog input measurement and data transfer to CRIO controller using LabVIEW simulation software.
15. Speed control of single phase induction Motor using CRIO and LabVIEW simulation software.
16. Speed control of Three phase induction motor using CRIO and LabVIEW simulation software.
17. Speed control of DC Motor using CRIO and LabVIEW simulation software.
18. Design of state machines (vending machine) using LabVIEW.

19EEL56 - EMBEDDED SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Develop an Assembly Language Program for the given design requirements*

CO2 : *Demonstrate the working of Timer/Counter Module using Assembly language program*

CO3 : *Select suitable sensors to meet the given specification and interface it with the microcontroller to actuate certain output devices.*

CO4 : *Experiment With PWM Technique*

CO5 : *Appraise the use of interrupt driven programming over polling*

LIST OF EXPERIMENTS

Programming PIC18F458 microcontroller using Assembly language - Simulation using MPLAB IDE

1. I/O Port programming
2. Time out generation using on - chip timer module.
3. Counter Programming
4. Code conversion (BCD to ASCII) for RTC implementation
5. Parity checking for error detection

Programming ARM using embedded 'C' - prototyping using mbed LPC1768 device

6. Display interface (LED, LCD, Seven segment display)
7. Generating a sinusoidal and Saw tooth waveform
8. Controlling PWM period with analogue input (POT)
9. Interfacing DC motor
10. Interrupt programming
11. Configuring ADC Module (Sensor interfacing)
12. Stepper motor interfacing
13. IOT based Temperature/Moisture monitoring system.

19EE61 - POWER ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 : *Describe the role of Power Electronics as an enabling technology in various applications and to understand the characteristics of the power semiconductor devices.*

CO2 : *Select the suitable power semiconductor device, based on the converter type and topology for the given specification and applications.*

CO3 : *Ascertain the steady state operation of the power electronic converters based on different operational modes subject to continuous and discontinuous operations.*

CO4 : *Seek and reach consensus on formulation of solution methodologies to design the power electronic converters for given applications.*

CO5 : *Design, simulate,develop and evaluate the efficiency of power electronic systems such as motion control systems and power supplies for given specifications*

POWER SEMICONDUCTOR DEVICES

Introduction - Need for power conversion - Generic Power Converter - Power Semiconductor Switches - Idealized Characteristics- Power diodes - Thyristor family of devices: SCR - TRIAC - GTO - IGCT - Transistor family of devices: Power MOSFETs - IGBTs- steady state and dynamic characteristics - Switching and Conduction losses - Comparison of power semiconductor switches-Intelligent Power Modules - protection circuits - Heat sink calculations- - Introduction of SiC and GaN based power devices - Introduction to driver circuits Synchronization and Isolation-Study of data sheet of power semiconductor devices (Qualitative Treatment only). **9**

AC - DC CONVERTERS

Introduction - Uncontrolled Rectifier - Limitations - phase angle control - Quadrants of operation -Single phase and Three phase semi bridge and full bridge converters - Dual converters - Introduction of high pulse converters - Estimation of performance parameters for continuous current operation - Effects of load and source inductances - Device selection- Development of control circuit (Block Diagram only) **8**

DC - DC CONVERTERS

Principle of chopper operation - Control strategies - Non - isolated switched mode regulators: Buck regulator - Boost regulator- Buck - Boost regulator - Cuk regulator - SEPIC regulator- Comparison of regulators - Isolated switch mode converters: Fly back Converter - Forward Converter - Bridge Converter - Device selection- Development of control circuit (Block Diagram only)- Introduction to resonant power converters (Qualitative Treatment only). **8**

AC - AC CONVERTERS

AC voltage Controllers - Principle of ON - OFF control and phase angle control - Single phase and Three phase voltage controllers- Estimation of performance parameters - Single phase transformer connection changers - PWM based AC voltage controller.

Cycloconverters - Basic principle of operation - Single phase and Three phase cyclo converters - output voltage equation -Device selection for AC - AC converters - Introduction to matrix converter- Device selection- Development of control circuit (Block Diagram only) **8**

DC - AC CONVERTERS

Principle of operation - classifications of inverters - Voltage source inverters and Current source inverters - Single phase and Three phase bridge configurations - Estimation of performance parameters - Voltage control of inverters - Harmonic reduction. Introduction to multi-level inverters - Introduction to active front converter (PWM Rectifier) - Development of control circuit (Block Diagram only)- Device selectionApplications (Qualitative Treatment - Block Diagram only): UPS - SMPS - LED Drivers - Electric Vehicles - Solar PV-Wind Energy Systems-Solar PV based water pumping-Solid State Transformer. **12**

TOTAL : 45

TEXT BOOKS

1. *M.H.Rashid, "Power Electronics", Pearson Education, New Delhi, 4th Edition, 2017.*
2. *Mohan.N.Tore. M.Undeland, and William.P.Robbins, "Power Electronic Converters, Applications and Design", John Wiley and Sons, New York, 3rd Edition, 2014.*

REFERENCE BOOKS

1. *Robert W.Erickson and Dragan Maksimovic, "Fundamentals of Power Electronics", Springer Nature Switzerland AG, 3rd Edition, 2020.*
2. *Yuriy Rozanov, Sergey Ryvkin, Evgeny Chaplygin and Pavel Voronin "Power Electronics basics - operating principles, design, formulas and applications" CRC Press, Taylor & Francis Group, 2015.*
3. *Andrej. M. Trzynadlowsk, "Introduction to Modern Power Electronics", John Wiley and Sons, 3rd Edition,New York, 2016.*
4. *M.D.Singh and K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition,2011*
5. *G.K.Dubey., et al, "Thyristorised Power Controllers", New Age Publishers, Chennai, 2nd Edition, 2010*
6. *L.Umanand, "Power Electronics: Essentials & Applications", Wiley India Pvt. Limited. New Delhi, 2009*
7. *http://nptel.ac.in/courses/webcourse - contents / IIT% 20 Kharagpur / Power%20 Electronics/ New_index1.html for Web type,*
8. *http://nptel.ac.in/courses/108101038/ for Video Type.*
9. *http://ocw.mit.edu/courses/electrical - engineering - and - computer - science/6 - 334 - power - electronics - spring - 2007*

19EE62 - DIGITAL PROTECTION OF POWER SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Summarize the need of digital protection and power system components, and the functional characteristics of different relays.*

CO2 : *Illustrate the concepts of protection of machines, transformers and bus zone.*

CO3 : *Recommend feasible Digital algorithmic solutions to various protection schemes of power system protection.*

CO4 : *Apply the circuit breakers, fuses, and travelling wave concepts for transmission line protection.*

CO5 : *Survey about AI-based numerical protection and recent trends to solve the problems encountered in the power system protection.*

POWER SYSTEM PROTECTION COMPONENTS: RELAYS, CIRCUIT BREAKERS, CT and VT

Need for Protective Systems-Nature and Causes of Faults-Classification of Protective Relays- Components of Protection System-Relay Construction and Operating Principles- Fault clearing time of a breaker-Current Chopping-Classification of Circuit Breakers-Current, Voltage, Summation Transformer - Phase - sequence current - segregating Network- Overcurrent Protection. **9**

RELAY PROTECTION OF MACHINES, TRANSFORMERS and BUSZONE

Distance Protection-Pilot Relaying Schemes-Differential Protection-Rotating Machines Protection-Transformer and Bus zone Protection. **9**

NUMERICAL PROTECTION

Numerical Relay-NR Algorithms-Mann-Morrison Technique-Differential Equation Technique-Discrete Fourier Transform Technique-Walsh-Hadamard Transform Technique- Numerical Overcurrent, Distance, Differential Protection-Microprocessor Based Numerical Protection. **9**

FUSES-PROTECTION AGAINST OVERVOLTAGES

Fuse Characteristics-Types-Application-Selection of fuses-Causes of Overvoltages- Waveshape of voltage due to Lightning-Protection of Transmission Lines, Sub-stations against Lightning-Protection against Travelling Waves-Surge Protection-BII Level. **9**

MODERN TRENDS IN POWER SYSTEM PROTECTION

Application of Artificial Intelligence to Power System Protection-Application of ANN to Overcurrent Protection, Transmission Line Protection-NN based Directional Relay-ANN and Wavelet Fuzzy combined approach for fault detection, location and classification-Application of ANN and Wavelet to protection of Power System Components-Modern Trends in Power System Protection. **9**

TOTAL : 45

TEXT BOOKS

1. *Badri Ram and D.N.Vishwakarma, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw Hill publishing company Ltd., New Delhi, 2011*
2. *L. P. Singh, "Digital Protection - Protective Relaying from Electromechanical to Microprocessor", 2nd Edition, New Age International Ltd., New Delhi, 2017.*

REFERENCE BOOKS

1. *B.Ravindranath and M.Chander, "Power System Protection and Switchgear", 5th Edition, New Age International Pvt. Ltd., New Delhi, 2014.*
2. *Stanley H.Horowitz and Arun G.Phadke, "Power System Relaying", 4th Edition, John Wiley and Sons Ltd., , 2014.*
3. *C.L.Wadhwa, "Electrical Power Systems", New Age International Pvt. Ltd., 6th Edition, 2011.*
4. *M.L.Soni, P.V.Gupta and U.S.Bhatnagar, "A Course in Electrical Power", 9th Edition, Dhanpat Rai and Sons, 2011.*
5. *Bhavesh Bhalja, R.P. Maheswari, Nilesh G. Chothani, "Protection and Switch Gear", 4th Edition, Oxford University Press, 2011.*

19EE63 - DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Interpret and process the discrete/digital signals to perform various signal operations.*

CO2 *: Perform statistical analysis and inferences on various types of signals.*

CO3 *: Apply the principles of z-transforms and Fourier transform analysis for processing digital signals.*

CO4 *: Realize IIR filter and FIR filter structures.*

CO5 *: Employ digital signal processing techniques to design discrete time systems and digital filters*

INTRODUCTION

Basic elements of a digital signal processing system - Advantages of digital over analog signal processing - Continuous time verses discrete time signals - Sampling of analog signals - Quantization of continuous amplitude signals - Signal representation - Classification of discrete time signal - Operation on signals - Convolution and Correlation of discrete time signals **9**

DISCRETE TIME SYSTEM

Causal, Dynamic, Linear, Time invariant, Stable systems - Frequency analysis of discrete time signals - Fourier series and its properties for discrete time periodic signals - Power density spectrum of periodic signals - Fourier transform and its Properties for discrete time signals **9**

TRANSFORMS

Overview of Z Transform and its application - Discrete Fourier Transform (DFT) and its properties - Fast Fourier Transform (FFT) algorithms - Radix - 2 FFT - DIT & DIF **9**

DIGITAL FILTERS DESIGN

Properties and Structures of FIR and IIR filter - Design of FIR filter using rectangular and hamming windows - Design of IIR filter from analog filters using bilinear and impulse invariance transformation. **9**

REALIZATION OF DIGITAL FILTERS

Realization of FIR filters (Direct Form, Cascade Form, Linear Phase FIR structures) and IIR filters(Direct Form I, Direct Form II, Cascade and Parallel Forms) - Application: Musical sound processing system **9**

TOTAL : 45

TEXT BOOKS

1. *Winser Alexander, Cranos M Williams "Digital Signal Processing Principles, Algorithms and System Design" 2nd edition, academic Press, 2017*
2. *Richard G. Lyons, "Understanding Digital Signal Processing", Prentice Hall, 3rd Edition, 2012*
3. *Vijay Madisetti "Digital Signal Processing Fundamentals", 2nd edition, CRC press, 2017*

REFERENCE BOOKS

1. *John G. Proakisand Dimitris G. Manolakis, "Digital Signal Processing: Principles Algorithm and Application", Prentice Hall of India, 4th Edition, 2007*
2. *P. Ramesh Babu, "Digital Signal Processing", Scitech Publication Pvt. Ltd., 7th Edition, Chennai, 2018*
3. *Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach", Tata Mc Graw Hill, New Delhi, 2007*
4. *B. P. Lathi, Roger A. Green, " Essentials of Digital Signal Processing", 1st edition Cambridge University Press 2014.*
5. *Ashok Ambardar, "Analog and Digital Signal Processing", Thomson Asia Pvt. Ltd, 2nd Edition, Singapore, 2002*

19EEL64 - POWER ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After successful completion of this course, the students will be able to,

CO1 : *Apprehend the static and dynamic characteristics of the power semiconductor devices and their selection for a given application*

CO2 : *Realize and develop the pulse width modulation techniques for power converters. Also Design and test the control and gate driver circuits for level triggered devices*

CO3 : *Study and analyse the operation of the various types of the power electronic converters and to understand their performance parameters. Also to understand the usage of true RMS meters and Power Quality Analyzers for power electronic measurements.*

CO4 : *Evaluate I - V & P - V characteristics, Estimate energy generation of solar PV modules and their applications*

CO5 : *Simulate the power electronic converters using compatible softwares*

LIST OF EXPERIMENTS

1. Steady State and Dynamic Characteristics of Power Electronic Devices.
2. Design of Universal PWM technique and Generation of different types of PWM signals for Power Electronic Converters
3. Design of Gate driver and Isolation circuits of MOSFET/IGBT
4. Load Test on Single Phase Half and Fully Controlled Bridge Converters
5. Load Test on Three Phase Half and Fully Controlled Bridge Converters and Power Quality Study
6. Load Test on Buck, Boost and Buck - Boost Converter
7. Study of Single-Ended Primary-Inductor Converter (SEPIC)
8. Load Test on Single Phase and Three Phase PWM Inverter
9. Load Test on Cascaded Multi Level Inverter (MLI).
10. Study of AC Phase Control using SCR and TRIAC
11. Load Test on Single Phase Cyclo-Converters
12. Study of IV characteristics of Solar PV Modules (Series, Parallel and Series - Parallel combinations)
13. Design, estimation and monitoring of Power Electronic Converters using IoT
14. Design of DC-DC converter for EV Battery charging application.
15. Simulation of Power Electronic Converters and development of controller using dspace.

19EEL65 - POWER SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Design and Select suitable Plug Setting Multiplier and test the over current protective relay using Electro - mechanical instrument*

CO2 : *Identify and locate the fault in power system using cable fault locator*

CO3 : *Analyze the IDMT characteristics of over/under voltage relay*

CO4 : *Measure experimentally the negative sequence components in unbalanced systems*

CO5 : *Analyze the harmonics in power system using MATLAB / Simulink & Perform various load flow techniques*

LIST OF EXPERIMENTS

1. Determination of Break Down Voltage (BDV) of transformer oil.
2. Load sharing of parallel connected alternators
3. Phase Sequence detection using Static Relay.
4. Over Current detection using Static Over Current Relay & Electromechanical relay
5. Over/Under Voltage detection using Static Relay.
6. Over/Under Frequency detection using Static Relay
7. Earth Fault detection using Static relay.
8. Differential Protection of transformer using Static Relay
9. Varley Loop test by using cable fault locator.
10. Power Quality Analysis (Sag and THD) using simulation software
11. Formation of Y-BUS/ Z-BUS & Load Flow Analysis using Gauss Seidal (GS) Method.
12. LG, LL and 3 phase “fault analysis of 3 phase” Synchronous machine.
13. Analysis of Hybrid solar and Wind power system.
14. Analysis of EMI.

19EE71 - SOLID STATE DRIVES AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Analyze the characteristics of motors, load dynamics and performance parameters of DC drives and selection of motor power rating under different load conditions.*

CO2 : *Outline the conventional method of DC drive and solid-state Drives for DC motors.*

CO3 : *Infer the performance characteristics of three phase Induction motor and the various methods of speed control based on solid state drives*

CO4 : *Summarize the concept of suitable power electronic circuitry to drive synchronous motor, brushless DC motor, special machines and SRM.*

CO5 : *Formulate suitable drive according to industrial, environmental standards and develop the control schemes for any electric drive. Describe the concept and application of special machines in modern electric drives.*

CHARACTERISTICS OF ELECTRICAL DRIVES AND LOADS

History and Development of drive Systems - Comparisons - Concept of electric drive - Block diagram representation - Advantages - Classification - AC and DC drives - Requirements of a good adjustable speed drive - Principle factors affecting the choice of drive - Speed - Torque characteristics of drive motor and load - Joint speed - torque characteristics - Selection of motor power rating for drive motor based on thermal overloading and Load variation factors - Load Equalization **7**

DC DRIVES

Introduction - Speed control of DC motors - Ward - Leonard scheme and its draw backs - Solid state control - Advantages - Performance parameters. Converter fed DC drives - Single phase and Three phase drives - Performance characteristics - Single, Two and Four quadrant operation - Supply side harmonics - Power factor and Effect of ripple on motor performance. Chopper fed DC drives - Chopper fed control of separately excited DC motor, DC Shunt and DC Series motor - Performance characteristics - Quadrants of Operation. **7**

INDUCTION MOTOR DRIVES

Three Phase Induction Motor Analysis and Performance-Operation under unbalanced Condition and non-sinusoidal voltage supply. Methods of speed control of three phase induction motor Stator Side Control: Stator voltage control - Stator frequency control - V/F control - Solid - state speed control schemes with AC voltage controllers - DC link inverters (Phase Controlled and PWM rectifier based) - Cyclo converters - Matrix converter - CSI fed IM variable frequency drives - Introduction to vector control. Rotor Side control: Rotor resistance control - Static rotor resistance control - Injection of voltage in the rotor circuit - Slip power recovery schemes: Static Scherbius - Modified Kramer drive. **12**

SYNCHRONOUS MOTOR DRIVES

Speed control of three phase synchronous motor - True synchronous and Self - controlled modes - Inverter fed synchronous motor drives - Cyclo converter control - Brushless DC motor drives - Current source inverter fed synchronous motor drive - Synchronous reluctance motor drive. **9**

SPECIAL DRIVES AND APPLICATIONS

DC Servo drives principle of operation - AC Servo drives principle of operation - Principle and control Stepper motor drives - Comparison between Servo drive and Stepper drive - Introduction to PLC based drives - Energy Efficient drives - Switched Reluctance motor drives - Solar and Battery powered drives. Selection of drive and Control schemes for Steel industry - Textile industry - Mining - Paper industry - Cement mils. **10**

TOTAL : 45

TEXT BOOKS

1. *G.K.Dubey, "Fundamentals of Electrical Drives", 2nd edition, Narosa Publishing House, New Delhi, Reprint 2020.*
2. *Bose B K, "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt. Ltd, New Delhi, 2014*
3. *G.K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989*

REFERENCE BOOKS

1. *Vedam Subramaniam, "Electrical Drives and Applications", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.*
2. *R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press Taylor & Francis Group, 2010.*
3. *S.K. Pillai, "A First Course on Electrical Drives", New Age International Publishers, 2nd Edition, 2010.*
4. *M.S.Berde, "Electric Motor Drives", Khanna publishers, New Delhi 1997.*
5. *P.C. Sen, "Thyristor DC Drives", John Wiley and Sons, New York, 1981.*
6. *J.M.D. Murphy, "Thyristor Control of AC Motor", Paragon Press, London, 1978*

19EE72 - GENERATION OF ELECTRICAL ENERGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Classify different types of loads and calculate the load demand - supply curve.*

CO2 : *Identify the areas of agreement and disagreement in safety aspects and environmental concern of conventional power generation schemes.*

CO3 : *Design solar PV based grid tied, off grid and hybrid systems for domestic applications.*

CO4 : *Examine the possibilities of wind energy systems in the particular locality.*

CO5 : *Assess the various sources of availability to design a microgrid for a given requirements.*

LOAD ANALYSIS

Demand for electric power - Load Curves and Load curve analysis - Reliability Evaluation - Outages, Causes and Interruptions - Cost versus Reliability - Short and Long range planning - Load demand - Diversity and Plant factors - Cost and Economic Evaluation **9**

CONVENTIONAL GENERATION SCHEMES

Hydroelectric power plants - Pumped storage plants - Thermal power plants: Steam power stations, Gas turbine stations and Diesel generators - Nuclear power plants - Safety aspects - Environmental concerns **9**

SOLAR PV SYSTEMS

Solar radiation and measurement - Influence of insulation and Temperature - Block diagram of solar photo voltaic system - Solar PV Cell - Characteristics and Types - Arrays and Panels - DC power conditioners - Maximum power point tracking algorithms - AC power conditioners - Line commutated thyristor inverters - Synchronized operation with grid supply - Standalone inverters.

Solar PV Applications: Water pumping and Street lighting. Energy Storage: Batteries, types and its parameters **9**

WIND ENERGY SYSTEMS

Basic principle of wind energy conversion - Nature of wind power in the wind - Site selection considerations - Components of Wind Energy Conversion System (WECS) - Classification of WECS - Generating Systems - Schemes of electrical generation. Applications - Water pumping and Village electrification. **9**

COGENERATION AND MICROGRID

Distributed generation versus traditional power systems - Concepts of micro grid - Additional sources of micro grids: Biomass and fuel cells - Structure and Configuration of AC and DC micro grid - Modes of operation and Control of micro grid: Grid connected and Islanded mode - Active and Reactive power control and protection issues. **9**

TOTAL : 45

TEXT BOOKS

1. *P Breeze, "Power Generation Technologies", Elsevier, 3rd Edition, 2019*
2. *Mukund R. Patel, "Wind and Solar Power Systems", 2nd Edition, CRC Press, New York, 2009*
3. *S. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", Institution of Engineering and Technology (IET Press), 2014.*
4. *Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals,Technologies and Applications", 3rd edition, PHI , Delhi, 2015*

REFERENCE BOOKS

1 *Digambar M. Tagare, "Electricity Power Generation: The Changing Dimensions", John Wiley & Sons, 2011.*
2. *C.L.Wadhwa, "Electrical Power Systems", New Age International, 2012*
3. *Joshua Earnest and Tore Wizelius, "Wind Power Plants and Project Development", PHI Learning Private Limited, 2nd edition, New Delhi, 2017.*
4. *Adolf Goetzberger and Volker Hoffmann, "Photovoltaic Solar Energy Generation", Springer - Verlag Berlin Heidelberg, 2005.*
5. *Roger Messenger and Jerry Venture, "Photovoltaic Systems Engineering", CRC Press, New York, 2007.*

19EE73 - SMART GRID

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Explain the basic concepts of smart grid , its components, architecture and distinguish from traditional grid*

CO2 *: Identify suitable power electronic converters for WAMPCS and select appropriate compensation methods for solar PV, micro - hydro, wind and battery storage connected micro - grids*

CO3 *: Diagnose and control the grid quality using different communication algorithms / systems and security concerns*

CO4 *: Summarize various metering services in smart grid & outline the concepts of attacks in metering*

CO5 *: Decide smart grid pathway through various case studies*

INTRODUCTION

Review Basic Elements of Electrical Power Systems - Evolution of Electric Grid - Definitions - Today's Grid Vs the Smart Grid - Need for Smart Grid - smart grid Roadmap -Transforming to smart grid- Interoperability Framework of Smart grid - Functions of Smart Grid and its Components - Overview of the technologies required for the Smart Grid - Concept of Resilient &Self Healing Grid - Present development & International policies in Smart Grid - Smart Grid Market Drivers - Stakeholders Roles and Function - Standards for Smart Grid - Opportunities, Challenges and Benefits. **9**

SMART GRID TECHNOLOGIES

Technology Drivers - Smart Energy Resources - Sustainable Energy Options for the Smart Grid - Variability Issues Associated with Sustainable Energy Technology - Demand Response Issues - Power Electronics in the Smart Grid - Smart substations - Power Quality issues in Smart Grid - Power Quality Conditioners for Smart Grid - Energy Storage Technologies: Batteries - Flow Battery - Fuel Cell and Hydrogen Electrolyze SMES - Super Capacitors E- mobility. **9**

INFORMATION AND COMMUNICATION TECHNOLOGY

Communication Technology - Two - way Digital Communications - Standards for Information Exchange - Communication Infrastructure and Protocols for Smart metering - Standards for smart metering - - IEC 61850 - Interoperability - Smart Grid Network Interoperability - Local Area Network (LAN) - MODBUS - DNP3 - Home Area Networks (HAN) / Home Energy Networks (HEN) - Wide Area Network (WAN) - Broadband over Power Line (BPL) - IP based Protocols - Basics of Web Service - Cloud Computing.

Cyber Security: Symmetric key encryption - Public key encryption - Authentication - Cyber security concerns associated with AMI - Cyber Security Challenges in Smart Grid - Load Altering Attacks - False Data Injection Attacks -Alarming Smart grid threats- Mitigation Approaches - Standards **9**

SMART METERS AND ADVANCED METERING INFRASTRUCTURE

Introduction to Smart Meters - Sensor Networks - Wide Area Monitoring Systems (WAMS) - Energy Management System (EMU)-Phasor Measurement Units (PMUs)-GIS and Google Mapping tools - Advanced Metering infrastructure (AMI) drivers and benefits - AMI protocols, standards and initiatives - AMI needs in the smart grid - SCADA - RTU - Distribution System Modeling - Intelligent Electronic Devices(IED) - Fault Detection, Isolation and Restoration - Self Healing Systems - Monitoring & Protection- IEC 61968- 9 **9**

SMART GRID PATHWAYS TO DESIGN AND CASE STUDIES

Introduction to Smart Grid Pathway Design - Barriers and Solutions to Smart Grid Development - Automation at Generation, Transmission, Distribution and End User Level. Demonstration Projects - Advanced Metering - Case Study for Renewable Energy Resource Integration: Smart city - Description of Smart Grid Activity - Approach for Smart Grid Application - Benchmarking - Smart grid for world's largest Power systems- Development targets interconnection with USA- Case study on south Korean smart grid Test bed on Jeju Island. **9**

TOTAL : 45

TEXT BOOKS

1. *Bernd M. Buchholz Zbigniew Styczynski, "Smart Grids Fundamentals and Technologies in Electricity Networks", Springer Berlin Heidelberg, Mar.2020*
2. *James Momoh, "Smart Grid - Fundamentals of Design and Analysis", IEEE Press, John Wiley & Sons, INC., New Jersey, 2012.*
3. *Janaka.E.Kanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons Ltd., West Sussex, 2012.*

REFERENCE BOOKS:

1. *ErsanKabalci, Yasin Kabalci, "From Smart Grid to Internet of Energy", 1st edition Elsevier Science,2019*
2. *Stephen F. Bush, "Smart Grid : Communication - Enabled Intelligence for the Electric Power Grid", Wiley - IEEE Press, 2014*
3. *Ali Keyhani, "Design of Smart Power Grid Renewable Energy System", IEEE Press, John Wiley & Sons, INC, New Jersey, 2011*
4. *Stuart Borlase, "Smart Grids: Infrastructure, Technology and Solutions", Taylor and Francis Group, CRC Press, 2013*
5. *K S Manoj,"Smart Grid, Concepts To Design", Notion press India, 2020*

19EEL74 - ELECTRICAL DRIVES LABORATORY

L	T	P	C
3	0	0	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Decide a suitable drive for a particular application based on power rating and characteristics of the application*

CO2 : *Determine the braking characteristics of DC shunt motor and Induction motor*

CO3 : *Assess the converter topologies, inverter topologies control principles and modern tools used in DC drives,AC drives and special electric drives*

CO4 : *Demonstrate the speed control of DC motors by using converters and chopper fed drive and also to demonstrate the speed control of AC motors by using inverter fed AC drive*

CO5 : *Integrate the drive-based energy saving technique through experimental verification and to perform the speed control techniques for special electric machines by using drive*

LIST OF EXPERIMENTS

1. Dynamic Braking Characteristics of DC Shunt Motor
2. Dynamic Braking and Reverse Current Braking Characteristics of Three - Phase Induction Motor.
3. Speed Control of DC Motor using Phase Controlled Converter
4. Speed Control of Induction Motor using Scalar and Vector Controlled Drive
5. DSP Based Speed Control of Three Phase Squirrel Cage Induction Motor
6. Load Test on Three Phase Induction Motor with Eddy Current Loading
7. PLC Based Speed Control of Three Phase Induction Motor Drive
8. Load Test on DC Shunt Motor Using Single Phase Dual Converter Drive
9. Performance and Harmonic Measurement of Air Compressor using AC drive
10. Performance analysis of Solar PV based DC and AC Pump
11. Study of BLDC Drives
12. Speed Control of Three Phase Induction Motor using Matrix Converter Drive
13. Speed Control of Switched Reluctance Motor Drive
14. Speed Control of Servo Motor Drive.
15. Load Test on Induction Generator by Feeding Back to Mains

19EEL75 - PROFESSIONAL COMPETENCY

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Demonstrate knowledge in the program domain.*

CO2 *: Develop the problem solving skill by analyzing the given criteria*

CO3 *: Present views cogently and precisely*

CO4 *: Exhibit professional etiquette suitable for career progression.*

CO5 *: Prepare the students to face the competitive examinations and interview*

TITLES TO BE COVERED

1. Electric circuits
2. Electromagnetic fields
3. Electrical Machines
4. Electrical and Electronic Measurements
5. Analog Electronics
6. Digital Electronics
7. Control Systems
8. Power Electronics
9. Power Systems
10. Signals and Systems

ELECTIVE COURSES
PROFESSIONAL ELECTIVES
19EEE01 - DESIGN OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Classify the materials used for the construction of electrical machines and also to determine the MMF in magnetic parts of rotating machines.*

CO2 : *Decide the appropriate parameters and design the major parts of DC machines.*

CO3 : *Determine and choose appropriate parameters for the design of major parts of synchronous machines for given specifications.*

CO4 : *Decide and select appropriate parameters for the design of stator and rotor of threephase induction machines.*

CO5 : *Decide the appropriate parameters and design the major parts of single phase induction motor.*

INTRODUCTION

Design factors - Limitation in design - Various Conducting materials, Insulating materials and Magnetic materials. Design of Magnetic Circuits: MMF calculation for Air gap and Teeth - Iron losses and Magnetizing current calculations. Design of Armature Windings: Types of Winding for AC and DC Machines. Introduction to machine design software: Speed, JMAG, Maxwell. **9**

D.C. MACHINES

Output equation - Choice of Specific loadings - Choice of poles and speed - Main Dimensions - Length of Air gap - Design of Armature - Design of Field System - Commutator and Brush Design. **9**

SYNCHRONOUS MACHINES

Choice of Electric and Magnetic loadings - Main dimensions - Length of Air gap - Short circuit ratio - Stator core design and Rotor core Design for salient pole and turbo alternators - Design of Pole and Field winding - Design of damper windings. **9**

THREE PHASE INDUCTION MOTORS

Output equation - Choice of Electric and Magnetic loadings - Main dimensions - Stator core design - Length of Air gap - Rotor core Design - No load current calculation - Stator and Rotor Resistance calculations - Introduction to Energy Efficient Motors. **9**

SINGLE PHASE INDUCTION MOTOR

Single phase induction motor: Main dimensions - Design of stator - Rotor design- Introduction to CAD. **9**

TOTAL : 45

TEXT BOOKS

1 *A.K. Sawhney, "A course in Electrical Machine Design", Dhanpat Rai & Sons, Reprint, 2010.*

2 *K.G.Upadhaya, "Design of Electrical Machines", New Age International, 1st Edition, 2008.*

3 *K.Sen, "Principles of Electrical Machine Design" - Oxford & IBH pub. Co. Pvt. Ltd., 2nd Edition, 2001.*

4 *K.M.V.Murthy,"Computer Aided Design of Electrical Machines",BS Publications,2008.*

REFERENCE BOOKS

1 *R.K.Agarwal, "Principles of Electrical Machine Design" - S.Kataria & Sons, 5th Edition, New Delhi, Reprint, 2014.*

2 *V.N. Mittle, "Design of Electrical Machines", Standard Publishers Distributors, 5th Edition,2014.*

3 *Juha Pyrhones, Tapans Jokines,"Design of Rotating Electrical Machines", John Wiley and Sons, 2009.*

4 *M.V. Deshpande, "Design and Testing of Electrical Machines", PHI Learning Private Limited, Delhi, 2013.*

5 *A.Shanmugasundaram, G.Gangadharan,R.palani, "Electrical machine Design data book, New Age Pvt. Ltd, Reprint of 1st Edition 2007.*

19EEE02 - SPECIAL ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Describe the open loop, closed loop speed control and power controllers for stepper motors.*

CO2 *: Illustrate the concepts of working and controllers used for Reluctance motors.*

CO3 *: Describe the electronic commutation and controllers of Permanent magnet brushless DC motors.*

CO4 *: Describe the self and vector control schemes of Permanent magnet Synchronous motors.*

CO5 *: Choose appropriate Special machines in computerized machining, Robotics and Aviation.*

STEPPER MOTORS

Constructional features - Principle of operation - types - Modes of excitation - Single phase stepping motors - Torque production in variable Reluctance (VR) stepper motor - Dynamic characteristics - Drive systems and circuit for open loop control - Closed loop control of stepping motor - Microcontroller based controller. **9**

RELUCTANCE MOTORS

Switched Reluctance Motors: Constructional features - Principle of operation - Torque equation - Power controllers - Characteristics and control. Microcontroller based controller - Sensor less control - Derivation of output equation - Synchronous Reluctance Motors: Constructional features - Axial and Radial air gap Motors. Operating principle - Reluctance torque - Phasor diagram - Motor characteristics. **9**

PERMANENT MAGNET BRUSHLESS DC MOTORS

Commutation in DC motors - Difference between mechanical and electronic commutators - Hall sensors - Optical sensors - Multiphase Brushless motor - Square wave permanent magnet brushless motor drives - Torque and EMF equation - Torque - speed characteristics - Microcontroller based controller - Sensor less control. **9**

PERMANENT MAGNET SYNCHRONOUS MOTORS

Principle of operation - EMF - Power input and Torque expressions - Phasor diagram - Power controllers - Torque speed characteristics - Self control - Vector control - Current control schemes - Sensor less control - Adaptive fuzzy control **9**

LINEAR ELECTRICAL MACHINES

Linear Machines - Basic difference between Linear Electrical Machines(LEMS) and Rotating Machines - Classification of LEMS - Linear motors and Levitation machines - Linear induction motors - Linear synchronous motors - DC linear motors - Linear levitation machines - Machines used in CNC, Robotics and Aviation **9**

TOTAL : 45

TEXT BOOKS

1 *T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.*

2 *T.Kenjo, "Stepping Motor and their Microprocessor Controls", Clarendon Press London, 1995.*

3 *B K Bose, "Modern Power Electronics & AC drives", Pearson Education Asia, 2002.*

4 *K.Venkataratnam,"Special Electrical Machines", Universities Press, First Edition 2008.*

REFERENCE BOOKS

1 *R. Krishnan, "Switched Reluctance Motor Drives", CRC Press,2001*

2 *J.R. Hendershot Jr and TJE Miller," Design of Brushless Permanent - Magnet Motors", Magna physics publishing and clarendon press, Oxford - 2010*

3 *Kenjo T, "Power Electronics for the Microprocessor Age", Oxford University Press, 1994.*

4 *Ali Emadi (Ed), "Handbook of Automotive Power Electronics and Motor Drives", CRC Press, 2005*

5 *H A Toliyat, S Campbell, "DSP Based Electro Mechanical Motion Control", CRC Press, 2004.*

19EEE03 - MODELING AND ANALYSIS OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Describe the fundamentals of electromagnetic energy conversion for singly and doubly excited systems.*

CO2 *: Analyze standard methods to determine accurate modeling/simulation parameters for DC machines.*

CO3 *: Illustrate reference frame theory.*

CO4 *: Examine the steady state operation and dynamic operation for load variation of induction machines*

CO5 *: Illustrate the behavior of synchronous machines under transient and steady state conditions.*

PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION

Magnetic circuits - Stored magnetic energy - Co - energy - Force and Torque - Singly and doubly excited system - MMF pattern for DC and AC machines - Calculation of air gap mmf and per phase machine inductance using physical machine data. **9**

DC MACHINES

Voltage and Torque equations - Dynamic characteristics of permanent magnet and shunt DC motors state equations - Solution of dynamic characteristics by Laplace transformation. **9**

REFERENCE FRAME THEORY

Static and Rotating reference frames - Transformation of variables - Reference frames - Transformation between reference frames - Transformation of a balanced set - Balanced steady state phasor and voltage equations - Variables observed from several frames of reference. **9**

INDUCTION MACHINES

Voltage and Torque equations in machine variables - Transformation in arbitrary reference frame - Voltage and Torque equation in reference frame variables - Analysis of steady state operation - Free acceleration characteristics - Dynamic performance for load variations - Computer simulation. **9**

SYNCHRONOUS MACHINES

Voltage and Torque equation in machine variables - Transformation in rotor reference frame (Park's equation) - Voltage and Torque equation in reference frame variables - Analysis of steady state - Dynamic performance for load variations - Computer simulation. **9**

TOTAL : 45

TEXT BOOKS

1 *Paul C.Krause, Oleg Wasyzczuk and Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, 2nd Edition, 2005.*

2 *R.Krishnan, "Electrical Motor Drives, Modelling, Analysis and Control", Prentice Hall of India, 2002.*

3 *Mrittunjay Bhattacharyya,"Electrical machines: modeling and analysis , PHI learning Pvt. Ltd,2016.*

REFERENCE BOOKS

1 *A.E.Fitzgerald, Charles Kingsley, Jr. and Stephen D.Umans, "Electric Machinery", TataMcGraw Hill, 5th Edition, 1992.*

2 *Subramanyam V., "Thyristor Control of Electric Drives", Tata McGraw Hill Publishing Company Limited, New Delhi 1998.*

19EEE04 - DIGITAL CONTROL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Design compensators for the given system satisfying the given specifications.*

CO2 *: Determine the stability of the discrete-time systems and design a stable system using root-locus and frequency response plots.*

CO3 *: Device and simulate state feedback controller with full order and reduced order observer.*

CO4 *: Estimate the states of a system using Kalman filter with the given model of the system.*

CO5 *: Convert the given continuous-time system to discrete form, design suitable digital controllers and estimators under deterministic and stochastic conditions.*

INTRODUCTION

Basic concepts of digital control systems - block diagram - analog to digital and digital to analog conversion - sampling and hold devices - multiplexing - sampling and sampling theorems. **9**

Z TRANSFORM

Definition and evaluation - basic properties - inverse Z transform - pulse transfer function - starred Laplace transform - applications. **9**

MAPPING BETWEEN Z PLANE AND S PLANE

Representation of poles and zeros in the Z plane - relation between Z plane and S plane - mapping - correspondence between pole location in the Z plane and system time response - analysis of simple loop containing a discrete time controller. **9**

STABILITY ANALYSIS AND DESIGN

Jury's stability test -Schurcohn Stability test - discrete root locus - frequency response methods - bilinear transformation - LMI techniques - design using root locus and Bode plot- discrete Nyquist stability criterion. **9**

DISCRETE STATE SPACE ANALYSIS

Introduction - state space representation of discrete systems - canonical forms - state transition matrix - solving discrete time state equations. **9**

TOTAL : 45

TEXT BOOKS

1 *Katsuhiko Ogata, "Discrete-Time Control Systems", II Edition, Pearson Education Asia, Singapore, 2005.*

2 *Gopal M, "Digital Control and State Variable Methods", III Edition, Tata McGraw Hill Publishing Co.Ltd., New Delhi, 2009.*

REFERENCE BOOKS

1 *Gene F. Franklin J. David Powell and Michael Workman, "Digital Control of Dynamic Systems", 3rd Edition, Addison Wesley Longman, 2006.*

2 *Benjamin C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press, 2007.*

3 *R. Isermann, “Digital Control”, Vol 1 Narosa Publications, 1993*

19EEE05 - SYSTEMS THEORY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Model the given physical system in state space.*

CO2 *: Identify the interaction between various elements in a control system and analyze its stability.*

CO3 *: Determine the controllability and observability of the given system.*

CO4 *: Design state feedback controllers and observers for the given system.*

CO5 *: Analyze the behavior of feedback controlled systems.*

STATE-SPACE ANALYSIS

Overview of classical control systems - advantages of state model - concepts of state, state variables and state model - state model for linear time-invariant continuous time systems - transfer function from state model - state transition matrix - properties - solution of state equations. **9**

DESIGN OF CONTROL SYSTEMS IN STATE-SPACE

Linear transformation - invariance of state model - concept of controllability and observability - controllable and observable canonical forms - Kalman and Gilbert tests - pole-placement by state feedback - Ackermann's formula - full order and minimum-order state observers. **9**

PHASE-PLANE ANALYSIS

Nonlinear systems - common physical nonlinearities - jump resonance - phase plane and phase portraits - singular points - types - construction of phase trajectories: analytical, isoclines, delta methods - limit cycle oscillations - stability analysis. **9**

DESCRIBING FUNCTION METHOD

Basic concepts - derivation of describing functions for saturation, dead-zone, backlash, ideal relay, relay with dead-zone, relay with saturation, relay with hysteresis - stability analysis by describing function. **9**

LIAPUNOV STABILITY ANALYSIS

Concepts of definiteness of sign - quadratic forms - Liapunov theorems on the stability and instability of nonlinear systems - asymptotic stability of linear systems by the second method of Liapunov -Krasovskki's theorem on the global asymptotic stability of nonlinear systems - variable-gradient method for generating Liapunov functions. **9**

TOTAL : 45

TEXT BOOKS

1. *J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International, New Delhi, 6th edition 2018.*
2. *Roy Choudhury D, "Modern Control Engineering", Prentice Hall of India, New Delhi, 2009.*

REFERENCE BOOKS

1 *Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2010.*
2. *John E. Gibson, "Nonlinear Automatic Control", McGraw-Hill Book Company, Inc, 1963.*
3. *Hassan K. Khalil, "Nonlinear Systems", 3rd Edition, Prentice Hall, 2002.*
4. *Yasumichi Hasegawa," System Theory of Continuous Time Finite Dimensional Dynamical Systems", The Memories of Tsuyoshi Matsuo and R. E. Kalman, Springer, Cham, 2020.*

19EEE06 - EMBEDDED CONTROL OF ELECTRIC DRIVES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Realize the fundamental concepts of electric drive systems and load dynamics*

CO2 : *Devise the solid-state speed control methods for DC motors using embedded controller*

CO3 : *Illustrate underlying Converter and Inverter principles for electric drives*

CO4 : *Infer the open loop and closed loop operation of synchronous motors using various methods*

CO5 : *Interpret the basic principle of operation and control of SRM Motor and BLDC Motor.*

INTRODUCTION

Electrical Drives - Driving forces and evolving technologies - Advantages and application range of electric drives - Energy savings through drive system - Elements of drive system - Drive characteristics - Load dynamics and steady state stability - Multiquadrant operation - Electric motors for drives - Modern trends in industrial drives and control - Motor Control Sensors: Voltage, Current and Speed sensing - Evaluation of microcontrollers for motor control - Introduction of digital signal controllers based electric drive system **9**

DC MOTOR DRIVES

Introduction to DC motor drives - Speed control of DC motor drive with controlled rectifiers and choppers - Embedded controller-based implementation of DC drives - Converter structure - Modes of operation - Control algorithm - Development of speed control algorithm for DC drives using digital signal controllers **9**

INDUCTION MOTOR DRIVES

Speed Control Methods - PWM inverter fed induction motor drives - Vector control - Open loop and Closed loop PWM control - Sensor less IM drives: a study - Direct torque and Flux control - Space vector PWM control - Embedded controller-based speed control implementation for IM drive - Control algorithm of speed measurement during high speed/low speed regions - Development of closed loop control block using digital signal controllers. **10**

SYNCHRONOUS MOTOR DRIVES

Open loop VSI fed drive and its characteristics - Self-control - Torque control - Torque angle control - Maximum Torque per Ampere control - Power factor control - Brush less excitation systems - Starting methods - Field oriented control - Design of closed loop operation of Synchronous motor drive systems.

PM Synchronous Motor Drives: Types and Torque developed in PMSM - Stationary and rotor reference frame modeling of PMSM - PMSM control system. **10**

SPECIAL MACHINES DRIVES

Switched Reluctance Motor drive: Fundamentals and control of SRM drives - Open loop and Closed loop torque and speed control. Brushless DC Motor Drives: Principle of operation - Torque generation - Open loop and Closed control of BLDC drive.

Stepper Motor Drives: Types and basic operation - Development of speed control algorithm for stepper motor drive using digital signal controllers. **8**

TOTAL : 45

TEXT BOOKS

1 *G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2014.*

2 *Bose B K, "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt. Ltd, New Delhi, 2014*

3 *Vedam Subramaniam, "Electrical Drives and Applications", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.*

4 *Werner Leonhard, "Control of Electric Drives", 3rd Edition, Springer, 2006.*

REFERENCE BOOKS

1 *G.K. Dubey, "Power Semiconductor Controlled Drives", 2nd edition Prentice Hall, Reprint 2018*

2 *R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press Taylor & Francis Group, 2017.*

3 *Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 3rd edition 2016.*

4 *S.K. Pillai, "A First Course on Electrical Drives", New Age International Publishers, 3rd Edition, 2012.*

5 *Richard Valentine, "Motor Control Electronics Handbook", McGraw Hill, New York, 2006.*

6 *Hamid A. Taliyat, Steven Campbell, "DSP - Based Electromechanical Motion Control", SRS Press, 2004.*

7 *Ertan, H.B., Üçtug, M.Y., Colyer, R., Consoli, A. (Eds.), "Modern Electrical Drives", Nato science series E, 2000*

8 *M.S.Berde, "Electric Motor Drives", Khanna publishers, New Delhi 1997.*

9 *P.C. Sen, "Thyristor DC Drives", John Wiley and Sons, New York, 1981.*

10 *J.M.D. Murphy, "Thyristor Control of AC Motor", Paragon Press, London, 1978*

11 *Data Manual of "TMS320 F 28335 Digital Signal Controllers", Texas Instruments, 2012. Available in http:www/ti.com/DSC.*

12 *Qian Cheng and Lei Yuan, "Vector Control of an Induction Motor based on a DSP", Master of Science Thesis, Chalmers University of Technology, Sweden, 2011.*

13 *Bob King and Edgar Saenz, "Stepper Motor Control with an MC68 HC 11E9 Microcontroller", Released by Free Scale Semiconductor document (AN 1285/D) available in http:www/freescale/AN1245/D.*

14 *M.N.Cirstea,et.al, "Neural and Fuzzy Logic Control of Drives and Power Systems" Newnes - An imprint of Elsevier Science, Oxford, 2012*

19EEE07 - ROBUST CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Design a robust control using classical and state space approach.*

CO2 *: Design a roust control using linear quadratic approach*

CO3 *: Design a robust control using H-infinity methods*

CO4 *: Synthesize controllers by solving LMI problems for the given design specifications..*

CO5 *: Design a robust control for uncertain systems*

OVERVIEW AND PRELIMINARIES

Overview on Robust control, Basics from Matrix Algebra, Norms of signals and systems. Classical Control, Root locus, Nyquist plots, Robustness and Disturbance rejection in SISO systems. Multivariable Linear Systems: Continuous time State space models, Discrete time state models. Transfer-functions, Frequency response, Poles, Zeros and Modes. Stability, Change of Basis, Controlloability Observability and Observer Feedback. Performance **12**

LINEAR QUADRATIC CONTROL

The Linear Quadratic Regulator (LQR) problem: LQR solution using the minimum principle, Generalization of LQR; LQR properties with classical interpretations; Optimal observer design- Kalman-Bucy filter. The Linear Quadratic Gaussian (LQG) problem: Introduction, LQG problem formulation and solution, Performance and Robustness of optimal state feedback, Loop Transfer Recovery (LTR) **9**

MODERN H_2 AND H_∞ OPTIMAL CONTROL

Modern H_2 and H_∞ optimal controller design and to LMI-based synthesis techniques for such controllers and for multi-objective design. Optimal regulator problem with finite time horizon, Riccati differential equation. Singular value plots, input and output directions; Mixed sensitivity design, H_∞ loop shaping, choice of weighting filters **12**

LINEAR MATRIX INEQUALITIES

Design specifications as LMI constraints (H_2, H_∞ and pole region); Controller synthesis by solving LMI problems, multi-objective design. **6**

ROBUST CONTROL OF UNCERTAIN SYSTEMS

Small gain theorem, representation of parameter uncertainty; Balanced realization and model order reduction. **6**

TOTAL : 45

TEXT BOOKS

1 *K. Zhou, J. Doyle, and K. Glover, “Robust and Optimal Control”, Prentice-Hall, 2006.*

2 *G. E. Dullerud and F. Paganini, “A Course in Robust Control Theory: a convex approach”, Vol. 36, Springer Science & Business Media, 2013.*

3 *Gene F. Franklin, J. David Powell, Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", Pearson, 8th Edition, 2018.*

REFERENCE BOOKS

1 *J. Ackermann, "Robust Control - Systems with Uncertain Physical Parameters", Springer-Verlag, 1993*

2 *S. P. Bhattacharya, H. Chapellat and L. H. Keel, "Robust Control: The Parametric Approach", Prentice-Hall, PTR, NJ07458, 1995.*

3 *Andrzej Bartoszewicz, “Robust Control: Theory and Applications”, InTech, 2011.*

4 *Basil Kouvaritakis, Mark Cannon, "Model Predictive Control - Classical, Robust and Stochastic", Springer, 2015.*

5 *Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall, 5th Edition, 2010*

19EEE08 - POWER QUALITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Realize the basic concepts of utility distribution and industrial power quality phenomena*

CO2 : *Classify the transients and elucidate the concepts and mitigation techniques*

CO3 : *Interpret the causes and consequences of short and long interruptions and able to choose suitable the mitigation techniques*

CO4 : *Identify the source, effects and mitigation techniques and explicate the earthing and bonding system*

CO5 : *Comprehend the need for monitoring the power quality and assess the power quality measurement data for any industrial plant*

INTRODUCTION TO POWER QUALITY

Power Quality definition - Need for power quality - sensitive loads - Nonlinear loads - inter connected power systems - Deregulation - Power quality characteristics - types of power quality problems - Transients: Impulsive, Oscillatory - Voltage Variations-Short, Long Duration- Voltage Imbalance-Waveform Distortions:- DC Offset, Harmonics, Notching, Noise - Power Frequency Variations. Sources of power quality problems- Effects of power quality problems - Responsibilities of the suppliers and user of electrical power - power quality standards- Computer Business Equipment Manufacturers Associations (CBEMA) and ITIC curves- Cost of Poor Power Quality. **8**

TRANSIENTS

Definition - Power system transient model - Parameters-types - Causes of transients -Sources- Internal Capacitor switching transients- Transients from load switching- External - Lightning transients - Effects of transients- Mitigation- Principles of Protection -Insulation Coordination - Devices for over voltage protection- Standards. **9**

SHORT AND LONG DURATION INTERRUPTIONS

Short duration interruptions - Definition - Magnitude, Duration - Causes of voltage sag, swell and interruption- Sources of voltage sag and short interruptions - Voltage during fault and post fault period, Current during fault period - Effects of voltage sag and short interruptions- Overview of mitigation methods(Qualitative treatment only)-Standards and voltage sag indices. Long duration interruptions-Definition - Failure, Outage, Interruption - Origin of interruptions - Causes of long interruptions - Principles of regulating the voltage - Voltage regulating devices, Applications : Utility side, End-User side -Reliability evaluation - Cost of interruptions. **11**

HARMONICS AND GROUNDING

Harmonics-Description of the Phenomena -Parameters- Voltage Distortion - Current Distortion - Definitions and terms -Sources of Current and Voltage - Harmonics Sources - Effects of Harmonics- - Guidelines for harmonics voltage and current limitation- standards and measures IEEE and IEC standards.

Harmonic filters: Harmonic Distortion Evaluations-Devices for Controlling Harmonic Distortion- Passive, Active and hybrid filters (Qualitative treatment only)-Case Studies.

Grounding-Definitions and terms -Typical Earthing System- Reasons for grounding - National Electrical Code (NEC) grounding requirements - Utility Power system grounding - End-User power system grounding- Typical Wiring and Grounding Problems-Solutions to Wiring and Grounding Problems. **12**

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POWER QUALITY MONITORING AND SURVEY

Introduction - Power quality monitoring- Monitoring Considerations - Evolution of power quality monitoring- Brief introduction to power quality measurement equipments - Planning, Conducting and Analyzing power quality survey - Assessment of Power Quality Measurement

Data - Utility-Customer interface-Introduction to thermo graphy in power quality assessment- Industrial Case Studies-Power Quality Monitoring Standards. **5**

TOTAL : 45

TEXT BOOKS

1. *Roger.C. Dugan, Mark.F. McGranagham, Surya Santoso, H. Wayne Beaty, "Electrical Power Systems Quality", McGraw Hill, 3rd Edition, 2017.*
2. *C.Sankaran, "Power Quality" CRC Press, 2011, New York*

REFERENCE BOOKS

1. *Angelo Baggini, "Handbook of Power Quality" John Wiley & Sons, New York 2011.*
2. *Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality: Problems and Mitigation Techniques" Wiley & Sons, United Kingdom, 2015.*
3. *Barry W. Kennedy, "Power Quality Primer" MC Graw Hill Publications, New York.2006*
4. *M.H.J.Bollen,"Understanding Power Quality Problems: Voltage Sags and Interruptions", Wiley,2011.*
5. *J.Arrillage, N.R.Watson And S.Chen, "Power System Quality Assessment", John Wiley&Sons,New York,2000.*
6. *Derek.A.Paice, "Power Electronic Converter Harmonics", IEEE Industrial Application Society, IEEE Press, New York 1996.*
7. *Short.T.A., "Distribution Reliability and Power Quality", CRC Press Taylor and Francis Group, 2006.*
8. *Fuch, Ewald, etal, “Power Quality in Power Systems and Electrical Machines” Academic Press / Elsevier, 2nd Edition, 2015.*

19EEE09 - ADVANCED POWER ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Describe different power semiconductor devices.*

CO2 : *Analyse resonant converters.*

CO3 : *Select appropriate phase shifting converter for a multi-pulse converter.*

CO4 : *Evaluate various multi-level inverter configurations.*

CO5 : *Comprehend various power electronic converters used for hybrid system. Compare various FACTS devices for VAR compensation.*

EMERGING POWER SEMICONDUCTOR DEVICES

Power MOSFETs - IGBT - IGCT - IGET - ETO - MOS Controlled thyristor and their driver circuits - Intelligent power modules -Thermal design - protection - gating circuits - digital signal processors used in gate control -SiC and GaN power semiconductor devices. **6**

ADVANCED DC - DC AND RESONANT CONVERTERS

Non - isolated dc - dc converters: SEPIC, Zeta in DCM and CCM. Isolated dc - dc converters - SEPIC, Zeta, half bridge, push -pull and bridge in DCM and CCM-applications, merits and demerits. Zero voltage and Zero current switching - Classification of resonant converters - Basic resonant circuit concepts - Load resonant converters - Resonant switch converters - Zero voltage switching, Clamped voltage topologies - Resonant DC link inverters and Zero voltage switching - High frequency link integral half cycle converters - Applications in SMPS and lighting. **12**

POWER CONDITIONERS AND IMPROVED UTILITY INTERFACE

Single - phase, single - stage converters, Power factor correction at AC mains - Power line disturbances - Noise and Surge reduction - Power conditioners - Static Servo Stabilizer - Uninterruptable power supply (UPS) - Types - Design of UPS - Filter design. Generation of current harmonics - Current harmonics and power factor -Harmonic standards and Recommended practices -Need for improved utility interface - Improved single phase utility interface - Improved three phase utility interface - EMI and RFI. **9**

MULTI-LEVEL CONVERTERS AND MULTIPULSE CONVERTERS

Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications, Introduction to carrier based PWM technique for multi-level converters. Concept of multi-pulse, Configurations for m- pulse (m=12,18,24 ….) converters, Different phase shifting transformer (Y - Δ1, Y - Δ2, Y-Z1 and Y-Z2) configurations for multi-pulse converters, Applications **9**

FACTS DEVICES

Introduction - Principles of reactive power control in load and transmission line compensation - Series and Shunt reactive power compensation - Concepts of Flexible AC Transmission Systems (FACTS) - Thyristor Controlled Reactor (TCR) - Thyristor Switched Capacitors (TSC) - Static VAR Compensators (SVC) - Static Synchronous Compensator(STATCOM) - Static Series Synchronous Compensator(SSSC) - Unified Power Flow Controller(UPFC) - Interline Power Flow Controller(IPFC). **9**

TOTAL : 45

TEXT BOOKS

1. *Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics Converters, Applications and Design", Wiley, India, 3rd Edition, New Delhi, 2012.*
2. *Euzeli dos Santos, Edison R. da Silva, "Advanced Power Electronics Converters: PWM Converters Processing AC Voltages "Wiley - IEEE Press, Newyork,2014.*

REFERENCE BOOKS

1. *Timothy. J.E. Miller, "Reactive Power Control in Electric Systems",BSP Books Pvt. Ltd., New Delhi, 2010.*
2. *Derek A. Paice, "Power Electronic Converter Harmonics - Multipulse Methods for Clean Power", IEEE Press, 1999.*
3. *James W. Clark, "AC Power Conditioners - Design and Applications", Academic Press Inc, California,1990*
4. *M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson India, New Delhi, 4th Edition,2014.*
5. *P.C. Sen, "Modern Power Electronics", S.Chand Publishers, 5th Edition, New Delhi, 2000.*
6. *N. G. Hingorani and L. Gyugyi, "Understanding FACTS",IEEE Press, Delhi,5th edition,2001.*
7. *A. I. Pressman, "Switch Mode Power Supply Design",McGraw - Hill, New York, 8th edition,2015.*
8. *J. Arrillaga, Y. H. Liu and N. R. Waston, "Flexible Power Transmission - The HVDC Options", John Wiley & Sons Ltd,Chichester, UK, 2007.*
9. *Vijay K. Sood, "HVDC and FACTS Controllers - Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Massachusetts, 2004.*

19EEE10 - POWER AND ENERGY MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Identify the demand supply gap of energy in current scenario.*

CO2 : *Carry out Auditing of energy equipment and to prepare energy flow diagrams and energy audit report*

CO3 : *Analyse the energy economic analysis methods and tools used.*

CO4 : *Evaluate the techno economic feasibility of the energy conservation technique adopted.*

CO5 : *Identify and evaluate the common energy conservation opportunities in different energy intensive industrial equipments*

INTRODUCTION

Global energy scenario - Role of energy managers in industries - Energy forecasting - Limitations of energy resources - Renewable energy resources - Load management - Demand Side Management (DSM) - Energy conservation in realistic distribution system Energy monitoring - Auditing - Targeting - Energy pricing - Energy security. **9**

ENERGY AUDIT

Energy auditing - Data to be collected in auditing - Needs, methodology and types of audit - Waste heat recovery - Sources of waste heat - High temperature heat recovery - Medium temperature heat recovery - Waste heat recovery applications. **9**

ENERGY ANALYSIS

Real Factory Systems: Process system optimization - Electrical system optimization - Cogeneration - Heating, ventilation and air conditioning systems. Real Transportation Systems: Energy conservation in transportation - New technologies - Progress in clean diesel technology. Real buildings systems: Consumption - Cost vs lifecycle cost - Building design - HVAC systems - Water supply systems - Lighting systems. **9**

PLANNING AND MONITORING

Energy Action Planning: Energy management system - Management commitment and Energy conservation policy - Energy performance assessment - Data collection and management - Analysis of data, baseline and benchmarking - Estimation of energy savings potential - Action planning and Training planning.

Monitoring and Targeting - Elements - Data and information, various techniques - Energy consumption, Production and Cumulative sum of differences (CUSUM). **9**

OPPORTUNITIES

Supply Side: Methods to minimize supply - Demand gap, Renovation and Modernization of power plants - Reactive power management - Energy conservation in boilers, compressors, water heaters and coolers, HVAC and FACTS. Demand side: Energy conservation in Lighting, Motors, Pumps and Fan systems - Energy efficient motors. **9**

TOTAL : 45

TEXT BOOKS

1. *Amlan Chakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2018.*
2. *"General Aspects of Energy Management and Energy Audit", BEE Guide book, 2015.*
3. *Frank Krieth and D Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, 2016.*

REFERENCE BOOKS

1. *Y P Abbi and Shashank Jain, "Handbook on Energy Audit and Environment Management", TERI, 2006.*
2. *Craig B. Smith, Kelly E. Parmenter ,"Energy Management Principles: Applications, Benefits, Savings", Pergamon Press, New York, 2015.*
3. *D. P. Sen Gupta, K. R. Padiyar, Indranil Sen, M.A, "Recent Advances in Control and Management of Energy Systems", Interline Publishers, Bangalore, 1993.*
4. *Albert Thumman, "Fundamentals of Energy Engineering", Prentice Hall, May 1984.*
5. *Hamies, "Energy Auditing and Conservation: Methods, Measurements, Management & Case study", Hemisphere, Washington, 1980.*
6. *Larry C Whit et.al, "Industrial Energy Management & Utilization", 1st Edition, Springer, 1988.*
7. *Diamant R.M, "Total Energy", Pergamon Press, Oxford Press, 1970.*

19EEE11 - ENERGY STORAGE TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Infer the need Energy storage and compare various energy storage methods*

CO2 *: Categorize the types of batteries and relate their usage for different applications by a proper mode*

CO3 *: Analyze different electric , magnetic & thermal energy storage systems and relate those in various applications..*

CO4 *: Select a suitable PCM for Energy storage and conservation*

CO5 *: Explain the working of fuel cells, flywheel and evaluate the energy storage technologies for power plant and heating applications.*

ENERGY STORAGE: GLOBAL SCENARIO, NEED & INTRODUCTION

Energy production and consumption in various sectors, Projected energy consumption for the next century - Environmental issues: Ozone layer depletion and Global warming. Need for energy storage - Types of energy storage (Physical & Electrical systems) - Comparison of different energy storage technology- Energy and power balance in a storage unit - Mathematical model of storage - Econometric model of storage **8**

ELECTROCHEMICAL ENERGY STORAGE SYSTEMS

Batteries: Basic concepts - Battery performance - Safety issues. Types of Batteries: Principle of operation- Primary, Secondary Batteries, Lithium, Solid - state and Molten solvent batteries; Lead acid batteries - Nickel Cadmium Batteries - Sodium ion batteries - Modern Batteries - Battery management system - generic model of a battery. **10**

MAGNETIC AND ELECTRIC ENERGY STORAGE SYSTEMS

Superconducting Magnet Energy Storage (SMES) systems - Capacitor and Batteries: comparison and application. Super Capacitor: Electrochemical Double Layer Capacitor

(EDLC) - Principle of working, Structure, Performance, Application and Supercapacitor Stacking - Energy and Power Densities of Electrochemical Supercapacitors- Role of activated carbon and Carbon nano - tubes. **9**

THERMAL ENERGY STORAGE

Fundamental concepts - Types - Phase Change Materials (PCMs) and its properties- - Selection criteria of PCMs. Solar Thermal Latent Heat TES systems - Energy conservation through LHTES systems - LHTES systems in refrigeration and air - conditioning systems. - compressed air energy storage systems (CAES) **9**

OTHER ENERGY STORAGE TECHNOLOGIES AND APPLICATIONS

Fuel cells: Principle - Difference between batteries and fuel cells - Types of Fuel cells. Flywheel energy storage -hydrogen storage- conversion from hydrogen into electricity- Pumped storage system - Applications: Power plant applications, Green house heating, Heating applications in Industry, Food Preservation, Energy storage plug in hybrid Electric vehicles **9**

TOTAL : 45

TEXT BOOKS

1. *Alfred Rufer, "Energy Storage Systems and Components" CRC Press, 2018*
2. *Glaize, C, "Lithium Batteries and other Electrochemical Storage Systems", Wiley Publications, 2013.*
3. *Ru - shiliu, Leizhang and Xueliang sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley publications, 2012*
4. *Ibrahim Dincer and Mark A. Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons, 2nd Edition, 2010.*
5. *Robert A. Huggins "Energy storage",Springer US, 1st Edition,2010*

REFERENCE BOOKS

1 *Yasar Demirel, "Energy Production, Conversion,Storage, Conservation, and Coupling", Edition, Springer,1st edition, 2012*
2. *Aiping Yu, Victor Chabot, and Jiujun Zhang," Electrochemical Supercapacitors for Energy Storage and Delivery", CRC Press,2013*
3. *Kordesch K and Simader G, "Fuel Cell and Their Applications", Wiley - Verlag publisher, Germany 1996*
4. *James Larminie and Andrew Dicks,"Fuel Cell Systems Explained", Wiley Publications, 2003.*
5. *A.G. Ter-Gazarian," Energy Storage for Power Systems" 2nd Edition, The Institution of Engineering and Technology,2011*

19EEE12 - UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Illustrate the suitable lighting schemes and interpret the energy conservation measures.*

CO2 *: Analyze the electric motors' characteristics for traction system and explain the concepts of train movement and braking system.*

CO3 *: Classify the methods of heating and infer the applications of electrolysis*

CO4 *: Illustrate the energy audit procedure and describe the protocols of environment and climate change.*

CO5 *: Identify and analyze the energy conservation measures of various electrical systems.*

ILLUMINATION

Terms and Definitions - Laws of illumination - Calculation of illumination - Choice of Lighting - Different types of lighting sources and Energy efficiency - Light control - Lighting Schemes - Street lighting and Flood lighting - Lighting standards for industries and commercial buildings - Energy conservation measures for lighting. **9**

ELECTRIC TRACTION

Choice of an Electric Motor - Traction Motors - Characteristics - Systems of railway electrification - Train movement and energy consumption: Speed time curves , Power and energy output from driving axles, Specific energy output and consumption - Electric braking - Aircraft electrical system **9**

HEATING AND ELECTROLYSIS

Methods of electric heating - Resistance heating - Arc furnaces - Induction heating - Dielectric heating. Faraday's laws of electrolysis - Applications of electrolytic Process: Electroplating, Production of metals, Electro forming, Anodizing- Current and Energy Efficiency - Power Supplies - Types of rectifiers. **9**

ELECTRICAL ENERGY AUDIT

Electricity billing, Electrical load management and Maximum demand control, Energy efficiency in electrical system and energy audit - Energy Conservation Act 2001 and its features - Energy and demand charges - Transmission and Distribution losses - Reactive power management for power factor correction - Environment and climate change - Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures - Prototype Carbon Fund (PCF). Government Schemes: Bachat Lamp Yojna - UJALA. **9**

ELECTRICAL ENERGY CONSERVATION

Energy Conservation potential in motors, Pumps, Fans and Compressors - Refrigeration and HVAC system - operation and maintenance practices for electrical energy conservation - Case studies. **9**

TOTAL : 45

TEXT BOOKS

1. *J.B.Gupta, "Utilisation of Electric power and Electric Traction", S.K.Kataria and Sons, 2015*
2. *R.K.Rajput, "Utilisation of Electrical Power", Laxmi publications (P). Ltd., 2018*

REFERENCE BOOKS

1 *A guide book on " Energy efficiency in electrical utilities" by Bureau of Energy Efficiency (BEE) , 2015*

2. *A guide book on "General aspects of energy management and energy audit" by Bureau of Energy Efficiency (BEE), 2015*

3. *C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt. Ltd., 2016.*

4. *Dr.N.V.Suryanarayana, "Utilisation of Electric power", Wiley Eastern Limited, New Age International Limited, 2018.*

5. *H.Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi, 2016*

19EEE13 - ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Identify and analyze the precautions and protection of electrical hazards*

CO2 : *Select and use the suitable personal protective equipment according to the working environment*

CO3 : *Interpret the safety procedures for the specific work place*

CO4 : *Analyze and apply the various grounding techniques*

CO5 : *Infer the electrical safety against low voltage and high voltage and to manage the medical equipments*

INTRODUCTION AND HAZARDS OF ELECTRICITY

Electrical Safety introduction : Hazard Analysis: Primary and secondary hazards - Arc, blast, shocks - Causes and effects - Summary of causes- Protection and precaution - Injury and death protective strategies - IE Rules 1956 - Basic rules for new installations: power system, Domestic and Industry (Qualitative treatment only) **9**

ELECTRICAL SAFETY EQUIPMENT

General inspection and testing procedure for electrical safety equipment - Electrical safety equipment for external protection: Flash and thermal protection - Head and eye protection - Insulation protection. Electrical safety equipment for internal protection: Over voltage, Short circuit, Earth Fault, Leakage current, High/ Low frequency - Single Line diagram of industrial power system with safety control - Electrician's Safety kit and materials. **9**

SAFETY PROCEDURES

Introduction - Six step safety method - Job briefings - Energized or De - energized - Safe switching of power systems - General energy control programs - Lockout - Tagout - Voltage measurement techniques - Placement of safety grounds - Flash hazard calculations and approach distances - Calculating the required level of arc protection (flash hazard calculations) - Barriers and warning signs - Tools and test equipment - Field marking of potential hazards - Shock avoidance techniques - One minute safety audit. **9**

GROUNDING AND ELECTRICAL MAINTENANCE

Need for electrical equipment grounding - System grounding - Equipment grounding - Types of Earthing - Earth testing for electrical equipment in Power house and Industry - Eight step maintenance program - Maintenance requirements for specific equipment and location - IEC and UL standard. **9**

VOLTAGE SAFETY SYNOPSIS AND MEDICAL SAFETY MANAGEMENT

Safety equipment and safety procedures for low voltage and high voltage system - Electrical safety around electronic circuits- Electrical safety for medical equipment like over current safety, Isolation, EMI and harmonics - Battery maintenance procedure-Stationary battery safety - Accident prevention - Accident investigation - First aid - Rescue techniques - Electrical safety program structure and development - Safety meetings - Safety audits. **9**

TOTAL : 45

TEXT BOOK

1. *John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel and Al Winfield, " Electrical Safety Handbook", 4th edition, Mc Grew Hill, 2012*

REFERENCE BOOKS

1 *Mohamed A El - Sharkawi, "Electric safety: Practice and Standards", CRC press, New York, 2013*

2. *Martha J. Boss and Gayle Nicoll, "Electrical Safety: systems, sustainability and stewardship", CRC press, New York, 2014*

3. *Ray A. Jones and Jane g. Jones, "The Electrical Safety Program Guide", National fire protection association, Quincy, 2011*

4. *Electrical Safety booklets issued by Government bodies*

19EEE14 - ENERGY EFFICIENT LIGHTING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Understand the properties of light, importance of lighting in various fields, types of light sources and methods of lighting.*

CO2 : *Perform the calculation of luminance parameters in various applications.*

CO3 : *Identify the criteria for selection of lighting equipment's and control systems in various applications.*

CO4 : *Impart design and technology for Interior lighting and Exterior lighting applications*

CO5 : *Review the various technologies used in Smart lighting systems.*

INTRODUCTION: BASICS OF LIGHTING

Lighting Physics - Optical Radiation - Concept of Color - Biological Factors : Human eye and brain response - Different entities of illuminating systems. Properties of Lighting - Natural and Artificial lighting - Good and Bad Lighting - Challenges in Lighting - Good Practices in Lighting - Types of Lighting. **7**

LIGHTING CALCULATIONS AND LIGHT SOURCES

Basic Terms in Lighting System - Luminance measurement - Laws of Illumination - Polar Curves - Rousseau's construction - Concept of Photometry - Introduction of lighting software.

Lamps: Incandescent Lamps: Halogen lamps - Discharge Lamps: MV and SV Lamps, Fluorescent Lamps: FTL, CFL - Arc lamps - Special Lamps: LED: Surface Mounted Devices (SMD-LEDs), Chip on Board (COB-LEDs) - Neon lamps - Lasers - Comparison of Lamps - Life Cycle Cost (LCC) Analysis - Efficacy. **12**

LIGHTING EQUIPMENTS AND STANDARDS

Luminaries, Wiring, Control gears, Switching boards, Reflectors and Control circuits - Heating, Harmonics and EMI Suppression techniques from lighting equipment - Switching and Dimming control algorithm - Recommendation of Illumination Levels for Various Tasks / Activities / Locations - Role of 3D printing technology for designing luminaries - International Standards and codes of lighting system. **9**

LIGHTING APPLICATIONS

Interior lighting: Industrial, Residential, Indoor stadium and Hospitals. Exterior lighting: Flood, Street, Aviation and Transport lighting - Sign and display Board Lighting - Lighting in Agriculture - Lighting in Automobiles. **8**

SMART LIGHTING SYSTEMS

Intelligent lighting system - Smart LED lighting systems - LED Smart Projector system - Solar Street Lighting Systems - Role of IoT in lighting system - Concept of Light Fidelity (Li-Fi) - Significance of UV-C lighting in medical - Concept of Artificial Moon for street lighting. **9**

TOTAL : 45

TEXT BOOKS

1. *Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to the Laser", Visions Communications, Washington DC, USA, 2nd Edition, 1994.*
2. *Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, New Delhi, 3rd Edition, 2008*
3. *Leon Gaster, John Stewart Dow, "Modern Illuminants and Illuminating Engineering", Nabu Press, Washington DC, 1st Edition, 2010.*
4. *Philip Gordon., "Principles and Practices of Lighting Design: The Art of Lighting Composition", Blue Matrix Productions, 2011.*

REFERENCE BOOKS

1. *Lighting Engineering: Practical Hand Book, INDALUX 2002*
2. *IES Lighting Handbook, 10th Edition, 2011.*
3. *NPTEL Course: Illumination Engineering*
4. *Lighting - Research paper reference from Philips - Lighting Academy and Signify Lighting University.*

19EEE15 - POWER SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After learning the course the students would be able to:

CO1 *: Predicting the sizes and location of generating stations, substations.*

CO2 *: Illustrating of power system earthing and measurement of earthing resistance.*

CO3 *: Analyzing of insulation co-ordination.*

CO4 *: Interpretation of generation planning, transmission planning and distribution planning.*

CO5 *: Modeling of primary and secondary distribution network.*

DESIGN OF POWER SYSTEM

Introduction-selection of sizes and location of generating stations-selection and specifications of transmission lines -sizes and location of substations, interconnection. **9**

POWER SYSTEM EARTHING

Objectives-definition- tolerable limits of body currents, soil resistivity, earth resistance, tolerable step, actual step and touch voltage-design of earthing grid-concrete encased electrode- tower footing resistance-measurement of earth resistance (R)-measurement of soil resistivity-impulse behaviour of earthing system. **9**

INSULATION CO-ORDINATION

Introduction, definitions- determination of line insulation-B.I.L and insulation levels of sub-station equipment-lightning arrester selection-power system overvoltage- tentative selection of arrestor voltage ratings-selection of arrestor discharge currents-arrestor discharge voltage-establishment of impulse voltage level of equipment-protective margin-establishment of separation limits-location of lightning arrestor. **9**

POWER SYSTEM PLANNING AND IMPROVEMENT

Introduction, methods of power system planning and improvement-power system improvement scheme, determination of the voltage regulation and losses in a power system-shifting of distribution transformer centre- financial aspects of the power system improvement scheme-Forecasting load and energy requirements-generation planning-transmission system planning-distribution system planning-reliability of electrical power systems-methods of measuring power system reliability **9**

DESIGN OF DISTRIBUTION SYSTEMS

Development of a distribution plan- transmission and distribution systems- types of distribution systems arrangements- primary distribution design- secondary distribution design- distribution substations-calculation of distributor sizes: voltage drops, voltage regulation, Lamp flicker **9**

TEXT BOOKS

1. *Electrical Power System Design - M. V. Deshpande, TMH publication, 2001.*
2. *Substation Design and equipment - P. S. Satnam & P. V. Gupta, Dhanpat Rai and Co. 2018.*

REFERENCE BOOKS

1. *Electrical Power System Analysis and Design - B. R. Gupta, S. CHAND Publications,6th Ed.2011.*
2. *M.L. Sony, P.V.Gupta, V.S Bhatnagar and A.Chakraborti, "A Text Book on Power Systems Engineering", Dhanpat Rai and Co., Delhi, 1997 - 98.*
3. *Electrical Power System Planning - A. S. Pabla, TMHpublication 1998.*

19EEE16 - HIGH VOLTAGE TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Distinguish the layout of HVAC/HVDC systems and analyze the choice of EHV AC/HVDC transmission systems in practice.*

CO2 : *Interpret an analysis on corona effects, construe the losses associated with transmission lines and suggest the appropriate conductors to meet the losses.*

CO3 : *Demonstrate the power circle diagram and implement the circuitry for various controllers used in EHVAC transmission systems.*

CO4 : *Plan an appropriate electric power transmission system between two destinations tosatisfy the pre-defined load requirement without compromising the technical performance.*

CO5 : *Comment over the causes of overvoltage,suggest the methods of protection and illustrate EHV cable transmission system.*

EHVAC AND HVDC TRANSMISSION - INTRODUCTION

Introduction to EHVAC and HVDC transmission - Comparison between HVAC and HVDC overhead and underground transmission scheme - Standard transmission voltages - Factors concerning choice of HVAC - Block diagram of HVAC and HVDC transmissions schemes **6**

EHV LINE CONDUCTORS

Properties of bundled conductors - Inductance and Capacitance of EHV lines - Surface voltage gradient on single, double and more than three conductor bundles - Corona effects - Power loss - Increase in radius of conductor - Charge voltage diagram - Qualitative study of corona pulses, their generation and properties **8**

EHVAC SYSTEMS

Properties of EHVAC transmission at power frequency - Generalized constants - Power circle diagram and its use - Voltage control using compensators - High phase order transmission. **8**

HVDC SYSTEMS

Review of rectification and inversion process - Constant Current and Constant Excitation angle Modes of operations - Analysis of DC transmission systems - Harmonics on AC and DC

sides and Filters for their suppression - Multiterminal DC transmission systems - Parallel operation of AC and DC transmission systems - Modern developments in HVDC transmission. **11**

OVER VOLTAGES & EHV CABLES

Overvoltage in EHV systems, origin and types - Ferro resonance overvoltage - Switching surges - Reduction of switching surges on EHV systems - Introduction to EHV cable transmission - Electrical characteristics of EHV cables - Properties of cable insulation materials - EHV insulators - Characteristics and pollution performance - Protection of HVAC and HVDC systems **12**

TOTAL : 45

TEXT BOOKS

1. *Begamudre, Rakosh Das, "Extra high voltage AC transmission engineering", 4th Edition, new academic science, 2013*
2. *S.Rao, "EHVAC and HVDC Transmission and Distribution Engineering (Theory, Practice and Solved Problems)", Khanna Publishers, 3rd Edition, 2004*
3. *Hao Zhou et al.,"Ultra-high Voltage AC/DC Power Transmission" Springer-Verlag Berlin Heidelberg,1st edition, 2018*

REFERENCE BOOKS

1 *Jos Arrillaga , "High Voltage Direct Current Transmission", 2nd Edition, Institution of Engineering and Technology, 2008*

2. *T.J.E.Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 2010*
3. *G.K.Dubey, S.R.Doraida, A.Joshi and R.H.K.Sinha, "Thyristorised Power Controllers", New Age International Publishers, 2012*
4. *K.R. Padiyar, "HVDC Power Transmission Systems", New Age International Publications, 3rd Edition, 2017.*

19EEE17 - DEREGULATED POWER SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Describe the role and essential of restructuring the power system.*

CO2 *: Identify the roles and responsibilities of different entities in power market*

CO3 *: Ascertain the security and describe ancillary service management in deregulated power system*

CO4 *: Recognize and interpret the importance of congestion management in deregulated environment.*

CO5 *: Comprehend the various pricing methods in deregulated power system*

INTRODUCTION

Deregulation - Reconfiguring Power systems - Unbundling of electric utilities - Background to deregulation and the current situation around the world - Benefits from a competitive electricity market after effects of deregulation - Role of the independent system operator **9**

DEREGULATED POWER SECTOR

Separation of ownership and operation - Deregulated models - Operational planning activities of ISO: ISO in Pool markets - ISO in Bilateral markets - Operational planning activities of a GENCO - GENCO in Pool and Bilateral markets - market participation issues - competitive bidding- Power wheeling - Transmission open access - Pricing of power transactions **9**

SECURITY IN DEREGULATED POWER SYSTEMS

Security management in deregulated environment and congestion management in deregulation - Ancillary services management - General description of some ancillary services - Ancillary services management in various countries - Reactive power management in some deregulated electricity markets. **9**

TRANSMISSION CONGESTION MANAGEMENT

Definition of congestion - Reasons for transfer capability limitation - Importance of congestion management in deregulated environment - Effects of congestion - Desired features of congestion management schemes - Classification of congestion management methods **9**

PRICING OF TRANSMISSION NETWORK USAGE AND LOSS ALLOCATION

Power wheeling - Issues involved- Principles of transmission pricing - Classification of transmission pricing methods - Rolled-in transmission pricing methods: Postage stamp method, Incremental postage stamp method, Contract path method, MW-Mile method - Distance based

- Power flow based - Power flow tracing - Marginal transmission pricing paradigm - Composite pricing paradigm - Introduction to loss allocation - Classification of loss allocation methods. **9**

TOTAL : 45

TEXT BOOKS

1. *Venkatesh P,Manikandan B V,Charles Raja S and Srinivasan, " A Electrical Power Systems Analysis, Security and deregulation", PHI Publications, 2nd Edition 2017*
2. *Tripathi M M,Restructured Power System and Electricity Market Forecasting Createspace Independent Publications, First Edition 2015*

REFERENCE BOOKS

1. *Pinni Srinivasa Varma and Sankar velamury, “Power System Deregulation Lap Lambert Academic Publishing”, First Edition 2017*
2. *Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.*
3. *Kundur P “Power System Stability and Control”, Tata McGraw Hill Third Edition 2012.*
4. *Mohammad Shahidehpour, M. Alomoush, "Restructured Electrical Power Systems: Operation: Trading, and Volatility", CRC Press, 2001*
5. *Daniel Kirschen and Goran Strbac, "Fundamentals of Power System economics" John Wiley & Sons Ltd, 2018.*

19EEE18 - ELECTRIC VEHICLES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Apprehend the fundamentals and importance of electric vehicles and its components*

CO2 : *Select the suitable drive scheme based on the motor and topology for the given specification and applications*

CO3 : *Design and categorize the battery system for electric vehicles and hybrid electric vehicles*

CO4 : *Recognize the suitable battery charging scheme for different environments and applications.*

CO5 : *Describe the significance of E-mobility and its various business opportunities*

ELECTRIC VEHICLES

An Overview of Conventional, Battery, Hybrid and Fuel Cell Electric Systems - Conventional IC Engine Vehicle - BEVs - HEVs - Series HEV - Parallel HEV - Series-Parallel HEV - FCEV - EV subsystems - Vehicle Dynamics: Vehicle Load Forces - Basic Power, Energy, and Speed Relationships - Aerodynamic Drag - Aerodynamic Drag and Fuel Consumption - Rolling Resistance - Gradability **9**

ELECTRIC PROPULSION

Electric Motors in EVs - Configuration and control of DC motor drives - Induction motor drives- Permanent Magnet motor drives - Switched reluctance motor drives - Transmission configuration, Components - gears, differential, clutch, brakes - regenerative braking - types - Motor sizing.- Matching the electric machine and the internal - combustion engine (ICE), Sizing the propulsion motor, sizing the power - electronics, selecting the energy storage technology, Communications- supporting subsystems **9**

BATTERIES

Introduction to Batteries - Energy Storage Requirements in Electric Vehicles: Batteries Types: Lead-Acid Battery - Nickel-Metal Hydride - Lithium-Ion - Battery Operation - Battery Parameters and Comparisons - Battery Packs - Battery Sizing - Battery based energy storage and its analysis - Fuel Cells - Fuel Cell based energy storage and its analysis - Super capacitors- Hybridization of different energy storage devices **9**

BATTERY CHARGING

Charging methods for battery- Fast charging - Battery Charging, Protection, and Management System - Termination methods - Charging from grid - Isolated and Non-isolated DC - DC Converters - Bidirectional DC-DC converter - High-frequency transformer based isolatedcharger topology - Transformer less topologies. **9**

E-MOBILITY

Energy Management Strategies - Automotive networking and communication, EV and EV charging standards, V2G, G2V, V2B, V2H - E-mobility business - Electrification challenges - Connected Mobility and Autonomous Mobility- Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). **9**

TEXT BOOKS

1. *Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 2nd Edition CRC Press, 2018.*
2. *Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021*

REFERENCE BOOKS

1. *James Larminie, John Lowry, Electric Vehicle Technology Explained, 2nd edition, Wiley, 2012*
2. *Soylu "Electric Vehicles - The Benefits and Barriers", InTech Publishers, Croatia, 2011.*
3. *J.M. Miller, "Propulsion Systems for Hybrid Vehicles", Institution of Electrical Engineers (IEE), 2nd edition, London, UK, 2010.*
4. *R. Stone and J.K. Bell, "Automotive Engineering Fundamentals", SAE International, Warrendale, PA, 2004.*
5. *Viswanathan B. and Scibioh Aulice M, "Fuel cells: Principles and Applications", University Press, 2008.*

19EEE19 - ENERGY EFFICIENCY IN THERMAL AND ELECTRICAL UTILITIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Preaudit the energy*

CO2 : *Analyse the possibility of energy savings*

CO3 : *Analyze the methods of energy savings*

CO4 : *Design the solutions*

CO5 : *Identify and perform appropriate energy management*

Energy Efficiency in Thermal Utilities -I

- Fuels and Combustion: Introduction to fuels, properties of fuel oil, coal and gas, storage, handling and preparation of fuels, principles of combustion, combustion of oil, coal, and gas.
- Boilers: Types, combustion in boilers, performance evaluation, analysis of losses, feedwater treatment, blowdown, energy conservation opportunities..
- Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.
- Insulation and Refractories: Insulation-types and application, the economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss.
- FBC boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, Retrofitting FBC system to conventional boilers, saving potential. **9**

Energy Efficiency in Thermal Utilities -II

- Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate, and flash steam recovery system, identifying opportunities for energy savings
- Cogeneration: Definition, need, application, advantages, classification and saving potentials.
- Waste Heat Recovery: Classification, advantages, and applications, commercially viable waste heat recovery devices, saving potential.
- Energy Management & Audit: Definition, need and types of an energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to the requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.
- Material and Energy balance: Facility as an energy system, methods for preparing process flow, material, and energy balance diagrams. **9**

Energy Efficiency in Electrical Utilities

- Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.

- Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy-saving opportunities with energy-efficient motors.
- Energy-Efficient Technologies in Electrical Systems: Maximum demand controllers, automatic power factor controllers, energy-efficient motors, soft starters with energy savers, variable speed drives, energy-efficient transformers, electronic ballasts, occupancy sensors, energy-efficient lighting controls.

9

Energy Efficiency in Thermo Electric Utilities - I

- Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities
- HVAC and Refrigeration System: Vapor compression refrigeration cycle, refrigerants, the coefficient of performance, capacity, and factors affecting Refrigeration and Air conditioning system performance and savings opportunities.
- Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system, saving potentially
- Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.
- Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. **9**

Energy Efficiency in Thermo Electric Utilities - II

- Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy-saving opportunities assessment of cooling towers.
- Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues.
- Diesel Generating system: Factors affecting the selection, energy performance assessment of diesel conservation avenues **9**

TOTAL : 45

Energy Performance Assessment for Equipment and Utility Systems

Open Book examination on the following energy performance assessments for equipment and utility systems:

- Boilers, Furnaces
- Cogeneration, Turbines (gas, steam)
- Heat Exchangers
- Electric Motors, Variable Speed Drives
- Fans and Blowers, Water Pumps, Compressors
- HVAC systems
- Lighting Systems
- Performing Financial Analysis.
- Applications of Non-conventional & Renewable Energy Sources (NRES)
- Waste minimization and resource conservation

TEXT BOOKS

1. *Mehmet Kano?lu, Yunus A. Çengel, "Energy efficiency and management for engineers", McGraw-Hill Education, 2020*
2. *Stephen A. Roosa, Steve Doty, Wayne C. Turner, "Energy Management Handbook", 9th edition, River Publishers, Taylore and Francis Group, 2020*
3. *Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency (BEE), Guide books*
4. *Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency (BEE), Guide books*

REFERENCE BOOKS

1. *Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2017*
2. *Wayne C. Turner," Energy Management Handbook", Eighth Edition, 2012*
3. *Stephen A. Roosa, Steve Doty, "Energy Management Handbook", 2018*
4. *General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency (BEE), Guide* books
5. Energy Performance Assistance for Equipment and Utility Systems, Bureau of Energy Efficiency (BEE), Guide books

19EEE20 - REAL TIME EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Illustrate embedded and real time system development processes.*

CO2 : *Develop real time scheduling algorithms and Cite real life examples for real time systems*

CO3 : *Outline program level optimization for low power consumption and build a reliable real time system.*

CO4 : *Summarize real time kernel concepts and Use appropriate testing techniques to develop fault tolerant embedded systems.*

CO5 : *Distinguish between traditional and real time databases problems*

INTRODUCTION

Real life Examples for Embedded Systems - Real Time Embedded Systems - Developing Embedded Systems - Linkers and Linking process - Executable and Linking format - Mapping to Target embedded system - Embedded System Initialization - Target system tools - Boot Scenarios - System software initialization - On - chip debugging. **9**

RTOS

Structure of a real time system - Characterization of real time systems and tasks - Hard and Soft timing constraints -Foreground , Background Systems - Critical Sections - Resources - Tasks - Context Switching - Kernel - Round robin - Task priorities - EDF - RM scheduling - Deadlock - Inter task communication - Interrupts - Memory requirements - Real time Kernels summary. **9**

SOFTWARE PERFORMANCE OPTIMIZATION

Program Optimization - Program Level Performance Analysis: Elements of program performance - Measurement driven performance analysis Program Level Energy and Power Analysis - Analysis and Optimization of Program Size. **9**

RELIABILITY AND FAULT TOLERANCE

Metrics for Reliability - Faults, Failures, Bugs - Testing techniques - Fault tolerance - CPU testing - Memory testing - System integration tools. **9**

DESIGN EXAMPLES

Data compressor - Alarm clock - Cell phone - Compact disc - DVD - Digital still camera - Audio player - Video accelerator **9**

TOTAL : 45

TEXT BOOKS

1. *Marilyn Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Morgan Kaufman Publishers, 2019.*
2. *C.M.Krishna and Kang G.Shin, "Real Time Systems", Tata McGraw Hill, 2019*

REFERENCE BOOKS

1. *Philip A.Laplante, "Real Time Systems Design and Analysis: An Engineers Handbook", Prentice Hall of India, 3rd Edition, New Delhi, 2018.*
2. *Jean J.Labrosse, "MicroC/OS - II - The Real - Time Kernel", CMP Books, 2nd Edition, 2018.*
3. *Qing Li , "Real time Concepts for Embedded Systems ", CRC Press, 2016.*
4. *David E. Simon, "An Embedded Software Primer" Pearson Education, 2016*
5. *Rajib Mall, "Real-Time Systems: Theory and Practice", First Edition, Pearson Education, 2012.*
6. *Jane Liu, "Real-Time Systems", First Edition, Prentice Hall, 2012.*

19EEE21 -VLSI DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Describe the construction and working of MOS transistors*

CO2 *: Analyze the performance of VLSI subsystems*

CO3 *: Differentiate the logic implementation of commercial FPGAs*

CO4 *: Demonstrate the need for chip level and system level VLSI testing*

CO5 *: Compare the testing techniques for chip level and board level circuits*

MOS AND CMOS CIRCUITS

nMOS, pMOS and CMOS Fabrication process - Electrical properties of MOS and BiCMOS circuits - nMOS inverter - pull-up to pull-down ratio - BiCMOS inverter - latch-up in CMOS circuits - stick diagrams - design rules and layout **9**

SUB SYSTEM DESIGN

Sheet resistance - capacitive loads - inverter delays - propagation delays - wiring capacitances. Switch logic - gate logic - combinational logic - structured design - clocked sequential circuits - bus drivers - power dissipation for CMOS and BiCMOS circuits - current limitations. **9**

PROGRAMMABLE LOGIC DEVICES

Programmable Logic Arrays (PLAs) - Programmable Array Logic Devices (PALs) - Complex Programmable Logic Devices (CPLDs) - 22V10 PAL Device - Altera MAX 7000 - Field Programmable Gate Arrays (FPGAs) - Altera Flex 10K, Xilinx XC4000 FPGA family architectures - Xilinx Spartan series FPGAs - Using CAD - Tools to implement circuits in CPLDs and FPGAs. **9**

VLSI SYSTEM TESTING

VLSI testing -need for testing, manufacturing test principles, design strategies for test, chip level and system level test techniques. **9**

TESTING TECHNIQUES

Basics of Testing: Fault models, Combinational logic and fault simulation, Test generation for Combinational Circuits. Current sensing based testing. Classification of sequential ATPG methods. Fault collapsing and simulation **9**

TOTAL : 45

TEXT BOOKS

1. *John F.Wakerly, "Digital Design Principles and Practices", 5th Edition, Pearson Education , 2018*
2. *Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", McGraw-Hill Higher Education, 2013*
3. *N. Jha & S.D. Gupta, "Testing of Digital Systems", Cambridge, 2003.*

REFERENCE BOOKS

1 *Wayne Wolf, "Modern VLSI Design : System On-Chip Design", Pearson Education Asia Pvt. Ltd., 2008.*
2. *Dauglas A. Pucknell, Kamran Eshraghian, "Basic VLSI Design",2006*
3. *W. W. Wen, "VLSI Test Principles and Architectures Design for Testability", Morgan Kaufmann Publishers. 2006*

19EEE22 - FPGA BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Distinguish FPGA and custom VLSI*

CO2 *: Illustrate the key features of FPGA fabrics*

CO3 *: Design data path controller using standard FPGA design techniques*

CO4 *: Outline the testing techniques for Electronic systems*

CO5 *: Perform system level design for real time application*

INTRODUCTION

Digital Design and FPGA - Role of FPGA - FPGA Types - FPGA Vs Custom VLSI - Goals and Techniques - Design Challenges-Design abstraction - Methodologies **9**

FPGA FABRICS

FPGA Architectures - SRAM Based FPGA - Logic Elements - Interconnection Networks - Antifuses - Logic Blocks - Chip I/O - Logic Elements - Interconnect - Circuit Design - Architecture of FPGA Fabrics - Logic Element Parameters - Interconnect Architecture-Pin out. **9**

DATA PATH CONTROLLER

Behavioral Design - Data path controller Architecture - Scheduling and allocation - Power - Pipelining - Design methodologies - Processes - Standards - Verification Design Example: Digital Signal Processor. **9**

ELECTRONIC SYSTEM TESTING

Introduction-Integrated Circuit Testing-Printed Circuit Board Testing-Boundary Scan Testing- Software Testing **9**

SYSTEM LEVEL DESIGN

Introduction-Electronic System Level Design-Case Study-DC Motor Control-Digital Filter Design-Translation Automation **9**

TOTAL : 45

TEXT BOOKS

1. *Wayne Wolf , "FPGA Based System Design" , Prentice Hall , Pearson Education, Inc. 2004.*
2. *Ian Grout, "Digital Systems Design with FPGAs and CPLDs", Elsevier, 2008*
3. *Stephen M.Trimbeger,"Field-Programmable Gate Array Technology", Springer, 2012*

REFERENCE BOOKS

1 *Stephen Brown , "Fundamentals of digital logic with verilog design", McGraw Hill Education, 2017*
2. *Charles Roth, Lizy K. John, ByeongKil Lee, "Digital Systems Design Using Verilog", Global Engineering, 2014*
3. *John. F. Wakerly , " Digital Design", Pearson Education, India, 2012*
4. *Joseph Cavanagh," Digital Design and Verilog HDL Fundamentals", CRC Press,2017*

19EEE23 - ROBOTICS AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Recognize, identify and select the major components of a robot for system specifications.*

CO2 *: Model the kinematics and dynamics of manipulators.*

CO3 *: Plan manipulator trajectories based on the kinematics of the robot.*

CO4 *: Choose a specific robot controller for various applications.*

CO5 *: Employ sensors for real time robotic application to include artificial intelligence in expert systems.*

INTRODUCTION

Introduction to robotics: Evolution of Robotics - Laws of Robotics - Classification - Robot Anatomy - DOF-Specification - Resolution - Repeatability and Precision movement. Introduction to robotic drives: Hydraulic, Electric and Pneumatic drives - Linear and Rotary actuators - End - Effectors. **9**

ROBOTIC ARM MODELING

Forward and Inverse Kinematics: Rotations and translation of vectors - Transformations and Homogenous transformations - Denavit - Hartenberg representation - Velocity kinematics - Manipulator Jacobian. Dynamics: Euler - Lagrange Equations - Equation of motion. (Algorithmic approaches only) **9**

ROBOTIC CONTROL

Trajectory planning - Control of robot manipulator: PID control scheme - Variable structure control - Resolved motion control - Computed torque control with effect of external disturbance - Force control of robotic manipulators - Sliding mode and Adaptive control. **9**

ROBOTIC SENSORS

Need for sensing system - Classification of robotic sensors - Status sensors, Environmental sensors, Quality control sensors, Safety sensors and Work cell control sensors - Non optical and Optical position sensors - Velocity sensors - Proximity sensors - Contact and Non-contact type sensors - Touch and Slip sensors - Force and Torque sensors - Selection of right sensors. Introduction to robotic vision systems: Stationary and Moving camera - Object recognition and categorization - Need for vision training and adaptation. **9**

ROBOTIC DESIGN AND APPLICATIONS

Robotic Design: System specification - Selection of Motor and Drive mechanism - Controller Design - Vision system consideration and Method of programming. Industrial Applications: Future scope of robotics - Safety in robotics - Robot intelligence and Task planning - Application of artificial intelligence and Expert systems in robotics. **9**

TOTAL : 45

TEXT BOOKS

1. *Deb. S. R, "Robotics Technology and Flexible Machine Design", Tata McGraw Hill Publisher, paperback 2010.*
2. *Fu K.S, Gonzalez RC and Lee CSG., "Robotics Control, Sensing vision and Intelligence", McGraw Hill Publisher, 1987*

REFERENCE BOOKS

1. *Antoni Grau, Zhuping Wang," Industrial Robotics: New Paradigms", BoD - Books on Demand, 2020.*
2. *Mikell. P. Groover, Michell Weis, Roger. N. Nagel and Nicolous G. Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill publisher,2005*
3. *Richard D Klafter,Thomas A.Chmielewski and Michael Negin, "Robotic Engineering: An Integrated approach", Prentice Hall of India, New Delhi, 2005.*
4. *Krishna Kant, "Computerized based Industrial Control" PHI, 2nd edition, 2012.*
5. *Carol Fairchild, Dr. Thomas L. Harman, "ROS Robotics By Example - Second Edition: Learning to control wheeled, limbed, and flying robots using ROS Kinetic Kame", 2nd Revised, 2019.*

19EEE24 - DIGITAL CONSUMER TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Describe the concepts of audio, video and digital display devices*

CO2 : *Outline the working of digital display devices*

CO3 : *Categorize the digital devices for internet and PC and analyze their applications*

CO4 : *Identify applications of the domestic digital devices*

CO5 : *Assess the usage of emerging consumer devices for industrial applications*

DIGITAL GENERATION AND CONSUMER DEVICES

Generation - Digitization of consumer products - Home networking - Era of digital consumer devices - Market Forecast - Market drivers - Success factors and challenges - Digital home. Perspective on global marketing - Process of consumer behavior - Connecting consumer research and consumer behavior. **9**

DIGITAL AUDIO AND VIDEO SYSTEMS

Microphones and Loud speakers - Construction, working principles and applications; Principles of digital audio systems - Internet audio formats and players - Components of MP3 - Components of digital TV - SDTV and HDTV technologies - Digital home theater systems. **9**

DIGITAL DISPLAY DEVICES AND DIGITAL IMAGING

LED Video - LCDs - Plasma Display Panels - Field Emission Displays - Digital light Processor - Comparison of different digital displays - Digital camcorders - Digital display interface standards. **9**

INTERNET AND PC DEVICES

Printers - Scanners - Smart Card readers - Benefits of using ebooks and challenges - Mobile phones and smart phone - DVD types and working, applications and challenges. **9**

EMERGING CONSUMER DEVICES

Net TV - Pen Computing and Digital notepad - Lighting control - Home control and security - Energy management systems - Home theatre and Entertainment - Vehicle Security - Home networking - PLC and Xilinx solutions. Geo - Spatial maps - Smart transportations. **9**

TOTAL : 45

TEXT BOOKS

1. *Bali S.P, "Consumer Electronics", Pearson Education, India, 2010.*
2. *Amit Dhir, "The Digital Consumer Technology - Hand book", Elsevier Publications, 2004.*

REFERENCE BOOKS

1. *Gupta R.G, "Audio Video systems", Tata Mc Graw Hill Publisher, 2010.*
2. *R.R Gulati, "Color Television - Principles & Practice" , Wiley Eastern Limited, New Delhi, 2003.*
3. *Thomas M. Coughlin, "Digital Storage In Consumer Electronics", Elsevier Publications, 2008.*

19EEE25 - ELECTRONIC PRODUCT DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Integrate engineering principles with real applications from a systems perspective*

CO2 *: Fabricate printed circuit boards intended for projects in industries.*

CO3 *: Analyze different hardware design and testing methods.*

CO4 *: Analyze different software design and testing methods.*

CO5 *: Equip themselves with the different product testing methods.*

PRODUCT DESIGN AND DEVELOPMENT

Overview of product ion development stages - Assessment of reliability - Ergonomic and aesthetic design - Techno commercial feasibility of a product - Quality assurance - Packing and storage - Estimating power supply requirement - HCMOS power dissipation - Power supply protection devices - Enclosure sizing and supply requirements - Selection of materials for enclosure - Noise reduction - Grounding, Shielding and Guarding Techniques - Thermal reduction. **9**

PRINTED CIRCUITED BOARD DESIGN PCB

Layout considerations - Issues related to PCB design - Parasitic elements in PCB due to vias - Parasitic elements in PCB due to traces - Multilayer PCB - Soldering Techniques - Automation in PCB design and manufacturing - High speed and EMI/ EMC considerations in PCB design - Packaging for semiconductor devices and IC's - Reliability issues in IC's - Introduction to SMD. **9**

HARDWARE DESIGN AND TESTING METHODS

Logic Analyzer - Digital Oscilloscope - Spectrum analyzer - Signal integrity issues - Mixed signal oscilloscope - Monte - Carlo Analysis - Evaluation of virtual instrumentation - Electronic gears. **9**

SOFTWARE DESIGN AND TESTING METHODS

Software design - Use of simulators - Use of emulators - Use of compilers - Algorithmic state machines - Finite state machines. **9**

PRODUCT TESTING

Environmental testing - Temperature testing - Humidity testing - Vibration test - Bump test - EMI/EMC Compliance testing - EMI/ EMC Test setup - Conducted emission test using time domain principle - Radiated emission test. **9**

TOTAL : 45

TEXT BOOKS

1. *R.G. Kaduskar and V.B. Baru, "Electronic Product Design" Wiley India, 2nd Edition, New Delhi, 2014.*
2. *James Angus and Anthony Ward, "Electronic Product Design", CRC Press, 1996.*
3. *Bert Haskell, "Portable Electronic Product Design and Development", Mc. Graw Hill, 2004.*

REFERENCE BOOKS

1 *Anand M.S, "Electronic Instruments and Instrumentation Technology", Prentice Hall of India, 2004.*

2. *John R Barnes, "Robust Electronic Design Reference Book", Volumes I and II, Kluwer Academic Publishers, New York, 2004.*

3. *Ott H.W, "Noise Reduction Techniques in Electronic System", John Wiley & Sons, New York, 1988.*

4. *Bruce R Archambeault, "PCB Design for Real - World EMI Control", Kluwer Academic Publishers, New York, 2002.*

5. *Mourad Samiha and Zorian Yervant, "Principles of Testing Electronic Systems", John Wiley & Sons, New York, 2000.*

6. *Walter C.Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, New Delhi, 2005.*

7. *Stillwell, Richard, "Electronic Product Design for Automated Manufacturing", United States, CRC Press, 2018.*

19EEE26 - MEDICAL ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Differentiate and analyse the biomedical signal sources.*

CO2 : *Elucidate cardiovascular system and related measurements.*

CO3 : *Explain the brain, respiratory and nervous systems and related measurements*

CO4 : *Measure non-invasive diagnostic parameters.*

CO5 : *Recommend problem solving and service procedures for safety use of medical instruments as per medical standards.*

BIO-POTENTIAL MEASUREMENTS.

Basic components of a biomedical system - Cell Resting and action potentials - Physiological measurements Electrodes: Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes- Electrode electrolyte interface and equivalent circuit- Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier - Different types of biotelemetry systems and patient monitoring, Use of Standard HL7. **9**

CARDIAC SYSTEM

ECG sources - Normal and Abnormal waveforms - Lead systems and recording systems - Cardiac pacemaker - External pacemaker - Implantable pacemaker - Different types of pacemakers - Fibrillation - Defibrillator - AC defibrillator - DC defibrillator - Arrhythmia monitor. **9**

NEUROLOGICAL SYSTEM AND SKELETAL SYSTEM

EEG - Wave characteristics -Frequency bands - Spontaneous and evoked response - 10-20% Lead system- Recording - Analysis of EMG waveforms - muscle latent velocity - Muscle and nerve stimulation - Fatigue characteristics **9**

RESPIRATORY MEASUREMENT AND VENTILATOR

Spirometer - Heart-Lung Machine - Oxygenators - Pnemograph - Artificial Respirator - IPR type - Functioning: Ventilators, Dialysis : Acute and Renal failure -Dialysis types and - Types of Machine - Blood Gas Analyser - pO2, pCO2, measurements. Finger-tip oximeter, ESR, GSR, measurements. **9**

THERAPHATIC AND MONITORING INSTRUMENTS

Electromagnetic and Ultrasonic blood flow meter - Equipment of physiotherapy - Transcutaneous Electric Nerve Stimulator (TENS) - Ultrasonic therapy - Extra corporeal shockwave lithotripsy - Diathermy - Audiometers - Medical Imaging: MRI and CT scan (Principle and Quantitative approach only) - Electrical safety Management and Maintenance: shock hazards, leakage current- safety of Medical Equipment. **9**

TOTAL : 45

TEXT BOOKS

1. *Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 3rd Edition, 2014.*
2. *Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2010.*

REFERENCE BOOKS

1. *John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2011.*
2. *Joseph J.carr and John M. Brown, "Introduction to Biomedical Equipment Technology", John Wiley and sons, New York, 2001.*
3. *Prof.Venkataram S.K, "Biomedical Electronics and Instrumentation", Galgotia Publications Pvt. Ltd., 2003.*
4. *Webb, Andrew G, " Principles of Biomedical Instrumentation. India", Cambridge University Press, 2018.*

19EEE27 - ANALOG AND DIGITAL COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Distinguish different analog modulation schemes for their efficiency and bandwidth.*

CO2 *: Predict the behaviour of a communication system in presence of noise.*

CO3 *: Evaluate pulsed modulation system and analyze their system performance.*

CO4 *: Illustrate various optimal detection schemes.*

CO5 *: Distinguish different digital modulation schemes and can compute estimate the bit error performance.*

CO6 *: Distinguish different analog modulation schemes for their efficiency and bandwidth.*

ANALOG MODULATION TECHNIQUES

Principles of Amplitude Modulation Systems - DSB, SSB and VSB modulations- Angle Modulation- Representation of FM and PM signals- Spectral characteristics of angle modulated signals-Noise in Analog Modulation - Review of probability and random process-Gaussian and white noise characteristics-Noise in amplitude modulation systems-Noise in Frequency modulation systems- Pre-emphasis and De-emphasis- Threshold effect in angle modulation. **9**

PULSE MODULATION

Sampling process- Pulse modulation (PAM, PCM, PWM, PPM) - Differential pulse code modulation- Delta modulation **9**

SIGNAL DETECTION THEORY

Elements of Detection Theory- ISI, Optimum detection of signals in noise - Coherent communication with waveforms- Probability of Error evaluations - Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion- Pass band transmission. **9**

DIGITAL MODULATION

Digital Modulation schemes : Phase Shift Keying, Frequency Shift Keying- Quadrature Amplitude Modulation - Continuous Phase Modulation and Minimum Shift Keying- Digital Modulation trade-offs. **9**

EQUALIZATION TECHNIQUES

Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver) - Equalization Techniques - Synchronization and Carrier Recovery for Digital modulation. **9**

TOTAL : 45

TEXT BOOKS

1. *Haykin. S., "Communications Systems", John Wiley and Sons, 2009, 5th Edition.*
2. *Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002, 2nd Edition.*

REFERENCE BOOKS

1. *B.Carlson, Introduction to Communication Systems, McGraw-Hill, 4th edition 2009.*
2. *Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, Third Edition(Reprint),2008.*
3. *Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.*
4. *Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2001.*
5. *J.S.Beasley & G.M.Miler, Modern Electronic Communication, 9th edition, Prentice-Hall, 2008.*
6. *Grami, Ali,"Introduction to Digital Communications. Netherlands, Elsevier Science", 2015.*
7. *Douglas.V.Hall,"Microprocessors and Interfacing: Programming and Hardware", Revised second Edition, Tata McGraw Hill, NewDelhi, 2006.*

19EEE28 - MULTIMEDIA SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Identify the taxonomy of compression techniques and describe information theory*

CO2 *: Interpret audio and video compression techniques.*

CO3 *: Ascertain the different approaches to image and text compression*

CO4 *: Conceive the video compression techniques and outline the wavelet based Compression*

CO5 *: Analyze challenges of implementing Internet Protocol and discover the applications.*

INTRODUCTION AND TEXT COMPRESSION

Special features of Multimedia - Graphics and Image Data Representations - Fundamental Concepts in Video and Digital Audio - Storage requirements for Multimedia Applications - Need for Compression - Taxonomy of compression techniques - Overview of information theory - Static Huffman coding - Dynamic Huffman coding - Lempel - Ziv coding - Lempel - Ziv Welsh coding. **9**

AUDIO COMPRESSION

Audio compression techniques - Frequency domain and filtering - Basic sub band coding - Application to speech coding - G.722 - Application of audio coding: MPEG audio - Silence compression - Speech compression techniques - Vocoders - Linear predictive coder **9**

IMAGE COMPRESSION

Approaches to image compression - Graphics interchange format - Tagged image file format, Digitized documents - Digitized pictures - JPEG - Quad trees - DCT coding - Wavelet methods - Filter banks - EZW coding - SPIHT coding - JPEG 2000 standards. **9**

VIDEO COMPRESSION

Video signal representation - Video compression techniques - MPEG1, 2, 4 - Motion estimation - H.261, H.263 - Overview of wavelet based compression - PLV performance real time compression. **9**

VoIP TECHNOLOGY

Basics of IP transport - VoIP challenges - H.323/ SIP Network Architecture, Protocols, Call establishment and release - VoIP and SS7 - Quality of Service - CODEC Methods - VoIP applicability **9**

TOTAL : 45

TEXT BOOKS

1. *Fred Halsall and James F. Kurose, "Multimedia communication Applications, Networks, Protocols and standards", Pearson Education Limited, 2004.*
2. *Prabhat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", Prentice Hall of India, Reprint 2015.*

REFERENCE BOOKS

1 *Sayood Khaleed, "Introduction to Data Compression", Morgan Kauffman publication, 4th Edition, 2012*
2. *Tay Vaughan, "Multimedia: making it work", TMH, 7th Edition, 2007.*
3. *Marcus Goncalves, "Voice over IP Networks", McGraw Hill Publisher, 1999*
4. *Jerry D. Gibson, "Multimedia Communications: Directions and Innovations", Morgan Kaufmann Publication, 2nd Edition, 2001*
5. *David Solomon, "Data Compression the complete reference", Springer publisher, 4th Edition, 2007.*

19EEE29 - AUTOMATION, RENEWABLE ENERGY AND FPGA LABORATORY

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

CO1 : *Apply an industrial IoT to access the data via industrial IoT*

CO2 : *Develop a controller for a plant/actuator using PCS7*

CO3 : *Design combinational and sequential logical relations to be implemented in FPGA based on applications*

CO4 : *Design a controller in FPGA to control electric drives*

CO5 : *Illustrate the basic concept of renewable energy generated by solar, wind, battery and super capacitor-based power generation.*

LIST OF EXPERIMENTS

Automation Lab

1. Access of Analog and Digital I/Os via Industrial IoT 2040 using Python, C/C++ compiler
2. Interfacing of IoT 2040 Gateway with Android Application.
3. Hardware configuration of PCS7 - combinational logics.
4. Design logic for traffic light controller using PCS7
5. Design a level process with PID controller for a real time plant
6. Study of Distributed Control System architecture and ES/OS Configuration of AS410 CPU in PCS7.
7. RF Communication and control of two end Nodes
8. Application server and End device Communication
9. Real time Data Monitoring and Device Control
10. Smart meter interfacing using LoRa
11. IoT based 1 phase pwm inverter

FPGA PROGRAMMING LAB

(Language: Verilog | Software: Xilinx | FPGA Board: Spartan 3E, Spartan 6)

1. Combinational circuits - Adders, encoders and decoders
2. Sequential circuits - counters and shift registers
3. Wallace Multiplier
4. 4-bit ALU
5. Programming an UART Module using FPGA
6. Analog input measurement using FPGA and data transfer to real time controller
7. PWM Generator for power electronic converters
8. Quadrature Encoder Interfacing Module
9. Speed control of Single Phase Induction Motor using FPGA
10. Speed control of Three Phase Induction Motor using FPGA
11. Speed control of DC Motor using FPGA
12. FPGA and IoT based static over current relay with test set-up

RENEWABLE ENERGY LAB

1. Characteristics of PV panel
2. Maximum power tracking of PV panel
3. Load test on Active front end PWM rectifier
4. Load test on Solar based DC-DC boost converter
5. Charging and Discharging Characteristics of bidirectional buck-boost converter for a super capacitor.
6. Study of transmission line simulator
7. Study of DC micro grid.

19EEE30 - COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Illustrate the basic computer organization and to design a micro sequencer based control unit*

CO2 *: Analyze and infer the various memory organizations*

CO3 *: Recall the concepts of various IO organizations*

CO4 *: Categorize the multiprocessor architecture and relate the performance*

CO5 *: Describe the concepts of parallel processing architecture*

INTRODUCTION

Classes of computers - Defining Computer Architecture - Trends in Technology - Trends in Power and Energy in Integrated Circuits - Trends in Cost - Dependability - Measuring - Reporting and Summarizing Performance - Quantitative Principles of Computer Design. **7**

DESIGN OF CPU

CPU organization - General register organization - Stack organization - Instruction formats - Addressing modes - Data transfer and manipulation - Program control - Hardwired and micro programmed control. Design and implementation of basic micro sequencer - Designing mapping logic - Design of ALU - Look up Rom - Wallace trees - CISC and RISC characteristics. **9**

MEMORY AND I/O ORGANIZATION

Memory Hierarchy - Main memory - Cache memory - Virtual memory concepts - IO interface - Modes of data transfer - Programmed IO and Interrupt driven data transfer - Direct memory access - Asynchronous data transfer - IO processor and IO channels. **9**

MULTIPROCESSOR ARCHITECTURE

Organization of multiprocessor system - Interconnection networks - Multiprocessor scheduling strategies - Shared memory architecture - Symmetric shared memory and distributed shared memory - Cache coherence - Snooping and directory based cache coherence - Synchronization - Parallel memory organization **10**

PARALLEL PROCESSING ARCHITECTURE

Principles of pipelining - Implementation - Pipeline hazards and resolution - Performance issues - Instruction level parallelism and thread level parallelism - Instruction prefetch and branch handling - Vector processor - Effectiveness of vectorization - Array processor - Parallel algorithms - Bubble sort - matrix multiplication - Superscalar processor. **10**

TOTAL : 45

TEXT BOOKS

1. *M. Morris Mano, "Computer System Architecture", Pearson Education, 3rd Edition, 2017*
2. *John L Hennessy and David A Patterson, " Computer Architecture: A quantitative approach", Morgan Kaufmann publishers, 5th Edition, 2018.*
3. *David. A. Patterson, John L. Hennessy, "Computer Architecture: A Quantitative approach", Fifth Edition, Elsevier, 2018.*

REFERENCE BOOKS

1 *Kai Hwang and Faye A. Briggs, "Computer Architecture and Parallel Processing", Tata McGrew Hill, 2018.*

2. *Carl Hamacher, Zvonko Vranesic, Safwatzaky, "Computer Organization", McGraw Hill, 6th Edition, 2016.*

3. *John D Carpinelli, "Computer system Organization and Architecture", Pearson Education, India. 2016.*

15EEE31 - MULTICORE ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Identify the problems related to multiprocessing and describe the concepts of shared memory*

CO2 *: Illustrate the thread - level parallelism*

CO3 *: Formulate various programming constructs in multi-core architecture.*

CO4 *: Describe various memory architectures*

CO5 *: Summarize various multicore programming models for given specifications.*

SUPERSCALAR PROCESSORS

Fundamentals of Superscalar Processor Design - Introduction to Multi core Architecture - Chip Multiprocessing - Homogeneous Vs heterogeneous design - SMP - Multi core Vs Multithreading. **9**

MEMORY ORGANIZATION

Shared memory architectures - Synchronization - Memory organization - Cache Memory - Cache Coherency Protocols - Design of Levels of Caches. **9**

PARALLEL PROGRAMMING

Fundamental concepts - Designing for threads - scheduling - Threading and parallel programming constructs - Synchronization - Critical sections - Deadlock - Threading APIs **9**

POWER PC ARCHITECTURE

RISC design - PowerPC ISA - PowerPC Memory Management - Power Multi core architecture design - Power 6 Architecture. **9**

PROGRAMMING SUPPORT FOR MULTI - CORE/MANY - CORE PROCESSORS

Cell Broad band engine architecture - PPE (Power Processor Element) - SPE (Synergistic processing element) - Cell Software Development Kit - Programming for Multi core architecture. **9**

TOTAL : 45

TEXT BOOKS

1. *Hennessey & Patterson,"Computer Architecture A Quantitative Approach", Harcourt Asia, Morgan Kaufmann publication, USA, 2018.*
2. *Kai Hwang,"Advanced Computer Architecture: Parallelism, Scalability and Programmability", McGraw - Hill Publications, 2014.*

REFERENCE BOOKS:

1 *Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2015*
2. *Joseph JaJa, "Introduction to Parallel Algorithms", Addison - Wesley publisher, 2012.*
3. *IBM Journals for Power 5, Power 6 and Cell Broadband engine architecture.2015.*
4. *Richard Y. Kain, "Advanced Computer Architecture: A System Design Approach", PHI, 2012*
5. *Rohit Chandra, Ramesh Menon, Leo Dagum, and David Kohr, "Parallel Programming in Open MP", Morgan Kaufmann Publication, 2016.*

19EEE32 - DATA COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Explain the need for the OSI model and the functions performed by each layer of the OSI model.*

CO2 *: Realize the basic network concepts and their transmission mode.*

CO3 *: Evaluate the signal conversions and understand the transmission of signals through different cables.*

CO4 *: Describe the different networking and internetworking devices and their applications.*

CO5 *: Explain the process of communication from source to destination through various layers of the communication protocol.*

BASIC CONCEPTS

Introduction - Line configuration topology - Transmission mode - Categories of networks - Internetworks - OSI Model and Functions of the Layers. **9**

SIGNALS AND TRANSMISSION

Various types of signals - Analog to Digital and Digital to Analog conversion - Interfacing - Co - Axial Cables - Fibre Optics - Wireless - Multiplexing - Error detection and correction. **9**

DATA LINK CONTROL AND PROTOCOLS

Flow control - Error control - Asynchronous protocols - Synchronous protocols - Character and Bit oriented protocols - TCP / IP Protocol - Point to Point protocol - X.25 Protocol. **9**

NETWORK AND SERVICES

Local Area Network - Ethernet - Token ring - Token bus - Fibre Distributed Data Interface - Metropolitan Area Networks - IEEE 802.16 - Switching - Integrated Services Digital Network - Asynchronous Transfer. **9**

NETWORKING AND INTERNETWORKING DEVICES AND APPLICATIONS

Repeaters - Bridges - Routers - Gateways - Routing algorithm - Distance vector and link state Routing - Client - Server model - Domain Name System - Simple Mail Transfer Protocol - Simple Network Management Protocol - Hypertext Transfer Protocol - World Wide Web. **9**

TOTAL : 45

TEXT BOOKS

1. *William A.Shay, "Understanding Data Communications and Networks", Brooks /Cole Publishing Company, 2008.*
2. *Behrouz. A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill Publisher, 2017.*
3. *Curt White, "Fundamentals of Networking and Data Communications", South-Western College Publishing, 2013.*
4. *William Stallings, "Data and Computer Communications", 10th Edition, Prentice Hall of India, New Delhi, 2014.*
5. *A.S. Tanenbaum, "Computer Networks", Prentice Hall of India, 6th Edition, New Delhi, 2020.*

REFERENCE BOOKS

1. *S.Keshav,"An Engineering Approach to Computer Networking", Addision Wesley, 2010.*
2. *Srikant and Lei Ying, "Communication Networks: An Optimization, Control and Stochastic Networks Perspective", Cambridge University Press, UK,2014*
3. *Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Elsevier, 2012.*
4. *Dimitri Bertzekas and Robert Gallager,"Data Networks", Prentice Hall of India", 2nd Edition, 2004.*

19EEE33 - FOG COMPUTING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Describe the knowledge in systems, protocols and mechanisms which supports fog computing*

CO2 : *Illustrate major security and privacy problems in the fog computing scenarios and how they are addressed with the security mechanisms.*

CO3 : *Identify the high level architecture of fog computing models.*

CO4 : *Formulate the cloud providers and software platforms.*

CO5 : *Design and implement a computing applications novel fog*

INTRODUCTION

Introduction to Fog Computing / Network - Definitions - Characteristics - Four layer fog computing architecture in smart cities **9**

SEVEN LAYER FC

Physical Devices & Device Controllers - Connectivity - Edge (Fog) Computing - Data Accumulation - Data Abstraction - Application- Collaboration & Processes - Interaction between each level. **9**

IoT FOR FC

IoT/IoE applications on the fog infrastructure - Cloud and IoT estimation - Comparison with Cloud Computing (CC) - Benefits of using Fog Computing. **9**

CHALLENGES & SOFTWARE PLATFORMS

Overview and Comparison of Microsoft Azure - Amazon Web Services - Google Cloud Platform - Security and Reliability - Storage - Monitoring and Automation - Introduction to Open-source softwares: Eucalyptus - Open Nebula - Open Stack - Apache Cloud Stack. **9**

APPLICATIONS

Healthcare and Activity Tracking - Smart utility services - Augmented reality - Caching and Preprocessing - Cognitive systems and Gaming. **9**

TOTAL : 45

TEXT BOOKS

1. *Amir Vahid Dastjerdi, Harshit Gupta, Rodrigo N. Calheiros, Soumya K. Ghosh, and Rajkumar Buyya, "Fog Computing: Principles, Architectures and Applications", Morgan Kaufmann Publications, Burlington, Massachusetts, USA.28 Jan 2016.*
2. *Amir Vahid Dastjerdi and Rajkumar Buyya, University of Melbourne "Fog Computing: Helping the Internet of Things Realize its Potential" on IEEE Computer Society,2016*

REFERENCE BOOK

1 *Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly, 2009.*

19EEE34 - INTERNET OF THINGS (IoT)

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Identify the architecture, emerging industrial infrastructure and challenges involved in deployment of IoT.*

CO2 *: Interpret the use of devices, gateways and hardware design constraints in IoT.*

CO3 *: Describe the design principles to realize enterprise integrated Web of Things*

CO4 *: Demonstrate the technical design constraints involved in IoT based industrial automation*

CO5 *: Apply the application of IoT in Industrial and Commercial Building Automation*

M2M To IoT

Introduction - Architecture of IoT - Challenges of IoT - M2M to IoT - IoT global context - Differing Characteristics - Deployment and Operational - IoT reference Model and architecture **9**

IoT FUNDAMENTALS

Devices and gateways - Local and wide area networking - Data management - Business processes in IoT - Everything as a Service (XaaS), M2M and IoT Analytics - Knowledge Management. **9**

DESIGN PRINCIPLES

An emerging industrial structure for IoT - The international driven global value chain - Global information monopolies - Building architecture - Design principles - Needed capabilities, Standards considerations. **9**

DESIGN CONSTRAINTS

Technical Design constraints - Hardware Design constraints - Data representation and visualization - Interaction and remote control. Introduction to Python and Library files and its applications. **9**

INDUSTRIAL AUTOMATION

Middleware - Service - oriented architecture based device integration - SOCRADES - Realizing the enterprise integrated Web of Things - IMC - AESOP - Web of Things to the Cloud of Things.

Case study: Cisco IoT System, Network connectivity, IOx and Fog Applications, Data analytics, Security, Cyber and Physical Management and Automation - Application platform. **9**

TOTAL : 45

TEXT BOOKS

1. *Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos and David Boyle, "From Machine -to - Machine to the Internet of Things: Introduction to a New Age of Intelligence", Academic Press, 1st Edition, 2014.*
2. *Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands - on - Approach)", VPT, 1st Edition, 2014.*

REFERENCE BOOKS

1 *Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", A - press Publications, 1st Edition, 2013.*

2. *J.P. Vasseur, A. Dunkels, "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kaufmann, 2010.*

19EEE35 - DATA ANALYTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Identify big data and its analysis techniques.*

CO2 *: Apply Probability and Statistics in Data Analysis*

CO3 *: Analyze the data for machine learning algorithms.*

CO4 *: Justify the performance measure of algorithms using Python language*

CO5 *: Identify appropriate data in real life applications*

TECHNOLOGY FOUNDATION FOR BIG DATA

Fundamentals of Big Data - Classification and characteristics of Big Data -Types of Data Analysis - Introduction to Opensource frameworks - Hadoop Environment - Mapper - Reducer - Combiner - Partitioner - Searching - Sorting - Compression - Hive - Introduction to features of MongoDB, Cassandra, Spark, Kafka **9**

MATHEMATICAL FOUNDATIONS

Population and Sample - Measures of Central Tendency - Measures of Deviation - Measures of Shape - Correlation Analysis-Bayes Theorem - Probability Density functions and distributions - Hypothesis Testing - Dimensionality Reduction - Principal Component Analysis - Analysis of Variance (ANOVA) **9**

DATA ANALYSIS IN MACHINE LEARNING

Overview of Machine learning concepts - Bias/variance, over fitting and train/test splits - Types of Machine learning - Supervised, Unsupervised, Semi-supervised- Classification and Regression algorithms-Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees - Metrics - Linear Regression-model assumptions - Regularization (lasso, ridge, elastic net) - Analysis of Time Series - Bagging and Boosting (to balance bias and variance) and random forest - Neural Networks-Learning And Generalization, Overview of Deep Learning - Unsupervised learning: K Means and Hierarchical clustering - Reinforcement learning **9**

PROGRAMMING TOOLS FOR DATA SCIENCE

Visualizing Data: Bar Charts, Line Charts, Scatter plots - Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction - Basics of Python (file handling, case- folding, spell check, split, strip, Regex, find, replace, etc.) - Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK **9**

APPLICATIONS OF DATA NALYTICS

Solar and Wind Forecasting algorithms - Naïve Bayes algorithms for Protective Relay - Connected homes - Smart thermostats - Wearable's: Fitness bands - Real - time analytics and Industrial automation - Connected cities - Smart meters - Connected cars - Fleet management. **9**

TOTAL : 45

TEXT BOOK

1. U.Dinesh Kumar, " Business Analytics- The Science of Data - Driven Decision Making", Wiley, 2018

REFERENCE BOOKS

1. *Goldman Sachs, "Big Data Analytics and the Internet of Things", Datameer, 2015.*
2. *Robert Stackowiak, Art Licht, Venu Mantha and Louis Nagode, "Big Data and The Internet of Things: Enterprise Information Architecture for A New Age", A press, 2015.*
3. *Michael Wessler, OCP & CISSP, "Big Data for Dummies", John Wiley & Sons, Inc, 2013.*
4. *Grolemund and Garrett, "Hands - On Programming with R", O'Reilly Media, 2014.*
5. *Ebook: Dr. Mark Gardener "Beginning R: The Statistical Programming Language", ISBN: 978 - 1 - 118 - 16430 - 3, 2012.*
6. *Judith Hurwitz, Alan Nugent, and Dr. Fern Halper, "Big Data for Dummies", John Wiley & Sons, Inc, 2013.*
7. *Seema Acharya, Subhashini Chellappan, " Big Data and Analytics", Wiley,2018*

19EEE36 -VIRTUAL INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Summarize the fundamental concepts of Digital and Virtual Instrumentation.*

CO2 *: Compare the interfacing of RS232, RS 422, RS 485 and USB standards with PC.*

CO3 *: Recall the concepts of various bus protocol implementations in virtual instrumentation.*

CO4 *: Choose the data acquisition components for the given application.*

CO5 *: Develop and emulate the real-time hardware applications virtually using LabVIEW Software.*

REVIEW OF DIGITAL INSTRUMENTATION

Representation of PC based DAQ System - Sampling theorem - Linearization and Quantization of amplitude and time - Analog I/O - Digital I/O - Counter/timer - DAQ software architecture - Networked data acquisition. **9**

FUNDAMENTALS OF VIRTUAL INSTRUMENTATION

Concept of virtual instrumentation-PC based data acquisition-Typical onboard DAQ card-Resolution and Sampling frequency-Multiplexing of analog inputs-Single-ended and Differential inputs-Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer - counter and analog outputs on the universal DAQ card. **9**

CLUSTER OF INSTRUMENTS IN VI SYSTEM

PC Interfacing - RS232, RS422, RS485 and USB standards - IEEE 488 standard-ISO-OSI model for serial bus-Introduction to bus protocols of MOD Industrial Ethernet-CAN. **9**

GRAPHICAL PROGRAMMING ENVIRONMENT IN VI

Concepts of graphical programming-Lab-view software-Concept of VI's and sub VI-Display types-Digital and Analog Chart- Oscilloscope types - Loops - Case and sequence structures - Types of data - Arrays - Formulae nodes - Local and global variables - String and File I/O. **9**

ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI

Fourier transform - Power spectrum - Correlation - Windowing and filtering tools - Simple temperature indicator - ON/OFF controller - PID controller - CRO and DSO emulation - Simulation of a simple second order system -Signal generation. **9**

TOTAL : 45

TEXT BOOKS

1. *Robert H. Bishop, "Learning with Lab - view", Prentice Hall, 1st Edition,2014.*
2. *Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Pvt. Ltd.,2010*

REFERENCE BOOKS

1. *KevinJames, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes publications,2000.*
2. *Gary W.Johnson, Richard Jennings, "Lab-view Graphical Programming", McGraw Hill Professional Publishing, 4th Edition, 2011.*
3. *Sanjay Gupta and Joseph John, "Virtual Instrumentation using LabVIEW", Tata McGraw - Hill Inc,2010.*

19EEE37 - CYBER PHYSICAL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Interpret the core principles behind CPS*

CO2 *: Identify the components required to build CPS*

CO3 *: Identify safety specifications and critical properties*

CO4 *: Inference the abstractions in CPS design*

CO5 *: Inference the pre- and post-conditions and invariants for CPS models*

INTRODUCTION TO CYBER-PHYSICAL SYSTEMS

Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, Industry 4.0, Auto-SAR, IIoT implications, Building Automation, Medical CPS **7**

CPS - PLATFORM COMPONENTS

CPS Hardware platforms - Processors, Sensors, Actuators, CPS Network - Wireless Hart, CAN, Automotive Ethernet, CPS Software stack - RTOS, Scheduling Real Time control tasks. **9**

PRINCIPLES OF AUTOMATED CONTROL DESIGN

Dynamical Systems and Stability Controller Design Techniques, Stability Analysis: CLFs, MLFs, stability under slow switching, Performance under Packet drop and Noise, State flow **9**

CPS IMPLEMENTATION

From features to software components, Mapping software components to ECUs, CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion **9**

SAFETY ASSURANCE OF CYBER-PHYSICAL SYSTEMS

Advanced Automata based modeling and analysis, Basic introduction and examples, Timed and Hybrid Automata, Definition of trajectories, Formal Analysis: Flow pipe construction, reachability analysis, CPS SW Verification, Frama-C, CBMC Secure Deployment of CPS **11**

TOTAL : 45

TEXT BOOKS

1. *Raj Rajkumar, Dionisio De Niz , and Mark Klein, "Cyber-Physical Systems", Addison-Wesley Professional, 2016.*
2. *Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015.*
3. *Lee E A and Seshia S A, "Embedded Systems: A Cyber-Physical Systems Approach", MIT Press, 2017.*

REFERENCE BOOKS

1 *André Platzer, Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics., Springer, 2010,ISBN 978-3-642-14508-7.*

2. *Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C", The publisher, Paul Temme, 2011.*
3. *P. Tabuada, Verification and control of hybrid systems: a symbolic approach, Springer-Verlag 2009*
4. *A.J. van der Schaft, J.M. Schumacher, An Introduction to hybrid dynamical systems, Lecture Notes in Control and Information Sciences, Vol. 251, Springer-Verlag, London, 2000.*
5. *Borrell F, Bemporad A and Morari M, Predictive control for Linear and Hybrid Systems, Cambridge University Press (2017)*

19EEE38 - INTELLIGENT TECHNIQUES FOR ELECTRICAL ENGINEERS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Interpreting the basics of intelligent techniques and the role of artificial intelligence in industrial controllers..*

CO2 : *Explain the fundamental modeling of a controller using fuzzy, expert systems and neural systems*

CO3 : *Apply the fundamental of fuzzy logic and reasoning to handle uncertainty and solve the control engineering problems*

CO4 : *Implementing genetic algorithms to basic optimal control problems.*

CO5 : *Outline the basic concepts of a heuristic algorithm to solve engineering problems*

INTRODUCTION TO AI & EXPERT SYSTEMS

Introduction to Artificial Intelligence and Computational Intelligence -Expert Systems - Fundamental Concepts, Architecture - Knowledge Base - Inference Engine Components and Mechanisms - Expert Systems Application - Expert System for Control in Power Systems. **9**

NEURAL NETWORKS

Biological neurons - NN terminology, Activation functions, Fundamental models; Architectures - Feed forward & Feedback NN, Types of NN based on learning methods, Applications of NNs- Identification, Control - Case Study - Neural Network Applications for Power System Monitoring and Control. **9**

FUZZY SYSTEMS

Introduction - Fuzzy versus Crisp, Fuzzy sets, Fuzzy relations, Fuzzy Systems: Fuzzy logic- universe of discourse, membership function, Quantifiers, Inference, Fuzzy Rule based system, Defuzzification methods, Fuzzy Controller, Constructing Fuzzy Model, Application of Fuzzy Logic in Control System. **9**

DECISION TREES & MULTIAGENT SYSTEMS

Introduction - Decision Trees - Construction - Pruning - Oblique Decision Trees - Applicationsof Decision Trees in Power Systems - Introduction to Multiagent Systems, Multiagent Technology Overview - Applications of Multiagent Systems in Power Engineering **9**

HEURISTIC OPTIMIZATION TECHNIQUES

Introduction to Genetic Algorithm; GA steps - Selection, Crossover and Mutation; Application of GA to optimal control problems - Particle Swarm Optimization, Ant Colony Algorithm, Unsupervised Learning and Hybrid Methods. **9**

TOTAL : 45

TEXT BOOKS

1. *Michael Negnevitsky, "Artificial Intelligence-A Guide to Intelligent Systems", Addison-Wesley, 3rd Edition, 2011.*
2. *Simon Haykin, "Neural Networks & Learning Machines", Pearson Education, 3rd Edition, 2016.*

3. *John Yen Timothy J. Ross, "Fuzzy Logic with Engineering Applications", John Wiley & Sons, 4th Edition, 2016*
4. *Omid Bozorg - Haddad, Mohammad Solgi, "Meta-Heuristic & Evolutionary Algorithms for Engineering Optimization", John Wiley & Sons, 2017*

REFERENCE BOOKS:

1 *Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson, 2015.*
2. *George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, Pearson, 2015*
3. *B. Yegnanarayana, "Artificial Neural Networks", PHI Learning Pvt. Ltd., 2009.*
4. *Xin-She Yang, "Nature-Inspired Optimization Algorithms", 1st Edition, Elsevier, 2014*
5. *Ben Coppin , "Artificial Intelligence Illuminated", Jones & Bartlett Learning, 2004.*
6. *S. N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", 3rd Edition, John Wiley & Sons, 2018*

19EEE39 INDUSTRIAL AUTOMATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Design and develop a suitable controller for automated system involving different disciplines to achieve more reliable and flexible system.*

CO2 *: Demonstrate hardware design, understand its internal operation and employ PLC programming for factory automation, process control and fault detection.*

CO3 *: Comprehend and define business strategies and plan toward the Fourth Industrial Revolution.*

CO4 *: Discuss the fundamental requirements of process control systems and describe the architecture of various distributed control systems.*

CO5 *: Choose suitable automation hardware for the given industrial application.*

BUILDING BLOCKS OF AUTOMATION SYSTEM

Automation strategies - Production economics - Costs in manufacturing - Break Even analysis. Smart Sensors, Transducers and Motion Actuators - PID Controller - Digital PID Controller. Multi microprocessor Systems - Local Area Networks - Analog and Digital I/O Modules - Supervisory Control and Data Acquisition Systems - Remote Terminal Unit - Intelligent Electronic devices (IEDs)-Industrial Process Models. **9**

PROGRAMMABLE CONTROLLERS

Introduction - Relay logic - PLCs - hardware design - Programming of PLCs - PLCs Internal operation and signal processing - Programming of PLC Systems. Application to Robotics and FMS - PLC to factory automation - PLC in process control - PLC maintenance - Internal PLC faults - Faults external to PLC - Programmed error - Watch dogs - Safety - Hardware safety circuits - Troubleshooting. **9**

DISTRIBUTED CONTROL AND INDUSTRIAL COMMUNICATION SYSTEMS

Introduction - DDC Structure - DDC Software - Fundamental requirements of Process Control System - System Architecture - Distributed Control Systems - Configuration - Popular Distributed Control Systems.

Data communication link, Reliability, Digital signal formats, Error detection, Correction and Recovery circuit, Message and Packet switching, RS485, Industrial Ethernet, Concept of Fieldbus, Study of MODBUS protocol, HART. **9**

INTRODUCTION TO INDUSTRY 4.0

Introduction - The Various Industrial Revolutions -Defining Industry 4.0 -Main Characteristics of Industry 4.0 - The Value Chain - Industry 4.0 Design Principles - Building Blocks of Industry 4.0 - Smart Manufacturing -Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0- Smart Factories- Real-World Smart Factories: GE?s Brilliant Factory - Siemens? Amberg Electronics Plant (EWA) - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation- The Journey so far: Developments in India, USA, Europe, China and other countries.**9**

INDUSTRIAL CONTROL APPLICATIONS

Industrial Control Applications - Cement Plant - Thermal Power Plant - Water Treatment Plant. Irrigation Canal Management - Steel plant - Petroleum Refineries - Pharmaceutical Industries - Automobile Industries - KAIZEN, SIX SIGMA - IoT in industrial control applications. **9**

TOTAL : 45

TEXT BOOKS

1. *Mikell. P. Groover, "Automation Production Systems and Computer Integrated Manufacturing", Pearson India Eduction Series Pvt. Limited, 4th Edition, New Delhi, 2016.*
2. *Krishna Kant, "Computer - Based Industrial Control ", Prentice Hall of India Pvt. Ltd., New Delhi, 2010.*

REFERENCE BOOKS:

1 *Alp Ustundag, Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation,Springer International Publishing AG; 1st ed. 2018*
2. *Curtis D.Johnson, "Process Control Instrumentation Technology", Pearson India Education Services Pvt. Ltd., 8th Edition, 2015.*
3. *David W. Pessen, "Industrial Automation: Circuit Design and Components", Wiley India Pvt. Ltd., New Delhi, 2011.*
4. *Ian G. Warnock, "Programmable Controllers operation and Application", Prentice Hall International, UK, 2008.*
5. *K.L. Sharma,"Overview of Industrial Process Automation", Elsevier, 2011.*
6. *Tan KokKiong and AndiSudjana Putra, "Drives & Control for Industrial Automation", Springer, 2010.*
7. *W.Bolton, "Programmable Logic Controllers", Elsevier, Fifth Edition, 2011.*
8. *Frank D.Petruzella, "Programmable Logic Controllers", McGraw Hill, 2nd Edition, 5th Edition, 2019.*

19EEE40 - DEEP LEARNING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Apply Mathematical foundations in deep learning*

CO2 *: Examine the performance measure of algorithms*

CO3 *: Analyze machine learning algorithms.*

CO4 *: Formulate Deep learning algorithms*

CO5 *: Identify appropriate networks in real life applications*

MATHEMATICAL FOUNDATIONS

Linear Algebra : Vectors, Matrices and Tensors - Linear Dependence and Span - Norms - Eigen Decomposition - Singular Value decomposition - Principal Component Analysis

Probability and Information Theory : Population and Sample - Measures of Central Tendency - Measures of Deviation - Measures of Shape - Correlation Analysis- Probability Distributions - Baye's Rule - Linear regression - Logistic Regression **9**

MACHINE LEARNING BASICS

Learning Algorithms - Capacity, over fitting and Under fitting - Hyper parameters and Validation Sets - Estimators , Bias and Variance - Supervised and Unsupervised Learning Algorithms **9**

DEEP NETWORKS

Deep feed forward networks - Gradient Based Learning - Back Propagation - Regularization - Dataset Augmentation - Multitask Learning - Early stopping - Difficulty of training deep neural networks, Greedy layer wise training - Bagging - Optimization strategies **9**

CONVOLUTIONAL AND RECURRENT NETWORKS

Convolution Neural Networks: Convolution - Pooling - Variants - Structured output - Data types- Unsupervised features

Recurrent Neural Networks: Back propagation through time- Long Short Term Memory- Gated Recurrent Units - Bidirectional LSTMs - Bidirectional RNNs **9**

RECENT TRENDS AND APPLICATIONS

Recent trends: Variational Auto encoders - Generative Adversarial Networks - Multi-task Deep Learning - Multi-view Deep Learning

Applications: Vision, NLP, Speech **9**

TOTAL : 45

TEXT BOOKS

1. *Ian Good fellow and Yoshua Bengio and Aaron Courville ,"Deep Learning", MIT Press, 2016.*
2. *Josh Patterson, " Deep Learning: A Practitioner's Approach, O'Reilly Media:, 2017*

REFERENCE BOOK

1. *François Chollet, "Deep Learning with Python", Manning Publications, 2021*

19EEE41 - SWITCHED MODE POWER CONVERSION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Recall the concepts of switched mode power conversion*

CO2 *: Analyze different non isolated DC-DC converters under steady-state condition.*

CO3 *: Design of magnetic components of dc-dc converters*

CO4 *: Analyze different soft-switched and resonant converters and power-factor correction techniques*

CO5 *: Select the EMI suppression techniques for different switched mode converters*

INTRODUCTION AND TRANSFORMER-ISOLATED CONVERTERS

Linear converters Vs switching converters - Basic principles of switch-mode power conversion - Single-switch and multi-switch transformer-isolated DC-DC converters - Flyback and forward converters; transformer isolated half-bridge, full-bridge converters. Push-pull converters. Voltage fed and current-fed converters. **9**

MAGNETIC COMPONENT DESIGN

Magnetic core materials and performance; basic inductor and transformer design; practical magnetic design; design aspects to be considered for designing transformers for specific applications - flyback, push-pull, bridge, forward converters. **9**

SWITCHING REGULATOR CONTROL

Small-signal models for switching regulators - Performance analysis and design of closed-loop system under different control methods, and operating modes. Measurement of small signal transfer functions. **9**

SOFT-SWITCHED AND RESONANT CONVERTERS

Hard-switching vs soft-switching - Introduction to resonant power converters and their characteristics - Detailed study of a few soft-transition converters - **7**

POWER-FACTOR CORRECTION, ELECTROMAGNETIC INTERFERENCE AND CHAOS ANALYSIS

Problems due to harmonics in the current drawn by equipment - Basic concept of active single phase power factor correction (PFC) techniques - Performance analysis and comparison of different PFC techniques -Introduction to EMI and Non-linear phenomena in switched mode power converters: Chaos. **11**

TOTAL : 45

TEXT BOOKS

1. *Middlebrook, R. D. (Robert David), and Slobodan Cuk, Advances in Switched-Mode Power Conversion, TESLA , Volumes I and II, 2nd Edition, 1983.*
2. *Marty-Brown, "Practical Switching power supply design" Academic Press, 1990*
3. *Abraham Pressman, Keith Billings, Taylor Morey," Switching Power Supply Design", Third edition, 2009.*

REFERENCE BOOKS

1. *Robert W. Erickson and DraganMaksimovic, "Fundamentals of Power Electronics", Springer, reprint of the original 2nd edition, 2012.*
2. *Flynn Whittington, "Switched Mode Power Supplies", Universities Press; Second edition, 2009*
3. *Simon Ang, Alejandro Oliva, "Power-Switching Converters ", CRC Press, Vol. No., third Edition, 2010. 1. Philip T Krein, "Elements of Power Electronics ", Oxford University Press, 2nd Edition, 2012.*
4. *Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley & sons. 2013 (reprint).*
5. *Keith Billings, Taylor Morey "Switch mode Power Supply Handbook, "McGraw Hill, third edition, November 2010.*
6. *L Umanand, S R Bhat , "Design Of Magnetic Components For Switched Mode Power Converters", New Age International (P) Ltd., Publishers, 2017*
7. *Lazar Rozenblat, "Switching Power Supply Design: A Concise Practical Handbook", Kindle Edition, 2021.*
8. *Tse, C.K., di Bernardo, M, "Complex behavior in switching power converter", CRC Press 2003.*

19EEE42 - UTILIZATION OF SOLAR ENERGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Infer the solar thermal energy system for thermal energy collection and storage and its' use in the buildings.*

CO2 : *Design the solar PV system for the given applications and to explain the data monitoring system.*

CO3 : *Interpret and analyze the applications of solar thermal energy system*

CO4 : *Interpret and analyze the applications of solar PV system*

CO5 : *Identify the factors involved in economic analysis and explain about E-waste management.*

SOLAR THERMAL ENERGY SYSTEM

Solar collectors: Liquid flat plate collectors, Concentrating collectors, advantages and disadvantages and comparison - Thermal energy storage: Sensible heat storage and latent heat storage - solar pond - Solar heating of buildings: Principle and system components - Solar cooling of buildings: Principle and system components - Solar pond: Principle of operation, applications of solar ponds - Basic concepts of energy efficient buildings **9**

SOLAR PHOTOVOLTAIC ENERGY SYSTEM

Design aspects of solar PV installation: Technical and general requirements of solar PV module, Main components of solar PV system: Solar panel, Batteries (types, parameters and factors affecting battery performance, Charge controllers, Converter requirements) - installation practices of solar panel -sizing of wires - Electrical safety standards and requirements - Data monitoring system: Remote monitoring - On-site monitoring **10**

SOLAR THERMAL APPLICATIONS

Principle of operation: Solar furnace, Solar Distillation, Solar Water Heating, Solar Air Heating and solar pumping system - Industrial process heat: Types and choice of solar collectors, examples for industrial applications - Solar green house concepts **10**

SOLAR PV APPLICATIONS

Home Lighting Systems - Street lighting systems - Battery Charging Stations - PV powered water pumping system - PV powered refrigeration system - Military uses - Solar lanterns - Solar energy utilization in space - MNRE schemes for grid connected and off-grid applications **9**

ECONOMIC ANALYSIS AND E-WASTE HANDLING

Initial cost - Annual cost - Annual savings - Cumulative savings - Life cycle savings - Payback period - Present worth factor - operation and maintenance cost - Economic Analysis Methods.

E-waste - Indian Scenario - Health and environmental hazards - Recycling concepts of E-waste - E waste generation and handling of solar power plants **7**

TOTAL : 45

REFERENCE BOOKS

1. *S.P. Sukhtme & J.K. Nayak, "Solar Energy: Principles of thermal collection and storage", McGraw-Hill Education (India), 3rd edition, 2015*
2. *G.D. Rai," Solar energy utilization", Khanna Publishers, New Delhi, 2017*
3. *H P Garg & J. Prakash, "Solar Energy - Fundamentals and applications", Mcgrew Hill Education, New Delhi, 2016*
4. *Chetan Singh Solanki, "Solar Photovoltaics, Fundamentals, Technologies and Applications", PHI learning, New Delhi 2009.*
5. *Hand book on installation and maintenance of solar panel - Government of India*
6. *Ministry of Electronics and Information Technology (MeitY) - Relevant downloads*

19EEE43 - WEARABLE SENSORS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Identify the development areas of wearables and its impact on various sectors*

CO2 *: Design & recognize various electrodes in monitoring devices for healthcare applications*

CO3 *: Discuss biochemical and gas sensors as wearable devices in medical & other allied industries*

CO4 *: Realize Electronic textiles in wearable technology and acquire the knowledge in textile sensors*

CO5 *: Comprehend the design & development of various wearable's for physiological changes and other detections in human body*

INTRODUCTION

Wearable Devices development -advent of wearable computing -wearable sensors in various sectors: Industry sectors' overview - sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety.

Wearable haptics: World of wearable's - Attributes of wearable's - Intelligent clothing: The meta wearable - Challenges and opportunities - Future of wearable's - Need for wearable haptic devices - Categories of wearable haptic and tactile display **9**

WEARABLE DEVICES FOR HEALTH CARE

Design, fabrication & geometry of Electrode- Wearable Bioelectric impedance devices for Galvanic skin response; Wearable ECG device, wearble EEG device, Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement - wearable surface electrodes, SEMG Signal Conditioning- Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor- Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles - thermistor, infrared radiation, thermopile **9**

WEARABLE SENSORS

Introduction - Challenges in chemical and biochemical sensing -Types Invasive, Non-invasive Wearable inertial sensors- Flex sensor, pulse oximeter, glucose sensor, Inertial sensor, dehydration sensor, pH sensor, heart rate sensor, gas sensor, haptic glove, fitness tracker-Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Conductive textile electrodes, Knitted Piezoresistive Fabric (KPF) sensors **9**

TEXTILE SENSOR TECHNOLOGY

Introduction to Textile electrode- smart fibers to textile sensors - Interlaced network-Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors- FBG sensor in Intelligent Clothing and Biomechanics.- textile sensor technology for athletes **9**

APPLICATIONS OF WEARABLE'S

Wearable's for the Monitoring of Physical and Physiological Changes in Daily Life- Wearing Sensors Inside and Outside of the Human Body for the Early Detection of Diseases- Wearable and Non-Invasive

Assistive Technologies- Application of Optical Heart Rate Monitoring -Wearable's with Global Positioning System (GPS) integration for tracking and navigation- Applications of wearables for military personnel's & its design difficulties -Photoplethysmography (PPG) **9**

TEXT BOOKS

1. *Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York*
2. *Edward Sazonov, Michael R. Newman, "Wearable Sensors: Fundamentals, Implementation and Applications", 2014, 1st Edition, Academic Press, Cambridge*
3. *Kate Hartman, "Make: Wearable Electronics: Design, prototype, and wear your own interactive garments", 2014, 1st Edition, Marker Media, Netherlands*

REFERENCE BOOKS

1 *John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press, Florida*

2 *Michael J. McGrath, Cliodhna Ní Scanaill, "Sensor Technologies Healthcare, Wellness, and Environmental Applications" 2013, Apress, springer*

3 *Subhas C. Mukhopadhyay" Wearable Electronics Sensors For Safe and Healthy Living",2015, Springer International Publishing*

4 *Katsuyuki Sakuma "Flexible, Wearable, and Stretchable Electronics" 2020,CRC Press*

5 *Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland*

6 *Gerd Keiser, "Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.*

OPEN ELECTIVES

19EEOE01 - ENERGY AUDITING

(Common to ECE, Mechanical, Civil and Chemical)

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Exhibit Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing

***CO2** : Compute the thermal efficiency of various thermal utilities and use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.*

***CO3** : Analyse the cost- benefit of various investment alternatives for meeting the energy needs of productive processes through energy conservation study.*

***CO4** : Illustrate the energy saving techniques to reduce power consumption of the non- productive loads*

***CO5** : Advocacy of strategic and policy recommendations on energy conservation and energy auditing.*

ENERGY AUDIT

Global energy scenario - Heat and Electrical energy - Role of energy managers in industries - Energy auditing -Types of energy audit- Data to be collected in auditing - Needs, methodology and types of energy audits - Simple payback period - Net present value of saving- Energy audit report **9**

ELECTRICAL ENERGY CONSERVATION

Basic Industrial electrical distribution- energy saving and energy efficiency with Transformers, reactive power correction and cable loss reduction- Energy saving in lighting systems -Specific Energy Consumption (SEC) - Load management - Demand Side Management (DSM). **9**

HEAT ENERGY CONSERVATION

Energy Audit - Losses in Boiler - Waste heat recovery - Sources of waste heat - High temperature heat recovery - Medium temperature heat recovery - Waste heat recovery applications- Cogeneration- Heating, ventilation and air conditioning systems (HVAC) :Types - energy conservation in cooling towers and Spray ponds. **9**

BUILDING, TRANSPORT AND UTILITY ENERGY CONSERVATION

Real buildings systems: Consumption - Cost versus lifecycle cost - Building design - Water supply systems Real Transportation Systems: Energy conservation in transportation - New technologies - Progress in clean diesel technology. Energy conservation inpumps, and fan and blowers - Energy efficient motors.**9**

ENERGY AUDIT PLANNING AND MONITORING

Energy Action Planning: Energy management system - Management commitment and Energy conservation policy - Energy performance assessment - Data collection and management - Analysis of data, baseline and benchmarking - Estimation of energy savings potential - Action planning and Training planning.

Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & targeting - Data and information, various techniques - Energy consumption, Production and Cumulative sum of differences (CUSUM). **9**

TOTAL : 45

TEXT BOOKS

1. *D. P. Sen Gupta, K. R. Padiyar, IndranilSen, M.A, "Recent Advances in Control and Management of Energy Systems", Interline Publishers, Bangalore, 1993.*
2. *AmlanChakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2012.*
3. *YP.Abbi and Shashank Jain, "Handbook on Energy Audit and Environment Management", TERI, 2006.*
4. *Frank Krieth and D Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, 2007.*
5. *C.B. Smith, "Energy Management Principles", Pergamon Press, New York, 1981.*

REFERENCE BOOKS

1. *"General Aspects of Energy Management and Energy Audit-Unit- 1,2,3,4", BEE Guide book, 2010.*
2. *Hamies, "Energy Auditing and Conservation: Methods, Measurements, Management & case study", Hemisphere, Washington, 1980.*
3. *Diamant R.M, "Total Energy", Pergamon Press, Oxford Press, 1970.*
4. *Albert Thumann, "Fundamentals of Energy Engineering", Prentice Hall, May 1984*
5. *Larry C Whit et.al, "Industrial Energy Management & Utilization", 1st Edition, Springer, 1988.*

19EEOE02 - SOLAR AND WIND ENERGY SYSTEMS

(Common to ECE, Mechanical & Chemical)

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Summarize the solar radiation, measurements and characteristics of solar PV cell.*

CO2 *: Develop the model of a PV system and its applications.*

CO3 *: Illustrate the basic types, mechanical characteristics and model of wind turbine.*

CO4 *: Analyse the electrical characteristics and operation of various wind-driven electrical generators.*

CO5 *: Utilize various power electronic converters used for hybrid system.*

SOLAR RADIATION AND SOLAR CELL FUNDAMENTALS

Basic characteristics of sunlight - solar spectrum - insolation specifics- irradiance and irradiation pyranometer - solar energy statistics- Solar PV cell - I-V characteristics -P-V characteristics- fill factor. Modeling of solar cell- maximum power point tracking. **9**

SPV SYSTEM PERFORMANCE AND APPLICATIONS

PV module - blocking diode and by -pass diodes- composite characteristics of PV module - PV array - solar cell array design concepts - Peak power operation-System components. PV- powered fan-PV fan with battery backup - PV-powered pumping system - PV powered lighting systems - grid - connected PV systems. **9**

WIND ENERGY FUNDAMENTALS AND COMPONENTS

Wind source-wind statistics-energy in the wind- Basic principle of wind energy conversion - nature of wind - power in the wind -turbine power characteristics- parts of wind turbines- braking systems-tower-Maximum power operation. **9**

WIND TURBINE TYPES AND CONTROL

Classification of WECS - Generating Systems - DC generator, Synchronous generator, Induction -generator, Doubly fed Induction generator, Direct -driven generator- generator control - load control. **9**

SYSETM INTEGRATION

Energy storage-Power electronic converters for interfacing wind electric generators - power quality issues-Hybrid system: wind - diesel systems, wind-solar systems. **9**

TOTAL : 45

TEXT BOOKS

1. *S N Bhadra, S Banerjee and D Kastha, "Wind Electrical Systems", Oxford University Press, 1st Edition, 2005.*
2. *Chetan Singh Solanki, "Solar Photovoltaic's: Fundamentals,Technologies and Applications" PHI Learning Publications, 3rd Edition, 2015.*

REFERENCE BOOKS

1. *Roger A. Messenger and Jerry Ventre, "Photovoltaic systems engineering", Taylor and Francis Group Publications, 2020.*
2. *M.Godoy Simoes and Felix A. Farret, "Alternative Energy Systems: Design and Analysis with Induction Generators", CRC press, 2nd Edition, 2008.*
3. *Ion Boldea, "The electric generators hand book - Variable speed generators", CRC press, 2015.*

ONE CREDIT COURSES

19EEOC06 - ELECTRICAL SAFETY STANDARDS AND PRACTICES

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 *: Expand skills to identify the presence of electrical hazards and measures the risks*

CO2 *: Select appropriate safety equipment for human protection.*

CO3 *: Realize the safety procedures, Maintenance and grounding.*

CO4 *: Realize the importance of Accident Prevention, First Aid and Rescue Techniques.*

CO5 *: Aware the International standards and certification for safety practices*

FUNDAMENTALS OF ELECTRICAL SAFETY

Review of practical electricity - Fundamentals of electrical safety - Hazard Analysis: Primary and Secondary hazards, Human body Response to current magnitudes, Causes of Injury and death - Switch gears used for electrical system protection (Switch, Fuse, MCB, ELCB, Isolators). **6**

EQUIPMENT'S, PROCEDURES AND GROUNDING

Electrical safety equipment's for human protection - General Electrical Safety procedures - Importance of Equipment grounding - Maintenance program - Accident Prevention methods - First Aid and Rescue Techniques. **6**

SAFETY STANDARDS AND CERTIFICATION

Introduction of IE Rules - International Electrical Safety Standards - Electrical safety license and Certification for Practices: NFPA 70E Electrical Safety and OSHA Electrical Safety Work Practices (OESWP) **3**

TOTAL : 15

TEXT BOOKS

1. *John Cadick, Mary Capelli-Schellpfeffr, Dennis K. Neitzel, “Electrical Safety Hand Book”, McGraw Hill, New York, USA, 2012.*
2. *Massimo A. G. Mitolo, “Electrical Safety of Low-Voltage Systems”, McGraw- Hill, USA, 2008.*

REFERENCES

1. *Mohamed A El-Sharkawi, "Electric Safety: Practice and Standards", CRC press,New York, 2013.*
2. *"Indian Electricity Rules 1956", Ministry of Power- Government of India, 2010*
3. *Palmer Hickman, “Electrical Safety-Related Work Practices”, Jones & Bartlett Publishers, London, 2009.*
4. *Kenneth G. Mastrullo, Ray A. Jones, “The Electrical Safety Program Book”, Jones and Bartlett Publishers, London, 2003.*

19EEOC07 - SCILAB PROGRAMMING

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Obtain the necessary knowledge to solve numerical problems through Scilab capacities*

CO2 *: Recognize and interpret the mathematical modeling in SCILAB-XCOS.*

CO3 *: Design and develop the tool boxes in SCILAB and hardware interfacing.*

INTRODUCTION

Introduction to simulation software- The general environment and the console - Simple numerical calculations - The menu bar - The editor - The graphics window - Windows management and workspace customization. **3**

PROGRAMMING

Variables, assignment and display - Loops Tests - 2D and 3D plots - Supplements on matrices and vectors - Calculation - accuracy - Solving differential equations **3**

FUNCTIONS

Variables - Numbers - Operators Functions - Expressions - The format Function, Suppressing Output, Entering Long Statements, Command Line Editing. **3**

TOOLBOXES

SCILAB Simulation - Tool Boxes In SCILAB - Creating toolboxes in SCILAB **3**

INTERFACING WITH SCILAB

Introduction to SCILAB and GUI - Interfacing with LabVIEW - interfacing with Arduino **3**

TOTAL : 15

TEXT BOOKS

1. *Rachna Verma, Arvind Verma "Introduction to SCILAB", Cengage publications. 2018*
2. *Sandeep Nagar" Introduction to Scilab: For Engineers and Scientists" A press,2017.*
3. *Ramachandran, Hema "Scilab- A free software to Matlab". S-Chand publications 2012.*

REFERENCE BOOKS

1. *Book by Tejas Sheth "Scilab: A Practical Introduction to Programming and Problem Solving",*
2. *Alain Vande Wouwer, Carlos Vilas, and Philippe Saucez "Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications" Springer 2017.*
3. *Varodom Toochinda "Feedback Control with Scilab and Arduino" E-book*
4. *Anita Gehlot, Rajesh Singh, Bhupendra Singh "Arduino and Scilab based Projects" Bentham Science Publishers Pte. Ltd. Singapore - 2019*

19EEOC08 - MACHINE VISION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Summarize the basic theory and algorithms that are widely used in digital image processing*

CO2 *: Discover current applications in the field of Image Processing*

CO3 *: Perform image manipulation with Open CV, including smoothing, blurring.*

CO4 *: Utilize Python and OpenCV to draw shapes on images and video*

CO5 *: Apply Neural Networks concepts with Tensor Flow and PyTorch*

MACHINE VISION OVERVIEW

Introduction, definition, Active vision system, Machine vision components, hardware's and algorithms, image function and characteristics, segmentation, data reduction, feature extraction, edge detection, image recognition and decisions **5**

OPENCV-TENSORFLOW-PYTORCH

OpenCV - Image processing techniques using OpenCV with hands on coding examples - Background subtraction and its applications with hands on coding examples-Object detection and classification Tensorflow- Object detection and classification Pytorch - Three industry scenarios - LPR detection, face recognition, car counting. **5**

INDUSTRIAL APPLICATIONS

Industrial machine vision in production and services, structure of industrial m/c vision, generic standards, rules of thumb, illumination, optics, image processing, interfacing machine vision system. **5**

TOTAL : 15

TEXT BOOKS

1. *Kenneth Dawson-Howe, A Practical Introduction to Computer Vision with OpenCV (Wiley-IS&T Series in Imaging Science and Technology) 1st Edition, Kindle Edition, 2014*
2. *Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill,2012*

REFERENCE BOOKS

1 *Haralick& Shapiro, "Computer and Robot Vision", Vol II, 1993*

2. *GerardMedioni and Sing Bing Kang "Emerging topics in computer vision,2004*
3. *Michael Avendi, PyTorch Computer Vision Cookbook: Over 70 recipes to master the art of computer vision with deep learning and PyTorch 1.x Kindle Edition, 2016*

19EEOC09 - CYBER SECURITY IN MANUFACTURING AND SMART GRID

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Analyze the risks and threat issues in industrial control system*

CO2 *: Elaborate the components and architecture of SCADA system*

CO3 *: Compare the ICS and SCADA system based on the attributes like security and threats*

CO4 *: Apply the knowledge of SCADA to an ICS.*

CO5 *: Analyze the case studies related to Industry 4.0, ICS,SCADA.*

INDUSTRY 4.0

Industry 1.0 to 4.0 Journey- Industry 4.0 Overview - Industrial Automation Components Industrial Control System (ICS) **3**

INDUSTRIAL CONTROL SYSTEM (ICS)

Industrial Control System (ICS) introduction - ICS Components - ICS Network & Communications- ICS Security Risks & Threats **3**

SCADA

SCADA introduction - SCADA Components - SCADA Objectives & Functions - SCADA Architecture- SCADA Software - SCADA Security Risks & Threats **3**

ICS & SCADA

ICS & SCADA - Network Security Threats & Solutions - ICS & SCADA - Application Security Threats & Solutions - ICS & SCADA - Org Security Threats & Solutions - ICS & SCADA - Physical Security Threats & Solutions **3**

CASE STUDIES

Major incidents related to Industry 4.0, Industrial Control System (ICS), SCADA, ICS & SCADA - Solutions related to Industry 4.0, Industrial Control System (ICS), SCADA, ICS & SCADA - Case Studies **3**

TOTAL : 15

TEXT BOOKS

1. *Gilbert N. Sorebo, Michael C. Echols, "Smart Grid Security -An End-to-End View of Security in the New Electrical Grid", CRC Press, 1st Edition, India, 2012.*
2. *Eric D. Knapp , Joel Thomas Langill, "Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control", Syngress, December 2014.*

REFERENCE BOOK

1. *Goel, S., Hong, Y., Papakonstantinou, V., Kloza, D, "Smart Grid Security", Springer, 2015.*

19EEOC10 - ROBOTICS AND AUTOMATION

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Interpret and identify Industrial robotics, automation and digital twin technology.*

CO2 *: Bridge the gap between the industries and institutions working in the area of robotics and automation*

CO3 *: Conceive organizational aspects and analyze the architecture of Digital Twin Technology.*

CO4 *: Facilitate the future industry tools NX CAD -3D Design Modeling, COMOS - Virtual Plant Control, SIMIT - Real Time simulation - With and Without H/W SIMATIC - Industry Distributed Controller ,Industrial IoT Gateway.*

CO5 *: Develop an application software to interface various peripherals with given design requirements*

INTRODUCTION

Overview of Process Simulate & Virtual Commissioning Case Study : Electric Vehicle Battery Pack Assembly-Integrated Mechatronics Engineering for Automation. **3**

DIGITAL TWIN

Digital Twin for Process Industry-Holistic approach Digital Twins for Optimizingthe value chain-COMOS: Lifecycle data platform **3**

ROBOTICS

Robotics modeling and control- Kinematics- Control of Index finger Exoskeleton using Surface- EMG signal-Neural Network control- Applications of Robotics. **3**

SOFTWARE

Introduction to PCS 7-Architecture of SIMATIC PCS V9.0-Real time examples- Perspectives in DCS and PLC. **3**

IOT

Trend in IOT- Smart manufacturing- Industry 4.0- Manufacturing Execution systems- Delta Vector Control Drive-C2000 series. **3**

TOTAL : 15

TEXT BOOKS

1. *Gerardus Blokdyk, "Digital twin A Complete Guide"- 2019 Kindle Edition*
2. *Bruno Siciliano and Oussama Khatib, "Handbook of Robotics"- Springer International Publishing 2018*

REFERENCE BOOKS

1 *Anand Iyer, "Digital Twin: Possibilities of the new Digital twin technology" Kindle 2017 Edition.*
2. *Sebastian Thrun, Wolfram Burgard, Dieter Fox, "Probabilistic Robotics" MIT Press, 2018*
3. *Ian Barkin, Pascal Bornet, Jochen Wirtz, "INTELLIGENT AUTOMATION" 2020*
4. *By Frank Lamb, "Industrial Automation: Hands On" McGraw-Hill Education, 2020*

19EEOC12 - AWS CLOUD PRACTITIONER ESSENTIALS

Module 1 : Introduction to Amazon Web Services
Module 2 : Compute in the Cloud
Module 3 : Global Infrastructure and Reliability
Module 4 : Networking
Module 5 : Storage and Databases
Module 6 : Security
Module 7 : Monitoring and Analytics
Module 8 : Pricing and Support
Module 9 : Migration and Innovation
Module 10 : The Cloud Journey
Module 11 : AWS Certified Cloud Practitioner Basics

19EEOC13 - INTRODUCTION TO IOT

Chapter 1 : Everything is connected
Chapter 2 : Everything Becomes Programmable
Chapter 3 : Everything Generates Data
Chapter 4 : Everything can be automated
Chapter 5 : Everything needs to be secured
Chapter 6 : Educational and Business Opportunities

19EEOC14 - TCS ION CAREER EDGE YOUNG PROFESSIONAL

Module 1 : Communicate to Impress
Module 2 : Deliver Presentations with Impact
Module 3 : Develop Soft Skills for the Workplace
Module 4 : Gain Guidance from Career Gurus
Module 5 : Write a Winning Resume and Cover Letter
Module 6 : Stay Ahead in Group Discussions
Module 7 : Ace Corporate Interviews
Module 8 : Learn Corporate Etiquette
Module 9 : Write Effective Emails
Module 10 : Learn Corporate Telephone Etiquette
Module 11 : Understand Accounting Fundamentals
Module 12 : Gain Foundational Skills in IT
Module 13 : Understand Artificial Intelligence (AI) - Part 1
Module 14 : Understand Artificial Intelligence (AI) - Part 2

EEC COURSES

19HOC31 - COMMUNICATION SKILLS FOR ENGINEERS - I

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Gain confidence, enhance Personality and develop positive attitude in their work and life.*

CO2 : *Effectively communicate and present opinions using appropriate functional expressions for a given situation*

CO3 : *Compose Emails, Reports for a given business scenario using appropriate sentence construction and in the prescribed format.*

CO4 : *Generate ideas and speak on a given topic in a competitive scenario like Debate, Group Discussion, and Public Speaking.*

PERSONALITY DEVELOPMENT

Motivation and Self Confidence, SCOT Analysis - Personality Development - What is Personality, Developing Positive Attitude towards work and life, Building Relationship with others - Personality Development - Paradigms of Human Interaction, Fear Management. **4**

VERBAL COMMUNICATION

English Conversation - Asking and Giving Opinions - English Conversation -Thanking People, Asking and Giving Suggestions - English Conversation - Asking for Direction, Agreeing and Disagreeing - Role Play-Business. **5**

BUSINESS COMMUNICATION

Email Writing - Format, Etiquettes and Tips - Report Writing -Introduction, elements and tips - Drafting a report - Error Identification - Rules, Common Mistakes and Exercises - Sentence Completion Filler (fill in the blanks using apt words). **5**

PUBLIC SPEAKING

How to start and sustain a conversation - Debate - Extempore - Group Discussion - Importance and Process - Public Speaking - Introduction, Tips - Drafting a Public Speech - Interview - Types, Dos and Don'ts - Mock Press. **6**

TOTAL : 20

REFERENCES

1. *https://nptel.ac.in/content/storage2/courses/109104030/references/references.pdf (online resource)*
2. *John Seelay, Oxford Guide to Effective Writing and Speaking, 2nd Edition, Kindle Edition by Oxford University Press, 2007.*
3. *Sabina Pillai, Agna Fernandez, Soft Skills and Employability Skills -Published by Cambridge University Press, 2017.*

19HOC41 - COMMUNICATION SKILLS FOR ENGINEERS - II

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Solve objective questions on analogy, Statement and Argument, Statement and Conclusion, Data Sufficiency and Sentence improvement within a given time.*

CO2 : *Construct grammatically correct sentences*

CO3 : *Speak confidently to describe a process, present information on the specified topic and disseminate information in a professional manner.*

SELF EVALUATION

Self believe and self Esteem - Activities based on Current Events **2**

VERBAL AND LOGICAL RESONING

Analogy - Introduction, Types and Exercises - Statement and Argument - Statement and Conclusion - Data Sufficiency - Sentence Improvement - Critical Reasoning/Theme Detection **5**

GRAMMAR

Basic Grammar- Subject Verb Agreement - One word substitute - Preposition- Cause and Effect -Basic level questions and Moderate level questions **4**

PRESENTATION TECHNIQUES

Describing a Process - Presentation Skills - Introduction, Planning and Preparation - Presentation on a Topic - Group Discussion - Dos and Don'ts - Functional Expressions used in Group Discussion - Interview Skills - Ideal Grooming for an interview, Preparing for the Interview. **9**

TOTAL : 20

REFERENCES

1. *Sanjay Kumar, PushpLata, Communication Skills 2nd Edition, published by Oxford University Press, New Delhi, India, 2015.*
2. *Anthony Manning, Chris Sowton and Craig Thaine, Cambridge Academic English, published by Cambridge University Press, U P, India, 2012.*

19HOC51 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - I

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : *Solve objective questions on Syllogisms, Data Interpretation, Critical Reasoning, Theme Detection, Sentence Completion and Business Vocabulary*

CO2 : *Develop appropriate responses for business phone calls and negotiate effectively.*

CO3 : *Speak with appropriate body language for a technical speaking task.*

CO4 : *Project the appropriate grooming and the right etiquettes, for interview and group discussion task.*

VERBAL APTITUDE

Syllogisms-Paragraph Comprehension -Data Interpretation-Critical Reasoning/Theme Detection - Grammar -Sentence Completion Filler -Business Vocabulary-Foreign phrases used in English **3**

PROFESSIONAL COMMUNICATION

Telephonic Conversation Skills - Telephonic Interview -Etiquettes - Professional, Dining & Telephone - Employability skills - Importance and Employability level of present Y and Z Generation - Interpersonal Skills - Negotiation Skills - Types, Expressions used in formal and informal negotiations, Stages of Negotiation -Time Management-Pareto principle, Prioritizing tasks, Barriers to time management **7**

THE ART OF SPEAKING

Types of Speaking - Barriers to Speaking - Presentation on a Technical Topic -Speaking on Current Trends in the Industry **5**

NON-VERBAL COMMUNICATION

Interview Skills -Non Verbal Communication - Smiling, Posture, Handshake, Tone of Voice and Eye Contact - GD tips & techniques and Mock GD-Body Language - Grooming. **5**

TOTAL : 20

REFERENCES

1. *Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.*
2. *Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.*
3. *John Hayes. Interpersonal Skills at Work. Second Edition. Routledge publication. 2005*

19HOC61 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - II

L	T	P	C
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ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 *: Exhibit Corporate Etiquettes with assertiveness and personal effectiveness.*

CO2 *: Build teams and solve problems at workplace.*

CO3 *: Manage conflicts in a professional manner*

CO4 *: Simulate an actual Job Interview scenario to prepare a candidate for a real Interview*

CORPORATE ETIQUETTE

Corporate Etiquette: Dos and Don'ts, -Conversational dos and don'ts - Creating elusive first impression- Assertiveness-Personal Effectiveness **4**

LEADERSHIP AND TEAM MANAGEMENT

Leadership Skills - Understanding Traits and Styles - Team Building: Bonding, Development and Delegation - Adaptability and Work Ethics - Handling Team Dynamics- Giving and Receiving Feedback-Problem Solving Skills **5**

STRESS AND CONFLICT MANAGEMENT

Emotional Intelligence: Recognition, Understanding and Managing - Stress Management: Techniques and Benefits - Conflict Management: Introduction- Handling Conflicts - Conflicts settlement **6**

GROUP DISCUSSION AND INTERVIEW SKILLS

Mock GD - Interview Skills - Answering challenging questions - Common Interview Questions **5**

TOTAL : 20

REFERENCES

1. *Barun K Mitra., Personality Development and Soft Skills. Second Edition. Oxford University Press. 2016*
2. *N. Krishnaswamy & Lalitha Krishnaswamy - Mastering Communication Skills and Soft Skills. New Delhi. Bloomsburry. 2015*
3. *Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.*

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Curriculum and Syllabi

THIRD TO EIGHTH SEMESTER

Under Choice Based Credit System

(For the students admitted during 2019 - 2020 and onwards)

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