COIMBATORE INSTITUTE OF TECHNOLOGY

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

COIMBATORE - 641 014, TAMILNADU, INDIA

<div style="border:1px solid">

DIAMOND JUBILEE

(1956 - 2016)

</div>

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 the academic year 2015 - 2016 and onwards)

INDEX

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 MISSION OF THE DEPARTMENT

VISION

To empower 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. Facilitate the development of students through a broad - based technology oriented education in the field of EEE.

2. Emphasize the application of emerging technologies to solve problems in the fields of EEE.

3. Design and develop products with creativity.

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Technically competent and successful Electrical and Electronics Engineers with their strong educational foundation, meet the demands of industry.

2. Engineers with their creative mind - set, provide innovative solutions for the problems of the real world.

3. Empowered with leadership qualities and ethical values, the engineers have concern for society and sustainable environment.

COIMBATORE INSTITUTE OF TECHNOLOGY

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

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:

POs	GRADUATE ATTRIBUTES	PROGRAMME OUTCOME
PO 1	ENGINEERING KNOWLEDGE	An ability to understand the fundamental concepts and reinterpret to achieve fresh insights and creativity.
PO 2	PROBLEM - ANALYSIS	An ability to identify engineering problems, evaluate and synthesize solution.
PO 3	DESIGN AND DEVELOPMENT OF SOLUTIONS	An ability to effectively model, simulate, experiment, interpret and analyze data for complex electrical and electronic systems
PO 4	CONDUCT INVESTIGATIONS OF COMPLEX PROBLEMS	To develop learning skills through design and implementation of a system, component, or process that meets the needs of electrical and allied fields.
PO 5	MODERN TOOL USAGE	An ability to construct and test the system behavior by analyzing and interpreting data and information using modern engineering tools.
PO 6	THE ENGINEER AND SOCIETY	An ability to produce desired output with a blend of skills in allied engineering fields for the benefit of the society.
PO 7	ENVIRONMENT AND SUSTAINABILITY	To inculcate self-confidence with a high degree of personal integrity to create a sustainable career.
PO 8	ETHICS	An ability to understand the responsibility of taking professional decisions based on the impact of socio-techno-economical issues.
PO 9	INDIVIDUAL AND TEAM WORK	An ability to develop skills and confidence to assume positions as competent professional leader.
PO 10	COMMUNICATION	An ability to express their creativity to deal with the unstructured situation.
PO 11	PROJECT MANAGEMENT AND FINANCE	An ability to present a techno-commercial feasibility report on the project.
PO 12	LIFE-LONG LEARNING	To impart knowledge in contemporary issues and recognition of the need for life-long learning.
PSO 1	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.
PSO 2	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

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

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING (FULL TIME)

CHOICE BASED CREDIT SYSTEM

Curriculum from the Academic Year 2015 - 2016 and onwards

Semester III

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15CEM 31	Complex Variables, Fourier Transforms and Partial Differential Equations	2	2	0	3	BS
2	15EE31	Electric Circuit Analysis	2	2	0	3	PC
3	15EE32	Electromagnetic Fields	2	2	0	3	ES
4	15EE33	DC Machines and Transformers	3	2	0	4	PC
5	15EE34	Analog Electronic Circuits	3	0	0	3	PC
6	15EE35	Digital Integrated Circuits	3	0	0	3	PC
7	15HSS01	Science of Creativity and Professional Ethics	1	1	0	1	HS
8	15EE36	DC Machines and Transformers Laboratory	0	0	2	1	PC
9	15EE37	Digital Integrated Circuits Laboratory	0	0	2	1	PC
		(BS - 3, HS - 1, ES - 3, PC - 15) Total Credits				**22**	

Semester IV

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EEM41	Numerical Methods, Random Process and Vector Spaces	2	2	0	3	BS
2	15EE41	Networks and Synthesis	2	2	0	3	PC
3	15EE42	Synchronous and Induction Machines	3	0	0	3	PC
4	15EE43	Measurements and Instrumentation Systems	3	0	0	3	PC
5	15EE44	Linear Integrated Circuits	3	0	0	3	PC
6	15EE45	Transmission and Distribution of Electrical Power	2	2	0	3	PC
7	15EE46	Synchronous and Induction Machines Laboratory	0	0	2	1	PC
8	15EE47	Linear Integrated Circuits Laboratory	0	0	2	1	PC
9	15EE48	Comprehensive Learning	0	0	4	2	EEC
		(BS - 3, PC - 17, EEC - 2) Total Credits				**22**	

Semester V

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EE51	Power System Analysis	3	2	0	4	PC
2	15EE52	Control Engineering	3	0	0	3	PC
3	15EE53	Embedded System Design	3	0	0	3	PC
4	15EE54	Digital Signal Processing	3	2	0	4	PC
5	15EE55	C++ in Electrical Engineering Applications	3	2	0	4	PC
6		Professional Elective - I	3	0	0	3	PE
7	15EE56	Control Engineering Laboratory	0	0	2	1	PC
8	15EE57	Embedded System Design Laboratory	0	0	2	1	PC
9	15EE67	Mini project	0	0	2	-	EEC
		(PC - 20,PE - 3) Total Credits				**23**	

Semester VI

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EE61	Generation of Electric Energy	3	0	0	3	PC
2	15EE62	Power Electronics	2	2	0	3	PC
3	15EE63	Digital Protection of Power Systems	3	0	0	3	PC
4	15EE64	Data Structures and Algorithms	2	2	0	3	PC
5		Professional Elective - II	3	0	0	3	PE
6		Professional Elective - III / Open Elective - I	3	0	0	3	PE/OE
7	15EE65	Power System Laboratory	0	0	2	1	PC
8	15EE66	Power Electronics Laboratory	0	0	2	1	PC
9	15EE67	Mini Project	0	0	2	2	EEC
		(PC - 14, PE/OE - 6, EEC - 2) Total Credits				**22**	

Semester VII

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EE71	Utilization and Conservation of Electrical Energy	3	2	0	4	PC
2	15EE72	Solid State Drives and Controls	3	0	0	3	PC
3	15EE73	Industrial Automation	3	0	0	3	PC
4	15EE74	FPGA Based System Design	3	0	0	3	PC
5		Professional Elective - IV / Open Elective - II	3	0	0	3	PE/OE
6	15EE75	Electric Drives Laboratory	0	0	2	1	PC
7	15EE76	FPGA Based System Design Laboratory	0	0	2	1	PC
8	15EE81	Project Work and Viva Voce	0	0	7	-	EEC
		(PC - 15, PE/OE - 3) Total Credits				**18**	

Semester VIII

S. No.	Course Code	Course Name	L	T	P	C	Category
1		Professional Elective - V	3	0	0	3	PE
2		Professional Elective - VI	3	0	0	3	PE
3		Professional Elective - VII	3	0	0	3	PE
4		Professional Elective - VIII	3	0	0	3	PE
5		Professional Elective - IX/Open Elective - III	3	0	0	3	PE/OE
6	15EE81	Project Work and Viva Voce	0	0	7	7	EEC
		(PE/OE - 15, EEC - 07) **Total Credits**				**22**	

TOTAL CREDITS : 181*

* Including First Year Credits

Category : **BS** - Basic Sciences, **HS** - Humanities and Social Sciences, **ES** - Engineering Sciences, **PC** - Professional Core, **PE** - Professional Elective, **EEC** - Employability Enhancement Course, **OE** - Open Elective

PROFESSIONAL ELECTIVE : STREAM

I. ELECTRICAL MACHINES AND CONTROL (EMC)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EEE01	Design of Electrical Machines	3	0	0	3	PE
2	15EEE02	Special Electrical Machines	3	0	0	3	PE
3	15EEE03	Modeling and Analysis of Electrical Machines	3	0	0	3	PE
4	15EEE04	Digital Control Systems	3	0	0	3	PE
5	15EEE05	Systems Theory	3	0	0	3	PE
6	15EEE06	Embedded Control of Electric Drives	3	0	0	3	PE

II. POWER AND ENERGY (PE)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EEE07	Electrical Safety	3	0	0	3	PE
2	15EEE08	Smart Grid	3	0	0	3	PE
3	15EEE09	Power Quality	3	0	0	3	PE
4	15EEE10	High Voltage Transmission systems	3	0	0	3	PE
5	15EEE11	Power and Energy Management	3	0	0	3	PE
6	15EEE12	Energy Storage Technology	3	0	0	3	PE
7	15EEE13	Advanced Power Electronics	3	0	0	3	PE
8	15EEE14	Energy Efficient Lighting System	3	0	0	3	PE

III. ELECTRONIC DESIGN (ED)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EEE15	Real Time Embedded Systems	3	0	0	3	PE
2	15EEE16	Digital Consumer Technology	3	0	0	3	PE
3	15EEE17	Electronic Product Design	3	0	0	3	PE
4	15EEE18	Medical Electronics	3	0	0	3	PE
5	15EEE19	Multimedia Systems	3	0	0	3	PE
6	15EEE20	Robotics and Control	3	0	0	3	PE

IV. COMPUTER AND COMMUNICATION (CC)

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EEE21	Computer Architecture and Parallel Processing	3	0	0	3	PE
2	15EEE22	Data Communication Networks	3	0	0	3	PE
3	15EEE23	Virtual Instrumentation	3	0	0	3	PE
4	15EEE24	Data Analytics	3	0	0	3	PE
5	15EEE25	Fog Computing	3	0	0	3	PE
6	15EEE26	Statistical Modeling	3	0	0	3	PE
7	15EEE27	Multi Core Architecture	3	0	0	3	PE
8	15EEE28	Internet of Things (IoT)	3	0	0	3	PE

BS - BASIC SCIENCES

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15FY11	Mathematics I	3	2	0	4	BS
2	15FY13	Engineering Physics	3	0	0	3	BS
3	15FY14	Engineering Chemistry	3	0	0	3	BS
4	15FY16	Physics Laboratory - I	0	0	2	1	BS
5	15FY17	Chemistry Laboratory - I	0	0	2	1	BS
6	15FY21	Mathematics II	3	2	0	4	BS
7	15FY23	Material Science	3	0	0	3	BS
8	15FY26	Physics Laboratory - II	0	0	2	1	BS
9	15FY27	Chemistry Laboratory - II	0	0	2	1	BS
10	15CEM 31	Complex Variables, Fourier Transforms, Partial Differential Equations	2	2	0	3	BS
11	15EEM41	Numerical Methods, Random Process and Vector Spaces	2	2	0	3	BS
		Total Credit				**27**	

HS - HUMANITIES AND SOCIAL SCIENCES

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15FY12	Technical English	2	0	2	3	HS
2	15FY22	Language Elective	2	0	2	3	HS
3	15FY24	Principles of Environmental Science and Engineering	3	0	0	3	HS
4	15HSS01	Science of Creativity and Professional Ethics	1	1	0	1	HS
		Total Credit				**10**	

ES - ENGINEERING SCIENCES

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15CS01	C Programming	3	0	0	3	ES
2	15EE02	Electronic Devices	3	0	0	3	ES
3	15FY15	Engineering Graphics - I	1	0	4	3	ES
4	15CS02	C Programming Laboratory	0	0	2	1	ES
5	15ME02	Home Appliances Laboratory	0	0	2	1	ES
6	15EE03	Electric and Magnetic circuits	3	0	0	3	ES
7	15CM01	Basic Civil and Mechanical Engineering	4	0	0	4	ES
8	15FY25	Engineering Graphics - II	1	0	4	3	ES
9	15ME01	Carpentry and Fitting Laboratory	0	0	2	1	ES
10	15EE32	Electromagnetic Fields	2	2	0	3	ES
		Total Credit				**25**	

PC - PROFESSIONAL CORE

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EE31	Electric Circuit Analysis	2	2	0	3	PC
2	15EE33	DC Machines and Transformers	3	2	0	4	PC
3	15EE34	Analog Electronic Circuits	3	0	0	3	PC
4	15EE35	Digital Integrated Circuits	3	0	0	3	PC
5	15EE36	DC Machines and Transformers Laboratory	0	0	2	1	PC
6	15EE37	Digital Integrated Circuits Laboratory	0	0	2	1	PC
7	15EE41	Networks and Synthesis	2	2	0	3	PC
8	15EE42	Synchronous and Induction Machines	3	0	0	3	PC
9	15EE43	Measurements and Instrumentation Systems	3	0	0	3	PC
10	15EE44	Linear Integrated Circuits	3	0	0	3	PC
11	15EE45	Transmission and Distribution of Electrical Power	2	2	0	3	PC
12	15EE46	Synchronous and Induction Machines Laboratory	0	0	2	1	PC
13	15EE47	Linear Integrated Circuits Laboratory	0	0	2	1	PC
14	15EE51	Power System Analysis	3	2	0	4	PC
15	15EE52	Control Engineering	3	0	0	3	PC
16	15EE53	Embedded System Design	3	0	0	3	PC
17	15EE54	Digital Signal Processing	3	2	0	4	PC
18	15EE55	C++ in Electrical Engineering Applications	3	2	0	4	PC
19	15EE56	Control Engineering Laboratory	0	0	2	1	PC
20	15EE57	Embedded System Design Laboratory	0	0	2	1	PC
21	15EE61	Generation of Electric Energy	3	0	0	3	PC
22	15EE62	Power Electronics	2	2	0	3	PC
23	15EE63	Digital Protection of Power Systems	3	0	0	3	PC
24	15EE64	Data Structures and Algorithms	2	2	0	3	PC
25	15EE65	Power System Laboratory	0	0	2	1	PC
26	15EE66	Power Electronics Laboratory	0	0	2	1	PC
27	15EE71	Utilization and Conservation of Electrical Energy	3	2	0	4	PC
28	15EE72	Solid State Drives and Controls	3	0	0	3	PC
29	15EE73	Industrial Automation	3	0	0	3	PC
30	15EE74	FPGA based System Design	3	0	0	3	PC
31	15EE75	Electric Drives Laboratory	0	0	2	1	PC
32	15EE76	FPGA based system design Laboratory	0	0	2	1	PC
		Total Credit				**81**	

EEC - EMPLOYABILITY ENHANCEMENT COURSE

S. No.	Course Code	Course Name	L	T	P	C	Category
1	15EE48	Comprehensive Learning	0	0	4	2	EEC
2	15EE67	Mini Project	0	0	4	2	EEC
3	15EE81	Project Work and Viva Voce	0	0	14	7	EEC
		Total Credit				**11**	

CREDIT CONTRIBUTION MATRIX

Category / Semester	BS	HS	ES	PC	PE/OE	EEC	Total Credits
1	12	03	11	-	-	-	26
2	09	06	11	-	-	-	26
3	03	01	03	15	-	-	22
4	03		-	17	-	02	22
5	-	-	-	20	03	-	23
6	-	-	-	14	06	02	22
7	-	-	-	15	03	-	18
8	-	-	-	-	15	07	22
Total Credits	**27**	**10**	**25**	**81**	**27**	**11**	**181**

Category : **BS** - Basic Sciences, **HS** - Humanities and Social Sciences, **ES** - Engineering Sciences,
PC - Professional Core, **PE** - Professional Elective, **OE** - Open Elective,
EEC - Employability Enhancement Course

COIMBATORE INSTITUTE OF TECHNOLOGY

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

LIST OF OPEN ELECTIVES

DEPARTMENT OF CIVIL ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
15CEE35	Disaster Management	3	0	0	3	All Branches
15CEE36	Renewable Energy Resources	3	0	0	3	All Branches
15CEE38	Environmental Impact Assessment	3	0	0	3	All Branches
15CEE39	Solid and Hazardous Waste Management	3	0	0	3	All Branches
15CEE40	Principles of Sustainable Development	3	0	0	3	All Branches
15CEE41	Safety Engineering in Building	3	0	0	3	All Branches

DEPARTMENT OF MECHANICAL ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
15MEOE01	Robotics	3	0	0	3	All Branches
15MEOE02	Low Cost Automation	3	0	0	3	All Branches
15MEOE03	Adaptive Control and Process Dynamics	3	0	0	3	All Branches
15MEOE04	Project Planning and Management	3	0	0	3	All Branches
15MEOE05	Supply Chain Management	3	0	0	3	All Branches
15MEOE06	Resource Management Techniques	2	2	0	3	All Branches
15MEOE07	Sustainable Development	3	0	0	3	All Branches
15MEOE08	Processing and Applications of Biomaterials	3	0	0	3	All except CSE & IT
15MEOE09	Numerical Simulation of Fluid Flow	3	0	0	3	All Circuit Branches
15MEOE10	Solar Energy Utilisation	3	0	0	3	Civil & Chemical

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
15EEOE01	Energy Auditing	3	0	0	3	ECE, Mech, Chemical, Civil
15EEOE02	Solar and Wind Energy Systems	3	0	0	3	ECE, Mech, Chemical
15EEOE03	Hybrid Smart Vehicles	3	0	0	3	All Branches except Civil, Chemical
15EEE07	Electrical Safety	3	0	0	3	All Branches
15EEE14	Energy Efficient Lighting System	3	0	0	3	All Branches

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
15ECOE01	Consumer Electronics	3	0	0	3	Civil & Mech
15ECOE02	ARM System Architecture	3	0	0	3	CSE & IT
15ECOE03	Broadband Communication	3	0	0	3	Mech, EEE, CSE & IT
15ECOE04	Robotics for Industrial Applications	3	0	0	3	Mech, CSE & IT
15ECOE05	Signal Processing and its Applications	3	0	0	3	Chemical, Mech & CSE

DEPARTMENT OF CSE

Course Code	Course Name	L	T	P	C	Eligible Branches
15CSOE01	Fundamentals of Software Engineering	3	0	0	3	EEE, ECE, Mech, Chemical & Civil
15CSOE02	Introduction to Data Warehousing and Data Mining	3	0	0	3	EEE, ECE, Mech, Chemical & Civil
15CSOE03	Introduction to Embedded Systems	3	0	0	3	Mech, Chemical & Civil
15CSOE04	Internet Programming	3	0	0	3	EEE, ECE, Mech, Chemical & Civil
15CSOE05	Customer Relationship Management Essentials	3	0	0	3	IT, EEE, ECE, Mech, Chemical & Civil
15CSOE06	E - commerce	3	0	0	3	IT, EEE, ECE, Mech, Chemical & Civil

DEPARTMENT OF IT

Course Code	Course Name	L	T	P	C	Eligible Branches
15ITOE01	Digital Computer Basics	3	0	0	3	Mech, Civil & Chem
15ITOE02	Programming in Java	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
15ITOE03	Fundamentals of Database Systems	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
15ITOE04	Cloud Computing Fundamentals	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
15ITOE05	Information Security Fundamentals	3	0	0	3	EEE, ECE, Mech, Civil & Chemical
15ITOE06	Introduction to Human Computer Interaction	3	0	0	3	CSE, EEE, ECE, Mech, Civil & Chemical
15ITOE07	Enterprise Resource Planning Concepts	3	0	0	3	CSE, EEE, ECE, Mech, Civil & Chemical

DEPARTMENT OF CHEMICAL ENGINEERING

Course Code	Course Name	L	T	P	C	Eligible Branches
15CHOE01	Industrial Safety Engineering	3	0	0	3	All Branches
15CHOE02	Risk Analysis and Hazop	3	0	0	3	All Branches
15CHOE03	Green Technology	3	0	0	3	All Branches
15CHOE04	Corrosion Science and Engineering	3	0	0	3	All Branches
15CHOE05	Introduction to Chemical Engineering	3	0	0	3	All Branches

DEPARTMENT OF MATHEMATICS

Course Code	Course Name	L	T	P	C	Eligible Branches
15MOE01	Graph Theory & Its Applications	3	0	0	3	All Branches
15MOE02	Methods of Applied Mathematics	3	0	0	3	All Branches
15MOE03	Linear and Non - Linear Programming	3	0	0	3	All Branches
15MOE04	Probability and Random Processes	3	0	0	3	All Branches

DEPARTMENT OF PHYSICS

Course Code	Course Name	L	T	P	C	Eligible Branches
15POE01	Introduction to Nanoscience and Nanotechnology	3	0	0	3	All Branches except IT
15POE02	Physics and Technology of Thin Films	3	0	0	3	Mech, EEE, ECE & Chemical
15POE03	Solar Cells Fundamentals and Materials	3	0	0	3	EEE, ECE & Chemical
15POE04	Advanced Material Processing Technologies	3	0	0	3	Mech & Chemical

DEPARTMENT OF CHEMISTRY

Course Code	Course Name	L	T	P	C	Eligible Branches
15COE01	Medical Nano Technology	3	0	0	3	Chemical
15COE02	Advanced Drug Delivery Systems	3	0	0	3	Chemical
15COE03	Biosensors	3	0	0	3	Chemical, ECE & EEE
15COE04	Nanocomposites	3	0	0	3	Mech, Chemical & Civil
15COE05	Biorefinery	3	0	0	3	Mech & Chemical

DEPARTMENT OF HUMANITIES

Course Code	Course Name	L	T	P	C	Eligible Branches
15HOE01	Principles of Management	3	0	0	3	All Branches
15HOE02	Current Trends in Indian Economy	3	0	0	3	All Branches
15HOE03	Monetary Economics	3	0	0	3	All Branches
15HOE04	Accounting for Managerial Decisions	3	0	0	3	All Branches
15HOE05	Entrepreneurship Development	3	0	0	3	All Branches
15HOE06	Employability Skills	3	0	0	3	All Branches
15HOE07	English for Academic Purposes	3	0	0	3	All Branches
15HOE08	English for Competitive Exams	3	0	0	3	All Branches
15HOE09	Life and Literature	3	0	0	3	All Branches

15CEM31 - COMPLEX VARIABLES, FOURIER TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1   :   *Familiar with complex differentiation.*

CO2   :   *Familiar with complex integration*

CO3   :   *Solve problems by partial differential equation ideas in modeling.*

CO4   :   *Solve Engineering problems and Fourier Transform ideas to analyze and solve communication oriented problems.*

CO5   :   *Solve problems related with the above mentioned areas and can identify the areas in their discipline wherein these ideas could be directly applied.*

COMPLEX DIFFERENTIATION

Analytic functions - Definitions and properties - Cauchy Riemann equations in Cartesian and polar coordinates - Construction of analytic functions - Conformal mappings - Bilinear Transformation - The mappings of the form $w = z+a$, az, $1/z$, z^2, e^z, $\sin z$, $\cos z$, - Simple problems. **(6+6)**

COMPLEX INTEGRATION

Cauchy's integral theorem - Integral formula - Taylor's and Laurent's series (without proof) - Types of singularities, Poles and residues - Cauchy's residue theorem - Applications - Contour integration using circular and semicircular contours. **(6+6)**

PARTIAL DIFFERENTIAL EQUATIONS

Formation by elimination of arbitrary constants and functions - Solution by direct method - Solution of first order non - linear PDE - Standard types - Lagrange's linear equation - Linear higher order homogeneous PDE with constant coefficients. **(6+6)**

FOURIER TRANSFORMS

Fourier integral theorem (without proof) - Infinite Fourier transform - Infinite Fourier sine and cosine transforms, properties and problems - Convolution theorem - Parseval's identity - Finite Fourier sine and cosine transforms, properties and problems. **(6+6)**

BOUNDARY VALUE PROBLEMS

Vibration of strings - One dimensional wave equations, one dimensional heat flow - Unsteady state and steady state - Two dimensional heat flow steady state in Cartesian coordinates - Separation of variables - Fourier series solution. **(6+6)**

TOTAL : 30 + 30 = 60

TEXT BOOKS

1.   *Srimanta pal and Subodh C. Bhunia, " Engineering Mathematics", Oxford University Press, 1ˢᵗ Edition, India, 2015.*

2.   *E.Rukmangadachari, "Engineering Mathematics Volume II & Volume III", Pearson Education, 1ˢᵗ Edition, India.*

3.   *Veerarajan .T, "Engineering Mathematics", (for Semester III), Tata McGraw - Hill Publishing company Ltd , 3ʳᵈ Edition, 4ᵗʰ Reprint, 2008.*

REFERENCES

1.   *Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons (Asia) Private Limited., 8ᵗʰ Edition, 2008.*

2.   *Grewal, B.S., "Higher Engineering Mathematics", Khanna Publishers, 40ᵗʰ Edition, 2007.*

3.   *Free ebook : Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons (Asia), Private Limited, 8ᵗʰ Edition, 2008. Web - link: http://www - elec.inaoep.mx/~jmram/Kreyzig - ECS - DIF1.pdf*

4.   *http://nptel.ac.in/courses/111105035/*

15EE31 - ELECTRIC CIRCUIT ANALYSIS

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Apply mesh and nodal analysis at steady state.

CO2 : Solve transient circuits using laplace transform techniques.

CO3 : Apply circuit theorems to solve electric circuit problems..

CO4 : Analyze resonance circuits and coupled circuits.

CO5 : Solve three phase star and delta connected Systems with balanced and unbalanced loads.

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 - Phasor diagrams - Concept of phasor and complex impedance and admittance - Analysis of simple, single phase ac series and parallel circuits - Apparent power, Active power, Reactive power and Power factor - Concept of complex power - Impedance and power triangle - Mesh and Nodal analysis in AC circuits.   **(6+6)**

CIRCUIT THEOREMS

Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem - Reciprocity theorem - Compensation theorem - Tellegen's theorem - Millman's theorem.   **(6+6)**

RESONANCE AND COUPLED CIRCUITS

Series Resonance - Impedance and phase angle of a series resonant circuit - Voltage and current in a series resonant circuit - Bandwidth of a RLC circuit - Quality factor and its effect on bandwidth - Magnification in resonance - Parallel resonance - Resonant frequency for a tank circuit - Variation of impedance with frequency - Q factor of parallel resonance - Magnification. Analysis of coupled circuits - Conductively coupled circuits - Analysis of single tuned and Double tuned coupled circuit. **(6+6)**

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 - Phasor diagram representation - Power measurement in three - phase circuits.   **(6+6)**

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 - Natural frequency and Damping factor.   **(6+6)**

TOTAL : 30+30 = 60

TEXT BOOKS

1.   Charles K. Alexander and Matthew N. O. Sadiku, "Fundamentals of Electric Circuits" McGraw - Hill, 5th Edition, 2013.

2.   Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Series, Tata McGraw Hill, New Delhi, 2011.

REFERENCES

1.   William H. Hayt Jr, Jack E. Kemmerly, and Steven M.Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, New Delhi, 2002.

2.   Sudhakar A. and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", Tata McGraw Hill, New Delhi, 2010.

3.   Paranjothi S.R., "Electric Circuit analysis", New Age International (P) Ltd, New Delhi, 2000.

4. Gupta B.R, "Fundamentals of Electric Circuits", S.Chand & Co. (P) Ltd, New Delhi, 2002.
5. Chakrabarti A., "Circuit Theory (Analysis and Synthesis)", Dhanpat Rai & Co. (P) Ltd, 6th Edition, New Delhi, 2010.
6. Free eBook: Charles K. Alexander and Matthew N. O. Sadiku, "Fundamentals of Electric circuits". Weblink:http://narimani.iut.ac.ir/sites/narimani.iut.ac.ir/files/files_course/parta_fundamentals_of_electric_circuits_5th_edgnv64.pdf
7. http://nptel.ac.in/courses/117106101

15EE32 - ELECTROMAGNETIC FIELDS

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Employ vector calculus concepts to solve electromagnetic field problems.

CO2 : Apply Coulomb's law, Gauss law, Poisson and Laplace equation to solve electrostatics problems for various charge distribution in free space and other media.

CO3 : Apply ampere's circuital law and Biot - Savart's law to determine magnetic field intensity and magnetic flux density magnetostatic problems.

CO4 : Deduce the capacitance and inductance for various configuration in electrostatic and magnetostatic fields.

CO5 : Explain Maxwell's equation for electromagnetic wave and derive electromagnetic wave equation in various medium.

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. **(5+6)**

ELECTROSTATIC FIELDS

Types of charge distributions - 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. **(5+6)**

ELECTRIC FIELD IN MATERIALS

Properties of Conductors - Continuity of current - Relaxation time - Properties and nature of dielectric materials - Polarization in dielectrics - Boundary conditions for perfect dielectric materials - Electric dipole - Potential and field due to an electric dipole - Capacitance - Determination of capacitance for different configurations - Electrostatic energy storage and Energy density.

(7+6)

MAGNETOSTATICS, MAGNETIC FORCES AND INDUCTANCE

Applications of Biot - Savart's law - Applications of Ampere's circuital law - Scalar and Vector magnetic potentials - Lorentz law of force - Force on a differential current element - Force between differential current elements - Torque on closed circuits - Magnetization - Magnetic boundary conditions - Inductance - Inductance of Solenoids, Toroids, Transmission lines and Cables - Magneto - static energy storage and energy density - Lifting force of a magnet. **(8+6)**

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 - Wave parameters: Velocity, Intrinsic impedance, Propagation constant and Skin depth - Electromagnetic waves in good conductors, lossy and lossless dielectrics - Poynting vector and Poynting's theorem. **(5+6)**

TOTAL : 30 + 30 = 60

TEXT BOOKS

1. *Matthew N.O.Sadiku, "Elements of Electromagnetics", Oxford University Press, 2010.*
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, 2011.*
2. *John D. Kraus and Daniel A. Fleisch, "Electromagnetics with Applications", Tata McGraw Hill, 5th Edition, 2010.*

3. *Joseph A. Edminister, "Theory and Problems of Electromagnetics", Schaum's Outline Series, Tata McGraw Hill Inc., New Delhi, 1993.*

4. *Ashutosh Pramanik, "Electromagnetism - Theory and Applications", Prentice Hall of India, New Delhi, 2006.*

5. *N.N. Rao, "Elements of Engineering Electromagnetics", Prentice Hall of India, New Delhi, 2003.*

6. *Free eBook: Matthew N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 3rd Edition, 2010. https://sandeepmnit.files.wordpress.com/2012/08/elementsofelectromagnetics - sadiku - 3rded2.pdf*

7. *http://nptel.ac.in/courses/115101005/*

8. *http://www.youtube.com/watch?v=pGdr9WLto4*

15EE33 - DC MACHINES AND TRANSFORMERS

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Explain the constructional features, principle of operation and types of d.c. machine*

CO2 : *Describe the characteristics of DC generator/ motor, discuss the starting, speed control and braking of DC machines.*

CO3 : *Analyze the performance of D.C machines by direct and indirect test.*

CO4 : *Describe the construction, working principle of transformer and analyze the performance of transformer by studying open circuit, short circuit and sumpner's test.*

CO5 : *Assess the need for parallel operation and analyze the load sharing between transformers.*

CO6 : *Analyze the various three phase connections and cooling methods of transformers.*

DC MACHINES

D.C. Machines - Construction - Principle of operation - Methods of excitation - Armature Winding - Armature reaction - Commutation.

(8+6)

DC GENERATORS AND DC MOTORS

D.C. Generators: EMF equation - Magnetization characteristics - Load characteristics - Parallel operation - Applications. D.C. Motors: Types - Torque equation - Circuit models - Electrical and Mechanical Characteristics - Starters - Speed control methods - Electric braking - Applications. **(10+6)**

TESTING OF DC MACHINES

Losses and Efficiency - Testing: Direct, Indirect and Regenerative methods to test DC machines - Separation of no load losses.

(9+6)

TRANSFORMERS

Transformers - Construction and types - Operation of single phase transformers - EMF equation - Phasor diagram - Equivalent circuit - Voltage regulation - Losses and Efficiency - All day efficiency - Parallel operation Testing: Open circuit and Short circuit tests - Polarity test - Sumpner's test - Separation of hysteresis and eddy current losses. **(9+6)**

THREE PHASE TRANSFORMERS AND AUTOTRANSFORMERS

Three phase Transformer: Various types of connection and their comparative features - Autotransformers - Construction - Principle - Applications - Comparison with two winding transformer - Harmonics in single phase and three phase transformers - Scott connections - tap changing of transformers - Cooling methods of transformers - Instrument transformers. **(9+6)**

TOTAL : 45 + 30 = 75

TEXT BOOKS

1. *Nagrath, I.J. and Kothari D.P. , "Electrical Machines" , Tata McGraw Hill Publishing Company Ltd., 4th Edition, 3rd reprint, New Delhi, 2011.*

2. *Smarajit Ghosh., "Electrical Machines I," Pearson Education in South Asia, 2012.*

REFERENCES

1. *Bhattacharya, P.S., "Electrical Machines", Tata McGraw Hill, 8th Reprint, 1997.*

2. *M.G.Say, "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors, New Delhi, 2002.*

3. *Free eBook: Stephen J. Chapman, "Electric Machinery Fundamentals", McGraw - Hill Companies, 4th Edition, 2005 - http://www.msalah.com/EM/EMtextbook4.pdf*

4. *http://nptel.ac.in/courses/108105017/*

15EE34 - ANALOG ELECTRONIC CIRCUITS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Explain the operation of rectifiers, filters and regulators for designing DC power supply.*

CO2 : *Analyze BJT and FET amplifiers using small signal models.*

CO3 : *Describe and evaluate the performance of power amplifiers.*

CO4 : *Differentiate the types of feedback amplifiers.*

CO5 : *Analyze and design wave shaping circuits, multivibrators and oscillators.*

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 hybrid π model. Multistage amplifier: RC Coupled - Transformer coupled amplifiers - Frequency response. FET Amplifier: Small signal model and frequency response of CS, CD and CG amplifier. Differential amplifier using BJT and FET. **(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 AND OSCILLATORS

Feedback concepts - Ideal feedback topologies - Advantages and Disadvantages of negative feedback - Analysis of voltage and current: Series and Shunt feedback amplifier circuits - Oscillators: Barkhausen criterion - RC phase shift oscillator - Hartley Oscillator - Colpitts Oscillator - Frequency Stability - Crystal Oscillator. **(9)**

WAVE SHAPING CIRCUITS AND MULTIVIBRATORS

Clippers - Clampers - Astable and Monostable multivibrators - Collector coupled configuration - Fixed biased bistable multivibrator - Schmitt trigger - Methods of generating a time base signal - Exponential sweep circuit - Transistor constant current sweep - Miller and Bootstrap voltage time base generators - Current time base generator - Triggered blocking oscillator (Base timing). **(9)**

TOTAL : 45

TEXT BOOKS

1. *Jacob Millman, Christos C Halkias and Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw - Hill, 2nd Edition, 2008.*

2. *Jacob Millman, Christos C Halkias and Chetan D Parika, "Millman's Integrated Circuits", Tata McGraw - Hill, 2nd Edition, 2008.*

3. *Allen Mottershead, "Electronic Devices and Circuits - An Introduction", PHI learning, 2011.*

REFERENCES

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, 9th Edition, New Delhi, 2005.*

3. *Salivahanan, "Electron Devices and Electronic Circuits", Tata McGraw - Hill, New Delhi, 2004.*

4. *Free ebook: Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall of India, 7th Edition*

   http://www.rtna.ac.th/departments/elect/Data/EE304/Electronic%20Devices%20and%20Circuit%20Theory.pdf

5. *http://www.satishashyap.com/2012/04/iit - video - lectures - on - introduction - to.html*

6. *http://nptel.ac.in/video.php?subjectId=117103063*

15EE35 - DIGITAL INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Select suitable logic family for designing digital circuits to meet out the given specifications

CO2 : Design combinational circuits using logic gates, multiplexers and decoders.

CO3 : Design, implement and analyze synchronous and asynchronous sequential circuits using flip flops and logic gates.

CO4 : Test combinational circuit for hazard elimination and derive test vector to test digital circuit faults

CO5 : Prepare programming table for implementing the logic functions using PLA and PAL.

NUMBER SYSTEMS,&DIGITAL LOGIC FAMILIES

Review of number systems - Conversion methods - Number representations - Signed, Unsigned, Fixed point, Floating point numbers - Computer codes - Error detection and correction codes - Parity codes - Hamming codes - Digital Logic Families - TTL, ECL, MOS and CMOS - Characteristics - Comparison of performances : speed, fan - in, fan - out, propagation delay, power dissipation and noise margin. **(9)**

COMBINATIONAL LOGIC CIRCUITS

Boolean algebra - Basic postulates and theorems - De Morgan's law - 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 - map and QuineMcCluskey minimization techniques - Multiplexers and Demultiplexers - Decoders and Encoders - Parity generators and checkers - Code converters - Comparators - Adders and Subtractors - BCD adders and subtractors.**(9)**

SEQUENTIAL LOGIC CIRCUITS

Flip Flops - counters - Asynchronous and synchronous type - Modulo counters - Shift registers - Ring and twisted ring counters. Mealy and Moore Machines - State table and excitation table - State diagram - State reduction - State assignment - Synthesis and Analysis of synchronous sequential circuits. **(9)**

ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS

Transition table - Flow table - Reduction of state - Minimization of completely specified machines and incompletely specified machines - Implication table - Merging of flow table - Race Free State assignment - Design and analysis of asynchronous sequential logic circuits. **(9)**

DIGITAL SYSTEM DESIGN AND TESTING

Design of combinational logic circuits using logic gates, multiplexer, demultiplexer, decoder and encoder. Design of sequential logic circuits - Counters using flip flops - Sequence detector and sequence generator - Frequency counter and Digital clock - Design of Logic circuit using PAL and PLA.

Combinational logic hazards - Fault detection and redundancy - Testing for single stuck faults and multiple faults - Methods of testing - Fault tables, Boolean difference and Path - sensitization method. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Morris Mano, "Digital Design", Prentice Hall of India Ltd, 4th Edition,2007.*

2. *MironAbrammovici, Melvin Breuer, "Digital System Testing and Testable Design", Jaico Publishing House, 2010.*

3. *Ronald J.Tocci, "Digital Systems - Principles and Applications", PHI Ltd., 11th Edition, 2011.*

REFERENCES

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.*

4. *http://nptel.ac.in/courses/108106069/*

5. *Free ebook: Morris Mano, "Digital Design", Prentice Hall of India Ltd., 4th Edition,2007.*

    http://uqu.edu.sa/files2/tiny_mce/plugins/filemanager/files/4281665/digital/digital_design - morris_mano - fifth_edition.pdf

15HSS01 - SCIENCE OF CREATIVITY AND PROFESSIONAL ETHICS

L	T	P	C
1	1	0	1

ASSESSMENT : THEORY

COURSE OBJECTIVE

To inculcate among students the need for creative thinking, life process and Nature's prevailing Law of Cause and Effect. Students will acquire an expanded awareness of their actions and walk more gently on this planet, creating love, peace and harmony wherever they go.

COURSE OUTCOME

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

CO1 : Explain about the principles of karma yoga and evolution of Universe and Living beings.

CO2. : Explicate the benefits of physical exercise and good thought process for better living, 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: Creation 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)**

TOTAL : 30

TEXT BOOKS

1. *Yogiraj Vethathri Maharishi, "Karma Yoga - The Holistic Unity", Vethathri Publications, 4ᵗʰ 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. Dr.V.Irai Anbu, "Ancient yet Modern: Management Concepts in Thirukkural", Allied Publisher, 1st Edition, 2012.

2. Swami Vivekananda and Swami Nikhilananda, "Karma Yoga and Bhakti Yoga", Ramakrishna Vivekananda Publications, 2nd Edition, 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", McGraw Hill, 4th Edition, NewYork, 2005.

5. M. Govindarajan, S. Natarajan and V.S. Senthilkumar, "Engineering Ethics", Prentice Hall of India, 1st Edition, 2009.

15EE36 - DC MACHINES AND TRANSFORMERS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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. a.   No Load Speed Control of DC Shunt Motor

    b.   Swinburne's Test
3. Load Test on DC Shunt Motor
4. Load Test on DC Shunt Generator
5. Load Test on DC Series Generator
6. Load Test on DC Series Motor
7. Load Test on DC Compound Generator
8. Load Test on DC Compound Motor
9. Hopkinson's Test
10. OC and SC Test on Single - Phase Transformer
11. Load Test on Single - Phase Transformer (R,L,C Loads)
12. Load Test on Scott - Connected Transformer
13. Sumpner's test
14. Study on Three Phase Transformers
15. Study of Starters

15EE37 - DIGITAL INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Design and test combinational circuits for the given specifications with maximum of 4 variables using logic gates.*

CO2 : *Design and test synchronous sequential circuits for the given specifications with maximum of two inputs and sixteen states using flip flops.*

CO3 : *Design and test Arithmetic and logic circuits like adder, subtractor and comparator using logic gates.*

CO4 : *Design and test asynchronous counter and frequency divider using flip flops.*

CO5 : *Test interfacing circuits for TTL and CMOS logic families*

CO6 : *Design and test Code converters using logic gates*

LIST OF EXPERIMENTS

Design and Implementation of digital circuits using digital I.C.'s

1. Interfacing TTL and CMOS Circuits.
2. Design and Implementation of Adders and Subtractors
3. Design and Implementation of Serial adder and Parallel adder
4. Design and Implementation of Magnitude Comparator
5. Design and implementation of ALU
6. Design and Implementation of Digital Clock
7. Design and Implementation of Multiplexer, Demultiplexer
8. Design and Implementation of combinational circuits using Multiplexer.
9. Design and Implementation of Encoder and Decoder
10. Design and Implementation of Synchronous Counters
11. Design and Implementation of Asynchronous Counters
12. Design and Implementation of Registers and PRBS Generators
13. Design and Implementation of Code converters
14. Design and Implementation of Error Detection and Correction circuits

15EEM41 - NUMERICAL METHODS RANDOM PROCESS AND VECTOR SPACES

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Familiar in the ideas of applying numerical methods for solving system of equations and ODE.*

CO2 : *Find solution of second order PDE using finite difference approximation.*

CO3 : *Know the two dimensional random variables and curve fitting and how these designs are used to test the various attributes in Engineering and Technological Applications.*

CO4 : *Know about the concept of Random Processes, Meaning, Properties Importance and Applications of them.*

CO5 : *Understand the concepts of vector spaces, linear transformation, Inner product space and analyses the engineering problem.*

NUMERICAL METHODS - I

Linear simultaneous equations : Gauss Elimination method - Gauss Jordan Elimination method - Crout's method - Gauss Seidal method - Relaxation method.

Ordinary differential equations (First order only) : Taylor's series - Modified Euler's - Runge - Kutta fourth order methods - Milne's predictor - Corrector method . **(6+6)**

NUMERICAL METHODS - II

Finite difference approximations - Solution of second order PDE - Laplace equation - Liebmanns iteration process - Poisson equation - Parabolic equation - Bender Schmidt and Crank - Nicholson methods - Hyperbolic equation - Explicit method.**(6+6)**

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 - Regression - Curve fitting - Least square technique, only curve of the form or reducible to the forms : $y = ax+b$; $y = ax^2 + bx + c$ **(6+6)**

RANDOM PROCESSES

Classification of random processes - Special classes of Random processes - Average values of Random processes - Stationarity - Analytical representation of random processes - Auto correlation function and its properties - Cross Correlation function and its properties - Ergodicity - Mean Ergodic theorem - Correlation Ergodic process - Distribution Ergodic process - Power spectral density function and its properties. **(6+6)**

VECTOR SPACES & LINEAR MAPPING

Definition of vector spaces - Linear dependence and independence - Sub spaces - Basis and Dimension of vector space - Representation of linear maps by matrices - Rank and Nullity of linear transformation - Inner product space properties - Cauchy Schwartz inequality - norm and its properties - Introduction of orthogonal basis and Gram - Schmidt - Orthogonalization process.

(6+6)

TOTAL : 30 + 30 = 60

TEXT BOOKS

1. *Srimanta pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press India, 1st Edition, 2015.*

2. *David C. Lay, "Linear Algebra and its Applications ", Pearson Education, 3rd Edition, 2010.*

3. *Veerarajan T , "Probability Statistics and Random Process', Tata McGraw Hill Publishing company Ltd, 3rd Edition, 2007.*

4. *Krishnamurthi V., et al., "An Introduction to Linear Algebra", Affiliated East West Press, 2004.*

REFERENCES

1. Kapoor .J.N and Sabena. H.C., "Mathematical Statistics", S.Chand and Company, 12th Edition, 2003.

2. Grewal .B.S., "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2007.

3. Kenneth Hoffman and Ray Kunze "Linear Algebra", Pearson Education, Prentice Hall, 2nd Edition, 3rd Imprint, 2008.

4. Stephen, H and Friedberg, "Linear Algebra", Prentice Hall of India (PHI), 2003.

5. Trivedi, K.S., "Probability and Statistics with Reliability, Queuing and Computer Science Applications", Prentice - Hall Inc., Englewood Cliffs, New Jercy, 2003.

6. Free eBook: Kenneth Hoffman and Ray Kunze, "Linear Algebra", Pearson Education, Prentice Hall, 2nd Edition, 3rd Imprint, 2008.

7. http://www.plouffe.fr/simon/math/Mathematics%20%20Linear%20Algebra%20%28Prentice -Hall,%20Edition%202,%201971%29.pdf

8. http://nptel.ac.in/courses/111106051/

15EE41 - NETWORKS AND SYNTHESIS

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Understand graph theory concepts and solve circuit theory problems*

CO2 : *Apply the concept of complex frequency in studying network functions and analyse two port network parameters using various models.*

CO3 : *Formulate mathematical models for linear systems and circuits and also determine the solution using state variable approach.*

CO4 : *Identify the given function for positive realness and synthesize reactive one port RC and RL network using Foster and Cauer methods.*

CO5 : *Design constant k, m derived filters and Attenuators.*

NETWORK TOPOLOGY

Basic definitions of a network graph - Oriented graph - Sub graph - Planar graph - Path and Circuit - Tree and its properties - Cut sets - Incidence matrix - Circuit matrix - Cut set matrix - Fundamental circuit or Tie set matrix - Fundamental cut set matrix. Network analysis using graph theory: Formation of network equations - Network equilibrium equations on the basis of loop analysis - Network equilibrium equations on the basis of node analysis - Application to DC networks.   **(6+6)**

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 - 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.   **(6+6)**

STATE VARIABLE ANALYSIS

State, State variables and State space - State space models - Continuous time models - State space models applicable for electric circuits - Classification of circuits in state variable analysis - State variable analysis of circuits with controlled sources - Solution of state equation - Formation of state equations using network graph theory - Zero state response of the state vector - Complete response of state vector.   **(6+6)**

ELEMENTS OF REALIZABILITY AND SYNTHESIS OF ONE - PORT NETWORKS

Hurwitz polynomials - Positive real functions - Frequency response of reactive one ports - Synthesis of reactive one ports by Foster method and Cauer method - Synthesis of RL and RC networks by Foster method and Cauer method.   **(6+6)**

FILTERS AND ATTENUATORS

Classification of filters - Filter networks - Equations of filter networks - Classification of pass band and stop band - Characteristic impedance in pass and stop bands - Constant K low pass, high pass, band pass and band elimination filters - Limitations of constant K filters - M - derived filters - Composite filter. Attenuators: T type, π type, Lattice, Bridged T and L type attenuators.

(6+6)

TOTAL : 30 + 30 = 60

TEXT BOOKS

1.   Ravish R. Singh, *"Network Analysis and Synthesis"*, TMH, New Delhi, 1st Edition, 2013.

2.   Sudhakar A. and Shyammohan S.P., *"Circuits and Networks: Analysis and Synthesis"*, TMH, New Delhi, 2011.

3.   Roy D.Choudhury, *"Networks and Systems"*, New Age Publications, New Delhi, 4th Edition, 2010.

REFERENCES

1. *Franklin F. Kuo, "Network Analysis and Synthesis" Wiley India Pvt. Ltd., New Delhi, 2nd Edition, 2012.*

2. *Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Series, TMH, New Delhi, 2011.*

3. *Chakrabarti A, "Circuit Theory: Analysis and Synthesis". Dhanpat Rai& Co. (P) Ltd, 6th Edition, New Delhi, 2014.*

4. *Paranjothi.S.R. "Electric Circuit Analysis" New Age International (P) Ltd., 4th Edition, New Delhi, 2010.*

5. *Free ebook: Norman Balabanian "Network Synthesis", Prentice Hall, 1958.*
   http://www.csun.edu/~ih20409/SCHOOL1/BALABANIAN16.pdf,
   http://nptel.ac.in/video.php?subjectId=108105065

15EE42 - SYNCHRONOUS AND INDUCTION MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Predetermine the voltage regulation of synchronous generator and analyze load sharing of alternators.

CO2 : Describe the starting methods and characteristics of synchronous motors and discuss two reaction theory.

CO3 : Discuss the types, torque - slip characteristics of three phase induction motor and analyze their performance.

CO4 : Discuss the types, torque - slip characteristics of single phase induction motor and analyze their performance.

CO5 : Describe various starting, speed control and braking methods of three phase induction motors.

SYNCHRONOUS GENERATOR

Constructional features - EMF equation - Phasor diagram - Armature reaction - Synchronous impedance - EMF, MMF & ZPF methods of predetermining voltage regulation - Parallel operation of Alternators - Synchronization and load division. **(9)**

SYNCHRONOUS MOTOR AND TWO REACTION THEORY

Principle of operation of synchronous motor - Starting methods of synchronous motors - Phasor diagram - Effect of load - Characteristics of synchronous motor - V curves and Inverted V curves - Two reaction theory of salient pole alternator - Phasor diagram - Power - angle characteristics - Determination of X_d and X_q. **(9)**

THEORY AND OPERATION OF THREE PHASE INDUCTION MOTORS

Constructional features - Torque equation - Phasor diagram - Equivalent circuit - Performance analysis - Torque - slip characteristics - No load and blocked rotor tests - Load test - Equivalent circuit - Circle diagram. **(9)**

STARTING, SPEED CONTROL AND BRAKING OF INDUCTION MOTORS

Starting methods of squirrel cage and wound rotor induction motors - Speed Control of squirrel cage and wound rotor induction motors - Crawling - Cogging - Electric Braking - Induction Generator (Qualitative treatment only). **(9)**

SINGLE PHASE INDUCTION MOTORS

Principle of operation of single phase induction motor - Double revolving field theory - Equivalent circuit - Determination of equivalent circuit parameters and Performance characteristics - Methods of starting - Capacitor start, Capacitor start and run, Shaded pole and Repulsion motors - Universal motor. **(9)**

TOTAL : 45

TEXT BOOKS

1. *M.G.Say, "The Performance and Design of Alternating Current machines", CBS Publishers and Distributors, New Delhi, 2002.*

2. *I.J. Nagarath and D.P.Kothari, "Electrical Machines", Tata McGraw Hill, 2nd Edition, 2006.*

REFERENCES

1. *S.K Bhattacharya, "Electrical Machines", McGraw Hill, New Delhi, 2008.*

2. *P.K.G. Mukherjee and S.Chakraborthi, "Electrical Machines", Dhanpat Rai and Sons, New Delhi, 1990.*

3. *P.S. Bhimbra, "Electrical Machinery", Khanna Publishers, 2003.*

4. *Cyrill. G. Veinott, "Fractional and Subfractional Horse Power Electric motors", TMH Publishers, 1996.*

5. *Free ebook: Ralph. R. Lawrence, "Principles of alternating current machinery", McGraw Hill, New York.*

   http://djm.cc/library/Principles_of_Alternating_Current_MachineryLawrence_edited.pdf

6. *http://nptel.ac.in/courses/108106072/1*

15EE43 - MEASUREMENTS AND INSTRUMENTATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Reproduce the functional elements and characteristics of Measuring instruments and Transducers.*

CO2 : *Describe the working principle of measuring instruments and choose appropriate measuring instruments for electrical, magnetic and non - electrical measurements.*

CO3 : *Correlate the significance of different measuring instruments, recorders and oscilloscopes.*

CO4 : *Apply various modes of telemetry, display and recording techniques for data acquisition.*

CO5 : *Develop a micro - controller based measuring unit for any practical application.*

INTRODUCTION

Functional Element of Generalized Measurement System - Static and Dynamic Characteristics - Measurement Standards - Transducers - Types - Factors influencing choice of Transducers - Principles and classification of Transducers - Electrical Transducers - Basic requirements of Transducers - Calibration - Introduction to MEMS and Smart Sensors. **(9)**

ELECTRICAL AND MAGNETIC MEASUREMENTS

Measurement of Voltage and Current - PMMC Instruments - Moving Iron Instruments - Dynamometer Type Wattmeter - Instrument Transformers - Induction Type Energy Meter - Measurement of R, L and C - Wheatstone, Kelvin, Maxwell, Anderson and Schering Bridges - Flux Meter - Determination of BH Curve and Hysteresis Loop - Maximum Demand Indicator - Electrodynamometer Power Factor Meter - Weston Frequency Meter - Synchroscope - Megger. **(9)**

MEASUREMENT OF NON ELECTRICAL QUANTITIES

Introduction - Strain gauge - Gauge factor - Types - Resistive Potentiometers - L.V.D.T - Variable Inductance and Capacitance Transducers - Piezo Electrical Transducers - Hall Effect Transducer - Opto Electronic Transducers - Classification of Flow Meters - Electromagnetic Flow Meter - Anemometers - Ultrasonic Flow Meters - Introduction to Temperature Measurement - Resistance Thermometers - RTD - Thermocouples - Thermistor - Application. **(9)**

ELECTRONIC MEASURING INSTRUMENTS

Analog CRO, Digital Storage Oscilloscope - Bistable Storage Oscilloscopes - Fast Storage Oscilloscopes - Multichannel Storage Oscilloscope - Signal Generator - Introduction to Arbitrary Waveform Generator - DVM - Digital Multi - Meter - Digital Frequency Meter - Harmonic Analyzer - Digital Energy Meter. **(9)**

DATA ACQUISITION, TELEMETRY AND DISPLAY DEVICES

Block Diagram of PC based Data Acquisition System - Methods of Telemetry - Land Line Telemetry - RF Telemetry - Multiplexing - Time Division Multiplexing - Frequency Division Multiplexing, Recorders - Galvanometer Type Recorders - Potentiometer Recorders - X - Y Recorder - Digital Tape Recorder - Dot Matrix Displays. **(9)**

TOTAL : 45

TEXT BOOKS

1. *A.K.Sawhney, "A Course in Electrical and Electronic Measurements", Dhanpat Rai and Sons, New Delhi, 2004.*

2. *Ernest O. Doeblin, "Measurement Systems - Applications and Design", McGraw Hill, 2001.*

REFERENCES

1. *H.S.Kalsi, "Electronic Instrumentation", Tata McGraw Hill Co., 2002.*

2. *A.D.Cooper and A.D.Helfrik, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, New Delhi, 2001.*

3. *S.Ramabhadran, "Electrical Measurements and Instruments", Khanna Publishers, New Delhi, 1993.*

4. *Moorthy, D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., 1995.*

5. *S.K.Singh, "Industrial Instrumentation and Control", Tata McGraw Hill Publishers, 2nd Edition, New Delhi, 2003.*

6. *http://nptel.ac.in/courses/108105064/*

15EE44 - LINEAR INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Explain various processing steps involved in CMOS IC fabrication and circuit elements.*

CO2 : *Summarize the DC/AC characteristics and compensation techniques of an operational amplifier*

CO3 : *Understand the working and design of various linear applications using op - amp IC741.*

CO4 : *Understand the working and design of various non - linear applications using op - amp IC741.*

CO5 : *Understand the working and design of analog circuits such as voltage regulator, VCO and multi - vibrators using other linear IC's.*

INTEGRATED CIRCUIT TECHNOLOGY

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. **(9)**

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 - Voltage follower - Summing, Scaling and Averaging amplifier - Inverting and Non - inverting amplifier - 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 - PLL - Applications - IC 566 Voltage Controlled Oscillators - IC 555 timer - Monostable and Astable mode of operations - Applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ramakant A.Gayakward, "Op - Amps and Linear Integrated Circuits", Prentice Hall of India, 4th Edition, New Delhi, 2007.*

2. *Roy Choudhury D and Shail Jain., "Linear Integrated Circuits", New Age Science Ltd., 4th Edition, 2010.*

REFERENCES

1. *Coughlin F.R. and Driscoll F.F., "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall of India, 6th Edition, New Delhi, 2001.*

2. *Sergio Franco, "Design with Operational Amplifiers and Analog and Integrated Circuits", Tata McGraw Hill Publishing Co., New Delhi, 3rd Edition, 2007.*

3. *Michael Jacob J., "Analog Integrated Circuit Applications", Prentice Hall of India, 1st Edition, New Delhi.*

4. *Sidney Soclof, "Design & Application of Analog Integrated Circuits", Prentice Hall of India, 1997.*

5. *David A. Bell, "Operational Amplifiers and Linear ICs", Oxford University Press, 2011.*

6. *Free eBook: Roy Choudhury D. and Shail Jain., "Linear Integrated Circuits", New Age Science Ltd., 4th Edition, 2010. http://noteshit.com/wp - content/uploads/2015/03/Linear - Integrated - Circuit - 2nd - Edition - D. - Roy - Choudhary.pdf*

7. *http://freevideolectures.com/Course/2915/Linear - Integrated - Circuits*

15EE45 - TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Quote the voltage standards, effects of corona, earthing for various transmission and distribution lines, the need for mechanical supports, insulators and sag in transmission lines.*

CO2 : *Compute the line parameters in single phase and three phase transmission lines, the potential gradient and capacitance in single and three core cables and tariffs for AC distribution systems.*

CO3 : *Model the short and medium transmission lines using nominal T and pi methods and analyze the regulation and efficiency under different loading conditions.*

CO4 : *Understand and choose the number of insulators to improve the string efficiency of transmission lines.*

CO5 : *Explain the types of cables, locate the cable fault using loop test and identify the substation/distribution system components from the layout.*

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.

(6+6)

LINE PERFORMANCE AND CORONA

Regulation and Efficiency 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. **(6+6)**

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. **(6+6)**

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.

(6+6)

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 - Substation - Types of substations - Layout and location of substations - Busbar arrangements - Introduction to substation automation protocols. **(6+6)**

TOTAL : 30 + 30 = 60

TEXT BOOK

1. *C.L. Wadhwa, "Electrical Power Systems", New Age International, 2010.*

REFERENCES

1. *Luces M.Fual Keribeery and Watter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 1996.*

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, 2007.*

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", Dhanpat Rai and Co., Delhi, 1997 - 98.*

6. *Toren Gonen, "Electrical Power Distribution", CBC, 2010.*

7. *Free eBook: TorenGonen, "Electric power distribution system engineering" McGraw Hill.*

8. *http://edsonjosen.dominiotemporario.com/doc/Livro_Electric_Power_Distribution_System_Engineering_ -_Turan_Gonen.pdf*

9. *http://www.nptelvideos.in/2012/11/power - sys - generation - transmission.html*

15EE46 - SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Analyze the performance of three phase and single phase induction machines experimentally by direct and indirect methods.*

CO2 : *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 : *Control speed of three phase induction motor using power electronic controllers.*

CO5 : *Draw the V - curves and Inverted V - curves of synchronous motor.*

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 non - salient pole alternator by Potier triangle method.

9. Predetermination of voltage regulation of three phase Salient pole alternator by slip test.

10. Determination of V and inverted V curves by synchronous motor.

11. Load test on cascaded induction motors.

12. Load test on Induction generators.

15EE47 - LINEAR INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Design and test regulated power supply for the given specifications using IC723, IC7805.*

CO2 : *Design and test waveform generators and wave shaping circuits using IC741 for the given specifications.*

CO3 : *Design and test the frequency response of first and second order filters using IC741.*

CO4 : *Design and test ADC and DAC circuits for the given specifications using IC741.*

CO5 : *Construct astable and monostablemultivibrator using IC555 timer for the given specification.*

CO6 : *Design and test various analog circuits for arithmetic operations using IC741.*

LIST OF EXPERIMENTS

To design and implement circuits using linear I.C's

1. DC and AC Characteristics of Operational Amplifier.

2. Design and Implementation - Linear applications of Operational Amplifier.

3. Design and Implementation of First order Filters.

4. Design and Implementation of Second order Filters.

5. Design and Implementation of Multivibrators using Operational Amplifier

6. Design and Implementation of IC 555 Timer Applications.

7. Design and Implementation of Precision Rectifier and Zero Crossing Detector.

8. Design and Implementation of Instrumentation Amplifier.

9. Design and Implementation of OP - AMP as Waveform Generators (Square, Triangle and Ramp).

10. Design and Implementation of Voltage Controlled Oscillator

11. Design and Implementation of Analog to Digital Converters

12. Design and Implementation of Digital to Analog Converters

13. Design of Regulated Power Supply.

14. Design and Implementation of Oscillator.

15EE48 - COMPREHENSIVE LEARNING

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : Model, simulate and/or fabricate simple electrical circuits.

CO2 : Model, simulate and/or fabricate simple electronics circuits.

CO3 : Recall and recite the technical concepts learnt during their industrial visits.

CO4 : Write a technical report on any given scientific topics.

CO5 : Associate as a team and ascertain the submitted report.

LIST OF ACTIVITIES

A. Modeling and Simulation of an Electrical system using a modeling tool

B. Modeling and Simulation of an Electronics system using a modeling tool

C. Industrial Visit and Report Writing

D. Technical Report Writing on Selected Topics Like

    i) Innovations in Battery Technologies for Portable Devices

    ii) Leveraging Multiphysics for Cost Effective and Successful Engineering Design

    iii) Energy and Environment

    iv) Technical Education and Rural Development

E. Team activity - Group discussion / Seminar Presentation on reports submitted.

15EE51 - POWER SYSTEM ANALYSIS

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Relate network parameters to mathematically model and diagrammatically express the power system network under healthy and faulty conditions.*

CO2 : *Apply mathematical equations to solve the load flow problems, charging line admittance, Transient analysis 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 power system network under open circuit and short circuit conditions.*

CO5 : *Derive the swing equation and find critical clearing angle to analyze the dynamics of power systems and understand the task of maintaining a reliable electric power systems.*

REPRESENTATION OF POWER SYSTEM COMPONENTS

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 - FDLF method - Introduction to Bus Voltage Control Methods using STATCOM and UPFC Devices. **(9)**

FAULT CALCULATIONS

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 - Grid collapsing concepts. **(9)**

TOTAL : 45+30 = 75

TEXT BOOK

1. *D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill, 2011.*

REFERENCES

1. *C.L. Wadhwa, "Electrical Power Systems", New Age International Ltd., 2010.*

2. *John J. Grainger and W.D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill, 2007.*

3. *B.R.Gupta, "Power System Analysis and Design", Wheeler Publishers, 3rd Edition, 2003.*

4. *HadiSaadat, "Power System Analysis", Tata McGraw Hill, Reprint, 3rd Edition, 2004.*

5. *B.M. Weedy, "Electric Power Systems", John Wiley, New York, 1987.*

6. *T.K. Nagsarkar and M.S. Sukhija, "Power System Analysis", Oxford University Press, 2007.*

15EE52 - CONTROL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1   :   Identify the basic components of a control system and determine the mathematical model of the system.

CO2   :   Analyze the response of the system using time domain and frequency domain techniques.

CO3   :   Determine the range of open loop gain for stability.

CO4   :   Choose suitable controllers to obtain desired response of the system.

CO5   :   Design compensators for the given system, satisfying the 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.   **(12)**

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 - Dynamic error coefficients - System response with additional poles and zeros.   **(6)**

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.   **(10)**

LINEAR SYSTEM DESIGN

Tuning of P, PI and PID controllers - Design of lag, lead and lag - lead compensators in frequency domain using bode plots.

(8)

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, 2012.

REFERENCES

1.   Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Private Ltd., 4th Edition, New Delhi, 2008.

2.   M.Gopal, "Control Systems - Principles and Design", Tata McGraw Hill Publishing Company Limited, 3rd Edition, New Delhi, 2008.

3.   Benjamin C. Kuo "Automatic Control Systems", Prentice Hall of India, 8th Edition, New Delhi, 2009.

4.   Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Prentice Hall, 10th Edition, NJ, 2008.

15EE53 - EMBEDDED SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Interpret register functionalities and identify the architectural features of PIC18Fxxx microcontroller and ARM processor.*

CO2 : *Use appropriate instructions and addressing modes to develop an assembly language program for data processing and accessing on - chip hardware units.*

CO3 : *Conceive organizational aspects and analyze three stage pipeline execution process.*

CO4 : *Illustrate the processor operations by citing examples with 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 given the 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 - ARM core dataflow model - Data path and control logic - Core State and Instruction Sets - ARM development tools - 3 stage pipeline ARM organization - 5 stage pipeline ARM organization - ARM instruction execution - ARM implementation - 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

Analogue input and output - Keypad interfacing - LCD Interfacing - Stepper Motor interfacing - Speed control of DC Motor - Measurement of frequency - Standalone data acquisition system - 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", Pearson Education, 1ˢᵗ Edition, 2008.*

REFERENCES

1. *Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier Inc., 2004*
2. *John Iovine, "PIC Microcontroller Project Book", McGraw Hill 2000.*
3. *John Crisp, "Introduction to Microprocessors and Micro controllers", Elsevier, 2ⁿᵈ Edition, 2004.*
4. *ARM Architecture, Reference Manual, ARM Ltd, 2016.*

15EE54 - DIGITAL SIGNAL PROCESSING

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Compute the response of any discrete time system for a given input signal using convolution technique.*

CO2 : *Apply z - transform and FFT techniques for processing digital signals.*

CO3 : *Design and implement digital IIR and FIR filters for the given specifications.*

CO4 : *Realize IIR filter and FIR filter structures.*

CO5 : *Employ digital signal processing techniques in musical sound processing systems.*

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+30=75

TEXT BOOKS

1. *Richard G. Lyons,"Understanding Digital Signal Processing",Prentice Hall, 3rd Edition, 2012.*
2. *Ashok Ambardar, "Analog and Digital Signal Processing",Thomson Asia Pvt. Ltd, 2nd Edition, Singapore, 2002.*

REFERENCES

1. *John G. Proakisand Dimitris G. Manolakis, "Digital Signal Processing: Principles Algorithm and Application", Prentice Hall of India, 3rd Edition, 2005.*
2. *P. Ramesh Babu, "Digital Signal Processing", Scitech Publication Pvt. Ltd., 4th Edition, Chennai, 2007.*
3. *Mitra Sanjit K., "Digital Signal Processing : A Computer Based Approach", Tata Mc Graw Hill, New Delhi, 2006.*
4. *TMS320LF2407/ Technical Reference Manual*

15EE55 - C++ IN ELECTRICAL ENGINEERING APPLICATIONS

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Obtain a systematic and comprehensive understanding of object oriented principles.*

CO2 : *Use algorithmic thinking to develop programs using C++ language.*

CO3 : *Develop programs using C++ constructs such as switch case, operators, control structures and library functions.*

CO4 : *Apply Object oriented principles such as data abstraction, encapsulation, polymorphism and overloading to develop programs.*

CO5 : *Develop program for specific electrical engineering application using object oriented principle.*

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. **(10)**

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. **(8)**

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+30 = 75

TEXT BOOKS

1. D.S.Malik, "C++ Programming: From Problem Analysis to Program Design", Cengage Learning, 7th Edition, 2015.

2. Larry Nyhoff,"Programming in C++ for Engineering and Science", CRC Press, Taylor and Francis Group, 2012. (For Electrical Engineering Applications)

REFERENCES

1. Stanley B. Lippman and JoséeLajoie, "C++ Primer", Addison - Wesley, 5th Edition, 2015.

2. Stephen Prata, "C++ Primer plus", Addison - Wesley, USA, 6th Edition, 2015.

3. BjarneStroustrup, "The C++ Programming Language", Pearson Education Inc, 4th Edition, 2015.

4. Joseph Valacich and Joey. G, "Essentials of Systems Analysis and Design", Pearson Education Inc., 2014.

ONLINE REFERENCES

1. MIT - open courseware
2. NPTEL materials

TUTORIALS

1. Basic Programs implementing Constructors, Destructors
2. Operator Overloading
3. Function Overloading
4. Multiple and Multi - level, Access Specifiers
5. Pure, Virtual Functions, Abstract Classes
6. Series RLC circuit transient analysis
7. Mesh and nodal analysis
8. Mason's gain formula
9. Determination of main dimensions for dc machine
10. File Handling - Tariff calculations.

15EE56 - CONTROL ENGINEERING LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

After successful completion of this course, 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.*

CO4   :   *Analyze the system response in frequency/time domain using MATLAB software.*

CO5   :   *Design embedded controller for second order systems and implement it using dsPIC.*

LIST OF EXPERIMENTS

1. Transfer Function of DC Motor.

2. Transfer Function of 2 phase AC Servo Motor.

3. Transfer function of magnetic levitation system

4. Frequency response and Time response plots using MATLAB.

5. Design of compensators using bode plots

6. PID controller using LabVIEW.

7. Modeling and System Identification of PMDC motor.

8. Speed control of PMDC motor using bode plot

9. PID tuning of PMDC motor using Ziegler - Nichols method

10. Speed control of PMDC motor using armature current.

15EE57 - EMBEDDED SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Translate the design requirements into Assembly Language Program.*

CO2 : *Devise an Assembly language program to Demonstrate Interfacing of display devices*

CO3 : *Select suitable sensor to meet the given specification and interface it with the microcontrollerto actuate certain output devices.*

CO4 : *Formulate an algorithm to implement 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. Code conversion (BCD to ASCII) for RTC implementation.

3. Parity checking for error detection.

4. Time out generation using on - chip timer module.

Programming ARM using embedded 'C' - prototyping using mbed LPC1768 device

1. Display interface (LED, LCD, Seven segment display)

2. Generating a sinusoidal and Saw tooth waveform

3. Controlling PWM period with analogue input (POT)

4. Interfacing DC motor

5. Interrupt programming

6. Configuring ADC Module (Sensor interfacing)

7. Stepper motor interfacing

REFERENCE

1. *http://ww1.microchip.com/downloads/en/DeviceDoc/39500a.pdf - PIC*

2. *http://ww1.microchip.com/downloads/en/DeviceDoc/51281F.pdf - PIC*

3. *https://developer.mbed.org/platforms/mbed - LPC1768/ - ARM*

15EE61 - GENERATION OF ELECTRICAL ENERGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Classify different types of loads and recognize 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 and develop 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, design, evaluate and justify the solar PV, wind, fuel cell and battery sources of energy for micro - grid installation 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, 2nd Edition, 2014

2.   Mukund R. Patel, "Wind and Solar Power Systems" CRC Press, New York, 2009

3.   S. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", Institution of Engineering and Technology (IET Press), 2010.

4.   Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI , Delhi, 2015

REFERENCES

1. Digambar M. Tagare, "Electricity Power Generation: The Changing Dimensions", John Wiley & Sons,2011

2. C.L.Wadhwa, "Electrical Power Systems", New Age International, 2007.

3. Joshua Earnest and Tore Wizelius, "Wind Power Plants and Project Development", PHI Learning Private Limited, New Delhi, 2011.

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.

15EE62 - POWER ELECTRONICS

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1   :   *Define the characteristics of the power semiconductor devices viz. DIODE, SCR, MOSFET, IGBT.*

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, 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 - Series and Parallel operation of power semiconductor switch (SCR only) - Introduction of SiC and GaN based power devices - Isolation - Introduction to driver circuits. **(6+6)**

AC - DC CONVERTERS

Introduction - Uncontrolled Rectifier - Limitations - phase angle control - Single phase and Three phase semi bridge and full bridge converters - Dual converters - Introduction of high pulse converters - Quadrants of operation - Estimation of performance parameters for continuous current operation - Effects of load and source inductances - Development of control circuit - Synchronization - Device selection. **(6+6)**

DC - DC CONVERTERS

Principle of chopper operation - Control strategies - Non - isolated switched mode regulators - Buck regulator - Boost regulator - Buck - Boost regulator - Cuk regulator - Comparison of regulators - Quadrants of operation - Isolated switch mode converters: Fly back Converter - Forward Converter - Bridge Converter - Control circuit - Device selection for DC - DC converters - Introduction to resonant power converters. **(6+6)**

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. **(6+6)**

DC - AC CONVERTERS

Principle of operation - Single phase series inverter - Parallel inverter - Bridge type 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 - Device selection - Introduction to multi level inverters - Introduction to active front converter (PWM Rectifier)

Applications: UPS - SMPS - HF induction heating - Electronic lamp ballast - LED Drivers **(6+6)**

TOTAL : 30 + 30 = 60

TEXT BOOKS

1. M.H.Rashid, "Power Electronics", Prentice of Hall of India, New Delhi, 4th Edition, 2014.

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.

REFERENCES

1. Robert W.Erickson and Dragan Maksimovic, "Fundamentals of Power Electronics", Springer International, 2nd Edition, 2005.

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, New York, 2011.

4. M.D.Singh and K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2011.

5. Joseph Vithayathil, "Power Electronics Principles and Applications", Tata McGraw - Hill Education, New Delhi, 2011.

6. G.K.Dubey., et al,"Thyristorised Power Controllers", New Age Publishers, Chennai, 2nd Edition, 2010.

7. L.Umanand, "Power Electronics: Essentials & Applications", Wiley India Pvt. Limited. New Delhi, 2009.

8. John.G.Kassakian,et.al, "Principles of Power Electronics", Pearson Education Asia, New Delhi, 2010.

9. http://nptel.ac.in/courses/108101038/ for Video Type.

10. http://nptel.ac.in/courses/webcourse - contents / IIT% 20 Kharagpur / Power%20 Electronics/ New_index1.html for Web type.

11. http://ocw.mit.edu/courses/electrical - engineering - and - computer - science/6 - 334 - power - electronics - spring - 2007.

15EE63 - DIGITAL PROTECTION OF POWER SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Explain the need of digital protection and power system components

CO2 : Describe the functional characteristics of different relays.

CO3 : Analyze travelling wave relays for EHV transmission lines

CO4 : Compare and select digital protection schemes for transmission line, synchronous machine and transformers.

CO5 : Discuss and classify numerical relaying algorithm for various protection schemes.

INTRODUCTION

Need for Power System Protection - Digital Protection: State of Art - Power System Components - Protective Schemes - Electro Mechanical Relays - Static Relays - Dual input comparator - Multi input comparator - Pilot relaying schemes. **(9)**

DIGITAL PROTECTION OF TRANSMISSION LINE

Protection of scheme of transmission line - Distance Relays - Travelling wave relays - Digital protection scheme based on fundamental signal - Digital protection of EHV/UHV Transmission line based upon Travelling wave Phenomena - New relaying scheme using amplitude comparison. **(9)**

DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR / TRANSFORMER

Introduction - Faults in synchronous generator - Protection schemes for synchronous generator - Digital Protection Synchronous generator - Faults in Transformer - Schemes used for transformer protection - Digital protection of Transformer. **(9)**

NUMERICAL RELAY

Introduction - Data Acquisition System (DAS) - Numerical Relaying Algorithm - Mann Morrison technique - Differential Equation technique - Discrete Fourier Transform Technique - Block pulse function technique - Numerical Over current Protection - Numerical Distance Protection - Numerical Differential protection. **(9)**

MODERN TRENDS IN POWER SYSTEM PROTECTION

Introduction - Gas Insulated Substation/switchgear (GIS) - Frequency relaying and Load shedding - Adaptive protection - Integrated protection and control - Relay reliability - Advantages of fast fault clearing **(9)**

TOTAL : 45

TEXT BOOKS

1. *L. P. Singh, "Digital Protection - Protective Relaying from Electromechanical to Microprocessor", New Age International Ltd., New Delhi, 2004.*

2. *Badri Ram and D.N.Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill publishing company Ltd., New Delhi, 2011.*

REFERENCES

1. *B.Ravindranath and M.Chander, "Power System Protection and Switchgear", New Age International Pvt. Ltd., New Delhi, 2011.*

2. *Stanley H.Horowitz and Arun G.Phadke, "Power System Relaying", John Wiley and Sons Ltd., 3rd Edition, 2013.*

3. *Bhavesh Bhalja, R.P. Maheswari, Nilesh G. Chothani, "Protection and Switch Gear", Oxford University Press, 2011.*

4. *C.L.Wadhwa, "Electrical Power Systems", New Age International Pvt. Ltd., 6th Edition, 2011.*

5. *M.L.Soni, P.V.Gupta and U.S.Bhatnagar, "A Course in Electrical Power", Dhanpat Rai and Sons, 2003.*

15EE64 - DATA STRUCTURES AND ALGORITHMS

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, 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 any algorithm 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. **(6+6)**

ADVANCED DATA STRUCTURES

Trees: Binary Tree - Tree Traversals - Binary Search Trees - AVL Trees - Splay Trees - B Trees - Red Black Trees. **(6+6)**

GRAPHS ALGORITHMS

Elementary Graph Algorithms - Minimum Spanning Trees - Topological Sorting - Single source Shortest Paths - All Pairs Shortest Paths. **(6+6)**

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. **(6+6)**

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 - Introduction to NP Problems. **(6+6)**

TOTAL : 30 + 30 = 60

TEXT BOOKS

1. *M A Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 3rd Edition, 2009.*

2. *Thomas H Cormen, Charles E Leiserson and Ronald L Rivest, "Introduction to Algorithms", MIT Press, 3rd Edition, Cambridge, Massachusetts, 2009.*

REFERENCES

1. *R G Dromey, "How to Solve it by Computers", Pearson Education Asia, 2005.*

2. *Robert L Kruse, Clovis L Tando and Bruce P Leung, "Data Structures and Program Design in C",Prentice Hall of India, 2nd Edition, 1996.*

3. *Jean Paul Trembley and Paul G Sorenson, "An Introduction to Data Structures with Applications",Tata McGraw Hill, 2nd Edition, 2007.*

15EE65 - POWER SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1   :   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.

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 Electromechanical relay
5.   Over Current detection using Static Over Current Relay
6.   Over/Under Voltage detection using Static Relay.
7.   Over/Under Frequency detection using Static Relay
8.   Earth Fault detection using Static relay.
9.   Differential Protection of transformer using Static Relay
10. Varley Loop test by using cable fault locator.
11. Stability Analysis on Relay Control System.
12. Power Quality Analysis (Sag and THD) using simulation software.

15EE66 - POWER ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Recall and reproduce the basic principles of power electronic devices.*

CO2 : *Test and infer the characteristics of converters and inverters for single phase, three phase and DC - DC Converters.*

CO3 : *Understand the pulse width modulation concepts for power electronics circuits.*

CO4 : *Estimate energy generation, evaluate I - V & P - V characteristics and efficiency of solar PV modules.*

CO5 : *Develop a reliable compatible software models for power electronic converters using PSIM/MATLAB/SIMULINK.*

LIST OF EXPERIMENTS

1. Steady State Characteristics of Power Electronic Devices

2. Load Test on Single Phase Half and Fully Controlled Bridge Converters

3. Load Test on Three Phase Half and Fully Controlled Bridge Converters

4. Study of Single Phase Dual Converter

5. Study of IGBT / MOSFET based Chopper

6. AC Phase Control using SCR and TRIAC

7. Load Test on Single Phase Cyclo Converters

8. Load Test on Series and Parallel Inverter

9. Load Test on IGBT / MOSFET based Single Phase Inverter

10. Load Test on Three Phase PWM Inverter

11. Load Test on Buck, Boost and Buck - Boost Converter.

12. Simulation of Power Electronic Converters using PSIM/MATLAB - SIMULINK.

13. Resonant DC - DC Converter.

14. a) Micro Controller Based Fault Detection in Converter Circuits.

    b) Study of Static Circuit Breakers.

15. Power Quality study on Non - Linear Loads.

16. Generation of Control Pulses for Power Electronic Converters using DSpace.

15EE67 - MINI PROJECT

L	T	P	C
0	0	4	2

ASSESSMENT : VIVA - VOCE

COURSE OUTCOME

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

CO1   :   *Understand the problems in societal and environmental contexts and to provide the technical support for sustainable development without affecting the nature.*

CO2   :   *Acquire practical knowledge within the chosen area of technology for project development.*

CO3   :   *Identify, Analyze, Formulate and Design a real time project with a comprehensive and Systematic approach by using modern tools.*

CO4   :   *Contribute as an individual or in a team in development of technical projects and to improve their effective team management and financial management skills through project activities.*

CO5   :   *Develop effective communication skills for presentation and to develop plagiarism free technical writing skills of project related activities*

15EE71 - UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY

L	T	P	C
3	2	0	4

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : State illumination standards, choose proper illumination and interpret energy conservation measures.

CO2 : Select traction motor by its characteristics, discuss their energy output and consumption in railways and outline the concept of aircraft electrical system

CO3 : List and explain heating, welding methods in detail and use different applications of electrolytic process.

CO4 : Design lighting of interior and electrodes used for heating

CO5 : Prepare energy audit report and interpret protocols to prevent global warming.

CO6 : Analyze the energy conservation methods through case studies.

ILLUMINATION

Laws of illumination - Calculation of illumination - Street lighting and Flood lighting - MSCP - Choice of Lighting - Different types of illumination sources and Energy efficiency - Control of Lighting - Lighting standards for industry and Commercial - Energy conservation measures for lighting.   **(9)**

ELECTRIC TRACTION

Choice of an Electric Motor - Traction Motors - Characteristic - Systems of railway electrification - Power and Energy output from driving axles - Specific Energy output and consumption - Electric Braking - System of railway electrification - Aircraft electrical system   **(9)**

HEATING, WELDING AND ELECTROLYSIS

Methods of electric heating - Resistance heating - Arc Furnaces - Induction heating - Dielectric heating. Electric Welding Types - Resistance welding - Arc welding - Electric oven heating. Faraday's laws of Electrolysis - Application 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 case of CDM - Bachat Lamp Yojna and Industry; Prototype Carbon Fund (PCF).   **(9)**

CONSERVATION OF ELECTRICAL ENERGY

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 + 30 = 75

TEXT BOOKS

1. *C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt. Ltd., 2012.*

2. *J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.*

REFERENCES

1. *Dr.N.V.Suryanarayana, "Utilisation of Electric power", Wiley Eastern Limited, New Age International Limited, 2004.*

2. *R.K.Rajput, "Utilisation of Electrical Power", Laxmi publications (P). Ltd., 2007.*

3. H.Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi,2004.

4. Luces M, Fual Keribeery, Watter Coffer, "Electrical power Distribution and Transmission", Pearson Education, 1996.

5. Hamies, "Energy Auditing and Conservation; Methods, Measurements, Management & Case Study", Hemisphere, Washington, 1980.

6. CB Smith, "Energy Management Principles", Pergamon Press, New York, 1981.

7. Bureau & Energy Efficiency, "Energy Efficiency in Electrical Utilities", Guide Book for National Certification Examination for Energy Managers and Energy Auditors, New Delhi, 2013. (www.bee - india.nic.in)

15EE72 - SOLID STATE DRIVES AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Analyze the characteristics of motors, load dynamics and performance parameters of DC and AC drives for different applications.

CO2 : Adjust the drive parameters to match the characteristics of the motor with load.

CO3 : Select the suitable drive according to industrial and environmental standards and also develop the control schemes for any electric drive.

CO4 : Apply the suitable speed control technique for DC motors, AC induction and synchronous motors by using solid state controllers in DC and AC drives.

CO5 : 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 power rating for drive motor based on thermal overloading and Load variation factors - Load Equalization - Starting, Braking and Reversing for various types of drive motors. **(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

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 - Power factor considerations **(12)**

SYNCHRONOUS MOTOR DRIVES

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 mills - Machine tools - Control system for Elevators and Cranes. **(10)**

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.*

REFERENCES

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. *Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 2008.*

5. *G.K.Dubey, "Power Semiconductor Controlled Drives", John Wiley and Sons, New York, 1999.*

6. *M.S.Berde, "Electric Motor Drives", Khanna publishers, New Delhi 1997.*

7. *P.C. Sen, "Thyristor DC Drives", John Wiley and Sons, New York, 1981.*

8. *J.M.D. Murphy, "Thyristor Control of AC Motor", Paragon Press, London, 1978.*

15EE73 - INDUSTRIAL AUTOMATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, 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 : *Construct the mathematical plant model, use modern tools to simulate, evaluate and improve the system.*

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

Fundamentals of Industrial Automation and Control Elements - Principles and Strategies - Types of Production - Functions - 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). **(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)**

MODELING AND SIMULATION OF PLANT AUTOMATION

Introduction - Overview of process models - Model based automatic control - System modeling - Development of mathematical model of plant - Modern tools for modeling and simulation of systems - Model evaluation and improvement - Application examples - Power system and Electrical automation. **(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)**

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, Industry 4.0 strategy - IoT in industrial control applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Krishna Kant, "Computer - Based Industrial Control ", Prentice Hall of India Pvt. Ltd., New Delhi, 2010.*

2. *Mikell. P. Groover, "Automation Production Systems and Computer Integrated Manufacturing", Pearson India Eduction Series Pvt. Limited, 4th Edition, New Delhi, 2016.*

REFERENCES

1. *David W. Pessen, "Industrial Automation: Circuit Design and Components", Wiley India Pvt. Ltd., New Delhi, 2011.*

2. *Ian G. Warnock, "Programmable Controllers operation and Application", Prentice Hall International, UK, 2008.*

3. *Richard, L. Shell, "Hand book of Industrial Automation", CRC Press New York, 2009.*

4. *K.L. Sharma,"Overview of Industrial Process Automation", Elsevier, 2011.*

5. *Tan KokKiong and AndiSudjana Putra, "Drives & Control for Industrial Automation", Springer, 2010.*

6. *W.Bolton, "Programmable Logic Controllers", Elsevier, Fifth Edition, 2011.*

7. *Frank D.Petruzella, "Programmable Logic Controllers", McGraw Hill, 2nd Edition, 2008.*

8. *Curtis D.Johnson, "Process Control Instrumentation Technology", Pearson India Education Services Pvt. Ltd., 8th Edition, 2015.*

9. *Evelio Padilla, Eleunion, "Substation Automation Systems: Design and Implementation", John Wiley & Sons Ltd., 2016.*

10. *www.fieldbus.org*

11. *www.honeywellprocess.com*

12. *https://www.automation.com/portals/advancing - automation - using - iiot - and - industry - 4.0 - concepts*

15EE74 - FPGA BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Distinguish different types of FPGA, recognize the challenges and understand the methodologies for FPGA design*

CO2 : *Interconnect logic elements of FPGA to synthesize digital circuits for the given requirement.*

CO3 : *Design and test a FPGA based digital signal processor for the given specifications.*

CO4 : *Use Verilog programming techniques to develop programs based on structural, behavioral and dataflow models for digital circuits.*

CO5 : *Design combinational and sequential circuits for the required specifications and develop Verilog programs to test the functionality of the designed circuit.*

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)**

VERILOG HDL

Hardware Description Languages - Verilog Description - Modules - Assignment - Always block - Delays - Data Types and Operators - Behavioral and Structural Verilog - Constants - Arrays - Loops - Testing Verilog Program **(9)**

HARDWARE MODELING USING VERILOG

Combinational logic design: Decoders - Encoders - Multiplexers - Demultiplexers - Adders / Subtractors - Comparators - Sequential logic design: Flip - Flops - Synchronous and Asynchronous counters - ALU/CPU. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Wayne Wolf , "FPGA Based System Design" , Prentice Hall , Pearson Education, Inc. 2004.*

2. *Charles Roth, Lizy K. John, ByeongKil Lee , "Digital Systems Design Using Verilog", Global Engineering, 1st Edition, 2014*

REFERENCES

1. *Stephen D Brown, "Fundamentals of Digital Logic", TMH Publication, 2007*

2. *John. F. Wakerly , " Digital Design", Pearson Education, India, 2012*

3. *S. Trimberger, "Field Programmable Gate Array Technology", Kluwer Academic Publications,1994*

4. *Bob Zeidman, "Designing with FPGAs and CPLDs", Elsevier publications, 2002.*

15EE75 - ELECTRIC DRIVES LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Select a drive for a particular application that based on power rating and characteristics of the application.*

CO2 : *Experimentally determine the braking characteristics of DC shunt motor and Induction motor.*

CO3 : *Understanding 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 : *Realize 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 DC Motor using Four Quadrant Chopper fed Drive
5. Speed Control of Induction Motor using Scalar and Vector Controlled Drive
6. Speed Control of DC Motor using Universal Motor Drive
7. DSP Based Speed Control of Three Phase Squirrel Cage Induction Motor
8. PLC based Speed Control of Three Phase Induction Motor drive
9. Performance analysis of Solar PV based DC and AC Pump
10. Study of BLDC Drives
11. Energy Saving of Air Compressor using AC Drive
12. Speed Control of AC Motor using Matrix Converter
13. Speed Control of Switched Reluctance Motor Drive
14. Speed Control of Servo Motor Drive.

15EE76 - FPGA BASED SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOME

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

CO1 : *Create appropriate truth table from the description of given logic function*

CO2 : *Create gate level implementation of the given logic function described by the truth table*

CO3 : *Develop suitable verilog programs for the gate level implementations obtained.*

CO4 : *Simulate and Verify the functionality using Xilinx simulation tool.*

CO5 : *Port the verilog program onto the given FPGA board and study various metrics such as speed, gate count, area and power dissipation.*

LIST OF EXPERIMENTS (SIMULATION AND PORTING ON FPGA BOARD)

For the Following Experiments, Design and Develop Verilog programs, Simulate using Xilinx and Port the same on the given FPGA board

Language : VERILOG

Software : Xilinx

FPGA Board: Spartan 3E, Spartan 6

1. Priority encoder
2. 4 bit ripple adder
3. 8 bit counter
4. 4 bit shift register.
5. Decoder.
6. Multiplexer.
7. Full - adder.
8. Parity checker.
9. 4 bit ALU
10. Boolean expression realization
11. Magnitude comparator
12. Wallace Multiplier

15EE81 - PROJECT WORK AND VIVA VOCE

L	T	P	C
0	0	14	7

ASSESMENT : VIVA - VOCE

COURSE OUTCOME

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

CO1 : *Analyze, Estimate and Manage a project within a stipulated project time line*

CO2 : *Refresh the electrical engineering fundamental concepts and principles related to the project work.*

CO3 : *Enhance the management skills to achieve the project goal by working as a team and also improve technical writing skills.*

CO4 : *Demonstrate the technical skills to provide feasible solutions for real - life problems.*

CO5 : *Know the importance of project management tools and the various costs associated with it.*

15EEE01 - DESIGN OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Classify the materials used for the construction of electrical machines and be able to calculate the MMF in magnetic parts of rotating machines.*

CO2 : *Derive the output equation and able to determine and choose appropriate parameters for designing the main dimensions of DC and AC machines.*

CO3 : *Capable of evaluating the procedure for the design of other major part of the DC and AC rotating machines.*

CO4 : *Equipped to apply in - depth knowledge related to the design of overall dimensions, core, windings, tank and cooling tubes of transformer.*

CO5 : *Estimate the no - load current and find the electrical parameters of three phase induction machine and transformers.*

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. Single phase induction motor: Main dimensions - Design of stator - Rotor design.   **(9)**

TRANSFORMERS

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 Tank and Cooling tubes - Design of inductors.   **(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.*

REFERENCES

1.   *R.K.Agarwal, "Principles of Electrical Machine Design" - S.Kataria & Sons, 4th Edition, New Delhi, Reprint, 2003.*

2.   *S.K.Sen, "Principles of Electrical Machine Design" - Oxford & IBH pub. Co. Pvt. Ltd., 2nd Edition, 2001.*

3.   *M.V. Deshpande, "Design and Testing of Electrical Machines", PHI Learning Private Limited, Delhi, 2013.*

4.   *V.N. Mittle, "Design of Electrical Machines", Standard Publishers Distributors, 2005.*

5.   *Juha Pyrhones, Tapans Jokines,"Design of Rotating Electrical Machines", John Wiley and Sons, 2009.*

15EEE02 - SPECIAL ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Explain the construction and working principle of Stepper motor, Reluctance motor, Permanent magnet motor and Linear motors.*

CO2 : *Derive the torque equation of Stepper motor, Reluctance motor and Permanent magnet motor.*

CO3 : *Describe the open loop and closed loop speed control of Stepper motor, Reluctance motor and Permanent magnet motor.*

CO4 : *Design the main parts of Stepper motor, Switched reluctance motor and Permanent magnet DC motor.*

CO5 : *Choose appropriate Special machines in computerized machining, Robotics and Aviation.*

STEPPER MOTORS

Constructional features - Principle of operation - 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 - Design procedure: Basic Design inputs - Motor Sizing - Optimization of Magnetic circuit - Hybrid stepper motor design example. **(9)**

RELUCTANCE MOTORS

Switched Reluctance Motors: Constructional features - Principle of operation - Torque equation - Power controllers - Characteristics and control. Microcontroller based controller - Sensorless control - Derivation of output equation - Selection of main dimensions - Number of phases, poles - Ratio of pole arc to pole pitch.

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 - Sensorless control - Design choices: Interior and Exterior rotor - Number of phases - Stator and rotor poles - Simplified motor design. **(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.*

REFERENCES

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 - 1994

3. Kenjo T, "Power Electronics for the Microprocessor Age", Oxford University Press, 1990.

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.

15EEE03 - MODELING AND ANALYSIS OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the fundamentals of electromagnetic energy conversion for singly and doubly excited systems.*

CO2 : *Reproduce the voltage and torque equation of DC and AC machines.*

CO3 : *Analyze standard methods to determine accurate modeling/simulation parameters for various general - purpose electrical machines.*

CO4 : *Summarize the static and rotating reference frames and transformation between reference frames.*

CO5 : *Examine the steady state operation and dynamic operation for load variation for induction and synchronous machines.*

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.

REFERENCES

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.

15EEE04 - DIGITAL CONTROL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Explain the basic concepts of digital control, sampling and reconstruction of signals.

CO2 : Determine the stability of the discrete - time systems and design a stable system using root locus and frequency response plots.

CO3 : Design 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 a continuous system into discrete form, design suitable digital controllers and estimators under deterministic and stochastic conditions

INTRODUCTION

Basic concepts of digital control system - Analog to Digital conversion - Digital to Analog conversion - Quantization - Sample and hold devices - Zero order hold and first order hold - Multiplexing - Sampling and sampling theorems - Choice of sampling period - Pulse Transfer function of the ZOH - Applications - Digital simulation of ZOH and FOH. **(9)**

STABILITY ANALYSIS IN Z PLANE

Jury's stability test - Schurcohn stability test - Bilinear transformation and Routh stability criterion - Transient and Steady state response analysis - Dead beat response. **(9)**

DESIGN OF DISCRETE TIME CONTROL SYSTEMS

Design based on root locus method - Effect of adding poles and zero's to the open loop transfer function - Frequency response methods - Analytical response method. **(9)**

DISCRETE STATE SPACE ANALYSIS

Introduction - State space representation of discrete systems - Canonical forms - State transition matrix - Solving discrete time equations - Pole placement by state feedback controller - Observer - Digital simulation of state variable model - Pole placement design by state feedback - Full order and reduced order observer design. **(9)**

STATE ESTIMATION

Introduction to probability theory - Least squares estimation - Weighted least squares estimation - Recursive least square estimation - Propagation of states and variances - Discrete Kalman filter - Extended Kalman filter - Unscented Kalman filter.

(9)
TOTAL : 45

TEXT BOOKS

1. *Katsuhiko Ogata, "Discrete Time Control Systems", Pearson Education, Asia, 2nd Edition, Singapore, 2002.*

2. *Dan Simon, "Optimal State estimation", A John Wiley & Sons Inc. Publications, 2006.*

REFERENCES

1. *Benjamin C. Kuo, "Digital Control Systems", Oxford University Press, 2nd Edition, 2007*

2. *Gopal M, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Co. Ltd., 3rd Edition, New Delhi, 2009.*

3. *Gene F.Franklin, J.David Powelland, Michael Workman, "Digital Control of Dynamic Systems", Addison Wesley Longman, 3rd Edition, 2006.*

4. *Astrom and Wittenmark, "Computer Controlled systems - Theory and Design", Prentice Hall Inc.,3rd Edition, 1997.*

15EEE05 - SYSTEMS THEORY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, 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 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 processes.*

STATE VARIABLE REPRESENTATION

Linear physical system - State space representation - Non uniqueness of state model - Linearization of a non - linear system - Degree of freedom - Impulse response for LTI systems - Transfer function to state space conversion - Controllable Canonical form, Observable Canonical form, Jordan Canonical form - Solution of non - homogeneous state equations. **(10)**

CONTROLLABILITY AND OBSERVABILITY

Controllability and Observability - Stabilisability and Detectability - Pole Placement by State Feedback - Full Order and Reduced Order Observers - Role of Eigen values and Eigen vectors - Design of controller and observer for tank system. **(9)**

STABILITY

SISO and MIMO systems - Interaction and Decoupling of control loops - Lyapunov stability - Eigen value conditions - BIBO stability - BIBO versus Lyapunov stability. **(8)**

OPTIMAL CONTROL SYSTEM

Linear Quadratic regulator - LQR design example - Stochastic Linear Quadratic Gaussian Estimation - Optimal Set Point Control - Algebraic Riccati Equation. **(9)**

ADVANCED CONTROL SYSTEM

Elements in a feedback controlled system - Dynamic behavior of feedback controlled processes. Systems with dead time - Feed forward control - Cascade control - Adaptive control. **(9)**

TOTAL : 45

TEXT BOOK

1. *Hespenha, "Linear System Theory", Princeton University Press, 2009.*

REFERENCES

1. *M. Gopal, "Modern Control System Theory", New Age International, 2005.*

2. *K. Ogata, "Modern Control Engineering", PHI, 2010.*

3. *Wilson J Rugh, "Linear System theory", PHI,1996.*

4. *B.Wayne Bequette, "Process Control: Modeling, Design, and Simulation", Prentice Hall of India, 2004*

5. *George Stephanopolus, "Chemical Process Control", Prentice Hall India,2000*

6. *John S. Bay, "Fundamentals of Linear State Space Systems", McGraw - Hill, 1999.*

7. *D. Roy Choudhury, "Modern Control Systems", New Age International, 2005.*

8. *John J. D'Azzo, C. H. Houpis and S. N. Sheldon, "Linear Control System Analysis and Design with MATLAB", Taylor and Francis, 2003.*

9. *Z. Bubnicki, "Modern Control Theory", Springer, 2005.*

15EEE06 - EMBEDDED CONTROL OF ELECTRIC DRIVES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Understand the fundamentals and control of DC,AC and Special machines drive.*

CO2 : *Illustrate underlying Converter and Inverter principles for electric drives.*

CO3 : *Devise the control circuit for DC, AC and Special machines drive.*

CO4 : *Design and Develop speed control algorithm for the given specifications by selecting appropriate sensors.*

CO5 : *Ascertain embedded controller for electric drive based on design requirement.*

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 - Power electronic converters for drives - Modern trends in industrial drives and control - Motor Control Sensors - Voltage, Current and Speed sensing - PWM signal generation - 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 of DC drives - 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

Induction Motor Drives: 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 - Development of speed control algorithm for AC drives using digital signal controllers. **(9)**

SYNCHRONOUS MOTOR DRIVE

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 - Development of speed control algorithm for Synchronous motor drive using digital signal controllers. **(9)**

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: Principals 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 Special Electrical Machines drive using digital signal controllers. **(9)**

TOTAL HOURS : 45

TEXT BOOKS

1. Bose B K, "Modern Power Electronics and AC Drives", Pearson Education Pvt. Ltd, New Delhi, 2014.

2. Vedam Subramaniam, "Electrical Drives and Applications", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.

3. G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd Edition, 2002.

4. Werner Leonhard, "Control of Electric Drives", 3rd Edition, Springer, 2001.

REFERENCES

1. Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 2008.

2. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press, Taylor & Francis Group, 2010.

3. Richard Valentine, "Motor Control Electronics Handbook", McGraw Hill, New York, 2006.

4. Hamid A. Taliyat, Steven Campbell, "DSP - Based Electromechanical Motion Control", SRS Press, 2004

5. Ertan, H.B., Üçtug, M.Y., Colyer, R., Consoli, A. (Eds.), "Modern Electrical Drives", Nato science series E, 2000.

6. G.K. Dubey, "Power Semiconductor Controlled Drives" John Wiley and Sons, New York, 1999.

7. Data Manual of "TMS320 F 28335 Digital Signal Controllers", Texas Instruments, 2012. Available in http:www/ti.com/DSC.

8. 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.

9. 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.

10. M.N.Cirstea,et.al, "Neural and Fuzzy Logic Control of Drives and Power Systems" Newnes - An imprint of Elsevier Science, Oxford, 2012.

15EEE07 - ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Expand skills in identifying the presence of electrical hazards, implementing measures to minimize risks.*

CO2 : *Develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.*

CO3 : *Analyze and apply various grounding and bonding techniques.*

CO4 : *Select appropriate safety method for low, medium and high voltage equipment.*

CO5 : *Assess and provide solutions to a practical case study.*

INTRODUCTION AND HAZARDS OF ELECTRICITY

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's 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's 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 BOOKS

1. *John Cadick, Mary Capelli - Schellpfeffer, Dennisneitzel, "Electrical Safety Handbook", Mcgraw Hill Publishing Company Ltd.,3rd Edition, 1994.*

2. *Dennis Neitzel and Al Winfield, "Electrical Safety Handbook", McGraw - Hill Education, 4th Edition, 2012.*

REFERENCES

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.   James H. Wiggins JR., "Managing Electrical Safety",Abs Consulting, Maryland, 2011.

5.   Maxwell Adams.J, "Electrical safety - a guide to the causes and prevention of electric hazards", The Institution of Electric Engineers, 1994.

6.   Ray A. Jones and Jane G. Jones, "Electrical safety in the workplace", Jones & Bartlett Learning, Technology and Engineering,2000.

7.   Video Link: Electrical Safety in the workplace seminar DVD - NFPA National fire protection association. http://www.nfpa.org/training - and - events/archived/training - videos/electrical - safety - videos

8.   E - Book: Johncadick, Marycapelli - schellpfeffer, Dennisneitzel, "Electrical Safety Handbook",McGraw Hill publishing company Ltd., 3rd Edition, 1994.

https://installist.files.wordpress.com/2009/12/electrical - safety - handbook.pdf

15EEE08 - SMART GRID

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Apply and associate the concept of electronic control in generation, transmission and distribution of electrical energy*

CO2 : *Interface suitable power electronic converters in the WMPCS and select appropriate compensation methods for solar PV, micro - hydro, wind and battery storage connected micro - grids.*

CO3 : *Select suitable data management protocols and extend security features as related with power quality issues in smart grid.*

CO4 : *Diagnose and control the grid quality using different communication algorithms / systems*

CO5 : *Decide on pricing and energy consumption connected to smart grid.*

INTRODUCTION

Review Basic Elements of Electrical Power Systems - Evolution of Electric Grid - Definitions - Today's Grid Vs the Smart Grid - Need for 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 - Diverse perspectives from experts and global Smart Grid initiatives - 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 - Plug in Hybrid Electric Vehicles (PHEV). **(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 - 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. **(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 - Sample Micro Grid Test Bed Environment - Effects of Micro Grids - Case Study for Renewable Energy Resource Integration: Smart city - Description of Smart Grid Activity - Approach for Smart Grid Application - Benchmarking - Economics and Market Operations - Pricing and Energy Consumption Scheduling - Wheeling Prices - Sample Design. **(9)**

TOTAL : 45

TEXT BOOKS

1. James Momoh, "Smart Grid - Fundamentals of Design and Analysis", IEEE Press, John Wiley & Sons, INC., New Jersey, 2012.

2. 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. Ali Keyhani, "Design of Smart Power Grid Renewable Energy System", IEEE Press, John Wiley & Sons, INC, New Jersey, 2011.

2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", Taylor and Francis Group, CRC Press, 2009.

3. Stuart Borlase, "Smart Grids: Infrastructure, Technology and Solutions", Taylor and Francis Group, CRC Press, 2013.

4. Stephen F. Bush, "Smart Grid : Communication - Enabled Intelligence for the Electric Power Grid", Wiley - IEEE Press, 2014

5. Uslar, "Standardization in Smart Grids: Introduction to IT related Methodologies, Architectures and Standards", Wiley Publication, 2013.

15EEE09 - POWER QUALITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Understand the concept of utility distribution and industrial electric power quality phenomena.*

CO2 : *Gain collective knowledge on transient phenomena.*

CO3 : *Understand the causes and consequences of short and long interruptions and learn about the mitigation techniques.*

CO4 : *Describe the source, effects and mitigation of harmonics, earthing and bonding system.*

CO5 : *Understand the need for monitoring the power quality and assess the power quality measurement data for any industrial plant.*

INTRODUCTION TO POWER QUALITY

Power Quality - Need for power quality - Sensitive loads - Nonlinear loads - Inter connected power systems - Deregulation - Power Quality Characteristics - Power Quality disturbances - Types : 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 Utilities and End user of electrical power - Power quality standards - Computer Business Equipment Manufacturers Associations (CBEMA) and ITIC curves, Cost of Poor Power Quality. **(8)**

TRANSIENTS

Introduction - 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 - 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. **(10)**

HARMONICS AND GROUNDING

Harmonics - Description of the Phenomena - Parameters - Voltage Distortion - Current Distortion - Definitions and terms - Sources of Voltage and Current Harmonics - Effects of Harmonics - Guidelines for harmonics voltage and current limitation - IEEE and IEC standards. 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 - Reason 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. **(11)**

POWER QUALITY MONITORING AND SURVEY

Introduction - Power quality monitoring - Monitoring Considerations - Evolution of power quality monitoring - Brief introduction to power quality measurement equipment - Planning, Conducting and Analyzing power quality survey - Assessment of power quality measurement Data - Utility - Customer interface. Introduction to thermography in power quality assessment - Industrial Case Studies - Power quality monitoring standards. **(7)**

TOTAL : 45

TEXT BOOKS

1. Roger.C. Dugan, Mark.F. McGranagham, Surya Santoso and H. Wayne Beaty, "Electrical Power Systems Quality", Tata McGraw Hill, 2012.

2. Math. H.J. Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", John Wiley and Sons, 2011.

REFERENCES

1. Angelo Baggini, "Handbook of Power Quality", John Wiley & Sons, New York 2011.

2. Barry W. Kennedy, "Power Quality Primer", McGraw Hill Publications, New York. 2006.

3. C.Sankaran, "Power Quality", CRC Press, New York, 2011,

4. J.Arrillage, N.R.Watson and S.Chen, "Power System Quality Assessment", John Wiley & Sons, New York, 2000.

5. Short.T.A, "Distribution Reliability and Power Quality", CRC Press, Taylor and Francis Group, 2006.

6. Bhim Singh, Ambrish Chandra, Kamal Al. Hadded, "Power Quality: Problems and Mitigation Techniques", John Wiley and Sons Ltd., 2015.

7. George J. Wakileh, "Power System Harmonics : Fundamentals, Analysis and Filter design", Springer, 2006.

8. Ewald F. Fuchs and Mohammad A.S. Masoum, "Power Quality in Power systems and Electrical Machines", Academic Press - Elsevier, 2008.

9. Arindam Ghosh and Gerard Ledwich, "Power Quality Enhancement using Custom Power Devices", Springer International Edition, 2010.

10. Derek.A.Paice, "Power Electronic Converter Harmonics: Multipulse Methods for Clean Power", IEEE Industrial Application Society, IEEE Press, New York, 1996.

15EEE10 - HIGH VOLTAGE TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the layout of HVAC and HVDC systems and choose when and where to use EHAV/HVDC transmission systems in practice.*

CO2 : *Explain the losses associated with transmission lines and suggest the appropriate conductors to meet out the losses.*

CO3 : *Design and implement of circuitry for various controllers used in HVDC transmission systems.*

CO4 : *Plan an appropriate electric power transmission system between two destinations to satisfy the pre - defined load requirement without compromising the technical performance*

CO5 : *Comment over the causes of over voltage and suggest the methods of protection.*

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. **(12)**

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. **(11)**

TOTAL : 45

TEXT BOOK

1. S.Rao, "EHVAC and HVDC Transmission and Distribution Engineering (Theory, Practice and Solved Problems)", Khanna Publishers, 3rd Edition, 2004.

2. Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Publishers, 3rd Edition, 2006.

REFERENCES

1. T.J.E.Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 2010.

2. G.K.Dubey, S.R.Doraida, A.Joshi and R.H.K.Sinha, "Thyristorised Power Controllers", New Age International Publishers, 2012.

3. K.R. Padiyar, "HVDC Power Transmission Systems", New Age International Publications, 3rd Edition, 2017.

15EEE11 - POWER AND ENERGY MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1   *:*   *Understand the vital role of power and energy side demand in current scenario.*

CO2   *:*   *Synthesis the monitoring and planning methods of energy management.*

CO3   *:*   *Select suitable energy conservation methods to reduce the wastage of power.*

CO4   *:*   *Contribute minimum energy cost without affecting the production and quality.*

CO5   *:*   *Recognize the opportunities for increasing use of efficient energy.*

INTRODUCTION

Global energy scenario - Role of energy managers in industries - Energy forecasting - Limitations of energy resources - Renewable energy recourses - 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 - Defining monitoring & targeting, Elements of monitoring & targeting - 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 fans, water heaters and coolers, HVAC and FACTS. Demand side: Energy conservation in Lighting, Motors, Pumps and Fan systems - Energy efficient motors. **(9)**

TOTAL : 45

REFERENCES

1. *D. P. Sen Gupta, K. R. Padiyar, Indranil Sen, M.A, "Recent Advances in Control and Management of Energy Systems", Interline Publishers, Bangalore, 1993.*

2. *Amlan Chakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2012.*

3. *Y P 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.

6.   Hamies, "Energy Auditing and Conservation: Methods, Measurements, Management & Case study", Hemisphere, Washington, 1980.

7.   Diamant R.M, "Total Energy", Pergamon Press, Oxford Press, 1970.

8.   Albert Thumman, "Fundamentals of Energy Engineering", Prentice Hall, May 1984

9.   Larry C Whit et.al, "Industrial Energy Management & Utilization", 1st Edition, Springer, 1988.

10.   "General Aspects of Energy Management and Energy Audit", BEE Guide book, 2010.

11.   http://www.serviciilocale.md/public/files/Energy_Management_Handbook.pdf

12.   https://resourceefficiency.files.wordpress.com/2009/11/handbook_of_energy_audits.pdf

15EEE12 - ENERGY STORAGE TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the global energy scenario and recognize the need for energy storage systems.*

CO2 : *Categorize the types of batteries and infer their usage for different applications.*

CO3 : *Describe the electric and magnetic energy storage systems and compare their relevance in various applications.*

CO4 : *Classify the different types of thermal energy storage system and explain their concepts.*

CO5 : *Explain the working of fuel cells, flywheel and evaluate the energy storage technologies for power plant and heating applications.*

GLOBAL ENERGY SCENARIO AND NEED FOR ENERGY STORAGE

Energy consumption in various sectors, Projected energy consumption for the next century, Exponential increase in energy consumption and Impact of exponential rise in energy consumption on global economy. Environmental issues: Ozone layer depletion and Global warming. Need for energy storage - Types of energy storage - Comparison of different energy storage technology.   **(9)**

ELECTROCHEMICAL ENERGY STORAGE SYSTEMS

Batteries: Basic concepts - Battery performance - Safety issues. Types of Batteries: Primary, Secondary, Lithium, Solid - state and Molten solvent batteries; Lead acid batteries - Nickel Cadmium Batteries - Sodium ion batteries - Modern Batteries - Battery management system - Energy management system.   **(9)**

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 and Application - Role of activated carbon and Carbon nano - tube.   **(9)**

THERMAL ENERGY STORAGE

Fundamental concepts - Types - Phase Change Materials (PCMs) - Selection criteria of PCMs. Solar Thermal Latent Heat TES systems - Energy conservation through LHTES systems - LHTES systems in refrigeration and air - conditioning systems. Enthalpy formulation - Numerical heat transfer in melting and freezing process.   **(9)**

OTHER ENERGY STORAGE TECHNOLOGIES AND APPLICATIONS

Fuel cells: Principle - Difference between batteries and fuel cells - Types of Fuel cells. Flywheel energy storage - Pumped storage system - Hydraulic storage - Applications: Power plant applications, Green house heating, Heating applications in Industry, Food Preservation, Energy storage in conventional and non - conventional energy systems - Pump storage systems.

(9)

TOTAL : 45

REFERENCES

1. Glaize, C, "Lithium Batteries and other Electrochemical Storage Systems", Wiley Publications, 2013.

2. Ru - shiliu, Leizhang and Xueliang sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley publications, 2012

3. Ibrahim Dincer and Mark A. Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons, 2002.

4. Robert A. Huggins, "Energy Storage", Springer Publication, 2010

5. Kordesch K and Simader G, "Fuel Cell and Their Applications", Wiley - Verlag publisher, Germany 1996.

6. James Larminie and Andrew Dicks, "Fuel Cell Systems Explained", Wiley Publications, 2003.

7. A.V.Desai, "Energy Economics", Wiley Eastern limited, Tokyo, 1990.

15EEE13 - ADVANCED POWER ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Recall the concept of resonant converters, harmonics, power line disturbances and reactive power control in electric systems.*

CO2 : *Generalize the zero switching concept and classify the resonant converters and also define how to link resonant converter with real time applications.*

CO3 : *Discuss the role of current harmonics and define the harmonic standards and also discuss the importance of improved utility interface.*

CO4 : *State the importance of power conditioners and define the various power conditioner equipment.*

CO5 : *Describe and Modeling the FACTS controllers. Identify the FACTS controllers for series and shunt compensation*

EMERGING POWER SEMICONDUCTOR DEVICES

Power MOSFETs - IGBT - IGCT - IGET - ETO - MOS Controlled thyristor and their power modules - Intelligent power modules - Thermal design - protection - gating circuits - digital signal processors used in gate control - New semiconductor materials for 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.

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)**

CUSTOM POWER DEVICES

Principles of reactive power control in load and its compensation - Series and Shunt reactive power compensation - Power quality mitigation devices: passive filters - active power filters - hybrid filters - Distribution Static Compensator (DTSTCOM) - Dynamic Voltage Restorer (DVR) - Universal Power Quality Conditioner (UPQC). **(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 BOOK

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics Converters, Applications and Design", Wiley India, 3rd Edition, New Delhi, 2012.

2. Arindam Ghosh and Gerard Led Wich, "Power Quality Enhancement using Custom Power Devices", International Edition, 2010.

REFERENCES

1. Timothy. J.E. Miller, "Reactive Power Control in Electric Systems", BSP Books Pvt. Ltd., New Delhi, 2010.

2. Mathur R.M., "Static Compensation for Reactive Power Control", Context Publication, Winnipeg, Reprint Edition, 1986.

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,2014.

5. P.C. Sen, "Modern Power Electronics", S.Chand Publishers, 2nd Edition, New Delhi, 2005.

6. N. G. Hingorani and L. Gyugyi, "Understanding FACTS",IEEE Press, Delhi, 2001.

7. A. I. Pressman, "Switch Mode Power Supply Design",McGraw - Hill, New York,2015.

8. Euzeli dos Santos, Edison R. da Silva, "Advanced Power Electronics Converters: PWM Converters Processing AC Voltages" Wiley - IEEE Press, Newyork,2014.

9. Bin Wu, "High - Power Converters and AC Drives", IEEE Press, A John Wiley & Sons, Inc Publication, New York,2006.

10. J. Arrillaga, Y. H. Liu and N. R. Waston, "Flexible Power Transmission - The HVDC Options", John Wiley & Sons Ltd, Chichester, UK, 2007.

11. Vijay K. Sood, "HVDC and FACTS Controllers - Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Massachusetts, 2004.

15EEE14 - ENERGY EFFICIENT LIGHTING SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Understand the properties of light, importance of lighting in various fields and types of lighting.*

CO2 : *Understand the properties and laws of illumination, working of discharge lamps, fluorescent lamps, tungsten filament lamps and light control techniques.*

CO3 : *Compare the various lighting techniques and employ sutiable lighting control methods for various applications.*

CO4 : *Choose the building materials and construction techniques for energy efficient lighting.*

CO5 : *Employ renewable energy methods for energy efficient lighting.*

LIGHTING

Lighting - Importance of lighting in buildings - Interior designing, Photography, Architecture - Difference between good and bad lighting - Challenges in lighting - Types of lighting. **(9)**

ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS

Introduction - Terms used in illumination - Laws of illumination - Polar curves - Photometry - Integrating sphere - Sources of light - Discharge lamps - Incandescent lamps - MV and SV lamps. **(9)**

ENERGY EFFICIENT LIGHTING

Smart lighting - Fluorescent lamps - Comparison between Tungsten filament lamps and Fluorescent tubes - Basic principles of light control - Types and design of lighting and flood lighting - CFL - LED - High Intensity Discharge lamps **(9)**

BUILDING MANGEMENT SYSTEM

Energy efficient landscape design - Natural lighting - Choice of building materials for energy efficient lighting - Light pipes - Light fixtures - Green buildings - Construction techniques. **(9)**

CASE STUDY

Solar lighting techniques - Lighting using wind power - Energy conservation building code - Energy efficient buildings in the country. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Philip Gordon., "Principles and Practices of Lighting Design: The Art of Lighting Composition", Blue Matrix Productions, 2011.*

2. *Jerry Yudelson, "Green Building Through Integrated Design" The McGraw - Hill Companies, Inc.,2009*

REFERENCES

1. *Derek Phillips, "Daylighting: Natural Light in Architecture", Elsevier, 2004*

2. *Jerry Yudelson , "Greening Existing Buildings", The McGraw - Hill Companies, Inc.,1st Edition, 2009.*

3. *Sam Kubba,"Handbook of Green Building Design and Construction", Elsevier Inc.,2012.*

4. *Solanki.C.S, "Solar Photovoltaic Technology and Systems", PHI, 2013.*

5. *J. F. Manwell, J.G. MC Gowan and A.L. Rogers, "Wind Energy Explained: Theory, Design and Application", Wiley, 2nd Edition, 2009.*

15EEE15 - REAL TIME EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Illustrate embedded and real time system development process.*

CO2 : *Conceive real time scheduling algorithms and Cite real life examples for real time systems*

CO3 : *Perform 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 system.*

CO5 : *Apply the embedded system design techniques to develop and debug solutions for real world 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

Foreground , Background Systems - Critical Sections - Resources - Tasks - Context Switching - Kernel - Round robin - Task priorities - EDF - RM scheduling - Deadlock - Intertask 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, 2012.*

2. *C.M.Krishna and Kang G.Shin, "Real Time Systems", Tata McGraw Hill, 2010.*

REFERENCES

1. *Philip A.Laplante, "Real Time Systems Design and Analysis: An Engineers Handbook", Prentice Hall of India, 3rd Edition, New Delhi, 2000.*

2. *Jean J.Labrosse, "MicroC/OS - II - The Real - Time Kernel", CMP Books, 2nd Edition, 2002.*

3. *Qing Li , "Real time Concepts for Embedded Systems ", CRC Press, 2003.*

4. *David E. Simon, "An Embedded Software Primer" Pearson Education, 1999.*

ONLINE RESOURCES

1. *http://nptel.ac.in/courses/108102045/*

2. *https://www.edx.org/course/embedded - systems - shape - world - utaustinx - ut - 6 - 03.*

15EEE16 - DIGITAL CONSUMER TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1   :   Understand the digitization of consumer products and global Marketing.

CO2   :   Describe the concepts of audio, video and digital display devices.

CO3   :   Compare the performance of the digital devices.

CO4   :   Categorize the digital devices for internet and PC and analyzetheir applications.

CO5   :   Analyze the applications of the digital devices and categorize the emerging consumer devices.

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

REFERENCES

1.   Bali S.P, "Consumer Electronics", Pearson Education, India,2010.

2.   Gupta R.G, "Audio Video systems", Tata Mc Graw Hill Publisher, 2010.

3.   Amit Dhir, "The Digital Consumer Technology - Hand book", Elsevier Publications, 2004.

4.   R.R Gulati, "Color Television - Principles & Practice" , Wiley Eastern Limited, New Delhi, 2003.

5.   Thomas M. Coughlin, "Digital Storage In Consumer Electronics", Elsevier Publications, 2008.

15EEE17 - ELECTRONIC PRODUCT DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, 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, 2012.

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.

REFERENCES

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. Halit Even, "Electronic Portable Instruments Design and Application", C.R.C. Press, Taylor and Francis group, 2003.

15EEE18 - MEDICAL ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the physiology and anatomy of human system.*

CO2 : *Review of learning Bio Electric Signal Measurement and Record.*

CO3 : *Recognize the technical concepts and operation of medical instrumentation.*

CO4 : *Discuss the clinical and laboratory medical aiding instruments.*

CO5 : *Choose the Safety Measures and discuss the internal circuitry of medical instruments and its maintenance.*

BIO - POTENTIAL ELECTRODES

Funtional Elements of Bio - Potential Measurements - Electrode electrolyte interface - Resting and action potentials - Polarization and Non - polarizable electrodes - Calomel electrode - Needle electrode - Microelectrode biological amplifiers - Lead systems and recording systems. **(9)**

CARDIAC SYSTEM

ECG sources - Normal and Abnormal waveforms - 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 - Recording and analysis of EMG waveforms - Muscle and nerve stimulation - Fatigue characteristics. **(9)**

RESPIRATORY AND CLINICAL LABORATORY MEASUREMENT AND VENTILATOR

Spirometer - Heart - Lung Machine - Oxygenators - Pnemograph - Artificial Respirator - IPR type - Functioning: Ventilators, Dialysis Machine - Blood Gas Analyser - PO_2, PCO_2, measurements. **(9)**

THERAPHATIC MONITORING AND DIAGNOSTIC INSTRUMENTS

Electromagnetic and Ultrasonic blood flow meter - Equipment of physiotherapy - Transcutaneous Electric Nerve Stimulator (TENS) - Ultrasonic therapy - Extra corporial shockwave lithotripsy - Diathermy - Audiometers - MRI and CT scan (Principle and Quantitative approach only) - Continuous patient monitoring system - Medical Equipment Maintenance and Management. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw - Hill, New Delhi, 2010.*

2. *Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 1997.*

REFERENCES

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, 1997.*

3. *Prof. Venkataram S.K, "Biomedical Electronics and Instrumentation", Galgotia Publications Pvt. Ltd., 2000.*

4. *Arumugam M, "Biomedical Instrumentation", Anuradha Publishers, 2003.*

15EEE19 - MULTIMEDIA SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, 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

REFERENCES

1. Fred Halsall and James F. Kurose, "Multimedia communication Applications, Networks, Protocols and standards", Pearson Education Limited, 2004.

2. Sayood Khaleed, "Introduction to Data Compression", Morgan Kauffman publication, 4th Edition, 2012.

3. Tay Vaughan, "Multimedia: making it work", TMH, 7th Edition, 2007.

4. Marcus Goncalves, "Voice over IP Networks", McGraw Hill Publisher, 1999.

5. Jerry D. Gibson, "Multimedia Communications: Directions and Innovations", Morgan Kaufmann Publication, 2nd Edition, 2001

6. David Solomon, "Data Compression the complete reference", Springer publisher, 4th Edition, 2007.

15EEE20 - ROBOTICS AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, 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 specific robot controller for various application.

CO5   :   Employ sensors for real time robotic application to include artificial intelligence in expertsystems.

INTRODUCTION

Introduction to robotics:Evolution of Robotics - Laws of Robotics - Classification - Robot Anatomy - Specification - Resolution - Repeatability and Precision movement. Introduction to robotic drives: Hydraulic, Electric and Pneumatic drives - Linear and Rotary actuators - End - Effectors.   **(6)**

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.   **(12)**

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 Noncontact 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.   **(12)**

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.   **(6)**

TOTAL: 45

TEXT BOOK

1.   *Deb. S. R, "Robotics Technology and Flexible Machine Design", Tata McGraw Hill Publisher, 2005.*

2.   *Fu K.S, Gonzalez RC and Lee CSG., "Robotics Control, Sensing vision and Intelligence", McGraw Hill Publisher, 1987.*

REFERENCES

1.   *Kozyrey Yu. "Industrial Robotics", MIR Publishers, Mascow, 1985.*

2.   *Mikell. P. Groover, Michell Weis, Roger. N. Nagel andNicolous 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.   *Ebook: Deb. S. R, "Robotics Technology and Flexible Machine Design", Tata McGraw Hill Publisher, 2005. https://www.accessengineeringlibrary.com/browse/robotics - technology - and - flexible - automation - second - edition*

5.   *NPTEL video link: http://nptel.ac.in/courses/112101099*

15EEE21 - COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the basic computer organization and to design a micro sequencer based control unit*

CO2 : *Explain and infer the various memory organizations*

CO3 : *Compare and analyze the various IO organizations*

CO4 : *Categorize the multiprocessor architecture and relate the performance*

CO5 : *Describe the concepts of parallel processing architecture*

BASIC COMPUTER ORGANIZATION

Instruction - Timing and Control - Instruction cycle - Fetching, Decoding and Execution of instructions - Register and Memory reference instruction - IO operations and Interrupt. **(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 - Programed 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, 2007.

2. John L Hennessy and David A Patterson, " Computer Architecture: A quantitative approach", Morgan Kaufmann publishers, 5th Edition, 2012.

REFERENCES

1. Kai Hwang and Faye A. Briggs, "Computer Architecture and Parallel Processing", Tata McGrew Hill, 2012.

2. Carl Hamacher, Zvonko Vranesic, Safwatzaky, "Computer Organization", McGraw Hill, 5th Edition, 2011.

3. John D Carpinelli, "Computer system Organization and Architecture", Pearson Education,India. 2012.

15EEE22 - DATA COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Explain need for OSI model and the functions performed by each layer of the OSI model*

CO2 : *Understand 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 INTERNETWORKINDG 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. *Behrouz. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill Publisher, 5th Edition, 2012*

2. *Curt White, "Fundamentals of Networking and Data Communications", Brooks /Cole Publishing Company, USA, 2013*

3. *William A.Shay, "Understanding Data Communications and Networks", Brooks /Cole Publishing Company, USA, 2008.*

REFERENCES

1. *A.S. Tanenbaum, "Computer Networks", Prentice Hall of India, 5th Edition, New Delhi, 2012*

2. *William Stallings, "Data and Computer Communications", Prentice Hall of India, 10th Edition, New Delhi, 2013.*

3. *Srikant and Lei Ying, "Communication Networks: An Optimization, Control and Stochastic Networks Perspective", Cambridge University Press, UK,2014*

4. *Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", Elsevier, 5th Edition, USA, 2012*

5. *Dimitri Bertzekas and Robert Gallager, "Data Networks", Prentice Hall of India", 2nd Edition, 2000.*

6. *S.Keshav,"An Engineering Approach to Computer Networking", Addision Wesley, 1999.*

7. *Open Source: http://www.nptel.ac.in/courses/106105082/*

15EEE23 - VIRTUAL INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the fundamental concepts of Digital and Virtual Instrumentation.*

CO2 : *Explain the interfacing of RS232, RS 422, RS 485 and USB standards with PC.*

CO3 : *Know about the implementation of various bus protocol.*

CO4 : *Choose the data acquisition components for the given application.*

CO5 : *Develop simple LabVIEW applications.*

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 on board 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, RS 422, RS 485 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 VIs and sub VI - Display types - Digital and Analog Chart - Oscilloscopic 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 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*

REFERENCES

1. *Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newness publications, 2000.*

2. *Sanjay Gupta and Joseph John, "Virtual Instrumentation using LabVIEW", Tata McGraw - Hill Inc, 2005.*

3. *Gary W. Johnson, Richard Jennings, "Lab - view Graphical Programming",McGraw Hill Professional Publishing, 4th Edition, 2011.*

15EEE24 - DATA ANALYTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Work with big data platform and its analysis techniques.*

CO2 : *Model a framework for Human Activity Recognition.*

CO3 : *Analyze the big data for useful business applications.*

CO4 : *Implement search methods and Visualization*

CO5 : *Identify and perform appropriate statistical test using R.*

TECHNOLOGY FOUNDATION FOR BIG DATA

Fundamentals of Big Data - Types of Big Data - Technology components - Virtualization - Cloud and Big Data.   **(9)**

BIG DATA MANAGEMENT

Operational database - Hadoop - Warehouses - Text analytics - Approaches for analysis of big data   **(9)**

BIG DATA IMPLEMENTATION

Integrating data source - Real time data stream - Security and Governance.   **(9)**

BIG DATA AND IoT (QUALITATIVE TREATMENT ONLY)

Introduction - Connected homes - Smart thermostats - Wearable's: Fitness bands - Real - time analytics and Industrial automation - Connected cities - Smart meters - Connected cars - Fleet management.   **(9)**

INTRODUCTION TO R

The R environment - R and statistics - R and the window system - Using R interactively - R commands, case sensitivity - Executing commands from or diverting output to a file - Data permanency and removing objects.   **(9)**

TOTAL : 45

TEXT BOOKS

1. Judith Hurwitz, Alan Nugent, and Dr. Fern Halper, "Big Data for Dummies", John Wiley & Sons, Inc, 2013.
2. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", Manual for R, Version 3.3.2, 2016.

REFERENCES

1. Goldman Sachs ,"Big Data Analytics and the Internet of Things", Datameer, 2015.
   Web - link: https://www.datameer.com/pdf/eBook - Internet - of - Things.pdf

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.
   Web - link: http://choonsiong.com/public/books/Beginning%20R.pdf

15EEE25 - FOG COMPUTING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Apply knowledge in systems, protocols and mechanisms which supports fog computing*

CO2 : *Explain major security and privacy problems in the fog computing scenarios and how they are addressed with the security mechanisms.*

CO3 : *Describe the high level architecture of fog computing models.*

CO4 : *Learn emerging concepts in fog computing which is related to electrical engineering.*

CO5 : *Design and implement a novel fog computing applications.*

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

Security and Reliability - Resource Management - Fault Tolerance - Power Consumption/ Energy Minimization. **(9)**

APPLICATIONS

Healthcare and Activity Tracking - Smart utility services - Augmented reality - Caching and Preprocessing - Cognitive systems and Gaming. **(9)**

TOTAL : 45

REFERENCES

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. 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*

3. *https://www.cisco.com/c/dam/en_us/solutions/trends/iot/docs/computing - overview.pdf*

4. *http://cdn.iotwf.com/resources/71/IoT_Reference_Model_White_Paper_June_4_2014.pdf*

5. *https://www.openfogconsortium.org/wp - content/uploads/OpenFog - Architecture - Overview - WP - 2 - 2016.pdf.*

6. *http://www.openfogconsortium.org/resources/#definition - of - fog - computing*

7. *http://telematics.tm.kit.edu/downloads/ForSem_2011_02_01_LIERS - VOLKERT.pdf*

8. *https://www.iaria.org/conferences2016/filesICSNC16/Softnet2016_Tutorial_Fog - MEC - Cloudlets - E.Borcoci - v1.1.pdf*

15EEE26 - STATISTICAL MODELING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Relate the concepts of statistical methods*

CO2 : *Infer the statistical models and develop the hypothesis*

CO3 : *Compare the advanced models and generalized model and analyze them.*

CO4 : *Assess and conclude the problem for the given samples*

CO5 : *Design and develop the models for engineering problems*

STATISTICAL LEARNING

Prediction - Statistical Decision theory - Statistical Models - Supervised Learning - Function approximation - Structured Regression Models - Classes of Restricted Estimators. **(9)**

REGRESSION TECHNIQUES

Simple Linear Regression - Multiple Linear Regression - Qualitative Predictors - Logistic Regression - Resampling Methods. **(9)**

TESTING OF HYPOTHESIS

Null and alternative hypothesis - Level of significance - One tailed and two tailed tests - Tests for large samples and small samples. **(9)**

INTRODUCTION TO R

The R environment - R and statistics - R and the window system - Using R interactively - R commands, case sensitivity - Executing commands from or diverting output to a file - Data permanency and removing objects. **(9)**

STATISTICAL MODELS IN R

Defining statistical modeling - Analysis of variance and model comparison - Updating fitted models - Generalized linear models - Nonlinear least squares and maximum likelihood models - Non - standard models. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning", Springer Texts in Statistics, 2016.*

2. *W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", Manual for R, Version 3.3.2, 2016.*

REFERENCES

1. *Trevor Hastie, Robert Tibshirani and Jerome Friedman "The Elements of Statistical Learning", Springer series in statistics, 2nd Edition, 2009.*

2. *Ebook: Dr. Mark Gardener "Beginning R: The Statistical Programming Language", 2012.*
   Web - link: http://choonsiong.com/public/books/Beginning%20R.pdf.

3. *Dirk P. Kroese, Joshua C.C. Chan, "Statistical Modeling and Computation", Springer Publication, 2014.*

4. *Barry Arnold, N Balakrishnan, Jose Maria Sarabia and Roberto Minguez,"Advances in Mathematical and Statistical Modeling", Springer Science & Business Media, 2009*

5. *Springer Science & Business Media Link. http://www - bcf.usc.edu/~gareth/ISL/*

6. *"Statistical Modeling: Applications and Recent Advances" .Stanford University http://statweb.stanford.edu/~ckirby/lai/pubs/ 2009_StatModeling.pdf*

15EEE27 - MULTICORE ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : Identify problems related to multiprocessing and describe the concepts of shared memory

CO2 : Explain the thread - level parallelism

CO3 : Describe the various programming models for multicore architecture and design of cache memory.

CO4 : Comprehend various memory architectures

CO5 : Develop various multicore programming models for given specifications.

SUPERSCALAR PROCESSORS

Fundamentals of Superscalar Processor Design - Introduction to Multicore Architecture - Chip Multiprocessing - Homogeneous Vs heterogeneous design - SMP - Multicore Vs Multithreading.   **(9)**

MEMORY ORGANIZATION

Shared memory architectures - Synchronization - Memory organization - Cache Memory - Cache Coherency Protocols - Design of Levels of Caches.   **(9)**

MULTICORE PROGRAMMING MODEL

Shared memory model - Message passing model - Transaction model - Open MP and MPI Programming.   **(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 Multicore architecture.   **(9)**

TOTAL : 45

REFERENCES

1. Hennessey & Paterson, "Computer Architecture A Quantitative Approach", Harcourt Asia, Morgan Kaufmann publication,USA,1999.

2. Joseph JaJa, "Introduction to Parallel Algorithms", Addison - Wesley publisher, 1992.

3. IBM Journals for Power 5, Power 6 and Cell Broadband engine architecture.2015.

4. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability and Programmability", McGraw - Hill Publications, 1993

5. Richard Y. Kain, "Advanced Computer Architecture: A System Design Approach", PHI, 1999

6. Rohit Chandra, Ramesh Menon, Leo Dagum, and David Kohr, "Parallel Programming in Open MP", Morgan Kaufmann Publication, 2000.

15EEE28 - INTERNET OF THINGS (IoT)

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Understand the architecture, emerging industrial infrastructure and challenges involved in deployment of IoT.*

CO2 : *Indicate the use of devices, gateways and hardware design constraints in IoT.*

CO3 : *Ascertain the design principles to realize enterprise integrated Web of Things*

CO4 : *Point out the technical design constraints involved in IoT based industrial automation*

CO5 : *Outline 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. **(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, VlasiosTsiatsis, 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

1. *Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", A - press Publications, 1st Edition, 2013.*

15CEE35 - DISASTER 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 : *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

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.*

REFERENCE BOOKS

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.*

15CEE36 - RENEWABLE ENERGY RESOURCES

	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 current energy scenario and future energy usage in India.*

CO2 : *Explain 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 : *Discuss 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 BOOK

1. *Sukathme, S.P, "Solar Energy", Tata McGraw-Hill Book Co., New Delhi, 1993.*

REFERENCE BOOKS

1. *Rai, G.D., "Solar Energy Utilization", Khanna Publishers, New Delhi, 1993.*
2. *Angrist, S.W, "Direct Energy Conversion", Allied Publishers Ltd., Boston, 1971.*

15CEE38 - ENVIRONMENTAL IMPACT ASSESMENT

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 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 ASSESMENT 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 ASSESMENT

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

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.*

15CEE39 - 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 WASTE AND e-WASTE

Sources - classification - effects of nuclear waste- initial treatment of nuclear waste - vitrification, ion exchange, synroc - long term management - above ground disposal, 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

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 Publication, 2002

15CEE40 - 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 : *Outline the concepts, components and factors affecting Sustainable development.*

CO2 : *Discuss the significance of International summits, conventions and agreements on Sustainable development.*

CO3 : *Describe the necessity and importance of Indian and International legal aspects in Sustainability.*

CO4 : *Illustrate the socio economic policies and public participation in Sustainable development.*

CO5 : *Discuss the role and commitment of developed countries in Sustainable development.*

CO6 : *Describe the concepts of Life cycle Assessment and Environmental Standards.*

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 -International Environmental summits, conventions and agreements- Action plan for Sustainable development- Transboundary issues - Role of developed and developing countries in sustainable development. **(9)**

ENVIRONMENTAL ASPECTS

Biodiversity- Types of biodiversity-Threats to biodiversity- Ecological indicators- Ecological foot print- Carbon foot print- Conservation biology- Strategic species concepts- Ecological economics- Environmental impact of agriculture, animal husbandry, fishery and land use- Habitat fragmentation- Desertification- Natural disasters, geological, hydrological, meteorological and health- Nuclear issues. **(9)**

ECONOMIC ASPECTS

Production, Consumption, Investment and Exchange of Goods and Services - Macroeconomic Aggregates, Circular Flow of Income and its Criticism- Methods of Calculating National Income- GNP and GDP- The Goods Market: determination of equilibrium output -Financial Markets: demand for money and interest rates- Goods and Financial markets: IS-LM Model- General Overview of Fiscal and Monetary Policies-relative effectiveness- International Transactions and exchange rates- Market failure & Incomplete markets Externalities -UN Sustainable development policies through trade- World Trade Organization- International monetary fund and World bank. **(9)**

SOCIAL ASPECTS

Indigenous Knowledge and Natural Resource Management (NRM) - Commodification, marginalization and degradation - Indigenous knowledge and its relevance to sustainable development - Biopiracy and Biopolitics over Traditional Ecological knowledge (TEK)- Environmental Degradation in developing countries - Overview of development- Globalisation and the structural adjustments- Governance and welfare state- Development processes and social justice -Social inequality as a global challenge- marginalized/vulnerable groups, indigenous people, resettlement & rehabilitation and development. **(9)**

STRATEGIES FOR SUSTAINABLE DEVELOPMENT

Economic growth, carrying capacity- Resource depletion and resource protection-Sustainable Management of Forest, Land, water, fishery, agriculture, energy and ecosystem- Natural Disaster management- Cleaner Production, definition, aim, application- Generic process of Cleaner Production Assessment- Life cycle Assessment- definition, necessity and elements- ISO Environmental standards- Environmental Audit. **(9)**

TOTAL : 45

TEXT BOOKS

1. Brian Snowdon and Howard R. Vane, "Modern Macroeconomics", Edward Elgar, USA, 2005

2. Gupta N.K., "Macroeconomics", National Council of Educational Research and Training, New Delhi, 2012

3. Arun Kumar, "Macroeconomic Aspects of Goods and Services Tax", Economic and Political Weekly, 2015

4. Ramakrishnan, P. S., "Ecology and Sustainable Development", National Book Trust, New Delhi, 2001

5. Paul Robbins, John Hintz, and Sarah A. Moore, "Environment and Society: A Critical Introduction", Wiley-Blackwell, 2014

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. Kolstad Charles D., "Environmental Economics", Oxford University Press, 2003

15CEE41 - SAFETY ENGINEERING IN BUILDINGS

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

After successful completion of the course, student will be able to

CO1 : *Demonstrate the safety concepts, policy and techniques.*

CO2 : *Demonstrate the issues related to physical and chemical hazards and control methods to reduce hazards.*

CO3 : *Outline the fire engineering and explosion control.*

CO4 : *Identify the method of safety provision in execution of civil works.*

CO5 : *Identify the safety consideration in erection and closing operations and material handling in civil construction works.*

CONCEPTS OF SAFETY ENGINEERING

Concept of safety - Evolution of modern safety concept- Safety policy - Safety Organization - line and staff - functions for safety- Safety Committee- budgeting for safety. Techniques- Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit. **(9)**

OCCUPATIONAL HEALTH AND HYGIENE

Physical hazards - Noise, noise exposure regulation, occupational damage, risk factors, and permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, control measures. Chemical hazards - Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, Methods of Control. Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases. **(9)**

FIRE ENGINEERING AND EXPLOSION CONTROL

Fire chemistry - Dynamics of fire behavior - Fire properties of solid, liquid and gas - Fire spread - Toxicity of products of combustion. Building evaluation for fire safety - Fire load -Fire resistance materials and fire testing -Structural Fire protection - Exits and egress. Statutory Rules and Techniques of fire fighting - Indian Explosive acts and rules -Techniques of fire fighting and demonstration. **(9)**

SAFETY IN CONSTRUCTION

General safety consideration - analyzing construction jobs for safety - Contract document -Safety certificate for statutory authorities for old building and construction. Safety in Erection and closing operation - Construction materials -Specifications - suitability - Limitations. Safety in typical civil structures - Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring. **(9)**

SAFETY IN MATERIAL HANDLING

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears. Selection, operation and maintenance of Industrial Trucks - Mobile Cranes - Tower crane -Checklist - Competent persons. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.*
2. *"Accident Prevention Manual for Industrial Operations", NSC 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.*

15MEOE01 - ROBOTICS

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 : *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 for a specific robot.*

CO3 : *Calculate mass and inertia for the links of a robot manipulator and also find its forward and inverse dynamics.*

CO4 : *Choose appropriate vision system for the robot and extract images for the desired output.*

CO5 : *Write a program to determine a path for obstacle avoidance for a specific task 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. **(6)**

GENERAL CONSIDERATION OF ROBOTIC MANIPULATORS

Introduction - Brief history of robotics- Robot geometrical configurations - wrist and gripper subassemblies - robot drive systems - robot software. **(7)**

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. **(13)**

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. **(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. **(10)**

TOTAL : 45

TEXT BOOK

1. *Fu.K S, Gonzales.R.C., and Lee.C.S.G., "Robotic Control, Sensing, Vision and Intelligence", McGraw Hill International, 2006.*

REFERENCE BOOKS

1. *Mikell.P.Groover, MitchellWeiss, Tooger.N.Nager, and NicholasG.Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill International, 2004.*

2. *Richard.D.Klafter, Thomas.A.Chmielewski, and Michaelnegin, "Robotic Engineering - An Integral Approach", Prentice Hall of India, 2002.*

15MEOE02 - LOW COST AUTOMATION

	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 : *Design and control simple automation systems using fluidics.*

CO2 : *Carry out design, selection and enhance existing automated system using fluidics.*

CO3 : *Demonstrate the importance of using electro mechanical systems in automation.*

CO4 : *Analysis and design of hydraulic circuits and some safety precautions in such circuits.*

INTRODUCTION

Fluid Power - Hydraulic and Pneumatic fluids - properties and selection. Advantages and applications of Fluid Power. **(2)**

HYDRAULIC PUMPS AND MOTORS

Symbolic representation of fluid power elements. Hydraulic pumps and motors- principle of working, calculation of discharge, power and efficiency - simple problems. **(8)**

HYDRAULIC VALVES

Pressure, flow and direction control valves, Electro hydraulic elements, accumulators, intensifiers, power calculations, size of accumulators - fluid seals - types and constructional details. **(8)**

BASIC HYDRAULIC CIRCUITS

Unloading, speed control, regenerative and sequencing circuits. Servo systems, typical hydraulic circuits for machine tools and other industrial applications. Circuit design for given functional requirements. **(9)**

PNEUMATICS

Air preparation units - Filter, Regulator and Lubricator. Valve configuration and controls. Pneumatic actuators, diaphragm actuators, back pressure sensors. Pneumatic circuits design - Cascade method. **(7)**

HYDRO PNEUMATICS AND ELECTRO PNEUMATICS

Hydro-pneumatics and electro-pneumatic elements and circuits, KV map method and Ladder diagram **(5)**

FLUIDICS

Fluidics - Coanda effect, wall attachment devices, digital and proportional devices. Fluidic amplifiers, typical application of fluidics for control in fluid power circuits. **(6)**

TOTAL : 45

TEXT BOOKS

1. *Anthony Esposito, "Fluid Power with Application", Prentice Hall,2008.*

2. *Stewart, "Practical Guide to Fluid Power", Taraporevala Sons & Co., Bombay, 2002.*

REFERENCE BOOKS

1. *Subir Kar, "An Introduction to Fluidics", Oxford and IBH Publishing Co., New Delhi, 1984.*

2. *Fitch, E.C. Jr., "Fluid Power and Control Systems", McGraw Hill Book Co., 1966.*

3. *Pippenger, J.J. and Hicks, T.G., "Industrial Hydraulics", McGraw Hill Book Co., 1979.*

4. *Andrew Parr, "Hydraulics and Pneumatics", Jaico Publishing House, 2008.*

15MEOE03 - ADAPTIVE CONTROL AND PROCESS DYNAMICS

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 : *Explain the different computer process control systems and its application.*

CO2 : *Develop the different digital controllers to suitable processes with or without time delay systems.*

CO3 : *Evaluate the advanced control concepts, system identification and process modeling.*

REVIEW OF SYSTEMS

Basic equation - Integral and instantaneous balances - Material and Energy balances - General form of dynamic models. Linearization of nonlinear systems in state space form - Response of lead-lag modules- Self-regulating system - transfer function analysis of higher order systems. **(6)**

SECOND ORDER SYSTEMS

A second order system - Pole-Zero cancellation - Systems in series - Blocks in parallel - linear boundary value problems - Parameter estimation of discrete linear systems. Phase plane analysis - generalization of phase plane behavior - nonlinear systems - Introduction to nonlinear dynamics - bifurcation behavior of systems **(9)**

APPLICATIONS

Stirred tank heaters, Absorption-isothermal, continuous stirred tank chemical reactors, Biochemical reactors - adiabatic continuous stirred tank reactor - ideal binary distillation columns. **(6)**

LINEAR DYNAMIC SYSTEM IDENTIFICATION

System Identification: Introduction, dynamic systems, models, system identification procedure. Simulation and Prediction. Non-parametric time and frequency domain methods. Linear dynamic system Identification: Overview, excitation signals, general model structure, time series models, models with output feedback, models without output feedback. Convergence and consistency. **(9)**

ADAPTIVE CONTROL

Parameter estimation methods, minimizing prediction errors, linear regressions and Least squares method, Instrumental - variable method, prediction error method. Recursive algorithms.Closed-loop Identification. Adaptive Control: Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback, pattern recognition, and correlation technique. **(9)**

ADAPTIVE ADVANCED CONTROL

Adaptive Smith predictor control: Auto-tuning and self-tuning Smith predictor. Adaptive advanced control: Pole placement control, minimum variance control, generalized predictive control. **(6)**

TOTAL : 45

TEXT BOOKS

1. *Bequette B.W., "Process Dynamics - Modeling, Analysis and Simulation", PHIPE, New Delhi, 1998.*

2. *Stephanopoulos G., "Chemical Process Control: An Introduction to Theory and Practice", Prentice Hall of India (P) Ltd., New Delhi, 2009.*

REFERENCE BOOKS

1. Shinsky F.G., "Process Control Systems: Application, Design and Adjustment", 3rd Edition, McGraw Hill Book Co., New York, 1988.

2. Nelles O., "Nonlinear System Identification", Springer Verlag, Berlin, 2011.

3. Ljung L., "System Identification: Theory for The User", Prentice Hall, Englewood Cliffs, 1999.

4. Astrom K., "Adaptive Control", Second Edition, Pearson Education Asia Pvt. Ltd., 2002.

15MEOE04 - PROJECT PLANNING AND MANAGEMENT

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 : *Evaluate and select the most desirable projects.*

CO2 : *Identify desirable characteristics of effective project managers.*

CO3 : *Apply appropriate approaches to plan a new project and develop a project schedule.*

CO4 : *Develop a suitable budget for a new project and Identify important risks.*

CO5 : *Apply appropriate techniques to assess ongoing project performance.*

INTRODUCTION

Project management- an overview, project identification and Screening; Project Appraisal. Introduction to Production Systems and a Generalized Model of Production. Life cycle of a Production System and Major managerial Decisions.　　　**(7)**

PROJECT PLANNING

Project Planning- Development of Project Network; Project Representation; Consistency and Redundancy in Project Networks; Project Scheduling- Basic Scheduling with A-O-A Networks; Basic Scheduling with A-O-N Networks; Project Scheduling with Probabilistic Activity Times.　　　**(7)**

TIME MANAGEMENT

Time/Cost Tradeoffs in Projects -Linear Time - Cost Tradeoffs in Projects: A Heuristic Approach; Resource Considerations in Projects - Resource Profiles and leveling. Limited Resource Allocation.　　　**(8)**

PROJECT IMPLEMENTATION

Project Monitoring and Control with PERT / Cost. Team Building and Leadership in Projects; Project Completion, Review and Future directions.　　　**(8)**

DECISION MAKING IN MANAGEMENT

Financial Evaluation of Production Related Decisions- Performance Measures of a Production System. Financial Evaluation of Capital Decisions. Decision Trees and evaluation of risk; Designing Products & Services - Introducing New Products and Services, Product Mix Decisions.　　　**(8)**

MANAGEMENT CONTROLS

Fundamentals of MRP I & MRP-II, Toyota production system - evolution of JIT - Waste elimination techniques - Pull control - kanban, kaizen. Lean manufacturing - agile manufacturing, Value chain analysis, Theory of Constraints (TOC) - bottleneck vs constrained resource - bottleneck identification and elimination - drum buffer rope systems.　　　**(7)**

TOTAL : 45

TEXT BOOKS

1. *Shtub A., Bard J. F. &Globerson S., "Project management: engineering, technology, and implementation", 2nd Edition Prentice Hall, 2004.*

2. *Lock D., "Project management", Gower Publishing Ltd., 9th Edition, 2007.*

3. *Kerzner H., "Project Management: A Systems Approach to Planning, Scheduling and Controlling", John Wiley & Sons, 11th Edition, 2013.*

REFERENCE BOOKS

1. *Murthy P.R., "Production and Operations Management", New Age International (P) Ltd. Publishers,2nd Edition, 2006.*

2. *Mayer R.R., "Production management", McGraw-Hill, 1968.*

3. *Harding H.A., "Production management", Macdonald and Evans Ltd, 1974.*

15MEOE05 - SUPPLY CHAIN MANAGEMENT

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 : *Outline the manufacturing and product life cycle management process involved in a product.*

CO2 : *Formulate the forecasting methods and inventory modelling*

CO3 : *Estimate the right procurement and logistics strategy based on the supply chain and product criterion requirements.*

CO4 : *Design and analyze the right supply chain structure for the product along with distribution network*

CO5 : *Produce the supply chain network diagram incorporating supply chain strategy and competitive strategies involving material and information flow lines*

INTRODUCTION

Supply Chain, Objectives & Stages, power of SCM - Process views of a supply chain - Strategic planning, Achieving a strategic fit in a supply chain and factors affecting the strategic fit - Value chain, supply chain flow lines - Understanding a product, Product life cycle, Fishers classification of products - Effective and efficient supply chain - case studies on products. **(9)**

SUPPLY CHAIN PROCESS

Forecasting in supply chain, forecast error distribution order quantity and reorder point characteristics & components of forecasting - time series methods of forecasting, Demand Management in MPC - MTS - ATO - MTO. Inventory, role of cycle inventory, economies of scale to exploit fixed costs, Economies of scale to exploit quantity discounts, Short term discounting and trade promotions Managing multi-echelon cycle inventory - Bullwhip effect - Product substitution, Postponement. **(9)**

PRODUCT PROCUREMENT & TRANSPORTATION

Procurement process, EOQ - Sourcing in a supply chain - deciding factors for in-house or outsourcing -Supplier selection - auctions and negotiations, risk management in sourcing Freight management, Transportation networks, Milk run, Cross Docking, tailored transportation, 3PL - 4 PL, Risk management in transportation. **(9)**

DESIGNING A SUPPLY CHAIN

Supply chain drivers - Supply chain performance measures - SCOR Model - Network design in a supply chain, factors influencing design, Framework for network design network, models for facility location and capacity allocation - Uncertainty in network design - Discounted cash flow analysis, Decision trees in evaluating network design - Distribution, factors influencing distribution, design options for a distribution network. **(9)**

INFORMATION TECHNOLOGY IN SUPPLY CHAIN

Lean Supply Chain, agile supply chain, Dynamic supply chain design, Impact of technology on SCM, Key trends in SCM, IT in supply chain coordination and design - MRP, ERP, CRM, ISCM - Performance metrics.Discussion on supply chain adopted by primary industrial sectors and case studies. **(9)**

TOTAL : 45

TEXT BOOK

1. *Ayers J., "Hand Book of Supply Chain Management", The St. Lencie Press/ APICS Series on Resource Management, 2000.*

REFERENCE BOOKS

1. Burt N.D., Dobler. W.D. and Starling L.S., "World Class Supply Chain Management, The Key to Supply Chain Management", Tata McGraw Hill Publishing Company Limited, 2005.

2. Chopra S., Meindl P. and Kalra, D.V., "Supply Chain Management, Strategy, Planning and Operation", Pearson Education, Inc., 2008

3. Fredendall D.L. and Hill E., "Basics of Supply Chain Management", The St. Lucie Press / APICS Series on Resource Management, 2001.

4. Monczka R., Trent R. and Handfield R., "Purchasing and Supply Chain Management", 3rd edition, Thompson Learning Inc., 2007.

5. Sople V.V, "Supply Chain Management", Pearson Education, 2012

6. Vollmann T.E., Berry L.W., Whybark D.C. and Jacobs, R.F., "Manufacturing Planning and Control for Supply Chain Management", Tata McGraw Hill Publishing Company Limited, 2008.

7. Wild T., "Best Practice in Inventory Management", Butterworth - Heinmann, Elsevier Science Ltd.,2002.

ADDITIONAL READING

1. European Journal of Innovation Management

2. Logistics Information Management an International Journal

3. Supply Chain Management an International Journal

4. Sethi P.S., Yan H. and Zhang H., "Inventory and Supply Chain Management with Forecast Updates", Springer International Series, 2006.

5. Mohantry P.R. and Deshmukh G.S., "Supply Chain Management, Theories and Practices", Published by Biztantra Innovations in Management, 2005.

6. Kulkarani S and Sharma A., "Supply Chain Management", Tata McGraw Hill Publishing Company Limited, 2008.

15MEOE06 - RESOURCE MANAGEMENT TECHNIQUES

L	T	P	C
2	2	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of the course, the students will be able to

CO1 : *Mathematically formulate a given engineering problem as a linear programming problem, and apply Graphical, Simplex, Two-Phase or Big-M methods to obtain the optimal solution.*

CO2 : *Construct or modify objective functions and constraints using primal and dual relationship, and apply the Dual Simplex Method to obtain optimal solutions.*

CO3 : *Justify the determined feasible solution (processing time and transportation cost) as optimal solution using MODI method and Hungarian method.*

CO4 : *Determine the optimal project duration and cost using CPM and PERT technique, also construct complex project network and control the complex project.*

CO5 : *Categorize (Inventory, Game Theory, Sequencing and Queuing) and solve various decision making problems using mathematical modeling.*

LINEAR PROGRAMMING

Linear programming formulation, graphical solutions, the essence of simplex method, setting up the simplex method, the simplex method in tabular form, Theory of simplex method, Big M Method, Two Phase Method.   **(5)**

DUALITY AND SENSITIVITY ANALYSIS

Primal - Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis.   **(4)**

TRANSPORTATION AND ASSIGNMENT

Formulation of Transportation Problem, Initial Feasible Solution Methods, Optimality Test, Degeneracy in Transportation Problem; Assignment Problem, Hungarian Method, Traveling Salesman Problem.   **(5)**

NETWORK MODELS

Definition of network models - minimal spanning tree algorithm, shortest route algorithm, maximal flow algorithms, PERT, CPM - LP formulation of minimal spanning, maximum flow and PERT, CPM calculations.   **(5)**

INVENTORY AND MODELS

Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, Newsboy Problem.

(3)

GAME THEORY AND SEQUENCING

Two Person Zero Sum Game, Pure and Mixed Strategies, Algebraic Solution Procedure, Graphical Solution, Solving by Linear Programming; Sequencing Problem, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem.   **(4)**

QUEUING AND SIMULATION

Elements of Queuing Model, Pure Birth Death Model, Single Server and Multi-server Markovian Models with Infinite and Finite Capacity, Machine Repair Model, Networks of Queues. System concepts - Types of systems and models - system simulation procedure - Monte- Carlo simulation method (simple problems) - Introduction to simulation languages.   **(4)**

TOTAL : 60

TEXT BOOKS

1. Mohan, C. and Deep, Kusum: "Optimization Techniques", New Age, 2009.
2. Mittal, K. V. and Mohan, C. "Optimization Methods in Operations Research and Systems Analysis", Fourth Edition, New Age, 2016.
3. Taha, H. A, "Operations Research - An Introduction", Pearson, (9th Edition), 2014.

REFERENCE BOOKS

1. Ravindran, A., Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2014.
2. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2015.
3. S. S. Rao, "Engineering Optimization: Theory and Practice", 4th Edition, John Wiley & Sons, 2009.

15MEOE07 - SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of the course, the students will be able to

CO1 : *Infer environmental sustainability and to implement in more suitable ways to the society.*

CO2 : *Identify methods for reducing energy consumption and to implement lower carbon technologies to achieve sustainable society.*

CO3 : *Collect and organize information about historical perspectives of sustainability and for further development of sustainable industries.*

CO4 : *Compare the balance between food production and population growth to plan the optimal usage of water resources and to evaluate the solution for the problems of urban sprawl.*

CO5 : *Explore the fossil fuels formation of oil, natural gas and coal, environmental effects of mining and metals processing and it's time to depletion.*

INTRODUCTION

The concept of environmental sustainability, Examples of non-sustainability and sustainability. The special role of engineers in helping society transition to a more sustainable state. Definitions, principles, and indicators of sustainability. Overall criteria for development that is sustainable. Indicator studies. **(12)**

THE RISE OF SUSTAINABILITY

Historical perspectives in Europe and in the US. Modern debates: Sustainability extremists, Environmentalists, Traditional Engineers, and Anti-sustainability extremists. "Tragedy of the commons" and the ethics of sustainability. Models for achieving sustainable industries. **(12)**

POPULATION GROWTH ON A FINITE EARTH

Population models, population growth, exponential and logistic growth, variation in population among nations,population policy, Food production,Protecting and Promoting Human Health - Food security and nutrition and sustainable agriculture- Water resources, Urban sprawl. **(9)**

NON-RENEWABLE RESOURCES

Fossil fuels - Formation of fossil fuels: oil, natural gas, coal. Modelling of oil reserves. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies-Time-to-depletion. **(12)**

TOTAL : 45

TEXT BOOK

1. *Tatyana P. Soubbotina, "An Introduction to Sustainable Development", Washington, 2nd Edition, 2004.*

REFERENCE BOOKS

1. *Jeffrey D. Sachs, "The Age of Sustainable Development", Columbia University Press, 4th Edition, 2015.*

2. *K.A.Rasure, "Globalization And Sustainable Development", Oxford book company, 2nd Edition, 2010.*

3. *Barry Dalal Clayton and Stephen Bass., "Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.*

4. *Karel Mulder, "Sustainable Development for Engineers"- A Handbook and Resource Guide, Green Leaf Publishing, 2006.*

15MEOE08 - PROCESSING AND APPLICATIONS OF BIOMATERIALS

	L	T	P	C
	3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of the course, the students will be able to

CO1 : *Identify the suitable material for human implants and perform mechanical and tribological characterization. (Tensile, compression, hardness, wear, corrosion and water absorption).*

CO2 : *Choose a bio compact material (calcium phosphate, ceramic, glass, bioinert ceramics, polymeric, HDPE, hybrid, metals and alloys, Ti Alloys - Co-Cr-Mo, Ni or Ta-Based Alloys - Other Non-Ferrous alloys) for a orthopedic joints.*

CO3 : *Develop successful implants (biological, mechanical, morphological Compatibility) for dental and bone applications.*

CO4 : *Evaluate biomaterials, metals, ceramics, polymers, micro/nano for Surface modification, micro/nano fabrication to find the tensile strength and micro structure.*

CO5 : *Estimate the percentage of reinforcement (particle, fiber, laminates) to increasing the strength (tensile, flexural, bending, fatigue, wear, and corrosion) under specified constraints (density) for human implants.*

CO6 : *Design a suitable shape of the implants for orthopedic joint applications.*

FUNDAMENTALS OF BIOMATERIALS AND BIOCOMPATIBILITY

Introduction - definitions and their Implications - Biomaterial - Biocompatibility -Host response - Cell-Material Interactions - Experimental Evaluation of Biocompatibility - In vitro Tests - In vivo Tests - Steps for characterizations of biomaterials - Broad overview of Fundamentals. **(7)**

MATERIALS FOR ORTHOPEDIC APPLICATIONS

Introduction - Structure and Properties of Hard Tissues - Processing and Properties of Bioceramics and Bioceramic Composites - Calcium Phosphate Based Biomaterials - Hydroxyapatite-Ceramic Composites - Glass-Ceramics Based Biomaterials - Mica Based Glass Ceramics - Other Bioglass-Ceramics - Bioinert Ceramics - Polymeric Biomaterials - Polymer-Polymer Composites - Polymer-Ceramic Composites - HDPE-Hap-Al2O3 Hybrid Composites - Metals and Alloys in Biomedical Applications - Issues Limiting Performance of Metallic Biomaterials - Wear of Implants - Corrosion of Metallic Implants - Ti-Based Alloys - Co-Cr-Mo, Ni or Ta-Based Alloys - Other Non-Ferrous Metals and Their Alloys - Coating on Metals. **(12)**

TITANIUM DENTAL IMPLANT SYSTEMS

Introduction - Requirements for Successful Implant Systems - Biological Compatibility - Mechanical Compatibility - Morphological Compatibility - Osseo integration and Bone/Implant Interface - Integrated Implant System. **(7)**

PROCESSING OF BIOMATERIALS

Introduction - Processing of Biomaterials - Metals - Ceramics - Polymers - Biocomposites - Sterilization - Processing for Scale - Micro/Nano Surface Modification - Micro/Nano Fabrication-Tensile testing, microscopy (SEM,AFM)evaluation. **(7)**

BIOMATERIAL APPLICATIONS

Introduction - Applications in Medicine, Biology, and Artificial Organs - Cardiovascular Medical Devices - Extracorporeal Artificial Organs - Orthopedic Implants - Dental Implantation - Bioadhesive - Opthalmologic Applications - Cochlear Prosthesis - Drug Delivery - Tissue Engineering - 2-D and 3-D tissue engineering applications and their mechanical characterization -Array Technologies and Specific Medical Applications. **(12)**

TOTAL : 45

TEXT BOOK

1. *BikramjitBasu, Ashok Kumar and Katti S., 'Advanced Biomaterials - Fundamentals, Processing and Applications', John Wiley & Sons, INC, Publication, 2015.*

REFERENCE BOOKS

1. *Joon. B. Park and Joseph D. Bronzino 'Bio Materials - Principles and Applications', CRC press, 2010.*

2. *Park J. B. and Lakes R.S., 'Bio Materials - An Introduction', Plenum Press, New York, 2009*

3. *Dee KC, Puleo and DA, Bizios R, 'An introduction to tissue-biomaterial interactions', John Wiley & Sons, 2007.*

15MEOE09 - NUMERICAL SIMULATION OF FLUID FLOW

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of the course, the students will be able to

CO1 : *Demonstrate ability to use the Finite-Volume Method to analyze one and two-dimensional problems of heat transfer and irrotational fluid flow*

CO2 : *Apply numerical techniques to solve systems of algebraic equations and integrate ordinary differential equations*

CO3 : *Evaluate heat transfer rates, fluid flow rates, etc.*

CO4 : *Judge the correctness of the numerical solutions;*

CO5 : *Recognize the need for turbulence models*

CONSERVATION LAWS OF FLUID MOTION AND HEAT TRANSFER

Introduction - Governing equations of fluid flow and heat transfer - Navier-Stokes (N-S) equations for a Newtonian fluid   **(9)**

IRROTATIONAL FLOWS AND LAMINAR BOUNDARY LAYERS

Introduction - Potential functions and stream functions - Numerical treatment of steady irrotational flows in two dimensions - Simple two-dimensional laminar flows - Boundary layer over a flat plate - Blasius solution - Numerical treatment of ordinary differential equations related to Blasius solution.   **(9)**

NUMERICAL HEAT TRANSFER - FINITE VOLUME METHOD

Introduction - Discretization of governing partial differential equations of heat transfer- Applications to steady and unsteady heat conduction in one and two dimensions - Treatment of heat sources - Explicit and implicit solution schemes for steady and unsteady heat conduction.   **(9)**

NUMERICAL TREATMENT OF FLUID FLOW - FINITE VOLUME METHOD

Discretization of governing partial differential equations of fluid flow - Differencing schemes for convective-diffusive flows - Treatment of flow boundary conditions - Introduction to the SIMPLE Algorithm.   **(9)**

TURBULENT FLOWS

Introduction - Reynolds Averaged N-S equations for turbulent flows - Eddy viscosity concept - Mixing length models - Brief overview of turbulence kinetic energy and dissipation (k-e) models - Brief overview of advanced turbulent flow models.   **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ghoshdastidar.P.S, "Computer Simulation of Flow and Heat Transfer", Tata McGrawHill, New Delhi, 1999.*

2. *Versteeg. H.K. and Malalasekara.W, "An Introduction to Computational Fluid Dynamics - The Finite Volume Method", Pearson Education, 2nd Edition, England, 2007.*

REFERENCE BOOKS

1. *Muralidhar. K., Sundararajan. T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.*

2. *Niyogi P., Chakrabarthy. S.K., Laha. M.K., "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.*

3. *Chung T.J., "Computational Fluid Dynamics", Cambridge Univ. Press, New York, 2002.*

4. *Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge Press, UK, 2005.*

5. *Titus Petrila and Damian Trif, "Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics", Springer, Boston, 2005.*

15MEOE10 - SOLAR ENERGY UTILISATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

At the end of the course student will be able to

CO1 : *Calculate solar time, local time, earth-sun angles, direct and indirect solar radiation for the given location using earth-sun geometry.*

CO2 : *Categorize solar cell materials with its properties and calculate energy conversion efficiency of solar cells using I-V characteristic curves.*

CO3 : *Derive the expression for overall heat transfer coefficient using network resistance method, relations for collector efficiency factor and collector heat removal factor of non- concentrating solar collectors.*

CO4 : *Calculate heating loads using F-chart method for air and liquid based solar heating systems.*

CO5 : *Analyze the Performance of the following thermo-electric devices: generators, refrigerators and heat pumps.*

INTRODUCTION TO SOLAR ENERGY

Introduction, overview of applications - calculation of solar constant, terminology related to solar radiation, definition and calculation of solar times, definition and calculation of all solar angles and related earth angles. **(4)**

PHOTOVOLTAICS

Fundamentals of solar cells: types of solar cells, semiconducting materials, band gap theory, absorption of photons, excitons and photoemission of electrons, band engineering; Solar cell properties and design; p-n junction photodiodes, depletion region, electrostatic field across the depletion layer, electron and holes transports, device physics, charge carrier generation, recombination and other losses, I-V characteristics, output power. **(9)**

SOLAR CELL

Solar Cell Applications - Solar cell manufacturing processes: material resources, chemistry, and environmental impacts; low cost manufacturing processes - Thin film solar cells - Single crystal, polycrystalline and amorphous silicon solar cells, cadmium telluride thin-film solar cells, conversion efficiency. **(6)**

SOLAR CALCULATION AND SOLAR COLLECTORS

Calculation of extra-terrestrial irradiation on a horizontal surface on a hourly and daily basis, relationship between radiation on titled and horizontal surfaces, effect of atmosphere on solar radiation, Hottel's estimation of clear sky radiation, types and classification of solar collectors, terminology related to non-concentrating collectors, efficiency of a solar collector. **(4)**

THERMAL MODELLING OF NON- CONCENTRATING COLLECTORS

Modeling of heat transfer processes in flat plate collector, formula for effective transmittance-absorptance product, estimation of top, bottom and overall heat loss coefficient using resistance network method, collector stagnation temperature, temperature distribution between tubes and along tubes, collector efficiency factor F, collector heat removal factor FR, collector heat exchanger modeling and combined efficiency factor FR. **(10)**

SOLAR THERMAL CONVERSION

Overview of active and passive heating - Calculation of space and water heating loads, degree-days, F-chart method for air and liquid based system. Low, medium and high temperature collectors, Heat storage, storage media, steam accumulator, other storage systems, heat exchangers and applications of stored energy. **(6)**

THERMO- ELECTRIC SYSTEMS

Thermoelectricity, Peltier effect, Seebeck effect; thermoelectric materials, Bismuth telluride, automotive thermoelectric generators, radioisotope thermoelectric generator; thermoelectric power generators, thermoelectric refrigerators and heat pumps. **(6)**

TOTAL : 45

TEXT BOOKS

1. *Principles of Solar Engineering, D. Yogi Goswami, Taylor and Francis, 2000, ISBN 10: 1-56032- 714-6*
2. *Garg H.P., Prakash J., "Solar Energy: Fundamentals & Applications", Tata McGraw Hill, New Delhi, 1997.*

REFERENCE BOOKS

1. *Applied Photovoltaics, Stuart Wenham, Martin Green, and Muriel Watt, Earthscan, 2007, ISBN 1-84407-407-3*
2. *Photovoltaic Engineering Handbook, F. Lasnier and T. G. Ang, IOP Publishing UK (Adam Hilger USA) 1990, ISBN 0-85274-311-4*
3. *Semiconductor Devices, Physics, and Technology, Second Edition, S. M., Sze, New York, NY: Wiley, 2001. ISBN: 0471874248*
4. *Solar Cells: Operating Principles, Technology and system Applications, Martin A. Green, Published by the University of New South Wales, 1998, ISBN 0 85823 580 3*
5. *S. P. Sukhatme, "Solar Energy", Tata McGraw Hill, New Delhi, 1999.*
6. *J. A. Duffie and W.A.Beekman, " Solar Engineering of Thermal Processes", John Wiley and Sons, New York, 2005.*
7. *Tiwari G.N.,Suneja S., "Solar Thermal Engineering System", Narosa Publishing House, New Delhi, 1997.*
8. *T.Bhattachariya, "Terrestial solar Photovoltaic", Narosa Publishers, New Delhi, 2008.*
9. *H.S.Rauschenbach, "Solar Cell Array Design Hand Book", Van NostrandReinfold Company, New York, 1980.*

15EEOE01 - ENERGY AUDITING

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

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

CO1 : *Understand the current energy scenario and the need for energy auditing.*

CO2 : *Describe the energy conservation schemes in steam systems.*

CO3 : *Identify the design considerations for minimizing energy consumption in compressors, fans and blowers.*

CO4 : *Understand the concepts of energy efficient electrical systems.*

CO5 : *List the techno commercial statement for the investment for energy saving.*

POWER AND ENERGY MANAGEMENT

Energy Scenario - Role of Energy Managers in Industries - Energy Monitoring, Auditing and Targeting - Economics of various energy conservation schemes - Total Energy Systems. **(9)**

ENERGY CONSERVATION IN MECHANICAL PROCESSES

Energy Audit - Various Energy Conservation Measures in Steam - Losses in Boiler - Energy Conservation in Steam Systems - Case studies. **(9)**

ENERGY CONSERVATION IN PRODUCTIVE PROCESSES

Energy Conservation in Centrifugal pumps, Fans, Blowers and Air compressor - Energy Consumption - Energy saving potentials - Design Consideration. **(9)**

ENERGY CONSERVATION IN NON - PRODUCTIVE PROCESSES

Refrigeration and Air conditioning - Heat load estimation - Energy conservation in cooling towers and Spray ponds - Energy Efficiency in Lighting - Case studies. **(9)**

ENERGY CONSERVATION CONTROL STRATEGIES AND IMPLEMENTATION

Control: Thermostats - Boiler controls - Proportional, Integral and Derivative control - Adaptive control - Compensators. Implementation: Investment and Pay back calculations for energy conservation measures - Organizational support for energy management motivation. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical publications, 1990.*
2. *Reay D.A, "Industrial Energy Conservation", Pergamon Press, 1st Edition, 1977.*
3. *Larry C Witte et. al, "Industrial Energy Management & Utilization". Springer Publication, 1st Edition, 1990.*

REFERENCE BOOKS

1. *D P Kothari and I J Nagrath, "Power System Engineering", Tata McGraw-Hill Co, 2nd Edition, 2008.*
2. *https://www.beeindia.gov.in/content/energy-auditors (Guide Book link)*

GUIDE BOOKS

2.1. *General Aspects of Energy Management & Energy Audit*

2.2. *Energy Efficiency in Thermal Utilities*

2.3. *Energy Performance Assistance for Equipment And Utility Systems*

2.4. *Energy Efficiency in Electrical Utilities*

15EEOE02 - SOLAR AND WIND ENERGY SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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

CO1 : *Describe the solar radiation, measurements and characteristics of solar PV cell.*

CO2 : *Develop the model of a PV system and its applications.*

CO3 : *Describe the basic types and mechanical characteristics and model of wind turbine.*

CO4 : *Analyse the electrical characteristics and operation of various wind-driven electrical generators.*

CO5 : *Understand 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 Bypass 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 - 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, 2nd Edition, 2011.

REFERENCE BOOKS

1. Roger A. Messenger and Jerry Ventre, 'Photovoltaic Systems Engineering', Taylor and Francis Group Publications, 2nd Edition, 2003.
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, 2010.

15EEOE03 - HYBRID SMART VEHICLES

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

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

CO1 : *Explain the dynamics of vehicle motion and propulsion systems.*

CO2 : *Identify various energy storage devices used in hybrid vehicles.*

CO3 : *Understand the application of electric machines in electric vehicles.*

CO4 : *Describe the working of hybrid electric drive train*

CO5 : *Describe the control and energy management strategies in hybrid vehicles.*

INTRODUCTION

Introduction to Hybrid Electric Vehicles - Social and Environmental importance of hybrid and Electric vehicles - Components, - Vehicle mechanics - Roadway fundamentals - vehicle kinetics - Dynamics of vehicle motion - Propulsion system **(9)**

ENERGY STORAGE

Energy Storage Requirements in Hybrid and Electric Vehicles. Battery, Fuel Cell, Super Capacitor - Flywheel based energy storage and its analysis - Hybridization of different energy storage devices. **(9)**

DC AND AC ELECTRICAL MACHINES

Motor and Engine rating - Requirements, DC machines, Three phase AC machines - Induction machines - Permanent magnet machines - Switched reluctance machines. Matching the electric machine and Internal Combustion Engine (ICE), - Sizing the motor - Sizing the power electronics - Selecting the energy storage technology - Communications - Supporting subsystems.

(9)

HYBRID ELECTRIC DRIVE-TRAIN

Basic concept of electric traction, Transmission configuration - Components - Gears - Differential - Clutch - Brakes Regenerative braking, Motor sizing. Hybrid traction : Various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel Efficiency Analysis. **(9)**

ENERGY MANAGEMENT STRATEGIES

Energy management strategies used in hybrid and electric vehicles, - Component level control and supervisory control- Comparison and its implementation issues of different energy management strategies. **(9)**

Case study: Volvo XC90 T8 Plug-In Hybrid, Nissan X-Trial hybrid

TOTAL : 45

REFERENCE BOOKS

1. Iqbal Hussain, "Electric & Hybrid Vehicles - Design Fundamentals", CRC Press, 2nd Edition, New York, 2010,

2. Mehrdad Ehsani, Yi mi Gao, Sebastian E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.

3. James Larminie and John Lowry, "Electric Vehicle Technology", Wiley Publishers, 2003.

15EEE07 - ELECTRICAL SAFETY

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

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

CO1 : *Expand skills in identifying the presence of electrical hazards, implementing measures to minimize risks.*

CO2 : *Develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.*

CO3 : *Analyze and apply various grounding and bonding techniques.*

CO4 : *Select appropriate safety method for low, medium and high voltage equipment.*

CO5 : *Assess and provide solutions to a practical case study.*

INTRODUCTION AND HAZARDS OF ELECTRICITY

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 - Tag out - 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's 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's 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 BOOKS

1. *John Cadick, Mary Capelli-Schellpfeffer and Dennis neitzel and Al Winfield "Electrical Safety Handbook",McGraw-Hill Publishing Company Ltd., 4th Edition, 2012.*

2. *Dennis Neitzel and Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 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.   James H. Wiggins JR., "Managing Electrical Safety", Abs Consulting, Maryland, 2011.

5.   Maxwell Adams. J, "Electrical Safety- A Guide to the Causes and Prevention of Electric Hazards", The Institution of Electric Engineers, 1994.

6.   Ray A. Jones and Jane G. Jones, "Electrical Safety in the Workplace", Jones & Bartlett Learning, Technology and Engineering, 2000.

7.   Video Link: Electrical Safety in the Workplace Seminar DVD - NFPA National Fire Protection Association.

    http://www.nfpa.org/training-and-events/archived/training-videos/electrical-safety-videos

8.   E-Book: Johncadick, Marycapelli-schellpfeffer, Dennis neitzel, "Electrical Safety Handbook", McGraw Hill publishing company Ltd., 3rd Edition, 1994.

    https://installist.files.wordpress.com/2009/12/electrical-safety-handbook.pdf

15EEE14 - ENERGY EFFICIENT LIGHTING SYSTEM

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

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

CO1 : *Understand the properties of light, importance of lighting in various fields and types of lighting.*

CO2 : *Understand the properties and laws of illumination, working of discharge lamps, fluorescent lamps, tungsten filament lamps and light control.*

CO3 : *Compare the various lighting techniques & employ lighting control methods.*

CO4 : *Choose the building materials and construction techniques for energy efficient lighting.*

CO5 : *Employ renewable energy methods for energy efficient lighting.*

LIGHTING

Lighting - Importance of lighting in buildings, Interior designing - Photography, Architecture - Difference between good and bad lighting - Challenges in lighting - Types of lighting. **(9)**

ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS

Introduction - Terms used in illumination - Laws of illumination - Polar curves - Photometry - Integrating sphere - Sources of light - Discharge lamps, Incandescent lamps - MV and SV lamps. **(9)**

ENERGY EFFICIENT LIGHTING

Smart lighting - Fluorescent lamps - Comparison between tungsten filament lamps and fluorescent tubes - Basic principles of light control - Types and Design of lighting and flood lighting.- CFL - LED - High Intensity Discharge lamps **(9)**

BUILDING MANGEMENT SYSTEM

Energy Efficient landscape design - Natural lighting - Choice of building materials for energy efficient lighting - Light pipes - Light fixtures - Green buildings - Construction techniques **(9)**

CASE STUDY

Solar lighting techniques - Lighting using wind power - Energy conservation building code - Energy efficient buildings in the country. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Philip Gordon, 'Principles and Practices of Lighting Design: The Art of Lighting Composition', Blue Matrix Publications, 2011.*
2. *Jerry Yudelson, 'Green Building Through Integrated Design', The McGrawHill Publisher, 2009.*

REFERENCE BOOKS

1. *Derek Phillips, "Daylighting: Natural Light in Architecture" Elsevier, 2004.*
2. *Jerry Yudelson, "Greening Existing Buildings", The Mc Graw Hill Companies, 1st Edition, 2009.*
3. *Sam Kubba, "Handbook of Green Building Design and Construction", Elsevier, 2012.*
4. *Solanki.C.S, 'Solar Photovoltaic Technology and Systems', PHI 2013.*
5. *J. F. Manwell, J.G. Mcgowan and A.L. Rogers, "Wind Energy Explained : Theory, Design and Applications", Wiley Publications, 2nd Edition, 2009.*

15ECOE01 - CONSUMER 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

CO1 : *Describe the fundamental concepts, construction and working of Audio systems*

CO2 : *Analyze the recording and reproduction techniques of Audio Systems*

CO3 : *Differentiate between the types of electronic music synthesizers*

CO4 : *Describe the fundamental concepts, construction and working of Video systems*

CO5 : *Identify the problem and troubleshoot the consumer electronic products like TV, Washing Machines, Air Conditioners*

AUDIO SYSTEM

Microphone - Characteristics of Microphones - Gun Microphones - Wireless Microphones - Headphones and Headsets - Electrostatic Phones - Electret Electrostatic Headphones - Hearing Impairments - Hearing Aids - Ideal Loudspeaker - Basic Loudspeaker - Loudspeaker Construction - Woofers - Mid range, Extended range and High frequency Loudspeakers - Multispeaker systems - Baffles - Horns - Stereo Systems. **(10)**

RECORDING AND REPRODUCTION

Making the Record - Stereo Pickup Techniques - Stereo Recording Systems - Disc Equipment: Recording and Playback Characteristics - Stereo Pickup heads - Magnetic recording and Playback - Magnetic Erasing - Optical Recording and Reproduction - Mono, Stereo and Quad - Stereo Multiplexing - Equalisers and Mixers. **(9)**

ELECTRONIC MUSIC SYNTHESIZERS

Typical Generator - Basic Modifiers - Voltage Control - Envelope Generator - Electric Guitar - Electric Wind Instrument -Recording - Digital Computer - Public Address System - Speaker Matching Systems - Theater Sound System: Sound track, Types of sound film, Theater Sound Reproduction system, Working of a Projector. **(9)**

VIDEO SYSTEMS AND DISPLAYS

Monochrome - Color TV standards - TFT, Plasma, HDTV, LCD,LED TV, Video Telephone and Video Conferencing **(9)**

DOMESTIC AND CONSUMER APPLIANCES

In Car Computers - Washing machines - Microwave ovens - Air-conditioners and Refrigerators - Airline Reservations - Remote controls Automated Teller Machines - Set top Boxes - Bar Codes - RFID **(8)**

TOTAL : 45

TEXT BOOKS

1. *Bali, Consumer Electronics, Pearson Education,1st Edition, 2005.*
2. *Philip Hoff, Consumer electronics for Engineers, Cambridge University Press,1st Edition, 1998.*

REFERENCE BOOKS

1. *Sridhar Canumalla, Puligandla Viswanadham P.S.Bimbra, Portable Consumer Electronics: Packaging, Materials, and Reliability, Pennwell Books, 1st Edition, 2010.*
2. *Douglas Kinney, A Beginners Guide to Consumer Electronics Repair: Hand Book and Tutorial, iUniverse, Inc, 1st Edition, 2006.*
3. *Thomas M. Coughlin, Digital Storage in Consumer Electronics: The Essential Guide, Elsevier Inc., 1st Edition, 2008.*
4. *U.S. Consumer Electronics Industry in Review, Electronic Industries Association, Consumer Electronics Group, 1993.*
5. *https://www.pssurvival.com/ps/electronic*

15ECOE02 - ARM SYSTEM ARCHITECTURE

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 : *Distinguish between the feature of ARM7 and cortex microcontroller and infer the architecture, instruction set and programming model of ARM Cortex.*

CO2 : *Interpret interrupt service handler & exception types of ARM processor to develop ALP programs.*

CO3 : *Exemplify memory mapping technique in ARM embedded system.*

CO4 : *Illustrate the programming concepts in real time embedded application.*

CO5 : *Examine debugging technique to develop application software for real time system.*

EMBEDDED HARDWARE

ARM Embedded system-CISC and RISC philosophy-Embedded system Hardwar-ARM and Cortex architecture- Programming model- Date flow- Operating modes - Instruction sets.   **(9)**

INTERRUPT AND EXCEPTIONS

Interrupts in ARM and cortex- Exception Types- Fault Exceptions- The NVIC and Interrupt Control - Interrupt Behavior.   **(9)**

MEMORY SYSTEMS

Memory System Features Overview- Memory Maps- Memory Access Attributes- Default Memory Access Permissions- Bit-Band Operations- Unaligned Transfers- Exclusive Accesses and Endian Mode   **(9)**

PROGRAMMING

Exceptions Programming- Advanced Programming Features and System Behavior- Efficient C Programming- FIR and IIR filter implementation-Introduction to RTOS   **(9)**

SYSTEM DEBUGGING

Debugging Features- CoreSight- Debug Modes- Debugging Events- Breakpoint- Accessing Register - Debugging Components-Case study: Embedded system (using ARM/cortex) for monitoring- controlling and industrial automation.   **(9)**

TOTAL : 45

TEXT BOOKS

1. *Andrew N. Sloss Dominic Symes Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier Inc 2010.*

2. *Joseph Yiu, "The Definitive Guide to the ARM Cortex-M", Elsevier- Newness, 2014.*

REFERENCE BOOKS

1. *Peter Barry Patrick Crowley "Modern Embedded Computing Designing Connected, Pervasive, Media- Rich Systems", Elsevier, 2012.*

2. *Steve Furber, "ARM system on Chip Architecture", Addision Wesley Professional, 2nd Edition, 2000.*

3. *Jonathan W Valvano, "Embedded systems : Introduction to ARM @ cortex TM - Micro controllers", 5th Edition, 2015.*

4. *Rajkamal, "Embedded system Architecture Programming and Design", Tata Mc Graw Hill, 2nd Edition, 2009.*

5. *Shibu K.V. "Introduction to Embedded Systems", Tata Mc Graw Hill, 1st Edition, 2009.*

15ECOE03 - BROADBAND 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 : *Describe the concepts and applications of Microwave and Millimeter wave communication*

CO2 : *Comprehend and explain the operation of Satellite communication and navigation systems*

CO3 : *Illustrate the operation of optical communication systems and high speed networks*

CO4 : *Exemplify the features and functionalities of cellular communication from 2G to 4G and beyond*

CO5 : *Distinguish and describe different wireless technologies based on its features and applications*

MICROWAVE AND MILLIMETER WAVE COMMUNICATION

Microwave concepts - devices and lines - waveguides and cavity resonators -Microwave semiconductor diodes-Microwave tubes - antennas - Microwave and millimeter applications **(9)**

SATELLITE COMMUNICATION

Satellite orbits - Satellite Communication Systems - Satellite subsystems - Ground stations - Applications - Global Navigation satellite systems **(9)**

OPTICAL COMMUNICATION

Optical principles - optical communication systems - fiber optics cables - optical transmitters and receivers - wavelength division multiplexing - passive optical networks -40/100Gbps networks and beyond **(9)**

CELLPHONE TECHNOLOGIES

Cellular telephone systems - Cellular industry overview - 2G and 3G digital cell phone systems -Long term evolution and 4G cellular systems - Base stations and small **(9)**

WIRELESS TECHNOLOGIES

Wireless LAN - PANs and Bluetooth - Zigbee and mesh wireless networks - Wi-Max and wireless Meteroploitan area networks - Infrared wireless - Radio frequency identification - Ultra wideband wireless-wireless applications **(9)**

TOTAL : 45

TEXT BOOK

1. *Louis E.Frenzel,"Principles of Electronic Communication Systems", Mc-Graw hill Education,4th edition,2016*

REFERENCE BOOKS

1. *Kennedy G, "Electronic Communication Systems", Tata McGraw Hill, 4th Edition, 1999.*

2. *Rappaport,T.S, "Wireless communications", Pearson Education, 2nd Edition, 2010*

3. *William Stallings, "Wireless Communications and networks", Pearson Prentice Hall of India, 2nd Edition, 2009.*

4. *David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 1st Edition, 2005.*

5. *Aditya K.Jagannathan, "Principles of Modern Wireless Communication Systems: Theory and Practice", Mc-Graw hill Education, 2016.*

15ECOE04 - ROBOTICS FOR INDUSTRIAL 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 : *Comprehend and appreciate the significance and role of industrial robot in the present contemporary world*

CO2 : *Exemplify the features and functionalities of the sensors in Robot*

CO3 : *Develop different language programs to design and develop robotic based systems*

CO4 : *Develop system for industrial automation and medical application*

CO5 : *Illustrate the methodologies to provide automatic solution for replacing humans in life threatening area*

SCOPE OF ROBOTS

The scope of industrial Robots - Definition of an industrial robot - Need for industrial robots -Economic and Social Issues- applications. **(4)**

ROBOT COMPONENTS

Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume -Precision of movement - End effectors - Sensors. **(9)**

ROBOT PROGRAMMING

Robot Programming - Methods - interlocks textual languages. Characteristics of Robot level languages, characteristic of task level languages. **(9)**

ROBOT WORK CELL

Robot Cell Design and Control - Remote Center compliance - Safety in Robotics. **(9)**

FUTURE TRENDS

Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots, Advanced robotics in Space - Specific features of space robotics systems - longterm technical developments, Next generation robots. **(14)**

TOTAL : 45

TEXT BOOKS

1. *Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.*

2. *John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.*

REFERENCE BOOKS

1. *Mikell P.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill Book Company 1986.*

2. *John Iovine, "Robots, Android and Animatronics", Second Edition, McGraw-Hill, 2012.*

3. *Fu K.S. Gonzaleaz R.C. and Lee C.S.G.,"Robotics Control Sensing, Vision and Intelligence",McGraw Hill, International Editions, 1987.*

4. *Bernard Hodges and Paul Hallam, "Industrial Robotics", British Library Cataloging in Publication 1990.*

5. *Deb, S.R., "Robotics Technology and flexible automation", Tata McGraw Hill, 1994.*

15ECOE05 - 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

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, 4th Edition,2011*

2. *Simon Haykins, "Digital Communications Systems", 1st Edition, Wiley, 2013.*

REFERENCE BOOKS

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*

15CSOE01 - FUNDAMENTALS OF SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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)*

REFERENCE BOOKS

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.*

15CSOE02 - INTRODUCTION TO DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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. Associtation 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.*

REFERENCE BOOKS

1. *Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, Sixth Edition, 2013.*

2. *Arun K Pujari, "Data Mining Techniques" Universities Press India Ltd., Third Edition, 2012.*

3. *Dunham, "Data Mining- Introductory and Advanced Topics", Pearson Education, New Delhi, First Edition, 2006.*

4. *Pieter Adriaans, Dolf Zantinge, "Data Mining ", Pearson Education, Third Edition 2009,Delhi.*

5. *Sam Anahory, Dennis Murray, "Data Warehousing in the Real World ", Pearson Education, Seventh indian Reprint New Delhi,2003.*

6. *George M. Marakas, " Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, First Edition, 2003*

7. *Paulraj Ponnaiah, "Data Warehousing Fundamentals", Wiley Publishers, Singapore, First Edition, 2001.*

15CSOE03 - INTRODUCTION TO EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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*

REFERENCE BOOKS

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.*

15CSOE04 - INTERNET PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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.*

REFERENCE BOOKS

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.*

15CSOE05 - CUSTOMER RELATIONSHIP MANAGEMENT ESSENTIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 with proper guidelines for privacy.*

CO3 : *Demonstrate the scoring process and apply the various CRM optimization techniques to optimize CRM process in order to improve customer profitability.*

CO4 : *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 - Other data mining tools -CRM tools - Next generation for CRM. **(10)**

TOTAL : 45

TEXT BOOK

1. Alex Berson, Stephen Smith, Kurt Thearling, "Building Data mining Applications for CRM", Tata McGraw Hill, Fifteenth Reprint, 2008.

REFERENCE BOOKS

1. Francis Buttle, Stan Maklan "Customer Relationship Management: Concepts and Technologies", Routledge, Third Edition, 2015.

2. Roger J. Baran, Robert J. Galka, "CRM: The Foundation of Contemporary Marketing Strategy", S.Chand (G/L) & Company Ltd, Second Edition, 2017.

15CSOE06 - E-COMMERCE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *Describe the features of e-commerce, various business models and marketing strategies used in e-commerce.*

CO2 : *Use the knowledge on the mechanics of building a secure e-commerce website and payment systems.*

CO3 : *Comprehensive online retailing, marketing and impact of social media.*

CO4 : *Illustrate the procurement process and supply chain management in B2B e-commerce.*

INTRODUCTION

E-commerce: E-commerce and E-business - Features of E-commerce Technology - Types of E-commerce. Understanding E-commerce: Technology - Business and Society. E-commerce Business Models and Concepts: Eight Key Elements - Strategy, Structure and Process: Industry Structure - Industry Value Chains - Firm Value Chains - Firm Value Webs - Business Strategy.

(7)

BUILDING E-COMMERCE WEBSITE

Building an Ecommerce Presence: Systematic Approach - Choosing Software and Hardware: Web Server Software - Application Servers - Merchant Server Software Functionality and Packages - Web Services and Open Source Options - Other E-commerce Site Tools - Developing Mobile Website and Building Mobile Applications.

(8)

E-COMMERCE SECURITY AND PAYMENT SYSTEMS

Ecommerce Security Environment - Security Threats - Management Policies, Business Procedures and Public Laws - Payment Systems - E-commerce Payment Systems.

(7)

SOCIAL, MOBILE AND LOCAL MARKETING

Introduction to Social, Mobile and Local Marketing - Social Marketing: Social Marketing Players - The Social Marketing Process - Face book Marketing - Twitter Marketing - Pinterest Marketing - The Downside of Social Marketing - Mobile Marketing: Basic Mobile Marketing Features - Mobile Marketing Tools - Mobile Marketing Campaign - Local and Location Based Marketing: Location Based Marketing Platforms - The Technologies - Marketing Tools - Marketing Campaign - Marketing Results.

(8)

ONLINE RETAIL SERVICES, AUCTIONS AND PORTALS

E-commerce in Action: E-tailing Business Models: Virtual Merchants - Multi-channel Merchants - Catalog Merchants - Manufacturer Direct - Online Financial Services - Online Travel Services - Online Career Services. Online Auctions: Measuring Growth of Auctions and Dynamic Pricing - Benefits of Auctions - Risks and Costs of Auctions for Consumers and Businesses. E Commerce Portals: Types of Portals - Portal Business Models.

(9)

E-COMMERCE, SUPPLY CHAIN AND COLLABORATIVE MANAGEMENT

Defining and Measuring the Growth of B2B Commerce - Benefits and Challenges of B2B E-commerce - The Procurement Process and Supply Chain - Types of Procurement. Trends in Supply Chain Management and Collaborative Commerce: Just-in-Time and Lean Production - Supply Chain Simplification - Adaptive Supply Chains - Accountable Supply Chains - Sustainable Supply Chains - Electronic Data Interchange - Supply Chain Management Systems - Collaborative Commerce.

(6)

TOTAL : 45

TEXT BOOK

1. *Kenneth C. Laudon,Carol Guercio Traver, "E-Commerce-Business,Technology, Society", Pearson India, Tenth edition, 2016.*

REFERENCE BOOKS

1.   Ravi Kalakota, Andrew Whinston, "Frontiers of Electronic Commerce", Pearson India, fourteenth Reprint 2007.

2.   Dave Chaffey, "E - Business and E - Commerce Management: Strategy, Implementation, and Practice:" Pearson India, Sixth Edition, 2013.

3.   Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Chang, "E-Commerce, Fundamentals and Applications", Wiley India Private Ltd Reprint 2008.

15ITOE01 - DIGITAL COMPUTER BASICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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. **(10)**

COMBINATIONAL CIRCUITS

Adder : Half Adder - Full Adder - Binary Parallel Adder - BCD Adder. Subtractor : Half Subtractor - Full Subtractor. Code Conversion. Decoders - De-Multiplexer - Encoders - Multiplexers. **(9)**

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 - Updown 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. Ciletti,"Digital Design with an Introduction to the Verilog HDL, Pearson Education, Fifth edition, 2013.*

REFERENCE BOOKS

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.*

15ITOE02 - PROGRAMMING IN JAVA

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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, Ninth Edition, McGraw Hill Education, 2014.*

REFERENCE BOOKS

1. *Deitel H.M and Deitel P.J, "Java - How to Program", Prentice Hall of India, Ninth Edition, 2012.*

15ITOE03 - FUNDAMENTALS OF DATABASE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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, Corlos M.Coronel, "Database Systems: Design, Implementation and Management", Thompson Learning Course Technology, Tenth edition, 2012.*

REFERENCE BOOKS

1. *Abraham Silberschatz, Henry F.Korth,S.Sudharshan,"Database System Concepts", McGraw-Hill, Sixth Edition, 2013.*

2. *Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, Sixth Edition, 2013.*

3. *Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 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, 2014.*

15ITOE04 - CLOUD COMPUTING FUNDAMENTALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 tools.   **(9)**

CLOUD SECURITY

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. *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)

REFERENCE BOOKS

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, 2012.

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.

15ITOE05 - INFORMATION SECURITY FUNDAMENTALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *Identify and analyze the security threats and attacks and apply device 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. **(5)**

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. **(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. **(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 - **(8)**

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 IT Act - 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)*

REFERENCE BOOKS

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.

15ITOE06 - INTRODUCTION TO HUMAN COMPUTER INTERACTION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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. **(11)**

WINDOWS & COMPONENTS

Windows: New Navigation Schemes - Selection of Window - Selection of Devices Based on Screen Based Controls.

Components: Text and Messages - Icons and Increases - Multimedia - Colors - Uses -Problems - Choosing colors. **(9)**

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 BOOKS

1. *Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.*

15ITOE07 - ENTERPRISE RESOURCE PLANNING CONCEPTS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 inorder to define the functionality of various departments in a company.*

CO4 : *Analyze the ERP marketplace 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)*

REFERENCE BOOKS

1. *Ellen F.Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Course Technology Ptr, Fourth Edition, 2013.*
2. *Vinod Kumar Garg and Venkitakrishnan N.K., "Enterprise Resource Planning - Concepts and Practice", Prentice Hall of India, New Delhi, Second Edition, 2012.*

15CHOE01 - INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After completion of the course, students are able to

CO1 : *Practice the safety norms and inspect turning machines, boring machines, milling machine, planning 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 t 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 protectivedevices, machine guarding, types, fixed guard, interlock guard,automatic guard, trip guard, electron eye, positional control guard, fixedguard fencing- guard construction- guard opening. Selection andsuitability: lathe - drilling - boring - milling - grinding - shaping - sawing- shearing presses - forge hammer - flywheels - shafts - couplings -gears - sprockets wheels and chains pulleys and belts - authorized entryto 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 ofindustrial 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, auxiliarymechanisms, feeding and cutting mechanism, hand or foot-operatedpresses, power press electric controls, power press set up and dieremoval, inspection and maintenance-metal sheers-press brakes. Hotworking safety in forging, hot rolling mill operation, safe guards in hotrolling mills - hot bending of pipes, hazards and control measures.Safety in gas furnace operation, cupola, crucibles, ovens, foundry healthhazards, work environment, material handling in foundries, foundryproduction 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 leaktest, 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.*

REFERENCE BOOKS

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.*

15CHOE02- RISK ANALYSIS AND HAZOP

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 BOOKS

1. *Daniel A Crowl., Louvar J.F., Chemical Process Safety: Fundamentals with Applications, Prentice Hall, New Jersey, 2002.*

15CHOE03 - GREEN TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 : *Analyze 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

REFERENCE BOOKS

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.*

15CHOE04 - CORROSION SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, the students will be 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 : *Analyze 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-H_2O 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 BOOK

1. *Banarjee.S.N., An introduction to corrosion and corrosion inhibitors, Oxonian Press Ltd., New Delhi, 1985.*

15CHOE05 - INTRODUCTION TO CHEMICAL ENGINEERING

	L	T	P	C
	3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

After successful completion of this course, the students will be 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 equipments 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

REFERENCE BOOKS

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.*

15MOE01 - 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 their respective main stream.*

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 AND SUBGRAPHS

Graph --Standard Concepts in Graphs - Subgraphs -Complete Graph - Bipartite Graph - Isomorphism - Adjacency Matrix and Incidence Matrix - Walk, Trail and Path -Bipartite Graph -Connectedness- The Shortest Path Problem- Disjkstra'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, McGraw Hill Education (India), 2006.*
2. *Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India Private Limited, 2004.*

REFERENCE BOOKS

1. *Douglas B.West, "Introduction to Graph Theory" II Edition, Prentice Hall of India Private Limited, 2000.*
2. *Reinhard Diestel, "Graph Theory", II Edition, Springer Publications, 2006.*
3. *Clark J. and Holton D.A, "A First Look at Graph Theory", Allied Publishers, 1995.*
4. *Frank Harary, Graph Theory, 10th Edition, Narosa Publishing House, 2001.*

15MOE02 - METHODS OF APPLIED MATHEMATICS

<div style="text-align: right">

L	T	P	C
3	0	0	3

</div>

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, Fourier - Bessel and Legedre Series **(9)**

PARTIAL DIFFERENTITAL EQUATIONS

Linerar and quasi - linear equations of the first and second order. Characterstics 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.

<div style="text-align: right">

(9)

TOTAL : 45

</div>

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 Edn. (EEE). Prentice Hall of India P. Ltd., (2014)*

REFERENCE BOOKS

1. *F.B. Hildebrand - Methods of Applied Mathematics, Second Edn. Prentice Hall of India P.Ltd., (2012)*

2. *C.Stephenson : An introduction to partial differential equation for Science students, ELBS.*

3. *E. D. Rainville : Special Functions.*

4. *Dettman : Mathematical methods in physics and Engineering.*

15MOE03 - 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 - Vogle'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 Salesman 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 2007, New Delhi*
2. *Resource management techniques by V.Sundaresan, Tenth Edition, 2016 A.R Publications, Chennai*

REFERENCE BOOKS

1. *Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt.Ltd., New Delhi, 2005.*
2. *O'Neil, P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.*

15MOE04 - 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 idea 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 ,2002.*

2. *T.Veerarajan, Probability, Statistics and Random Processes, Second Edition, TataMcGraw-Hill 2007*

REFERENCE BOOKS

1. *Rohatgi V.K. (2002) : Introduction to Mathematical Statistics, Wiley. 2. Bhat, B. R. (2005) : Modern Probability Theory - An Introductory Text Book, Third Edition, New Age International.*

2. *Cochran, W.G.(2007): Sampling Techniques, Wiley Eastern Private Limited*

3. Sukhatme, P.V. and Sukhatme, B.V.(1977): Sampling Theory of Survey with Applications, Asia publishing House.

4. Venkataraman M.K, "Higher mathematics for Engineering and Science" National Publishing Company ,2000

5. Ibe , O.C., "Fundamentals of Applied Probability and Random processes", 1st Indian Reprint , Elsevier , 2007.

6. Peebles , P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill , 4th Edition , New Delhi, 2002.

15POE01 - INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 - Structural,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 Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.*

3. *Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.*

4. *Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)*

5. *Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.*

REFERENCE BOOKS

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. *Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007*

15POE02 - PHYSICS AND TECHNOLOGY OF THIN FILMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 ablation 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)*

REFERENCE BOOKS

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. *KiyotakaWasa, Makoto Kitabatake, Hideaki Adachi, Thin Films Material Technology, Springer-Verlag Berlin Heidelberg, 2004.*

15POE03 - SOLAR CELL FUNDAMENTALS AND MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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.*

REFERENCE BOOKS

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.*

15POE04 - ADVANCED MATERIAL PROCESSING TECHNOLOGIES

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOME

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*

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 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. **(9)**

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. **(9)**

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. *BetzalelAvitzu, "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.*

REFERENCE BOOKS

1. *Michael Barsoum, "Fundamentals of Ceramics", McGraw Hill Publishing Co., INC, 1997*

2. *Gowariker V R, Viswanathan N V, JayadevSreedhar, "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.*

15COE01 - 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. *GerogeW.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*

REFERENCE BOOKS

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.*

15COE02 - 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

REFERENCE BOOKS

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.*

15COE03 - 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 microporus 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

REFERENCE BOOKS

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.*

15COE04 - NANOCOMPOSITES

L	T	P	C
3	0	0	3

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

REFERENCE BOOKS

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*

15COE05 - 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*

REFERENCE BOOKS

1. *Martin Kaltschmitt; Hermann Hofbauer. "Biomass Conversion and Biorefinery", Springer Publishing, 2008*

15HOE01 - PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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*

INTRODUCTION TO MANAGEMENT

Meaning, Definition and Significance of Management-Basic functions of Management-Development of Management Thought

(9)

MANAGEMENT CONCEPTS

Planning, Organizing, Staffing, Directing and Controlling- MBO-Six sigma **(9)**

ORGANIZATIONAL BEHAVIOR

Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and Perceptions at work **(9)**

BUSINESS PROCESS REENGINEERING

Need for BPR, Various phases of BPR, Production and Productivity-Factors influencing Productivity. **(8)**

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*

REFERENCE BOOKS

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*

15HOE02 - CURRENT TRENDS IN INDIAN ECONOMY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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*

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)**

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)**

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)**

SERVICE SECTOR

Service sector in India-Banking-Insurance-Telecommunication-IT sector-Sofware exports-BPO-Contribution to GDP   **(9)**

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 BOOK

1.   *Ruddar Datt and Sundaram, KPM, Indian Economy, S.Chand and company, New Delhi-2015 Ramesh Singh Indian Economy, McGraw hill Education 7ᵗʰ edition, 2015*

REFERENCE

1.   www.jagranjosh.com

15HOE03 - MONETARY ECONOMICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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*

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)**

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)**

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)**

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)**

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*

REFERENCE BOOKS

1. *Sethi TT, "Monetary Economic Theory", S Chand & Co, New Delhi 1996*
2. *Mithani DN, "Money Banking and International Trade", Himalaya, Mumbai 2013*

15HOE04 - ACCOUNTING FOR MANAGERIAL DECISIONS

	L	T	P	C
	3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *Differentiate Financial and Management Accounting*

CO2 : *Analyze the profit and loss of the firm using the classifications of ratio analysis*

CO3 : *Prepare a fund flow statement*

CO4 : *Sketch the Break even chart and interpret the results for a given data*

MANAGEMENT ACCOUNTING

Introduction to Management Accounting - Nature and Scope of Management Accounting - Importance - Functions - Distinguish between Financial and Management Accounting - Tools in Management Accounting - Limitations - Disadvantages **(9)**

FINANCIAL STATEMENTS

Ratio Analysis - Meaning - Significance - Classifications - Liquidity Ratios - Turnover Ratios - Profitability Ratios - Solvency Ratios **(8)**

FUND FLOW AND CASH FLOW STATEMENT

Meaning and concept of flow of Funds-Meaning of fund Flow Statement - Difference between Fund flow statement and Income statement - Preparation and Interpretation of cash flow statement **(9)**

INVESTMENT DECISION

Budgeting - Objectives - Features - Advantages - Disadvantages - Cash Budget - Flexible Budget **(9)**

MARGINAL COSTING AND WORKING CAPITAL MEASUREMENT

Marginal Costing - Importance - Advantages - Breakeven Point - Breakeven Chart - Margin of Safety - Profit Volume Analysis - Working Capital - Importance - Factors Affecting Working Capital - Computation of Working Capital Requirements **(10)**

TOTAL : 45

TEXT BOOK

1.   *R.K.Sharma and Sasi K.Gupta, "Management accounting", 2014*

15HOE05 - ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 a 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

REFERENCE BOOKS

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

15HOE06 - EMPLOYABILITY SKILLS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *Set a goal and outline stratigies to achieve it*

CO2 : *Prepare a job application letter with a resume for a position in a corporate sector*

CO3 : *Analyse the listening comprehension and answer the questions*

CO4 : *Find a solution for a problem in the corporate sector applying problem solving skills*

GOAL SETTING AND TIME MANAGEMENT

Goal Setting - Immediate, Short Term and Long Term Goals - Smart Goals - Strategies to Achieve Goals - Confidence Building, Self-esteem, Motivation - Time Management - Identifying Time Wasters - Time Management Skills. **(9)**

SPEAKING

Ice-breakers - Self introduction - Role Play - Debate - Group Discussion: Purpose - Group Behavior - Analyzing Performance. Job Interviews: Identifying Job Openings - Interview Process - Types of Questions - Mock Interviews - Professional Grooming. **(11)**

READING AND WRITING

Reading Comprehension - Speed Reading Necessary for Reading Letters and Files - Vocabulary Development - Preparing Job Applications - Writing Covering Letter and Résumé - Applying for Jobs Online - Creative Writing - Article Writing - Book Review **(9)**

LISTENING

Listening to - Conversations, Long Speeches, Narrations, Descriptions, Famous Speeches. **(8)**

LEADERSHIP AND TEAM MANAGEMENT

Qualities of a Good Leader - Leadership Styles - Decision Making - Problem Solving - Etiquettes - Email, Professional, Dining & Telephone - Team Building - Team Work - Delegation. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Aruna Koneru. "Professional Communication". Tata MacGraw Hill Publishing Company Limited. New Delhi, 2008.*

2. *Jones, Leo and Richard Alexander. "New International Business English" Cambridge University Press, 2003.*

REFERENCE BOOKS

1. *Corneilssen, Joep. "How to Prepare for Group Discussion and Interview". New Delhi: Tata-McGraw-Hill, 2009.*

15HOE07 - ENGLISH FOR ACADEMIC PURPOSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *Write a description of a system.*

CO2 : *Formulate a research paper*

CO3 : *Listen to a lecture and prepare a summary.*

CO4 : *Construct dialogues using appropriate expressions.*

FOCUS ON LANGUAGE

Sentence Construction- Types of Clauses- Sequence words - Co ordination- Subordination- Paragraphing Information - Describing a System & Procedure **(8)**

READING

Understand a writer's purpose - Use strategies to ascertain meaning from unfamiliar vocabulary encountered in context - Recall and use vocabulary regarding urbanization and mega cities - 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. **(8)**

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 . The Methodology - The Results - The Discussion - The Conclusion - Citing Sources - Proof reading Your Paper **(10)**

LISTENING

Listening to conversation - Lectures - Topics - Discussions - Listening comprehension on specific topics - Listening to recognize formal and Informal spoken English **(8)**

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 **(11)**

TOTAL : 45

TEXT BOOK

1. *MLA Handbook 8th edition published 2016. ISBN : 9781603292627*

REFERENCE BOOKS

1. *English for writing Research papers, Authors : Wall work, Adrian Published 2016, Spinger Publication.*

15HOE08 - ENGLISH FOR COMPETITIVE EXAMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : *Listen to TOEFL, IELTS and GRE 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

TEXT BOOK

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.*

REFERENCE BOOKS

1. *Sharpe J.Pamela. Barron's TOEFL iBT Internet- Based Test. 12th Edition, Galgotia publications Pvt.Ltd: New Delhi, 2009.*

2. *Longman Indroductory course for the TOEFL Test.*

15HOE09 - LIFE AND LITERATURE

	L	T	P	C
	3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

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 of the fiction*

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)**

POEMS

Stopping By Woods on a Snowy Evening by Robert Frost

The Ballad of Father Gilligan by W.B. Yeats **(9)**

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 **(10)**

Albert Einstein and Steve Jobs

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

TEXT BOOKS

1. Kumara Pillai. ed. A Book of Modern Short Stories. Macmillan: New Delhi, 2009

2. Colleen and Darius Krishnaraj. ed. Convergence, A Book of Short Stories. Macmillan: New Delhi, 2009

3. Ernest Hemmingway. The Old Man and the Sea. Arrow: Warwickshire, 2000.

4. Baroness Emma Orczy, The Scarlet Pimpernel. Hutchinson : 1995

REFERENCE BOOKS

1. Xavier. ed. An Anthology of Popular Essays and Poems. Macmillan: New Delhi, 2009