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 COMPUTER APPLICATIONS

VISION AND MISSION

VISION

The Department of Computer Applications strives to groom students with diverse backgrounds into competitive software professionals and pioneering leaders in offering innovative solutions to dynamic global challenges in tune with the needs of the society.

MISSION

The Mission of Department of Computer Applications is to :

M1 Provide an environment for students to gain expertise in theoretical foundations of computer applications with emphasis on strong practical training that will enable them to develop real world applications catering to the global needs.

M2 Offer students a quality learning process in a research oriented environment with industrial collaboration that motivates them to innovate and explore.

M3 Develop intellectual curiosity and a commitment to lifelong learning in students, with societal and environmental concerns.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF COMPUTER APPLICATIONS

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs for MCA programme are designed based on the Department Mission.

MCA Graduates will be able to :

PEO 1 : Develop software solutions to problems across a broad range of application domains through analysis and design.

PEO 2 : Contribute to research of their chosen field and function and communicate effectively, to perform both individually and in a multi-disciplinary team.

PEO 3 : Continue the process of life-long learning through professional activities; adapt themselves with ease to new technologies, while exhibiting high ethical and professional standards.

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DEPARTMENT OF COMPUTER APPLICATIONS

PROGRAMME OUTCOMES (POs)

The following are Programme Outcomes for the MCA Programme :

PO1 : Graduates will be able to apply knowledge of computing fundamentals, computing specialization and domain knowledge for the abstraction and conceptualization of computing models from defined problems and requirements.

PO2 : Graduates will have the ability to understand and analyze a given real-world problem and propose feasible computing solutions.

PO3 : Graduates will be able to analyze customer requirements, create high level design, implement and document robust and reliable software systems.

PO4 : Graduates will be able to transform complex business scenarios and contemporary issues into problems, investigate, understand and propose integrated solutions using emerging technologies.

PO5 : Graduates will be able to use the techniques, skills and modern hardware and software tools necessary for innovative software solutions.

PO6 : Graduates will possess leadership and managerial skills with best professional ethical practices and social concern.

PO7 : Graduates will recognize the need for self-motivation to engage in lifelong learning.

PO8 : Graduates will be able to master fundamental project management skills, concepts and techniques, set attainable objectives and ensure positive results, meeting scope, time and budget constraints.

PO9 : Graduates will be able to communicate technical information effectively, both orally and in writing

PO10 : Graduates will be able to recognize the social, professional, cultural, and ethical issues involved in the use of computer technology and give them due consideration in developing software systems.

PO11 : Graduates will be able to work collaboratively as a member or leader in multidisciplinary teams.

PO12 : Graduates will be able to assess the need for innovation and initiate the process through entrepreneurship or otherwise.

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DEPARTMENT OF COMPUTER APPLICATIONS

MCA 2 YEARS PROGRAMME 2020

Curriculum from the Academic Year 2020 and onwards

Under Choice Based Credit System

Name of the degree : MCA

Specialization : Computer Applications

Semester I

Course Code	Course Name	L	T	P	C	CY
20MCA11	Mathematical Foundations of Computer Applications	3	0	0	3	FC
20MCA12	Data Structures and Algorithms	3	0	0	3	FC
20MCA13	Database Management Systems	3	0	0	3	FC
20MCA14	Operating System Principles	3	0	0	3	FC
20MCA15	Software Engineering	3	0	0	3	FC
20MCA16	Data Structures Laboratory	0	0	4	2	FC
20MCA17	Database Management Systems Laboratory	0	0	4	2	FC
20MCA18	Python Programming Laboratory	0	0	4	2	PC
20MCA19	Communication Skills	0	0	2	1	EEC
	Total Credits				22	

Semester II

Course Code	Course Name	L	T	P	C	CY
20MCA21	Artificial Intelligence	3	0	0	3	FC
20MCA22	Advanced Java Programming	3	0	0	3	PC
20MCA23	Virtualization and Cloud Computing	3	0	0	3	FC
20MCA24	SOA and Web Services	3	0	0	3	FC
	Elective I	3	0	0	3	PE
20MCA25	Artificial Intelligence Laboratory	0	0	4	2	FC
20MCA26	Advanced Programming Laboratory	0	0	4	2	PC
20MCA27	Professional English	0	0	2	1	EEC
20MCA28	Mini Project	0	0	2	1	EEC
20HAC01	Hackathon	0	0	0	1	EEC
	One Credit Course	1	0	0	1	OC
	Total Credits				23	

Semester III

Course Code	Course Name	L	T	P	C	CY
20MCA31	Cryptography and Network Security	3	0	0	3	FC
20MCA32	Machine Learning	3	0	0	3	FC
	Elective II	3	0	0	3	PE
	Elective III	3	0	0	3	PE
	Elective IV (Management Elective)	3	0	0	3	PE
20MCA33	Cryptography and Network Security Laboratory	0	0	4	2	FC
20MCA34	Machine Learning Laboratory	0	0	4	2	FC
	Elective Lab	0	0	4	2	PE
20MCAIT01	Inplant Training	0	0	0	1	EEC
	Total Credits				22	

Semester IV

Course Code	Course Name	L	T	P	C	CY
20MCA41	Project work and viva voce	-	-	-	13	EEC
	Total Credits				13	
	Total Credits				**80**	

#One Credit Course

Course Code	Course Name	L	T	P	C	CY
20MCAOC01	Recent Trends in Web Technology	1	0	0	1	OC
20MCAOC02	Devops Essentials	1	0	0	1	OC

Professional Electives - IT Electives

Course Code	Course Name	L	T	P	C	CY
20MCAE101	Graphics and Multimedia	3	0	0	3	PE
20MCAE102	Advanced Database Management Systems	3	0	0	3	PE
20MCAE103	Distributed Systems	3	0	0	3	PE
20MCAE104	Grid and Cluster Computing	3	0	0	3	PE
20MCAE105	Internet of Things	3	0	0	3	PE
20MCAE106	Software Metrics and Measurement	3	0	0	3	PE
20MCAE107	Agile Methods for Software Development	3	0	0	3	PE
20MCAE108	Software Architecture and Design Patterns	3	0	0	3	PE
20MCAE109	Basics of Robotics	3	0	0	3	PE
20MCAE110	GPU and Parallel Programming	3	0	0	3	PE
20MCAE111	Digital Image Processing	3	0	0	3	PE
20MCAE112	Blockchain Technologies	3	0	0	3	PE
20MCAE113	Single page web applications	3	0	0	3	PE

Course Code	Course Name	L	T	P	C	CY
20MCAE114	Digital Marketing	3	0	0	3	PE
20MCAE115	Software Project Management	3	0	0	3	PE
20MCAE116	Computer Vision	3	0	0	3	PE
20MCAE117	Software Testing and Quality Assurance	3	0	0	3	PE
20MCAE118	Open Source Ecosystem	3	0	0	3	PE
20MCAE119	Enterprise Management and Computing	3	0	0	3	PE

Professional Electives - Data Science Electives

Course Code	Course Name	L	T	P	C	CY
20MCAE201	Data Analytics	3	0	0	3	PE
20MCAE202	Intelligent Information Retrieval	3	0	0	3	PE
20MCAE203	Big Data Technologies	3	0	0	3	PE
2OMCAE204	Data Mining and Warehousing	3	0	0	3	PE
20MCAE205	Natural Language Processing	3	0	0	3	PE
20MCAE206	Social Network Analysis	3	0	0	3	PE

Professional Electives - Networking Electives

Course Code	Course Name	L	T	P	C	CY
20MCAE301	Computer Networks	3	0	0	3	PE
20MCAE302	Internetworking Protocols and Management	3	0	0	3	PE
20MCAE303	Mobile Computing	3	0	0	3	PE
20MCAE304	Wireless networks	3	0	0	3	PE
20MCAE305	Ad Hoc Networks	3	0	0	3	PE

Professional Electives - Management Electives

Course Code	Course Name	L	T	P	C	CY
20MCAE401	Organizational Behaviour	3	0	0	3	PE
20MCAE402	Principles of Management	3	0	0	3	PE
20MCAE403	Accounting and Financial Management	3	0	0	3	PE
20MCAE404	E-Commerce	3	0	0	3	PE
20MCAE405	Decision Making	3	0	0	3	PE
20MCAE406	Entrepreneurship Development	3	0	0	3	PE
20MCAE407	Principles of Environmental Science	3	0	0	3	PE

Professional Electives Laboratories

Course Code	Course Name	L	T	P	C	CY
20MCAEL01	Mobile Application Development Laboratory	0	0	4	2	PE
20MCAEL02	Graphics and Multimedia Laboratory	0	0	4	2	PE
20MCAEL03	Internet of Things Laboratory	0	0	4	2	PE
20MCAEL04	Data Analytics Laboratory	0	0	4	2	PE
20MCAEL05	Data Mining Laboratory	0	0	4	2	PE
20MCAEL06	GPU and Parallel Programming Laboratory	0	0	4	2	PE
20MCAEL07	Image Processing Laboratory	0	0	4	2	PE
20MCAEL08	Web Frameworks Laboratory	0	0	4	2	PE
20MCAEL09	Natural Language Processing Laboratory	0	0	4	2	PE
20MCAEL10	Social Network Analysis Laboratory	0	0	4	2	PE
20MCAEL11	Networks Programming Laboratory	0	0	4	2	PE
20MCAEL12	Digital Marketing Laboratory	0	0	4	2	PE

BRIDGE COURSE**

SEMESTER I

Course Code	Course Name	L	T	P	C	CY
20MCAB11	Basics of Data Structures	1	0	0	0	FC
20MCAB12	Programming in C	1	0	0	0	FC
20MCAB13	Computer Hardware and Organization	1	0	0	0	FC

SEMESTER II

Course Code	Course Name	L	T	P	C	CY
20MCAB21	Basics of Internet	1	0	0	0	FC
20MCAB22	Software Project Management	1	0	0	0	FC
20MCAB23	Object Oriented Programming in C++	1	0	0	0	FC

** Applicable to the candidates who has been admitted with Non Computer Science Undergraduate Degree

FC - Foundation Course, PC - Professional Core, OC- One Credit Course, PE - Professional Elective, EEC - Employability Enhancement Course.

20MCA11 - MATHEMATICAL FOUNDATIONS OF COMPUTER APPLICATIONS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Apply the concept of system of linear equation to real time problems*

CO2 : *Understand basic statistical concepts and measures.*

CO3 : *Apply the concept of probability distribution and random variables to different problems and apply the principles of correlation and regression.*

CO4 : *Analyse and solve problems using sampling theory.*

CO5 : *Acquire sound knowledge of analysis in the time series and decision making through analysis of variance in the field of data analysis.*

LINEAR ALGEBRA

System of linear equations - Solution Sets of Linear Systems - Linear Independence - Linear transformation - Matrix of linear transformations **(8)**

MEASURES OF CENTRAL TENDENCY AND DISPERSION

Measures of Central Tendency : mean, median, mode, Geometric mean, Harmonic mean - Measures of Dispersion: Range, mean deviation, standard deviation and coefficient of variation - Skewness and Kurtosis. **(8)**

PROBABILITY

Probability Axioms - Conditional Probability - Laws of total probability - Baye's theorem. One Dimensional Random variables - Discrete case and Continuous case - Distributions: Binomial, Poisson and Normal Distributions. Mathematical expectation - Two dimensional random variables - Joint distributions - mean and variance - Correlation and Regression. **(10)**

SAMPLING THEORY

Population and sample - sampling and its need - parameter of statistics - Test of significance - standard error- level of significance - test of hypothesis - test of significance for small samples: student t-test , F-test and Chi-square test: Goodness of fit and Independence of attributes - test of significance for large samples: mean ,proportion and variance. **(9)**

TIME SERIES AND ANALYSIS OF VARIANCE

Component of time series - measurement of trend - moving average method - least square method for linear and exponential curves. Basic principles of experimental design - analysis of variance for one way classification - completely randomized design - Latin square design. **(10)**

TOTAL : 45

REFERENCES

1. *David C Lay, "Linear Algebra and Its Applications", 5th Edition, Pearson Education, 2015.*
2. *Gupta, S.C. and Prof. Kapoor, V.K., "Fundamental of Applied Statistics", Edition 4, reprint, S.Chand & Co., 2015.*
3. *Gilbert Strang, "Linear Algebra and Its Applications", Brooke/Cole Ltd., New Delhi, Fourth Revised Edition, 2012.*
4. *Veerarajan.T, "Fundamentals of Mathematical Statistics", 1st Edition, Yes Dee Publishing Pvt Ltd, 2017.*
5. *Michael Baron, "Probability and Statistics for Computer Scientists", 2nd Edition, CRC Press, 2014.*
6. *Richard I Levin and David S. Rubin, "Statistics for Management", 8th Edition, Pearson (2017).*

20MCA12 - DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Choose and design data structures such as array, linked list, stack, queue, trees and graphs to effectively model information in a problem.*

CO2 *: Choose and apply operations like insertion, deletion, traversal and searching mechanism on various data structures relevant to a problem.*

CO3 *: Judge efficiency trade-offs between data structures.*

CO4 *: Apply standard algorithms for searching and sorting based on given problem.*

CO5 *: Apply algorithm analysis techniques to evaluate performance of an algorithm.*

BASIC CONCEPTS

System Life Cycle - Algorithm Specification - Data Abstraction - Primitive Data Structures - Iterative and Recursive algorithms - Performance Analysis - best case - worst case - average case complexities - Notations. **(5)**

ARRAYS

Array as an Abstract Data Type (ADT) - Polynomial ADT - Sparse Matrix ADT - Representation of Multidimensional Arrays - String ADT. **(8)**

STACKS AND QUEUES

Stack ADT - Queue ADT - Mazing Problem - Evaluation of Expressions - Multiple Stacks and Queues. **(6)**

LINKED LISTS

Pointers - Singly Linked Lists - Dynamically Linked Stacks and Queues - Polynomials - Additional List Operations - Equivalence Relations - Sparse Matrices - Doubly Linked Lists. **(8)**

TREES

Introduction - Binary Trees - Binary Tree Traversals - Additional Binary Tree Operations - Threaded Binary Trees - Heaps - Binary Search Trees. **(6)**

GRAPHS

Introduction - Elementary Graph Operations - Graph Traversal - Minimum Cost Spanning Trees Shortest Paths. **(6)**

SEARCHING AND SORTING

Searching and List Verification - Insertion Sort - Quick Sort. **(6)**

TOTAL : 45

REFERENCES

1. *Ellis Horowitz, Sartaj Sahni, Anderson Freed, "Fundamentals of Data Structures in C", Universities Press, 2nd Edition, 2008.*
2. *Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures - A Pseudocode Approach with C", Cengage Learning, 2nd Edition, 2007.*
3. *Yashavant P. Kanetkar, "Data Structures through C", BPB Publications, 2nd Edition, 2003.*
4. *Seymour Lipschutz, "Data Structures with C", Schaum's Outline Series, McGraw Hill Publications, 2nd Edition, 2014.*

20MCA13 - DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

***CO1** : Identify the components of RDMS software and its significance.*

***CO2** : Analyze the data requirements and create conceptual design of the database using Entity Relationship model.*

***CO3** : Identify functional dependencies and apply normalization techniques to optimize the data design.*

***CO4** : Write SQL queries based on the functional requirements of any real world database applications.*

***CO5** : Implement different concurrency control techniques in transactions and recovery mechanisms used in database.*

DATABASES AND DATABASE USERS

Introduction - Characteristics of the database approach - Actors - Advantages- Database system, Concepts and Architecture: Data models, schemas and instances - Three schema architecture - Data Independence - DBMS Languages and Interfaces - DBMS component modules - Centralized DBMS architecture - Basic Client/Server Architecture. **(6)**

DATA MODELING

Using high-level conceptual data models - Entity types, Entity sets, Attributes and Keys, Relationship types, Relationship sets, roles and structural constraints, Weak entity types - ER Naming conventions-Examples of ER design - Relationship types of degree higher than two- EER Model: Subclasses, Super classes and Inheritance-Specialization and Generalization. **(7)**

RELATIONAL DATA MODEL

Relational Model Concepts - Relational Model Constraints - Relational Database Schemas - Update Operations, Transaction and Dealing with Constraint Violations. Relational Algebra and Calculus - Unary Operations - Set Operations - Binary Operations - Additional Relation Operations. ER and EER to Relational Mapping. **(6)**

BASIC SQL

SQL Data Definition - Specifying Basic Constraints in SQL- Basic Retrieval Queries in SQL- Insert, Delete, Update Statements in SQL- Complex Queries: Views - Schema Change Statements in SQL- PL/SQL Programming. **(7)**

NORMALIZATION

Informal Design Guidelines for Relational Schema- Functional Dependencies - Normal Forms Based on Primary Keys - General Definitions of Second and Third Normal Forms- Boyce Codd Normal Form-Multi-Valued Dependency and Fourth Normal Form-Join Dependencies and Fifth Normal Form. **(7)**

TRANSACTION PROCESSING CONCEPTS

Introduction-Transaction and System Concepts - Desirable Properties of Transactions- Characterizing Schedules Based on Recoverability and Conflict Serializability. **(6)**

CONCURRENCY AND RECOVERY

Concurrency Control Techniques: Two Phase Locking-Concurrency Based on Time Stamp Ordering. Recovery: Database Recovery Concepts - Recovery Techniques Based on Deferred Update and Immediate Update-Shadow Paging. **(6)**

TOTAL : 45

REFERENCES

1. *Ramez Elmasri, Shamkant B. Navathe Durvasula, V.L.N. Somayajulu, Shyam K. Gupta, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2015.*
2. *Abraham Silberschatz. A, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", John Wiley, 10th Edition, 2018*
3. *Christopher Allen, Simon Chatwin, Catherine A. Creary, "Introduction to Relational Databases and SQL Programming", Tata McGraw-Hill, 2010.*

20MCA14 - OPERATING SYSTEM PRINCIPLES

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

***CO1** : Demonstrate the structure of operating system, batch programming, system calls and virtual machines*

***CO2** : Demonstration of Kernel Management specific to concurrent process for Inter Process Communication systems*

***CO3** : Estimate system performance through scheduling algorithms - FIFO, round robin, priority, shortest job first*

***CO4** : Recognize memory allocation and de-allocation for both static and dynamic storage*

***CO5** : Design and develop a simple File System using Disk and File System Management*

INTRODUCTION

Abstract view of an Operating system - extended view of resource manager - Over view: Simple batch system multi programmed batch systems - time sharing systems - parallel systems - distributed systems - real time systems - system structure: IO structure- memory- CPU-Kernals and micro kernels - dual-mode operation - operating - system services - system calls - Structure of Operating system- Various components of Operating system **(8)**

PROCESS MANAGEMENT

Process Concepts - Process creation - Process Termination - Process states - Process Description - Process control - Relationship between process and threads - Thread State - Thread Scheduling- Thread Synchronization-Multithreading model - Concurrent Process -process synchronization: critical section problem - mutual exclusion - Dekker's algorithm -synchronization hardware - semaphore - classical problem of synchronization - critical regions - monitors - atomic transaction - race condition. Dead lock characterization - handling dead locks - prevention - avoidance - detection and recovery - combined approach **(10)**

PROCESSOR MANAGEMENT

Basic Concepts - scheduling criteria - preemptive versus non-preemptive scheduling - scheduling algorithms: FIFO - Shortest job first, priority, round robin, multi level queue - multi level feedback queue - multiprocessor scheduling **(9)**

MEMORY MANAGEMENT

Basic Concepts - logical versus physical address - swapping - Fixed partition and Dynamic partition - Simple paging - multi level paging - Inverted paging - simple segmentation- combined paging and segmentation - virtual memory - demand paging - thrashing- Working set model -demand segmentation. **(9)**

I/O AND FILE MANAGEMENT

I/O: hardware - application I/O interface - Logical structure of I/O functions -I/O Buffering - Disk I/O - disk scheduling . File management: file concepts - access methods - directory structure - file system structure - allocation methods - free space management. **(9)**

TOTAL : 45

REFERENCES

1. *Abraham Silberschatz. A, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", John Wiley, 10th Edition, 2018.*
2. *William Stallings, "Operating Systems: Internals and Design Principles", Prentice-Hall, 2008.*
3. *H.M.Dietel, "An Introduction to Operating Systems", Addison Wesley, 2nd Edition, 2007.*
4. *Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall of India Pvt. Ltd, 2008.*

20MCA15 - SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Choose applicable software life-cycle model to develop software for given customer need and justify choice with reference to complexity, cost and time.*

CO2 : *Determine software requirements based on customer need and develop industry standard Software Requirement Specification (SRS) document*

CO3 : *Construct models using functional and object oriented design principles, concepts and tools based on SRS document.*

CO4 : *Prepare suitable structural and behavioural analysis models based on SRS document.*

CO5 : *Formulate test cases and test data using white box and black box techniques to deliver defect free software.*

INTRODUCTION TO SOFTWARE ENGINEERING

Software Engineering - Process Models - Agile Development. **(9)**

MODELING

Understanding Requirements - Requirements Modeling - Scenario Based Methods, Class Based Methods, Behavior, Patterns, and Web/ Mobile Apps. **(9)**

DESIGN ENGINEERING

Design Concepts - Architectural Design - Component Level Design - User Interface Design - Pattern Based Design - WebApp Design - MobileApp Design **(9)**

QUALITY MANAGEMENT

Software Testing Strategies - Testing for Conventional Software - Testing for Object Oriented Software - Testing for Web Applications - Testing for MobileApps **(9)**

MANAGING SOFTWARE PROJECTS

Project Management Concepts - Process and Project Metrics - Maintenance and Reengineering - Emerging Trends in Software Engineering. **(9)**

TOTAL : 45

REFERENCES

1. *Roger S. Pressman, "Software Engineering - A Practitioner's approach", McGraw Hill International, 8th Edition, 2019.*
2. *Rajib Mall, "Fundamentals of Software Engineering", PHI. 5th Edition, 2018.*
3. *Pankaj Jalote, "An Integrated Approach to Software Engineering", Narosa Publishing House, 3rd Edition, Reprint 2019.*

20MCA16 - DATA STRUCTURES LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

20MCA12

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Choose appropriate Data structures for implementing given scenario.*

CO2 *: Demonstrate the applications of Linked Lists, Stack, Circular Queue and Priority Queue.*

CO3 *: Design recursive algorithms and implement in real time application.*

CO4 *: Demonstrate various operations on Heap and Binary Search Tree.*

CO5 *: Compare various sorting and searching techniques in term of time complexity and space complexity.*

CONCEPTS TO BE COVERED

1. Applications of 2D, 3D arrays
2. Compute time and space complexity for simple programs
3. Implement linear linked list, doubly linked list
4. Basic operations of stack- Array, linked list implementation
5. Building applications using stack
6. Basic operations of queue- Array, linked list implementation
7. Implementing priority queue, circular queue
8. Recursion - Towers of Hanoi, Fibonacci series
9. Building Binary Search Tree, operations on BST operations on AVL trees
10. Graph operations
11. Implement Sorting & Searching technique

20MCA17 - DATABASE MANAGEMENT SYTEMS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Design the conceptual data model as Entity Relationship diagram and create the database using DDL statements for a given application*

CO2 : *Formulate simple DML SQL queries to retrieve the required data for real world applications*

CO3 : *Generate DML queries using Sub Queries, Joins, Group By, Order By and Aggregate functions to filter and aggregate the data of the real world applications*

CO4 : *Construct reusable PL/SQL blocks with Functions, Procedures, Packages, Triggers, Exception Handling, and Cursors as required by OLTP applications*

CO5 : *Develop a database project by constructing ER model, Creating Tables and write SQL and PL/SQL blocks using RDBMS software.*

CONCEPTS TO BE COVERED

PART I : SQL

1. Implementation of DDL and DML Statements
2. DCL and TCL Commands
3. Single Line and Group Line functions
4. Queries using multiple tables, Join
5. Set Operations in SQL
6. Aggregating data using Group functions, Use of Group by/Having clause
7. Sub queries in SQL
8. Constraints
9. Views, Sequence, Index, Synonym

PART II : PL/SQL

1. Simple programs
2. Exception Handling
3. Trigger and Cursor
4. Functions, Procedure and Packages

PART III - Client/Server Application

1. Embedded SQL within a programming language like VB.NET/Java, etc.

20MCA18 - PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Write, test, and debug simple Python programs using conditional and looping statements.*

CO2 *: Develop modular programs using functions.*

CO3 *: Represent compound data using strings, lists, tuples, and dictionaries.*

CO4 *: Perform numerical operations on large datasets.*

CO5 *: Apply suitable library function to analyze and classify the data.*

CONCEPTS TO BE COVERED

1. Simple programs using variables and operators.
2. Program development using conditional, control and repetition statements.
3. Data manipulation using lists, tuples and dictionaries.
4. Handling text data using string handling operations and functions.
5. Modular programming using functions and lambdas.
6. The use of local, global and built-in names within functions.
7. File operations - read, write, copy, word count.
8. Performing numerical operations using NumPy package.
9. Analyzing large datasets using Pandas package.

20MCA19 - COMMUNICATION SKILLS

L	T	P	C
0	0	2	1

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Develop Communication and Soft skills through self assesment to excel at work place.*

CO2 : *Apply intonation rules, Phonetic patterns and formulate appropriate speech patterns .*

CO3 : *Apply the rules of grammar viz., Parts of speech, Idioms, Phrasal Verbs, Concord, Cause and Effect, purpose and function and write a technical passage correctly.*

CO4 : *Summarize a technical text and write a process description.*

CO5 : *Plan, Structure and present a 15 minutes presentation on a technical topic.*

COMMUNICATION SKILLS

Introduction - Code and Content - Stimulus and Response: Source - The Encoding Process - The Channel - The Decoding Process - The Receiver - Speaking Skills - Effective Speaking Guidelines - Communicating Soft Skills: A Self-assessment - Closing Tips on Improving Speaking Skills.

INTRODUCTION TO SPEECH SOUNDS

Pronunciation Etiquette - Phonetics: Phonetic Chart - Exercise - Syllabus - Stress - Accent - Rhythm - Intonation

FOCUS ON LANGUAGE

Synonyms and Antonyms - Idioms - Phrasal Verbs - Nouns-Compound Nouns & Noun Phrases - Gerunds & Infinitives - Subject Verb Agreement- Tenses - Adjectives and Adverbs - Active Passive voice - Cause and Effect Sentences - Purpose and Function.

READING & WRITING

Reading Comprehension - Techniques for Good Comprehension - Skimming & Scanning -Sequencing of Sentences - Paragraph Construction - Paragraph Patterns - Kinds of Paragraph - Writing a First Draft, Revising & Finalizing - Steps to Effective Précis Writing - Process Description - Dialogue Writing

LISTENING & SPEAKING

Importance of Listening & Empathy in Communication - Reasons for Poor Listening - Traits of a Good listener - Listening Modes - Short Dialogues - Short Conversation Achieving Confidence, Clarity & Fluency - Paralinguistic Features - Barriers to Speaking - Types of Speaking - Persuasive Speaking - Public Speaking-Conversations - Telephonic Conversations & Etiquette - Effective Presentation Strategies - Planning - Outlining & Structuring - Nuances of Delivery.

REFERENCES

1. *Meenakshi Raman, Sangeeta Sharma, "Technical Communication - English Skills for Engineers", Oxford University Press, New Delhi, 2015.*
2. *Kiranmani Dutt P., "A Course in Communication Skills", Cambridge University Press, 2011.*
3. *Samson T, "Innovate with English", Cambridge University Press, 2012.*
4. *Michael Mc Carthy and Felicity O'Dell, "English Vocabulary in Use", Cambridge University Press, 2012.*

20MCA21 - ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

PRE-REQUISITES

20MCA11

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Apply various heuristic search strategies in optimal decision making.*

CO2 *: Understand uncertainty in real world situations.*

CO3 *: Employ first order logic for building knowledge base and demonstrate reasoning.*

CO4 *: Express different planning strategies to deal with problems.*

CO5 *: Describe and apply various knowledge representation techniques.*

INTRODUCTION

Foundation of AI - Agents and Environments- Concept of Rationality - Nature of Environments - Structure of Agents. **(6)**

PROBLEM SOLVING

Problem-Solving Agents and examples - Uninformed and Informed Search Strategies - Heuristic Functions - Local Search Algorithms and Optimization Problems - Local search in Continuous spaces - Searching with Nondeterministic actions and Partial Observations. **(12)**

ADVERSARIAL SEARCH AND CONSTRAINT SATISFACTION PROBLEMS

Games - Optimal Decisions in Games - Alpha-Beta Pruning. Constraint Satisfaction Problems (CSP) - Backtracking Search for CSPs - Local Search for Constraint Satisfaction Problems - Structure of Problems. **(8)**

KNOWLEDGE AND REASONING

Knowledge based Agents - The Wumpus World - Logic - Propositional Logic- Syntax and Semantics of First-Order Logic - Using First-Order Logic - Knowledge Engineering in First-Order Logic - Unification and Lifting - Forward Chaining - Backward Chaining - Resolution - Knowledge Representation. **(12)**

PLANNING

Definition of classical planning - Algorithms for Planning as State-Space Search - Planning Graphs - Hierarchical Task Network Planning - Planning and Acting in Nondeterministic Domains - Multi agent Planning. **(7)**

TOTAL: 45

REFERENCES

1. *Stuart J Russell and Peter Norvig, "Artificial Intelligence- A Modern Approach", Pearson Education Series, Fourth Edition, 2020.*
2. *Dan W.Patterson, "Introduction to AI and ES", Pearson Education, First Edition, 2007*
3. *M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc., First Edition, 2008.*
4. *Elaine Rich, Kevin Knight, Shiva Shankar B Nair, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2013.*
5. *David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.*

20MCA22 - ADVANCED JAVA PROGRAMMING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Design an object oriented software solution by discovering appropriate classes and objects and identifying attributes, behavior and hierarchy among the classes*

CO2 *: Write java programs by employing the object oriented constructs of inheritance and polymorphism for a given software requirement*

CO3 *: Organize the application programs into packages and prepare a deployable application for the given software solution*

CO4 *: Generate robust java applications for a given user requirement by employing applicable object oriented concepts and handling all possible exceptions*

CO5 *: Design and develop full stack web applications using React JS and Node JS*

BASIC LANGUAGE ELEMENTS

Features of Java Language - JVM and Bytecode - Data Types - Variables - Keywords - Constants - Comments - Operators and Expressions - Control Statements. **(5)**

OBJECT ORIENTED PROGRAMMING

Classes - Object & Object reference - Constructors and Initialization - Access Control - Accessor and Mutator Methods - Overloading Methods and Constructors - Static Members - Use of Modifiers with Classes and Methods.

ARRAYS AND STRINGS

Defining an Array - Initializing and Accessing Array - Multi-dimensional Array- String Handling - Mutable & Immutable Strings - Creating Strings using StringBuffer. **(7)**

EXTENDING CLASSES AND INHERITANCE

Use and Benefits of Inheritance in OOP - Types of Inheritance in Java - Inheriting Data members and Methods - Role of Constructors in Inheritance - Overriding Super Class Methods - Use of "super" keyword - Dynamic Method Dispatch - Using Abstract Classes - Using Final with Inheritance - The Object Class - Interfaces - Implementing Interfaces - Nested Interfaces - Variables in Interfaces. **(8)**

PACKAGES

Organizing Classes and Interfaces in Packages - Access Protection - Defining Package - Importing Packages.

EXCEPTION HANDLING

Exception Hierarchy - Types of Exception - Control Flow In Exceptions - Use of try, catch, finally, throw, throws in Exception Handling -In-built and User Defined Exceptions - Checked and Un-Checked Exceptions. **(5)**

THREADS

Java Thread Model - Need for Concurrent Programming - Thread Life Cycle - Thread Priorities - Creating a Thread - Extending a Thread - Creating Multiple Threads - Using Thread Methods - Thread Exceptions - Inter-thread communication - Synchronizing Threads. **(5)**

WEBCLIENT UI

Introduction to HTML and CSS - Web Development using Bootstrap CSS - Client side scripting using Javascript - Developing reusable UI components using React JS. **(8)**

JDBC AND SERVERSIDE SCRIPTING

Introduction to JDBC - JDBC Drivers & Architecture - CURD operations Using JDBC - Connecting to conventional Databases - Server side scripting using Node JS. **(7)**

TOTAL : 45

REFERENCES

1. *Herbert Schildt, "Java The Complete Reference", Tata MCGraw Hill Publishing Company Limited, 9th Edition, 2019.*
2. *E. Balagurusamy, "Programming with Java:A Primer", Tata MCGrawHill Publishing Company Limited, 5th Edition, 2017.*
3. *Cay S. Horstmann, Gray Cornell, "Core Java Volume I - Fundamentals", Pearson Education, 9th Edition, 2013.*
4. *Herbert Schildt, "Java: A Beginners Guide", Tata MCGraw Hill Publishing Company Limited, 6th Edition, 2014.*

20MCA23 - VIRTUALIZATION AND CLOUD COMPUTING

L	T	P	C
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PRE-REQUISITES

20MCA14

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure*

CO2 : *Describe various service delivery models of cloud computing architecture*

CO3 : *Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services and Google AppEngine.*

CO4 : *Describe the virtualization technology behind the working of cloud computing.*

CO5 : *Identify security and privacy issues in cloud computing and devise appropriate security solutions for protecting cloud resources.*

OVERVIEW OF VIRTUALIZATION

Basics of Virtualization - Virtualization and Cloud Computing - Need of Virtualization - Virtualization Types - Application Virtualization - Desktop Virtualization - Network Virtualization - Storage Virtualization - System-level or Operating System Virtualization - Server Virtualization: Understanding Server Virtualization, Types of Server Virtualization - Virtualization Advantages. **(7)**

RESOURCE VIRTUALIZATION

Virtual Machine Basics - Types of Virtual Machines, Resource Virtualization: Processor - Memory - Input/Output - Hypervisor Concepts and Types - Creation and Migration of Virtual Machines using open source Hypervisors. Case Study: VMWare - Xen - KVM. **(9)**

UNDERSTANDING CLOUD COMPUTING

Cloud Computing - Definition and Characteristics - History of Cloud Computing - Cloud Architecture - Benefits and Challenges of Cloud Computing - Cloud Deployment models: Private cloud - Public cloud - Hybrid cloud **(6)**

CLOUD SERVICE MODELS

Software-as-a-Service - Understanding SaaS - Architecture of SaaS - Platform-as-a-Service - Understanding PaaS - Architecture of PaaS - Infrastructure-as-a-Service - Understanding IaaS - Architecture of IaaS - Developing and Deploying applications using Google App Engine - Creating instances in Amazon EC2 - Deploying and Accessing Applications in Amazon EC2. **(8)**

CLOUD SECURITY AND TRUST MANAGEMENT

Privacy and Security in Cloud - Security Service Boundary - Securing Data - Encryption - Data Integrity and Auditing - Identity Management and Access Control - Trusted Computing - Cloud Storage Services: Create and manage Amazon S3 instances - Upload files to S3 after applying proper security mechanisms to ensure data confidentiality and integrity. **(9)**

DISASTER RECOVERY AND SCALING

Disaster Recovery Planning - Disasters in Cloud - Disaster Management - Scaling a Cloud Infrastructure: Capacity Planning - Cloud Scale. **(6)**

TOTAL : 45

REFERENCES

1. *George Reese, "Cloud Application Architectures", 1st Edition, O'Reilly, 2019.*
2. *James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", 1st Edition, Elsevier/ Morgan Kaufmann, 2017.*
3. *Barrie Sosinsky, "Cloud Computing Bible", Wiley India Pvt. Ltd., 2012*
4. *William von Hagen, "Professional Xen Virtualization", Wrox Publications, January, 2008.*
5. *Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", Tata McGraw Hill, 2009.*
6. *Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", 1st Edition, O'Reilly Media, 2009.*

20MCA24 - SOA AND WEB SERVICES

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand and use the concepts of Service-Oriented Architecture for building platform independent distributed applications.*

CO2 : *Design and develop simple to complex web services by analyzing the requirements of web applications.*

CO3 : *Apply the concepts of RESTful web services and create dynamic web applications*

CO4 : *Determine the security requirements of web services and incorporate them in building web applications.*

CO5 : *Examine the requirements of distributed applications, identify and justify the need for using web services.*

SERVICE ORIENTED ARCHITECTURE

Architecture for Enterprise applications-Software platforms for Enterprise applications-Evolution of SOA - Key components of SOA - Considerations for Enterprise-wide SOA- Strawman architecture - Enterprise SOA layers- Solution architecture for Enterprise Applications - SOA Programming Models **(8)**

DISTRIBUTED INFORMATION SYSTEMS

Understanding middleware - RPC-TP Monitors - Object Brokers- Message Oriented Middleware-Technologies for connecting remote clients **(8)**

INTRODUCTION TO WEB SERVICES

Web Services and their Approach to Distributed Computing-Web Service Technologies - Web Services Architecture Case studies on overheads in gRPC and Business Process Management **(9)**

WEB SERVICES TECHNOLOGIES

JSON-gRPC open source RPC framework-WSDL-UDDI-RESTful Web Service: Architecture- RESTful, Web Service Design Technologies Relationship Run time Vs Design, SoaML Unified Modelling language, Service components and Profile **(12)**

WEB SERVICE SECURITY AND PERFORMANCE

Securing Web Service-Custom Token Authentiction-HTTP Basic Authentiction-OAuth- Performance **(8)**

TOTAL : 45

REFERENCES

1. *K. Milos SIA, "Web Services and Service Oriented Architecture", SIA Publishers, 2nd Edition 2020.*
2. *Thomas Erl, "SOA Principles of Service Design", Prentice Hall, 3rd Edition, 2017*
3. *Shankar Kambhampaty, "Service-Oriented Architecture for Enterprise and Cloud Applications", Wiley India, 2nd Edition, 2010.*
4. *Jose Sandoval, "RESTful Java Web Services", Packt Publishing, 2009.*
5. *Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju, "Web Services", Pearson, 2018.*

20MCA25 - ARTIFICIAL INTELLIGENCE LAB

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0	0	4	2

PRE-REQUISITES

20MCA11, 20MCA18

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Design and implement heuristic search procedures.*

CO2 *: Develop constraint satisfaction problem solution.*

CO3 *: Design and implement solutions for classical Artificial Intelligence problems.*

CO4 *: Design and implement knowledge based system.*

CO5 *: Become familiar with use of Artificial Intelligence tools.*

CONCEPTS TO BE COVERED

1. Implementing state space search algorithms for solving puzzle problems.
   a. A* Search
   b. Hill-climbing Search.
2. Implementation of MiniMax Search Procedure with alpha beta pruning for finding the solutions of games.
3. Implementation of Constraint Satisfaction Problem for solving Crypt-arithmetic.
4. Develop a knowledge base system consisting of facts and rules about some specialized knowledge domain of your choice.
5. Implementation of Unification algorithm by considering Resolution concept.
6. Solve the classical Water Jug problem.
7. Solve the classical Monkey Banana problem.
8. Solve the classical Blocks World problem.
9. Development of programs for simulation of computer games like : Tic-Tac-Toe, N-queens Problems, travelling salesman problem, Chess, etc.

20MCA26- ADVANCED PROGRAMMING LABORATORY

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PRE-REQUISITES

20MCA22

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Understanding Object oriented concepts and developing software modules.*

CO2 *: To develop effective GUI on Client side using Java Client and Server Side Technologies*

CO3 *: Write codes to handle the requests of client using JSP,*

CO4 *: Handle the backend processing from both client and server side.*

CO5 *: Choose a suitable development stack for the industry requirements.*

1. Exercises on basic OOPS Concepts and Java applets
2. Web Page using Bootstrap CSS
3. Client side Scripting using javascript
4. Handling Html elements with jquery
5. Design User Interface Component using React
6. Server side scripting using JSP
7. Storing and exchanging data using JSON

20MCA27 - PROFESSIONAL ENGLISH

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Generate ideas, Acquire right communication and interpersonal skills.*

CO2 *: Set career goals and formulate strategies by Prioritizing, Organizing and Scheduling for the required task.*

CO3 *: Project appropriate grooming and right etiquette in the corporate context.*

CO4 *: Prepare a job application letter with a Resume or C.V.*

CO5 *: Exhibit appropriate grooming and right etiquettes for Interviews and Group Discussion tasks.*

SOFT SKILLS

Introduction to Soft Skills - Lessons from the Three Case Studies - Change in Today's Workplace: Soft Skills as a Competitive Weapon - Antiquity of Soft Skills - Classification of Soft Skills: Time Management - Attitude - Responsibility - Ethics, Integrity, Values and Trust - Self-confidence and Courage - Consistency and Predictability - Teamwork and Interpersonal Skills - Communication and Networking - Empathy and Listening Skills - Problem Solving, Troubleshooting and Speed Reading - Leadership

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.

ETIQUETTE

Etiquettes - Email, Professional, Dining & Telephone -Social Etiquette - Corporate Etiquette - Personal Grooming - Using minimal Body Language - Leadership and Entrepreneurship : Corporate Training - Professionalism - Self awareness - Creativity skills - Cognitive Development - Assertiveness - Positive Thinking and Attitude.

WRITING

- Job Applications: Writing Resume or Curriculum Vitae: Introduction - Difference between a Resume and a CV - The Strategy of Resume Writing - A Favourable First Impression - The Main Body of the Resume - A Fresher's Resume - A Few Helpful Tips - E-mails.

SPEAKING

Job Interviews: Introduction - Types of Interviews - Groundwork before the Interview -Importance of body Language in Interview - Need for proper Articulation - Concluding an Interview - Telephonic or Video Interview - A Mock Interview - Group Discussion: Introduction - Ability to Work as a Team - Communication Skills - Active Listening - Non-verbal Communication - Leadership and Assertiveness - Reasoning - Ability to Influence - Innovation. Creativity, and Lateral Thinking - Flexibility - Key Steps to Succeed in a Group Discussion - The Responsibility of the First Speaker - Concluding the Discussion - Dos and Don'ts during a Group Discussion

REFERENCES

1. *Meenakshi Raman, Sangeeta Sharma, "Technical Communication - Principles and Practice", 2nd edition, Oxford University Press, New Delhi, 2015.*

2. *Simon Sweeney, "English for Business Communication", Cambridge University Press, 2013.*
3. *Mukhopadhyay Lina, "Poly Skills: A Course in Communication Skills and Life Skills" Cambridge University Press, 2012.*
4. *Krishna Mohan & Merra Banerji, "Developing Communication Skills", 2nd Edition. Macmillan Publishers India Ltd. 2012.*
5. *Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press, 2011.*

20MCA28 - MINI PROJECT

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Analyze different domains, identify problems that require software solutions and justify.*

CO2 *: Choose appropriate problem solving techniques for the identified problem.*

CO3 *: Practice software engineering principles and programming skills in developing software solutions.*

CO4 *: Test the developed software to ensure compliance of requirements.*

CO5 *: Write the project report demonstrating the contribution and complete technical details.*

Students have to undertake a project approved by their concerned supervisor. Starting from Analysis to implementation, they have to follow software engineering concepts effectively. At the end of the semester, Students have to submit a report. Evaluation of the project will be carried out by a panel of examiners duly constituted twice besides the final presentation.

AREAS FOR PROJECT

1. Application using Android platform
2. Application in Internet of Things
3. Data Analytics / Data Mining applications using latest implementation software.
4. Network based applications
5. Application on Cloud computing
6. Application in Security/Block chain Management
7. Accounting / Commercial / Information Management / Scientific / web applications using latest software.
8. Not limited to the above. Any latest Concepts / Social problems can be considered.

20HAC01 - HACKATHON

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- One Credit course on Hackathon is Compulsory for the students of 2nd Semester MCA
- Evaluation will be done under continuous assessment Scheme
- The maximum mark is 100 and will be converted to appropriate grades. Pass is mandatory for the award of degree.
- There will be two reviews and the performance of the students participating in the Hackathon
- will be jointly evaluated by two examiners (One Internal + One External) during 2nd semester
- 75% attendance is mandatory for the students to appear in the final review.
- Candidates have to submit a detailed report on the Hackathon that he or she has attended and this report should be submitted during the final review.
- Candidates with shortage in attendance or failing to attend the final review have to redo the hackathon during the even semester of the next academic year.
- Credits earned shall be over and above of the credit requirement for the award of degree. Idea Submission and Evaluation Process
- Students are unveiled of problems on various hackathon portals for being aware of hackathons few of them listed as below

Sl.No	Name of Hackathon	Company
1.	Codevita / HackQuest	TCS
2.	Tata Cruicible Campus Hackathon	TATA
3.	Code Gladiators 2020	TECHGIG
4.	Smart India Hackathon 2020	MHRD

- Theme and problem statement of hackathon is chosen and duration and dates of hackathon are specified
- Students are allowed to participate as 6 member teams.
- The evaluation is of two stages first one for submission of a proposal and the second one for building a prototype.
- The hackathons are to be presented by the teams in two reviews first to the internal member and final to the external member
- Mark split up for internal and external members are decided with a total of 100 marks of which the pass percentage is 50%.

20MCA31 - CRYPTOGRAPHY AND NETWORK SECURITY

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand the basic principles of security and develop simple cryptosystems using classical ciphers*

CO2 : *Analyze the adequate basic security required by any computing system and apply cryptography algorithms to protect the confidentiality of information resources across networks*

CO3 : *Analyze security policies and best practices and apply suitable security technique to achieve integrity, and non-repudiation of information*

CO4 : *Demonstrate different threats and vulnerabilities of network security and apply suitable security controls to protect internal and external networks*

CO5 : *Understand threats against various system components and choose a best technique to control the threat*

CRYPTOGRAPHY : CONCEPTS AND TECHNIQUES

Need for Security - Security Approaches - Principles of Security - Plain Text and Cipher Text - Substitution Ciphers -Transposition Ciphers - Stream and Block Ciphers - Encryption and Decryption - Symmetric and Asymmetric Key Cryptography - Steganography. **(7)**

ENCRYPTION TECHNIQUES

Data Encryption Standard - Advanced Encryption Standard - Confidentiality using Symmetric Encryption - Public-Key Cryptography and RSA - Key Management - Diffie-Hellman Key Exchange - Elliptic Curve Cryptography - Symmetric Key Distribution - Kerberos - X.509 Authentication Service. **(10)**

HASH FUNCTIONS AND SIGNATURES

Message Authentication and Hash Functions - Description of MD Hash Family - Secure Hash Algorithms - SHA-512 - Digital Signatures and Authentication Protocols - Digital Signature Standard - Process - Services - Attacks on Digital Signature - Digital Signature Schemes. **(10)**

NETWORK SECURITY

Threats in Networks: Vulnerability - Categories of Attack - Software Based Packet Sniffing - Impersonation - Message Confidentiality Threats - Message Integrity Threats - Website Vulnerabilities - DoS - DDoS. Network Security Controls: Security Threat Analysis - Architecture - Encryption - Content Integrity - Strong Authentication - Access Controls - Wireless Security - Alarms and Alerts - Honeypots - Firewalls - Intruders - Intrusion Detection Systems - Types - Goals - Strengths and Limitations - Snort. **(9)**

SYSTEM SECURITY

Program Security: Secure Programs - Nonmalicious Program Errors - Targeted Malicious Code - Controls against Program Threats. Database Security: Security Requirements - Reliability and Integrity - Two-Phase Update - Redundancy / Internal Consistency - Recovery - Concurrency / Consistency - Monitors - Case studies on Cryptography and Security - Single Sign On (SSO). **(9)**

TOTAL : 45

REFERENCES

1. *William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson Education, 2017.*
2. *Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", 4th Edition, Pearson Education, 2007.*
3. *Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill, 3rd Edition, 2017.*
4. *Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, 2017.*
5. *Joseph Migga Kizza, "A Guide to Computer Network Security", Springer International Edition, 2010.*

20MCA32 - MACHINE LEARNING

L	T	P	C
3	0	0	3

PRE-REQUISITES

20MCA11

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Recognize fundamental issues and challenges of machine learning : data, model selection, model complexity, supervised and unsupervised learning.*

CO2 : *Understand and apply Decision trees and Artificial Neural Networks.*

CO3 : *Distinguish the strength and weakness of Bayesian learning.*

CO4 : *Analyze and apply Instance based learning and rule based learning.*

CO5 : *Assess capability of Reinforcement learning and study its application.*

INTRODUCTION, CONCEPT LEARNING AND DECISION TREES

Designing a Learning System - Perspectives and Issues in Machine Learning - Concept Learning Task- Concept Learning as Search- Find-S- Version Space- Inductive bias. Decision tree representation, Decision tree Learning Algorithm- Hypothesis Basis- Inductive bias-Issues in Decision Tree learning. **(10)**

ARTIFICIAL NEURAL NETWORKS

Introduction- Neural Network Representations- Perceptrons - Multilayer Networks Back Propagation Algorithm- Remarks on the Back propagation Algorithm- Face Recognition Example- Advanced Topics in Artificial Neural Networks. **(10)**

EVALUATING HYPOTHESIS

Motivation, Estimating Hypothesis Accuracy, Basis of Sampling Theory, A General Approach for Deriving Confidence Intervals - Difference in Error of Two Hypothesis- Comparing Learning Algorithms **(5)**

BAYESIAN LEARNING

Bayes Theorem - Bayes theorem and Concept Learning- Maximum Likelihood and Least Square Error Hypothesis- Maximum Likelihood Hypothesis for Predicting Probabilities- Minimum Description Length Principle- Bayes Optimal Classifier- Gibs Algorithm- Naive Bayes Classifier-Bayesian Belief Networks- The EM Algorithm.

INSTANCE BASED LEARNING : k - Nearest Neighbour Learning, Locally weighted Regression- Radial Basis Functions- Case based Reasoning. **(10)**

LEARNING SET OF RULES : Sequential Covering Algorithms- Learning First Order Rules- Learning Sets of First order Rules FOIL- Induction as Inverted Deduction- Inverting Resolution.

REINFORCEMENT LEARNING : The learning task - Non deterministic Rewards and Actions - Temporal Difference Learning - Generalizing from Examples - Relationship to Dynamic Programming. **(10)**

TOTAL : 45

REFERENCES

1. *Tom M Mitchell, "Machine Learning", McGraw Hill, 1st Edition, 2018.*
2. *Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.*

20MCA33 - CRYPTOGRAPHY AND NETWORK SECURITY LAB

L	T	P	C
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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand the classical crypto systems used for the confidential information exchange and use different ciphers in secure data transfer*

CO2 : *Demonstrate understanding of security best practices and techniques to preserve confidentiality of information at rest, and in Transit and apply suitable cryptographic algorithm to preserve the confidentiality of information*

CO3 : *Apply hash and message digest algorithms to preserve the integrity of information*

CO4 : *Apply standard digital signature scheme to verify the authenticity of information and use Steganography to hide secret messages*

CO5 : *Demonstrate the working of network security tools including Packet capturing and Intrusion Detection*

CONCEPTS TO BE COVERED

1. Implementing Substitution and Transposition ciphers
2. Applying symmetric encryption algorithms to protect the confidentiality of users data
3. Applying asymmetric encryption algorithms to protect the confidentiality of users data
4. Comparing the performance of symmetric and asymmetric encryption algorithms in terms of computation time and storage space
5. Applying hash and message digest algorithms to ensure the integrity of users data

6 Using standard digital signature scheme to verify the authenticity of user's document

7. Applying Steganography to hide secret message in a document (image / text)
8. Given a scenario, choose appropriate security mechanisms to ensure confidentiality, integrity and non-repudiation of user's data and apply them to protect the data
9. Learning to install and work with an open source Packet capturing tool
10. Learning to install and work with an open source Intrusion Detection tool

20MCA34 - MACHINE LEARNING LABORATORY

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PRE-REQUISITES

20MCA11, 20MCA18

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Introduce students the basic concepts and techniques of machine learning.*

CO2 *: Develop skills using recent machine learning software for solving practical problems.*

CO3 *: Gain experience of doing independent study and research in machine learning.*

CO4 *: Apply various classification and clustering techniques for problems.*

CO5 *: Design and development of game and traffic control system using reinforcement learning.*

CONCEPTS TO BE COVERED

1. Implement the FIND-S algorithm.
2. Demonstrate Decision Tree - ID3 Algorithm
3. Supervised Learning : Classification
   i) Implement Naïve Bayes Classifier on a Data set. Test for Accuracy and Precision.
   ii) Implement K-Nearest Neighbor Classifier on a Data set. Test for Accuracy and Precision.
4. Implement Artificial Neural Network Algorithms to simulate logical gates.
5. Implementing the Backpropagation algorithm and test the same using appropriate data sets.
6. Implement Bayesian network to demonstrate the diagnosis of a medical data.
7. Apply EM algorithm to cluster a set of data stored in a .CSV file.
8. Implement clustering algorithm for identifying cancerous data.
9. Apply reinforcement learning and develop a game of your own.
10. Develop a traffic signal control system using reinforcement learning technique.

20MCAIT01 - INPLANT TRAINING

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Exposure to the industrial environment, recognize the requirement of the industry and cope up with the Industrial scenario.*

CO2 : *Recognize career paths taking into account their individual abilities and prepare a report about the work experience in industry*

CO3 : *Communicate effectively about the training through technical presentation.*

CO4 : *Develop their employability and start-up skills and to enhance the ability to engage in, life-long learning*

CO5 : *Develop individual confidence to handle various engineering assignments and ability to think strategically and expose themselves to acquire life skills to meet societal challenges*

20MCA41 - PROJECT WORK AND VIVA VOCE

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PRE-REQUISITES

Consent of the Supervisor assigned.

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Comprehensively demonstrate understanding of the software development processes and practices.*

CO2 : *Work to a professional standard in a specified role.*

CO3 : *Contribute effectively/co-operatively within a team.*

CO4 : *Exhibit industry-standards of professionalism in their work through knowledge or use of latest techniques and tools.*

CO5 : *Reflect on the work done and own role and present their work through a report and formal viva.*

20MCAOC01 - RECENT TRENDS IN WEB TECHNOLOGY

L	T	P	C
1	0	0	1

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

Web development using HTML, CSS and JavaScript

AJAX - Bootstrap CSS - Develop Website using Html5 and Bootstrap - Introduction to React - Client side JS.

Introduction to NodeJs - Server side JS.

Based on the industry requirements additional topics may be included as and when needed.

TOTAL : 15

REFERENCES

1. *https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML*
2. *http://web.mit.edu/6.813/www/sp16/labs/lab1-html-css/*
3. *https://github.com/kbalog/web-programming*
4. *https://speakerdeck.com/kbalog/web-programming-ajax*
5. *https://speakerdeck.com/kbalog/web-programming-bootstrap*
6. *https://developer.mozilla.org/en-US/docs/Learn/Tools_and_testing/Client- Side_JavaScript_frameworks/React_getting_started*
7. *https://developer.mozilla.org/en-US/docs/Learn/Server-side/First_steps/Introduction*
8. *https://developer.mozilla.org/en-US/docs/Learn/Server-side/Express_Nodejs*

20MCAOC02 - DEVOPS ESSENTIALS

L	T	P	C
1	0	0	1

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

After competing this course, the student will be able to

CO1 : *Understanding the concept of continuous development, continuous integration and continuous deployment / delivery.*

CO2 : *Understanding the automation, culture, and metrics that are essential to develop a successful DevOps project.*

CO3 : *Learn the working knowledge on the cutting edge tools in the industry like Git, Jenkins, Nexus, Sonar, Docker, Kubernetes and Grafana.*

CO4 : *Understand the benefits of DevOps over other software development processes.*

CO5 : *Learn real world applications of DevOps.*

Introduction to Devops : Devops Overview, Devops lifecycle, stages.

Git & Maven : Basics of Git, Commands, Maven architecture, plugins.

Jenkins: Introduction, plugins, Configuration, Build system.

Sonar & Nexus : Code quality and automatic deployment.

(Lecture - 6 hours, Practical - 3 hours)

Docker : Introduction to Docker, Containerization, images, Docker files, Kubernetes basics and architecture.

Portainer & Grafana : Basic overview and usage of tools.

(Lecture - 4 hours, Practical - 2 hours)

TOTAL : 15

REFERENCES

1. *Tim O'Brien, Ason Van Zyl, Brian Fox, John Casey, "Maven: The Complete Reference", Sonatype, 2010.*
2. *James Turnbull, "The Docker Book: Containerization is the new virtualization", James Turnbull, 2nd edition, 2014.*
3. *Brayden Smith, "A Step by Step Guide to Learn and Master Kubernetes", Brayden Smith, 2019.*

20MCAE101 - GRAPHICS AND MULTIMEDIA

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Employ point- line and circle scan conversion algorithms for drawing graphical object.*

CO2 : *Employ fill area scan conversion algorithms for drawing of graphical objects.*

CO3 : *Construct a world coordinate scene from its constituent elements (defined in their local coordinate systems) by applying geometric transformations on the constituent elements.*

CO4 : *Determine the clipping operations required to change from the current display to a new display- when interactive operations through keyboard or mouse are performed.*

CO5 : *Analyse the performance of image- video- audio- text and graphics data compression techniques.*

INTRODUCTION

Graphics hardware - raster and random scan - display devices - input devices -hard copy devices. Implementation algorithms for graphic primitives - line- poly line- circle- ellipse- curves - attributes **(8)**

TRANSFORMATIONS AND VIEWING

wo dimensional geometric transformations - translation - scaling - rotation - reflection - shearing - composite transformations. Two dimensional viewing - window port- viewport - clipping - point - line - Cohen-Sutherland- Liang-Barsky- Nicholl-Lee-Nicholl. Three-Dimensional Geometric Transformations -Translation - Scaling - Rotation - reflection - shearing - affine transforms **(10)**

COMPUTER ANIMATIONS

Raster methods - double buffering - raster operations - morphing - simulating accelerations - motion Specifications - character animations - motion capture - OpenGL animation procedures. **(8)**

INTRODUCTIONS TO MULTIMEDIA

Multimedia Applications - Multimedia Systems Architecture - evolving technologies - defining objects - Compression and Decompression - Binary image compression - Color - gray scale- Still-video images - JPEG compression - video Image Compression. **(10)**

FILE FORMATS AND MULTIMEDIA I/O

Flich - text format - TIFF - RIFF - MIDI file formats- JPEG DIB- MPEG- AVI file formats. TWAIN - architecture - setting up new WAVE type. Pen Input- Video image display systems- Print output- Image Scanners- Digital Video and Audio- Video images and animation- Full-Motion video. **(9)**

TOTAL: 45

REFERENCES

1. *Donald D. Hearn, M. Pauline Baker, Warren, "Computer Graphics with Open GL", 4th Edition, Prentice Hall, 2010.*
2. *Prabhat K. Andleigh, KiranThakrar "Multimedia Systems Design", 2nd Edition, Prentice Hall of India Pvt. Ltd., 2007.*
3. *James D. Foley, Andries Van Dam, Steven K. Feiner, F. Hughes John, "Computer Graphics", 3rd Edition, Prentice Hall of India Pvt. Ltd., 2012.*

4. *Ralf Steinmetz and KlaraNahrstedt, "Multimedia: Computing- Communications and Applications", 2nd Edition, Pearson Educations, 2009.*
5. *Tarun kumar ghosh, "Graphics and Multimedia" First Edition, Penram, 2017.*
6. *Pakhira, Malay K, "Computer Graphics, Multimedia and Animation", Second Edition, PHI, 2017.*

20MCAE102 - ADVANCED DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

PRE-REQUISITES

20MCA13

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Analyze the background processes involved in queries and determine their impact on database operations and design.*

CO2 : *Analyze different methods and techniques for parallel and distributed query processing and apply appropriate algorithms for optimizing query execution.*

CO3 : *Demonstrate the usage of different architecture and design strategies for distributed and parallel databases.*

CO4 : *Apply the concepts of SQL for enterprise applications.*

CO5 : *Design data models for advanced applications using object oriented and other databases.*

QUERY PROCESSING

Overview - Measures of query Cost - Selection Operations - Sorting - Join Operations - Other Operations -Evaluation of Expressions.

QUERY OPTIMIZATION

Overview-Heuristics in query Optimization **(7)**

PARALLEL DATABASES

Introduction - I/O Parallelism - Interquery Parallelism - Intraquery Parallelism - Intraoperation Parallelism - Interoperation Parallelism.

DISTRIBUTED DATABASES

Homogenous and Heterogenous Databases - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control in Distributed Databases - Availability - Distributed Query Processing - Heterogenous Distributed Database - Cloud Based Databases. **(12)**

XML

Structure of XML Data - XML Document Schema - Querying and Transformation - Application Program Interfaces to XML - Storage of XML Data - XML Applications. **(9)**

OBJECT AND OBJECT RELATIONAL DATABASES

Introduction to Complex Objects - Object model of ODMG-ODL - OQL - Object Relational and Extended - Relational Systems - SQL and its Relational Features - Nested Relational Model. **(8)**

NoSQL DATABASES

Introduction to NoSQL - SQL vs NoSQL - Types - MongoDB - CRUD Operations - Advantages and Disadvantages. **(9)**

TOTAL : 45

REFERENCES

1. *Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 7th Edition, Mc Graw Hill International Edition, 2019.*
2. *Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2006.*
3. *Raghu Ramakrishnan, Johannes Gehrke, "Databases Management Systems", 3rd Edition, Graw Hill, 2003.*

20MCAE103 - DISTRIBUTED SYSTEMS

L	T	P	C
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PRE-REQUISITES

20MCA13, 20MCA14

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Analyze the advantages and disadvantages of various models for a distributed system*

CO2 : *Compare Remote Procedure Call and Remote Method Invocation from the perspective of developing distributed applications*

CO3 : *Describe the role of distributed Operating System and distributed File System in developing distributed systems*

CO4 : *Design the process of discovering and locating distributed objects using Naming and Directory services*

CO5 : *Demonstrate the concurrency control mechanism for distributed transactions*

INTRODUCTION

Characterization of Distributed Systems : Example of Distributed Systems - Resource Sharing and Web - Challenges - System Models : Architectural Models and Fundamental Models - Distributed Objects and Components.

Remote Invocation : Communication between Distributed Objects - Request - Reply protocols - Remote Procedure Call - Remote Method Invocation. **(9)**

OPERATING SYSTEM SUPPORT

Introduction - Operating System Layer - Protection - Process and Threads - Communication and Invocation - OS Architecture.

DISTRIBUTED FILE SYSTEMS

Introduction - File Service Architecture - Sun Network File System. **(8)**

NAME SERVICES

Name Services and DNS - Directory and Discovery Services - Global Name Service - X.500 Directory Service.

CLOCK SYNCHRONIZATION

Clocks - Events and Process States - Synchronization - Logical time and Logical clocks - Global States. **(10)**

DISTRIBUTED TRANSACTION MANAGEMENT

Transaction and Concurrency Control: Transactions - Nested Transactions - Locks - Optimistic Concurrency Control - Time Stamp Ordering - Comparison of Methods for Concurrency Control. Distributed Transactions: Flat and Nested - Atomic Commit Protocols - Concurrency Control - Distributed Deadlock - Transaction Recovery. Replication: System model and Group Communication Fault Tolerant Services - Highly Available Services - Transactions with Replicated Data. **(12)**

DISTRIBUTED SHARED MEMORY

Design and Implementation Issues - Sequential and Release Consistency - Other Consistency Models. **(6)**

TOTAL : 45

REFERENCES

1. *George Colouris, Jean Dollimore and Tim KindBery, "Distributed Systems,Concepts and Design", 5th Edition, Pearson Education, 2018.*
2. *Andrew S Tanenbaum, Maarten Van Steen, "Distributed Systems, Principles and Paradigms", 2nd Edition, Pearson Education, 2017.*
3. *Sloman M Kramer J, "Distributed System and Computer Networks", Prentice Hall of India, 2009.*

20MCAE104 - GRID AND CLUSTER COMPUTING

L	T	P	C
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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand the basics of distributed systems and programming models.*

CO2 : *Examine grid computing architecture and its components.*

CO3 : *Apply concepts of grid computing and build distributed applications.*

CO4 : *Access and Identify the need for cluster computing.*

CO5 : *Design cluster computing based solutions for real world problems by incorporating load balancing.*

GRID COMPUTING

The data centre- Cluster and Grid computing-Meta computing-Different types of Grids-Web services and the grid. **(7)**

TECHNOLOGIES AND ARCHITECTURE FOR GRID

Clustering and grid computing- Issues in data grids-Functional requirements in grid computing-Standards-Trends in large data grids. **(8)**

GRID STANDARDS AND TOOLKIT

Standards organization- Toolkit- Frameworks and middleware-Globus toolkit -Standards:OGSA and WSRF-Sample grid projects. **(8)**

CLUSTER COMPUTING

Basic Concepts: Approaches to parallel computing- Architecture and functionality of cluster -Categories of cluster. Cluster middleware-Early cluster architecture and High through put Computing Clusters-Setting up and administering a cluster. **(10)**

PROCESS AND MEMORY IN CLUSTER COMPUTING

Cluster architectures for high availability-Process scheduling: Job Management System-Resource management system - Jobs and Resource - Scheduling parallel jobs - Load sharing and load balancing-Distributed shared memory:Issues-Write synchronization for data consistency. **(12)**

TOTAL : 45

REFERENCES

1. *Prabhu C.S.R., "Grid and Cluster Computing" PHI Learning, 2018 Reprint*
2. *Daniel Minoli, "A Networking Approach to Grid Computing" John Wiley and Sons, INC Publications, 2010.*
3. *Hamid R. Arabnia, Fernando G. Tinetti, "Grid, Cloud and Cluster Computing and Applications", Csrea Publishers, 2017.*

20MCAE105 - INTERNET OF THINGS

L	T	P	C
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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand general concepts of Internet of Things (IoT)*

CO2 : *Recognize various devices and challenges*

CO3 : *Apply design concept to IoT solutions*

CO4 : *Analyze various M2M and IoT architectures*

CO5 : *Develop IoT solutions using sensors, actuators and Devices*

INTRODUCTION TO IOT

Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Scope, Characteristics - Applications - Physical and logical design of IoT, Communication models & APIs - IoT Enabling Technologies. **(8)**

M2M vs IoT AN ARCHITECTURAL OVERVIEW

IoT and M2M - System Architecture - Main design principles and needed capabilities - An IoT architecture outline, standards considerations. **(5)**

IoT REFERENCE ARCHITECTURE

Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical design Constraints. **(5)**

IoT LOGICAL DESIGN USING PYTHON

Introduction to Python - IoT Physical devices and Endpoints - Building blocks of an IoT device - Raspberry pi - Raspberry Pi interfaces - Programming Raspberry Pi with Python - Other IoT devices. **(12)**

DEVELOPING IOT SOLUTIONS

Introduction to Arduino - Implementation of IoT with Arduino and Raspberry pi , Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT. **(10)**

DOMAIN SPECIFIC APPLICATIONS OF IOT - CASE STUDIES

Home Automation - Cities - Environment - Agriculture - Productivity Applications **(5)**

TOTAL : 45

REFERENCES

1. *Arshdeep Bahga, Vijay Madisetti “Internet of Things: A Hands on Approach”, Universities Press, 2014.*
2. *Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle,"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.*
3. *Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, "Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024", Yole Dévelopment Copyrights, 2014*
4. *Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.*

20MCAE106 - SOFTWARE METRICS AND MEASUREMENT

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Analyze the problem to ascertain the type of software measurement.*

CO2 : *Apply selected statistical methods and enlist the findings of analysis.*

CO3 : *Design and tailor the selected metric to match the information reliabilities need.*

CO4 : *Determine a plan to decide what data to collect and who should collect it.*

CO5 : *Interpret and communicate the metric results.*

FUNDAMENTALS OF SOFTWARE MEASUREMENT

Measurement in software engineering - scope of software metrics - measurement and models - measurement scales and scale types - classifying software measures - determining what to measure software measurement validation. Software metrics data collection - Analyzing software measurement data: Introduction- Analyzing the results of experiments- Simple analysis Techniques- Overview of statistical tests. **(10)**

SOFTWARE METRICS

Product quality metrics- In- Process quality metrics - Complexity metrics and models - Size metrics - Effort- cost and time measurement - Object Oriented metrics - software maintenance metrics **(10)**

SOFTWARE RELIABILITY MEASUREMENT

Basics of reliability theory- software reliability problem- parametric reliability growth models- the recalibration of software reliability growth predictions **(9)**

METRICS TO MANAGE PROJECTS

Tracking software progress - software project metrics - utilization and efficient project management **(7)**

MEASUREMENT AND MANAGEMENT

Planning a measurement program - Metrics plan - developing goals- questions and metrics - mapping measures to activities - measurement tools - measurers- analysts and audience - Measurement in practice. **(9)**

TOTAL : 45

REFERENCES

1. *Stephen H Kan, "Metrics and Models in Software Quality Engineering", Pearson Education, Second Indian Reprint, New Delhi, 2014.*
2. *N orman Fenton and Shari Lawrence Pfleeger, "Software Metrics - A Rigorous & Practical Approach", Third Edition, Thomson Asia Pvt Ltd, Singapore- 2014.*
3. *Highsmith J, "Agile Software Development Ecosystems", Addison Wesley, 2005.*
4. *Kent Beck, "Junit Pocket Guide", O'Reilly Media, First Edition, 2004.*
5. *Craig Larman, "Agile & Iterative Development - A Manager's Guide", Pearson Education, 2009.*

20MCAE107 - AGILE METHODS FOR SOFTWARE DEVELOPMENT

L	T	P	C
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PRE-REQUISITES

20MCA15

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Ascertain the need of software development methodologies with agility and self adaptability features to develop the software which meets the user needs.*

CO2 : *Compare the practices followed in different agile methodologies and choose the suitable methodology for a given project*

CO3 : *Synthesize the various agile methodology practices to produce a methodology for a project*

CO4 : *Develop the system by employing test first programming concept using Junit framework*

CO5 : *Develop a simple application using Scrum or XP methodology*

INTRODUCTION TO AGILE DEVELOPMENT

Agile and Self Adapting : The Cooperative Game Principle - Agile Overview-Evolution of Agile - Agile Software Development Ecosystem -Iterative and Evolutionary approach. Evolution of Agile Methodologies - Agile outside Software Development **(9)**

AGILE SOFTWARE DEVELOPMENT ECOSYSTEMS (ASDE)

The Scrum Process - Scrum's Contributions - Dynamic Systems Development Method (DSDM) Principles - The DSDM Process- DSDM's Contributions-Crystal Methodology Design Principles - The Crystal Framework - Crystal Methods - Crystal's Contributions. **(9)**

FEATURE DRIVEN DEVELOPMENT

The Feature Driven Development(FDD) Process Model - Beyond the FDD process Description - Conceptual Similarities and Differences - FDD's Contributions - Extreme Programming(XP) Basics - XP values and Principles - XP's Contributions - Adaptive Software Development Life Cycle - Leadership-Collaboration Management - ASD's Contributions **(9)**

DEVELOPING AN ASDE

Articulating Ecosystem - Designing Agile Methodology - The Agile Metamorphosis **(8)**

JUNIT FRAMEWORK

I/O : Automatic Tests - Goal -Fixtures-Testing Exceptions - JUnit's Implementation - JUnit API - Test First Programming - Stub - Other Uses for Tests - Extending JUnit - JUnit and Ant - Running JUnit Standalone - JUnit and IDEs-Test Infection. **(10)**

TOTAL : 45

REFERENCES

1. *Rubin Kenneth S, " Essential Scrum: A Practical Guide to the Most Popular Agile Process", Addison-Wesley, First Edition, July 2012.*

2. *Todaro, Dave, "The Epic Guide to Agile: More Business Value on a Predictable Schedule with Scrum", R9 Publishing LLC, Kindle Edition, 2019.*
3. *Sagar Salunke, "JUnit with examples", O'Reilly Media, First Edition, Createspace Independent Pub; 1st Edition, 23 May 2016.*
4. *Craig Larman, "Agile & Iterative Development, A Manager's Guide", Pearson Education, 2009.*

20MCAE108 - SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Ascertain the need for Software Architecture and its features to develop software that meets user needs.*

CO2 *: Choose the suitable architectural style for a given project*

CO3 *: Synthesize the various architectural styles to produce a quality project*

CO4 *: Develop system by employing Design Patterns.*

CO5 *: Develop a simple application using Software Architecture and Design Pattern.*

INTRODUCTION TO SOFTWARE ARCHITECTURE

Introduction Software Architecture Definition Prospects - State of Art Architecture Business Cycle-Importance of Software Architecture - Architectural Structures. **(9)**

SOFTWARE ARCHITECURAL STYLES

Architectural Styles: Pipes and Filters- Layered Systems- Repositories -Process Control- Other familiar Architecture- Heterogeneous Architecture - Organizing Architectural Styles **(9)**

SOFTWARE ARCHITECTURE QUALITY

The Architectures and Quality Attributes Achieving Qualities - Achieving Quality goals with Architectural Styles -Unit Operations - Applying Unit Operations to User Interface - Case Studies- World Wide Web **(9)**

INTRODUCTION TO DESIGN PATTERN

Introduction - Definition - Making a pattern - Pattern categories - Relationship between patterns - Patterns and software architecture **(9)**

DESIGN PATTERNS

Creational patterns - Structural patterns - Behavioral patterns - Frameworks for patterns - Patterns catalogs and writing patterns. Case studies in UML. **(9)**

TOTAL : 45

REFERENCES

1. *Len Bass, Paul Clements & Rick Kazman, "Software Architecture in Practice", Addision Wesley, 3rd Edition, 2013.*
2. *Mary Shaw & David Garlan, "Software Architecture Perspectives on an emerging discipline", Prentice Hall of India, 3rd Indian Reprint, 2006.*
3. *Eric Gamma, Richard Helm, Ralph Johnson, John Vissides, "Grady Booch, Design Patterns", Addision Wesley, 2007.*
4. *Craig Larman, "Applying UML and Patterns", Prentice Hall, 2009.*

20MCAE109- BASICS OF ROBOTICS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand the architecture of robots by learning paradigms and intelligence.*

CO2 : *Apply the Forward and Inverse Kinematics of manipulators and understand the dynamics in locomotion control and trajectory generation.*

CO3 : *Program an application for industrial robots.*

CO4 : *Synthesize the Machine Intelligence in robots by studying the functions of industrial manipulators using AI approach.*

CO5 : *Understand the automation in robotics by using drive system for gripper movement.*

INTRODUCTION TO ROBOTIC PARADIGMS

Robots-Intelligent Robots-Paradigm-Robotic Paradigms-Primitives Sense-Plan-Act-Overview of Three Paradigms-Hierarchical-Reactive and Hybrid Deliberative/Reactive-Architectures **(7)**

BASICS OF MECHANICS AND CONTROL

Description of position and orientation Mechanics-Kinematics-Forward and Inverse kinematics of manipulators-Dynamics. Introduction to Jacobian of the Manipulator-Trajectory generation- Programming Robots-Off-line Programming and simulation **(9)**

ROBOT PROGRAMMING LANGUAGES AND SYSTEMS

Levels of Robot Programming- A Sample Application in industrial robot - Requirements of a Robot Programming Language-Internal world model versus external reality-Context Sensitivity- Error Recovery **(9)**

TELEOPERATION TO AUTONOMY

Overview-Machine Intelligent-Use of Robots-Implications-Brief History-Industrial Manipulators-Space Robotics and the AI approach-Teleoperation-Telepresence-Semi-autonomous control- Seven Areas of Robotic AI **(10)**

BASICS OF ROBOTICS TECHNOLOGY AND AUTOMATION

Introduction - End-Effectors-Drive System for Grippers-Mechanical- Magnetic- Vaccum and Adhesive-Design of Multiple DOF-Sensory Devices-Types of Sensors-Robot Vision Systems-Low Level- Sensing- Digitizing-Preprocessing techniques-Noise reduction-enhancement. **(10)**

TOTAL : 45

REFERENCES

1. *Bruno Siciliano, Oussam Khati "Handbook of robotics", 2nd Edition, Springer, 2020.*
2. *Robin R.Murphy, "Introduction to AI Robotics", A Bradford Book, 2nd Edition, 2019.*
3. *Kevin M.Lynch, Frank C.Park, "Modern Robotics-Mechanics, Planning and Control"Cambridge University Press, 1st Edition, 2017.*
4. *John J. Craig, "Introduction to Robotics, Mechanics and Control", Pearson Education Inc-3rd Edition, 2013.*
5. *S.R. Deb, S.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Education, 2nd Edition, 2012.*

6. *S.K. Saha, "Introduction to Robotics", Tata McGraw Hill Education, 4th Edition, 2011.*
7. *Robert J.Schilling, "Fundamentals of Robotics, Analysis & Control", PHI Learning, 2010.*
8. *Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, "Industrial Robotics Technology, Programming and Applications", 2nd Edition, 2012.*

20MCAE110 - GPU AND PARALLEL PROGRAMMING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Understand the basic concepts of super-computing and parallel programming architecture*

CO2 *: Identify the difference between serial and parallel programming needs to solve real-time problems.*

CO3 *: Demonstrate the ability to use GPUs for parallel programming to solve compute intensive tasks.*

CO4 *: Identify CUDA architecture and its components.*

CO5 *: Apply parallel programming methods and solve problems using CUDA platform*

HISTORY OF SUPER COMPUTING

Von Neumann Architecture - Cray - Connection Machine - Cell Processor - Multinode Computing - The Early Days of GPGPU Coding - The Death of the Single - Core Solution - NVIDIA and CUDA - GPU Hardware Alternatives to CUDA: OpenCL - Direct Compute - CPU alternatives - Directives and libraries. **(8)**

UNDERSTANDING PARALLELISM WITH GPUS

Introduction - Traditional Serial Code - Serial/Parallel Problems Concurrency: Locality - Types of Parallelism: Task - based parallelism - Data-based parallelism - Flynn's Taxonomy - Some Common Parallel Patterns: Loop-based patterns - Fork/join pattern - Tiling/grids - Divide and conquer. **(10)**

CUDA HARDWARE- GRIDS- BLOCKS- AND THREADS

PC Architecture - GPU Hardware-CPUs and GPUs - Setting up CUDA - Threads: Problem decomposition - Task execution model - Threading on GPUs - CUDA kernels - Blocks: Block arrangement - Grids: Stride and offset - X and Y thread indexes. **(10)**

MEMORY HANDLING WITH CUDA

Introduction- Caches : Types of data storage - Register Usage - Shared Memory: Sorting using shared memory - Constant Memory: Constant memory caching - Constant Memory Broadcast - Global Memory - Score boarding - Global memory sorting - Sample sort. **(8)**

CUDA IN PRACTICE

Introduction - Serial and Parallel Code - Design Goals of CPUs and GPUs - Processing Datasets Using ballot and other intrinsic operations - Profiling - Case Study on AES Algorithm. **(9)**

TOTAL : 45

REFERENCES

1. *Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufman, 2012.*
2. *David Kirk, Wen-meiHwu, "Programming Massively Parallel Processors: A Hands-on Approach", Morgan Kaufman, 2010.*

20MCAE111 - DIGITAL IMAGE PROCESSING

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Describe different modalities and current techniques in image processing*

CO2 : *Provide mathematical foundations for digital manipulation of image acquisition, pre-processing, enhancement, segmentation and compression.*

CO3 : *Apply image processing techniques in both the spatial and frequency (Fourier) domains*

CO4 : *Learn different feature extraction techniques for image analysis and recognition.*

CO5 : *Develop and compare various Image Compression and Decompression Techniques.*

FUNDAMENTALS OF IMAGE PROCESSING

Introduction - Elements of visual perception- Steps in Image Processing Systems - Image Acquisition - Sampling and Quantization - Pixel Relationships - Colour Fundamentals and Models- File Formats, Introduction to the Mathematical tools. **(8)**

IMAGE ENHANCEMENT AND RESTORATION

Spatial Domain : Gray level Transformations- Histogram Processing- Spatial Filtering - Smoothing andSharpening. Frequency Domain: Filtering in Frequency Domain - DFT- FFT- DCT- Smoothing and Sharpening filters - Homomorphic Filtering- Noise models- Constrained and Unconstrained restoration **(10)**

IMAGE SEGMENTATION AND FEATURE ANALYSIS

Detection of Discontinuities - Edge Operators - Edge Linking and Boundary Detection - Thresholding - Region Based Segmentation - Motion Segmentation- Feature Analysis and Extraction. **(8)**

MULTI RESOLUTION ANALYSIS AND COMPRESSIONS

Multi Resolution Analysis : Image Pyramids - Multi resolution expansion - Wavelet Transforms- FastWavelet transforms- Wavelet Packets. Image Compression: Fundamentals - Models - Elements of Information Theory - Error Free Compression - Lossy Compression - Compression Standards - JPEG/MPEG. **(10)**

APPLICATIONS OF IMAGE PROCESSING

Representation and Description- Image Recognition- Image Understanding - Image Classification - Video Motion Analysis - Image Fusion - Steganography - Colour Image Processing **(9)**

TOTAL : 45

REFERENCE S

1. *Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", 4th Edition, Pearson Education, 2018.*
2. *Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 4th Edition, Brooks Cole, 2015.*
3. *Anil K.Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2019.*
4. *Madhuri A. Joshi, "Digital Image Processing: An Algorithmic Approach", 2nd Edition, Prentice Hall India, 2018.*
5. *Rafael C.Gonzalez, Richard E.Woods and Steven L. Eddins, "Digital Image Processing Using MATLAB", 3rd Edition, Pearson Education, 2020.*

20MCAE112 - BLOCKCHAIN TECHNOLOGIES

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3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand the basics of distributed environment and decentralization.*

CO2 : *Describe the fundamentals of Blockchain.*

CO3 : *Analyze the working principles of Bitcoin.*

CO4 : *Develop Cryptography algorithms and protect Cryptocurrencies.*

CO5 : *Examine the development platform ethereum and Hyperledger.*

BLOCKCHAIN

Introduction - Distributed Systems- History of blockchain- Introduction to blockchain- Types of blockchain- CAP theorem and blockchain- Benefits and limitations of blockchain. Decentralization - Decentralization using blockchain- methods of decentralization- routes to decentralization- blockchain and full ecosystem decentralization- smart contract- decentralized autonomous organization- corporations- societies- application- Platforms for decentralization - Cryptography. **(10)**

CRYPTOCURRENCIES

Cryptographic primitives - Hash Functions- Bitcoin- keys and addresses-Public keys in bitcoinPrivate keys in bitcoin- Bitcoin currency units - Base58Check encoding- Vanity addresses- transactions- Types of transactions- blockchain- bitcoin payments- Alternative coins - theoretical foundations- bitcoin limitations - Block Chain Technologies. **(10)**

SMART CONTRACTS AND ETHEREUM

Smart Contracts - Recardian Contracts - Ethereum - Introduction- ethereum blockchain- elements- precompiled contracts- accounts- block- ether- messages- mining- clients and wallets- trading and investment- symbols- ethereum network- applications- scalability and security. **(9)**

CONTRACT DEVELOPMENT AND DEPLOYMENT

Ethereum development - Setting up a development environment- development tools and clients- Solidity Web3. **(9)**

HYPERLEDGER

Hyper ledger Projects - Fabric- Fabric architecture-block chain services- components of fabric- Sawtooth lake -PoET- CORDA-Architecture-components-Nodes-Permission services - Development environment-Case study in block chain management **(7)**

TOTAL : 45

REFERENCES

1. *Imran Bashir- "Mastering Blockchain", Packt Publishing, First Edition, 2017.*
2. *Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, 2016.*
3. *Roger Wattenhofer, "The Science of the Blockchain", Inverted Forest Publishing, First Edition, 2016.*
4. *Don and Alex Tapscott, "Blockchain Revolution", Portfolio Penguin, 2016.*
5. *Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly, Second Edition, 2017.*

20MCAE113 - SINGLE PAGE WEB APPLICATIONS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Learn to build modern browser-based applications that take advantage of stronger client platforms and more predictable bandwidth.*

CO2 : *Learn the SPA design approach*

CO3 : *Explore new techniques like structured java scripts and responsive design*

CO4 : *Know how to capitalize trends like server side JavaScript and NoSQL data stores*

CO5 : *Develop frameworks that makes JavaScript more manageable and testable as a first class language.*

INTRODUCTION

Build first SPA - user benefits of well-written SPA. Re introducing JavaScript - variable scope, hoisting and execution context-scope chain, prototype chain and functions.

THE WEB SERVER

Role - the Node.js advance routing, authentication and authorization, Web Socket, Socket.IO. The server database, MongoDB, client data validation, CRUD

BUILD THE MODEL

Set up model and files. People object: design and build. Chat model, add avatar support. Chat feature and avatar feature, Data binding and jQuery. Create data module.

SPA CLIENT

Files and name spaces. The feature container - create, render and manage. Manage application state. Feature module: strategy, file design method API,. Implementation API, add frequencies.

READYING SPA FOR PRODUCTION

Optimising SPA for search engines, cloud and third party services, CDN, Caching and Cache Busting.

TOTAL : 45

REFERENCES

1. *Michael S. Mikowski and Josh C. Powell, "Single Page Web Applications", Manning Publicatons, September 2018.*
2. *Chris Love, "High Performance Single Page Web Applications", Chris Love, kinley edition January 11, 2014.*
3. *Emmit Scott, "SPA Design and Architecture: Understanding Single Page Web Applications", Manning Publications, 2015.*

20MCAE114 - DIGITAL MARKETING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Assess the impact of digital technology on the practice of marketing.*

CO2 : *Analyse the use of different forms of digital marketing in the development of an online presence.*

CO3 : *Develop a plan for marketing a product of business online.*

CO4 : *Integrate social media tools into a marketing communications strategy.*

CO5 : *Use a publishing platform to build a web presence with integrated data collection and links to social media.*

Understanding Marketing Management: Importance, Scope, Core Marketing Concepts, Marketing Tasks. Company Orientation towards Market Place: Evolution, New Marketing Realities. **(9)**

Introduction to Digital Marketing : Need for digital marketing - Commonly used terminology - 4Cs : Customer, Content, Context and Conversation - Three essential ingredients: Traffic, Insights and Conversions - Introduction to customer personas, buying process and their usability - Designing a basic digital marketing plan. **(9)**

Developing Marketing Strategies : Market Segmentation: Levels, Patterns, Bases, Effective Segmentation Criteria. Targeting: Approaches.Positioning:Steps, Differentiation Strategies. **(9)**

Building Online Presence : Introduction to Building online presence for businesses - basic terminology and technology - Website Domain: naming, working & registration - Website operation - Hosting website - Introduction to WordPress - basic concepts of linking content using HTML.

Building Traffic : Different techniques for driving traffic or visitors to a website - Introduction to search engine optimization, Social media marketing, Referral traffic, Display ads, Search engine marketing, Affiliate marketing and email marketing. **(9)**

Getting Insights : Collect and analyze data of visitors to websites - Introduction to Google Analytics and Google Webmaster Tools - Workings of web analytics - Set up Google Analytics for a website - Set up goals and filters in Google Analytics - Access and interpret reports - Set up and use Google Webmaster Tools for effectiveness of search engine optimization.

Driving Conversions : Convert website visitors into buyers - Basic conversion tracking using Google Analytics and ad platforms - Introduction to Landing Pages - Different types of conversions - Campaign optimization - Learn to create a landing page using UnBounce. **(9)**

TOTAL: 45

REFERENCES

1. *Seema Gupta, "Digital Marketing", McGraw Hill, 2018.*
2. *Philip Kotler, Kevin Lane Keller, Abraham Koshy & MithileshwarJha, "Marketing Management: A South Asian Perspective", 14th Edition, Pearson, New Delhi , 2014*
3. *Damian Ryan, "Understanding Digital Marketing - Marketing Strategies for Engaging the Digital Generation", 3rd Edition, Kogan Page Ltd., 2014*
4. *Dave Evans and Jake Mckee, "Social Media Marketing - The Next Generation of Business Engagement", Wiley India pvt. Ltd, New Delhi, 2011.*
5. *Perry Marshall, Thomas Melloche, "Ultimate Guide to Facebook Advertising", Tata McGraw Hill, New Delhi, 2011.*

20MCAE115 - SOFTWARE PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

PRE-REQUISITES

20MCA15

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Gain knowledge of how a project will be broken down into stages and what each stage contributes to the project*

CO2 *: Select appropriate techniques for use in the stages of a project*

CO3 *: Justify the appropriateness of these techniques- and apply them to practical situations*

CO4 *: Know the limitations of the project approach in developing information/software systems*

CO5 *: Test and apply metrics on the developed software to ensure compliance of requirements.*

INTRODUCTION

Projects - Software Projects Vs Other type of projects-Management-Requirement Specification. Step-wise Planning - Project Evaluation - strategic assessment - technical assessment - cost-benefit evaluation techniques- risk evaluation. Project analysis and contents list-choice of process models - Waterfall Model- V-Process Model - Software Prototyping - tools. **(9)**

SOFTWARE ESTIMATION & RISK MANAGEMENT

Software Estimation - Introduction-problems with over & under estimation - basis for estimation - various types of estimation. Activity Planning - objectives - project schedules and activities from different planning models. Risk Management: Nature-managing risk - evaluating risks. Resource Allocation: Nature - resource requirements-creating critical path and counting the cost. **(9)**

MONITORING AND CONTROL

Resposibility - assessing progress-setting check points - taking snapshots - collecting data - visualizing progress-cost monitoring-priority monitoring. Managing People & Organizing teams: Understanding behavior-organization behavior-Motivation - Olman Hackman job characteristics model - working in groups - becoming ateam - decision making & leadership. Planning for small projects - problems with students projects - content of project plan. **(9)**

SOFTWARE QUALITY ASSURANCE

Software Quality Factors - Quality Metrics - Software Quality Assurance approach - Software Quality Assurance Plan - ISO 9000 Quality System - SEI CMM - IEEE standards. Software Reliability - definition - concept of reliability and availability - software error and faults - reliability models - availability models. **(9)**

CASE STUDY

Using tool - project information - task information - Scheduling - resource allocation - leveling resources - cost estimation - reports - case studies and examples. **(9)**

TOTAL: 45

REFERENCES

1. *Bob Hughes , Mike Cotterell & Rajib Mall, "Software Project Management", Tata McGraw Hill, 6th Edition, 2017.*
2. *Roger S.Pressman, "Software Engineering: A Practitioners Approach", Tata McGraw Hill, 7th Edition, 2010.*
3. *"Microsoft Project Version 2002 Step by Step", Microsoft Press, 2002.*
4. *Walker Royce, "Software Project Management - A Unified Framework", Addison Wesley, 2004.*
5. *Ramesh Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2008.*

20MCAE116 - COMPUTER VISION

L	T	P	C
3	0	0	3

PRE-REQUISITES

20MCAE101

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Implement fundamental image processing techniques required for computer vision.*

CO2 *: Perform shape analysis and implement boundary tracking techniques.*

CO3 *: Apply Hough Transform for line, circle, and ellipse detections.*

CO4 *: Apply 3D vision techniques and implement motion related techniques.*

CO5 *: Develop applications using computer vision techniques*

UNIT I IMAGE PROCESSING FOUNDATIONS

Review of image processing techniques - classical filtering operations - thresholding techniques - edge detection techniques - corner and interest point detection - mathematical morphology - texture. **(8)**

UNIT II SHAPES AND REGIONS

Binary shape analysis - connectedness - object labeling and counting - size filtering - distance functions - skeletons and thinning - deformable shape analysis - boundary tracking procedures - active contours - shape models and shape recognition - centroidal profiles - handling occlusion - boundary length measures - boundary descriptors - chain codes - Fourier descriptors - region descriptors - moments. **(9)**

UNIT III HOUGH TRANSFORM

Line detection - Hough Transform (HT) for line detection - foot-of-normal method - line localization - line fitting - RANSAC for straight line detection - HT based circular object detection - accurate center location - speed problem - ellipse detection - Case study: Human Iris location - hole detection - generalized Hough Transform (GHT) - spatial matched filtering - GHT for ellipse detection - object location-GHT for feature collation. **(10)**

UNIT IV 3D VISION AND MOTION

Methods for 3D vision - projection schemes - shape from shading - photometric stereo - shape from texture - shape from focus - active range finding - surface representations - point-based representation - volumetric representations - 3D object recognition - 3D reconstruction - introduction to motion - triangulation - bundle adjustment - translational alignment - parametric motion - spline-based motion - optical flow - layered motion. **(9)**

UNIT V APPLICATIONS

Application: Photo album - Face detection - Face recognition - Eigen faces - Active appearance and 3D shape models of faces Application: Surveillance - foreground-background separation - particle filters - Chamfer matching, tracking, and occlusion - combining views from multiple cameras - human gait analysis Application: In-vehicle vision system : locating roadway - road markings - identifying road signs - locating pedestrians. **(9)**

TOTAL : 45

REFERENCES

1. *D. L. Baggio et al., "Mastering OpenCV 3", Second Edition, Packt Publishing, 2017.*
2. *E. R. Davies, "Computer Vision: Principles, Algorithms, Applications, Learning", Fourth Edition, Academic Press, 2017.*

3. *Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.*
4. *Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Fourth Edition, Academic Press, 2019.*
5. *R. Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, Springer 2021.*
6. *Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, Hardback 2019.*

20MCAE117 - SOFTWARE TESTING AND QUALITY ASSURANCE

L	T	P	C
3	0	0	3

PRE-REQUISITES

20MCA15

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Analyze different approaches to test software, and select applicable techniques for different situations and projects.*

CO2 : *Prepare a software quality plan for a software project considering process evaluation models including issues related to change management, configuration management, verification and validation, and measurement.*

CO3 : *Design test plans, create test procedures and design measures to evaluate result of tests.*

CO4 : *Apply black box and white box testing techniques at various testing levels for given requirements to achieve adequacy criteria.*

CO5 : *Use standards, models and techniques aimed at achieving quality assurance in different software development environments*

INTRODUCTION

The Role of Process in Software Quality - Testing as a Process - Overview of the Testing Maturity Model (TMM) - Basic Definitions - Software testing principles - Origins of defects - Defect classes, The defect repository, and Test Design - defect example : The coin problem. **(9)**

TESTING STRATEGIES

Test case design strategies - Black box approach - Random testing - Equivalence Class Partitioning - Boundary Value Analysis - Cause and Effect graphing - State Transition testing - Error Guessing- White Box approach - Test adequacy criteria - Coverage and Control Flow Graphs - Covering code logic- Data flow and White box test design - Loop testing - Mutation testing - Evaluating test Adequacy Criteria. **(12)**

LEVELS OF TESTING

Unit test: functions, procedures, classes and methods as units - Unit test planning - Designing the unit tests - The class as a Testable Unit -The test harness - Integration test : Goal- Integration Strategies for Procedures and Functions - Integration Strategies for Classes - Designing Integration Test - System Test : the different types - Regression testing - Alpha, Beta and Acceptance test- Test planning - Test Plan Components - Test Plan Attachments - Reporting Test Results. **(10)**

SOFTWARE QUALITY

Theory of software quality : Defining quality - Importance of Quality - Quality control v/s Quality Assurance - Quality Assurance at each phase of SDLC, Hierarchical Models of Quality : Hierarchical Models of Boehm and McCall, Planning for Software Quality Assurance : Software Quality Assurance Plans, Product Quality and Process Quality : Product Quality - Models for Software Product Quality - Process , Walkthroughs and Inspections **(7)**

SOFTWARE METRICS AND MODELS

Software Measurement and Metrics : Introduction to Selenium and Jmeter, Classification of Software Metrics, Defect Metrics, Requirement Related Metrics, Earned Value Analysis, Object Oriented Metrics. ISO 9000 series, ISO 9001 : Origins, ISO Standards Development Process, ISO 9000 Family, ISO 9001:2000, ISO Certification, Assessment Process. CMM Model - CMM and ISO Comparative analysis - CMM -I - P-CMM, SPICE, Malcolm Baldrige Award Model - EFQM Excellence Model **(7)**

TOTAL : 45

REFERENCES

1. *Ilene Burnstein, "Practical Software Testing", Springer International Edition, 1st Indian Reprint, 2004.*
2. *Stephan Goericke, "The future of Software Quality Assurance", Springer publications, 1st Edition Kindle, 2020*
3. *Dr.Anand Nayyar, "Software testing, An Approach to software testing, Principles,Applications, Techniques and Practices", BPB Publications, 2nd Edition, 2019.*
4. *Rex Black, Erik van veenendaal, Dorothy Graham, "Foundations of Software Testing" , Cengage Learning emea Publications, 4th Edition, 2019.*
5. *Abu Sayed Mahfuz, "Software Quality Assurance", Auerbach Publications; 1st Edition, 2016.*

20MCAE118 - OPEN SOURCE ECOSYSTEM

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Know about the professional management and implementation of Open Source Technologies*

CO2 : *Analyse the differential combination of new technologies with the matured one*

CO3 : *Decide on the boundaries of business which the web changed from building the business case to doing hands-on experimentation*

CO4 : *Self teach the issues faced in transitioning to the new technologies, ranging from business to social concern.*

CO5 : *Understand roles for open source software in organization.*

INTRODUCTION

Open Source Software : Definition- History- Successful Areas with Examples.The Good- Bad and the ugly of Open Source Systems. Open Source Opportunities - Create Lab - Migration - Build Applications - Bring the New Desktop Systems Underserved and Migrate Applications and Databases to Open Source. **(7)**

ADVANCED OPEN SOURCE OPPORTUNITIES

Introduction - Directory Services - Email - Complex Web Publishing - Manage User Desktops - Other Possibilities'.Open Source Operating Systems - Linux Distribution Vendors- Enterprise Distribution Vendors- Community Supported Distribution Vendors- International Alternatives **(12)**

SERVER AND DESKTOP APPLICATONS

Server Applications - Infrastructure services - Web Servers - Database Servers - Mail Servers - Systems Management. Desktop Applications - Graphical Desktops - Web Browsers - The Office Suit - Mail and Calendar Clients. **(12)**

IMPLEMENTATION AND ARCHITECTURE

Methodology- Language and Cross Platform Code. System Implementation Process- Principles- Key Documents and integration with Open Source Community. Architecture - Managing Tiered Design - Performance and Scalability - Interoperability - Platform. **(8)**

COST AND LISCENCING

Ownership Costs - Staffing- Hardware- Software and Third Party Applications. Pricing - Types of Costs and Scenarios. Licensing - Types - License in use - Dual Licensing - Intellectual Property Issues **(6)**

TOTAL : 45

REFERENCES

1. *Paul Kavanaugh, "Open Source Software, Implementation and Management", Elsevier Press, 2004.*
2. *Stephen Koch, "Free/Open Source Software Development", Idea Group Publishing, 2005.*
3. *Karl Fogel, "Producing Open Source Software: How to Run a Successful Free Software Project", under the Creative Commons Attribution, ShareAlike, 2018.*

20MCAE119 - ENTERPRISE MANAGEMENT AND COMPUTING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Make computing available as a utility under the internet.*

CO2 : *Understand the fundamentals of enterprise architecture and enterprise computing.*

CO3 : *Implement cloud programming paradigms like MapReduce.*

CO4 : *Describe the emerging development paradigms and technologies and discuss how these will change the way the enterprise applications should be architected.*

CO5 : *Understand the benefits of open source technologies on enterprise computing.*

INTRODUCTION

Architecture - Mainframe- Client/Server- 3-tier Architecture with TP monitors- Dev 2.0 Platforms- Cloud Computing. Enterprise Architecture - Data and process- Components- Application Integration and SOA- Data Centre Infrastructure. **(9)**

CLOUD PLATFORMS

Cloud Economics -Virtualization Technology - Multi-tenant Software. Data in the Cloud- Big Table- HBase and Dynamo. Map Reduce and Extensions. Software Architecture- Enterprise software - ERP- SCM & CRM. Custom Enterprise Applications. **(10)**

WORKFLOW AND BUSINESS PROCESS

Implementing workflow- Meta Model using ECA rules- ECA WorkFlow Engine- Process Modelling and BPMN. Enterprise Analytics and Search. **(10)**

ENTERPRISE CLOUD COMPUTING

Ecosystem - Cloud Management Platforms and Tools- Tools for Building Private Clouds. Future of Enterprise Cloud Computing. **(8)**

OPEN SOURCE ENTERPRISE COMPUTING

Open Source Licenses- Management of Open Source Software Projects- Open Standards. Business Strategies - Revenue Streams- Analysis and Critical Success Factors. **(8)**

TOTAL : 45

REFERENCES

1. *Wolf Rogner, Allgemeinbeeideter and Gerichtlichzertifizierter Sachverstandiger "Open Enterprise Computing", Students Handbook, 2016*
2. *Gautam Shroff, "Enterprise Cloud Computing, Technology, Architecture and Applications", Cambridge University Press, UK, 2010.*
3. *Gunasekaran- Angappa, "Global Implications of Modern Enterprise Information Systems: Technologies and Applications", IGI Global, 2008*

20MCAE201 - DATA ANALYTICS

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Outline the definitions, concepts and enabling technologies of data analytics.*

CO2 *: Analyze different statistical analysis techniques to be applied on different types of datasets.*

CO3 *: Develop regression models using R for a given dataset.*

CO4 *: Apply text analysis methods to analyze unstructured data.*

CO5 *: Create solutions for real world business problems and effectively present results using data visualization techniques.*

INTRODUCTION

Introduction to Big Data Analytics : Big Data Overview - State of the Practice in Analytics - Key Role for the New Big Data.

Ecosystem- Examples of Big Data Analytics. Data Analytics Lifecycle: Overview - Discovery - Data Preparation - Model Planning- Model Building - Communicate Results - Operationalize - Case Study. **(10)**

BASIC DATA ANALYTIC METHOD USING R

Introduction to R - Exploratory Data Analysis - Statistical Methodsfor Evaluation. **(8)**

REGRESSION AND TIME SERIES ANALYSIS

Linear Regression - Logistic Regression- Time Series Analysis : Box-Jenkins Methodology-ARIMA Model: Autocorrelation Model - Auto Regressive Models - Moving Average Model ARMA and ARIMA Models. **(9)**

TEXT ANALYSIS

Text Analysis Steps with Example- Collecting- Representing Text - Term Frequency -Categorizing Documents by Topics - Determining Sentiments. **(10)**

DATA ANALYTICS PROJECT

Communicating and Operationalizing and Analytics Project - Creating the Final Deliverables Data Visualization. **(8)**

TOTAL : 45

REFERENCES

1. *EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley, 2015.*
2. *Thomas A. Runkler, "Data Analytics - Models and Algorithms for Intelligent Data Analysis", Springer, 2012.*

20MCAE202 - INTELLIGENT INFORMATION RETRIVEL

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand algorithms and techniques for information retrieval.*

CO2 : *Design a search engine or any text retrieval system.*

CO3 : *Apply data mining techniques and quantitative evaluation methods for IR systems.*

CO4 : *Develop applications with retrieval capabilities.*

CO5 : *Combine aspects of information visualization and mining for information retrieval and web information retrieval.*

BASICS OF INFORMATION RETRIVEL

Boolean Retrieval - The Term Vocabulary and Posting Lists - Scoring- Term Weighting and the Vector Space Model - Computing Scores in a Complete Search System - Evaluation in Information Retrieval. **(11)**

IR MODELS

XML Retrieval - Probabilistic Information Retrieval : Review - Ranking Principle Binary Independence Model - Language Models for Information Retrieval : Language Models - Query Likelihood Model **(10)**

TEXT CLASSIFICATION AND SVM MODEL

Text Classification and Naïve Bayes : Text Classification Problem - Naïve Bayes Text Classification Bernoulli Model - Properties of Naïve Bayes - Feature Selection. Support Vector Machines and Machine Learning on Documents : SVM Models - Machine Learning methods **(9)**

CLUSTERING AND MATRIX DECOMPOSITIONS

Flat Clustering : Problem Statement - K-means - Hierarchical Clustering: Agglomerative Clustering - Centroid Clustering - Divisive Clustering - Matrix Decompositions and Latent Semantic Indexing. **(9)**

WEB SEARCH AND IR

Web Search Basics - Web Crawling and Indexes : Overview - Crawling - Link Analysis : Pagerank. **(6)**

TOTAL : 45

REFERENCES

1. *Christopher Manning, Prabhakar Raghavan and Hinrich Schutze, "Introduction to Information Retrieval", Cambridge University Press, 2012.*
2. *Ricardo Baeza-Yates, Berthier Ribeiro-Neto, "Modern Information Retrieval: The concepts and Technology behind Search" (ACM Press Books), Second Edition, 2011.*
3. *D.A. Grossman, O. Frieder, "Information Retrieval: Algorithms and Heuristics", Springer, 2004.*
4. *Bruce Croft, Donald Metzler and Trevor Strohman, "Search Engines: Information Retrieval in Practice", Addison Wesley, First Edition, 2009.*
5. *Mark Levene, "An Introduction to Search Engines and Web Navigation", Wiley, Second Edition, 2010.*

20MCAE203 - BIG DATA TECHNOLOGIES

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Build single and multi-node Hadoop clusters on Linux or Windows platform*

CO2 : *Use Hadoop file system commands to load and execute programs on it.*

CO3 : *Write map-reduce programs for data intensive applications and execute them on the Hadoop platform.*

CO4 : *Use NoSQL databases like MongoDB in data processing applications.*

CO5 : *Choose appropriate big data technologies to analyse big data for a given analytic requirement.*

FUNDAMENTALS OF BIG DATA

Classification of Digital Data- Characteristics of Data-Evolution of Big Data-Definition-Challenges-Traditional Business Intelligence versus Big Data. **(6)**

BIG DATA ANALYTICS

Introductionto Big Data Analytics-Classification of Analytics-Challenges of Big Data-Terminologies used in Big Data Environments-Big Data technologies: NoSQL and Hadoop. **(6)**

HADOOP

Data Storage and Analysis-Comparison with Other Systems-A Brief History of Hadoop-Apache Hadoop and the Hadoop Ecosystem-Setting up a Hadoop Cluster. **(8)**

HADOOP DISTRIBUTED FILE SYSTEM

Design of HDFS -HDFS Concepts: Blocks-Name Nodes and Data Nodes-HDFS Federation-HDFS High-Availability-The Command-Line Interface-Basic File System Operations-Hadoop File Systems-The Java Interface-Reading Data From a Hadoop URL-Reading Data Using the File System API- Writing Data-Directories-Querying the File System-Deleting Data. **(9)**

MAP REDUCE

A Weather Dataset- Data Format- Analyzing the Data with Hadoop -Map and Reduce- Java Map Reduce-Scaling Out-Data Flow-Combiner Functions-Running a Distributed Map Reduce Job-Map Reduce Program Examples. **(9)**

NOSQL AND MONGODB

Introduction to NoSQL-Types of NoSQL Databases-Advantages and Use-SQL versus NoSQL. Introduction to MongoDB-Data Types-MongoDB Query Language. **(7)**

TOTAL : 45

REFERENCES

1. *Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", 2nd Edition, Wiley, 2019.*
2. *Tom White, "Hadoop: The Definitive Guide, O'Reilly Media", 3rd Edition, Yahoo Press, 2012.*
3. *Chuck Lam, "Hadoop in Action", Manning Publications, 2011.*
4. *Srinath Perera,Thilina Gunarathne, "Hadoop Map Reduce Cookbook", Packt Publishing Limited, 2013.*

20MCAE204 - DATA MINING AND WAREHOUSING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Examine a given dataset identify the analysis goals and providing data mining solutions to achieve those goals.*

CO2 : *Choose proper pre-processing techniques by studying the characteristics of the attributes of the dataset and prepare it for data mining.*

CO3 : *Apply association rule mining techniques such as Apriori and FP-Tree to a given dataset and generate association rules from it.*

CO4 : *Analyze the suitability of classification (Decision Tree) and clustering algorithms(K-Means and K-Medoids) for a given data analysis requirement.*

CO5 : *Mine hidden patterns from the dataset after applying pre-processing techniques and derive inference from the results of mining.*

INTRODUCTION

Definition- Need for Data Mining- Kinds of Data and Patterns- Applications and Issues. Types of data: Data objects and Attribute-Types-Measuring Data Similarity and Dissimilarity. Data Preprocessing: Overview- Data Cleaning-Data Integration-Data Reduction-Data Transformation-Data Discretization. **(12)**

DATA WAREHOUSE AND OLAP TECHNOLOGY

Data Warehouse-Basic Concepts-Data Warehouse Modeling-Data Warehouse Implementation. **(7)**

ASSOCIATION AND CLASSIFICATION TECHNIQUES

Mining Frequent Patterns and Associations : Basic Concepts-Frequent Itemset Mining Methods.

Classification : Basic Concepts-Decision Tree Induction- Bayes Classification Methods. **(12)**

CLUSTER AND OUTLIER ANALYSIS

Cluster Analysis Concepts-Partitioning Methods-Hierarchical Methods : Agglomerativeand Divisive Hierarchical Clustering-BIRCH. Outlier Detection : Outliers and Outlier Analysis-Outlier Detection Methods. **(7)**

MINING COMPLEX DATA TYPES

Mining Sequence Data-Mining Graphs and Networks-Mining Other Kinds of Data- Visual and Audio Data Mining. **(7)**

TOTAL : 45

REFERENCES

1. *Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining - Concepts and Techniques", 3rd Edition, Elsevier Publications, 2012.*
2. *Paul C. Zikopoulos, Chris Eaton, Dirk deRoos and George Lapis, "Understanding Big Data", Mc-Graw Hill, 2012.*
3. *Arun K. Pujari, "Data Mining Techniques", Universities Press, 2009.*
4. *Mohammed J. Zaki, Wagner Meira, "Data Mining and Machine Learning : Fundamental Concepts and Algorithms", 2nd Edition, Cambridge University Press, 2020.*

20MCAE205 - NATURAL LANGUAGE PROCESSING

L	T	P	C
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PRE-REQUISITES

20MCA21

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand core algorithms and data structures used in NLP*

CO2 : *Utilize corpora and annotations added to them*

CO3 : *Build statistical NLP components such as n-gram language models, text classifiers and Parts-of-speech taggers, that learns from such corpora*

CO4 : *Evaluate the merits of different machine learning methods for given NLP tasks*

CO5 : *Appreciate the relationship between linguistic representations and computational applications*

INTRODUCTION

Human languages- Models- Ambiguity - Processing paradigms; Phases in Natural Language Processing- Applications. Text Representation in Computers- Encoding Schemes - Linguistics Resources. **(8)**

Introduction to Corpus - Elements in Balanced Corpus- TreeBank- PropBank- WordNet- VerbNet. Resource Management with XML- Management of Linguistic Data with the help of GATE- NLTK. **(7)**

WORD LEVEL ANALYSIS

Regular Expressions and Automata- Morphology and Finite State Transducer- Probabilistic Models of Pronunciation and Spelling- N-grams- HMMs and Speech Recognition. **(9)**

SYNTACTIC ANALYSIS

Word classes and Part-of-Speech Tagging- Context - Free Grammars- Parsing with Context- Free Grammars- Features and Unification- Lexicalized and Probabilistic Parsing- Language and Complexity. **(11)**

SEMANTIC ANALYSIS AND DISCOURSE PROCESSING

Representing Meaning- Semantic Analysis- Lexical Semantics- Word Sense Disambiguation and Information Retrieval. Simple Applications in NLP. **(10)**

TOTAL : 45

REFERENCES

1. *Jurafsky D. and J. H. Martin, "Speech and language processing: An Introduction to Natural Language Processing: Computational Linguistics and Speech Recognition", 2nd Edition, Pearson Paperback, 2013*
2. *Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.*
3. *Jurafsky and Martin, "Speech and Language Processing", Prentice Hall, 1st Edition, 2000.*

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20MCAE206 - SOCIAL NETWORK ANALYSIS

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand concept of semantic web and related applications.*

CO2 : *Represent knowledge using ontology.*

CO3 : *Model social network data.*

CO4 : *Understand importance of communities in social network.*

CO5 : *Apply techniques for visualization of social networks.*

INTRODUCTION

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key Concepts and Measures in Network Analysis - Electronic Sources for Network Analysis: Electronic Discussion Networks- Blogs and Online communities - Web-based Networks - Applications of Social Network Analysis **(9)**

MODELLING- AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web : Ontology-based Knowledge Representation - Ontology Languages for the Semantic Web: Resource Description Framework - Web Ontology Language. **(7)**

MODELLING AND AGGREGATING SOCIAL NETWORK DATA :

State-of the-art in network data representation - Ontological representation of Social Individuals - Ontological Representation of Social Relationships - Aggregating and Reasoning with Social Network Data - Advanced Representations. **(9)**

EXTRACTION AND MINING COMMUNITIES IN WEB S

Extracting Evolution of Web Community from a Series of Web Archive - Detecting communities in Social Networks - Definition of community - Evaluating Communities - Methods for Community Detection and Mining - Applications of Community Mining Algorithms - Tools for Detecting Communities Social Network Infrastructures and Communities - Decentralized Online Social Networks - Multi- Relational Characterization of Dynamic Social Network Communities. **(10)**

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix Representation - Visualizing Online Social Networks- Visualizing Social Networks with Matrix-based Representations - Matrix and Node-Link Diagrams - Hybrid Representations - Applications - Cover Networks - Community Welfare - Collaboration Networks - Co-Citation Networks. **(10)**

TOTAL : 45

REFERENCES

1. *Peter Mika, "Social Networks and the Semantic Web", 1st Edition, Springer, 2007.*
2. *BorkoFurht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.*
3. *Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking Techniques and Applications", 1st Edition, Springer, 2011.*

4. *Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.*
5. *Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access:Techniques for Improved User Modelling", IGI Global Snippet, 2009.*
6. *John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009.*

20MCAE301 - COMPUTER NETWORKS

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Identify the components required to build different types of networks and have an understanding of network models.*

CO2 : *Analyze the layered functionality and data communication mechanisms used between nodes.*

CO3 : *Identify the protocols involved at the various layers and demonstrate the role of each protocol.*

CO4 : *Analyze and describe the working principles of Internet.*

CO5 : *Apply various routing protocols, demonstrate the best routing between nodes and describe the network functionalities for a given application.*

INTRODUCTION

Uses of computer networks - Network hardware - Network software - Reference models - Example networks: RFID and Sensor Networks. Physical Layer: Theoretical basis for data communication - Guided transmission media: Twisted pairs- Coaxial cable- Fiber Optics - Unguided transmission: The Electromagnetic spectrum - Radio wave transmission- Micro wave transmission - Infrared transmission. **(9)**

DATA LINK LAYER

Design issues - Services provided to the network layer - Framing - Flow Control - Error Control. Error detection and correction - Elementary data link protocols: A Simplex Stop- and-Wait protocol for an Error -Free Channel - Sliding window protocols: A One-Bit Sliding window Protocol. Example Data Link protocols: Packet over SONET. MAC Layer: Channel allocation problem - Multiple access protocols: ALOHA - CSMA. **(9)**

NETWORK LAYER

Design issues - Services provided to the Transport Layer - Routing algorithms: Shortest Path Algorithm - Distance Vector Routing - Link State Routing. Congestion control algorithms: Traffic aware routing - Admission Control. Internetworking: Tunneling - Internetwork Routing - Packet Fragmentation. **(9)**

TRANSPORT LAYER

Transport service - Services provided to upper layer - Transport Service primitives - Elements of transport protocols -Addressing - Connection Establishment and Release - Error Control and Flow Control - Multiplexing - A Simple transport protocol: TCP: Introduction -Service Model - Connection Establishment and Release **(9)**

APPLICATION LAYER

Domain Name System: The DNS Name Space - Domain Resource Records - Name Servers - Electronic mail: Architecture and Services - The User Agents - Message Formats - Message Transfer and Delivery - World Wide Web: Architectural overview - Static and Dynamic Web Pages- HTTP - Mobile Web - Web Search. **(9)**

TOTAL : 45

REFERENCES

1. *Andrew S Tanenbaum and David J. Wetherall, "Computer Networks", Pearson Education, Asia, 5th Edition, 2011.*
2. *Behrouz A.Forouzan, "Data Communications and Networking", McGraw-Hill Science/Engineering/Math Publication, 5th Edition, 2012.*

3. *James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Addison- Wesley, 6th Edition, 2008.*
4. *Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers, 5th Edition,2011.*
5. *William Stallings, "Data and Computer Communication", Pearson Education, 8th Edition, 2007.*

20MCAE302 - INTERNETWORKING PROTOCOLS AND MANAGEMENT

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Illustrate the working principles of link layer and network layer protocols used for data communication in the Internet.*

CO2 : *Determine the suitability of User Datagram Protocol for the given application in terms of reliability and Performance.*

CO3 : *Understand and experiment the working of Transmission Control Protocol for the given application based on its requirements.*

CO4 : *Analyze the requirements for monitoring and controlling a network using Simple Network Management Protocol and the Management Information Base.*

CO5 : *Develop TCP and UDP based socket programs for the given client server communication scenario.*

LAYER I & II PROTOCOLS

OSI and TCP/IP Reference model - Concepts of multiplexing and switching - MAC protocols - ALOHA, CSMA/CD - Address Resolution Protocol- IPv4 headers-IP forwarding- Host Processing of IP datagrams - IP Fragmentation - ICMPv4 - DHCP Auto configuration Protocol **(9)**

UDP AND APPLICATIONS

Introduction to UDP - UDP Header and Encapsulation - Broadcasting and Multicasting - Internet Group Management Protocol - Trivial File Transfer Protocol - Bootstrap Protocol **(9)**

TRANSMISSION CONTROL PROTOCOL

Introduction to TCP - TCP Header and Encapsulation - Connection Management - Timeout and Retransmission - Data Flow and Window Management - Congestion Control - TCP Timers **(9)**

NETWORK MANAGEMENT

Introduction - Network Monitoring - Network Control. SNMPv1: Concepts - Management Information Standard MIBs - Simple Network Management Protocol **(9)**

SOCKET PROGRAMMING

Introduction to Sockets - Socket Addresses - Elementary and advanced Socket System Calls-Client Server Communication using Sockets: Connection Oriented Protocol- Connection less Protocol - Socket Options **(9)**

TOTAL : 45

REFERENCES

1. *Kevin R. Fall, W. Richard Stevens, "TCP/IP Illustrated- Volume 1:The Protocols", Pearson Education Asia, 2nd Edition, 2012.*
2. *William Stallings, "SNMP, SNMPv2, SNMPv3 and RMON 1 and 2", Pearson Education Asia, 3rd Edition, 2013.*
3. *W. Richard Stevens, "UNIX Network Programming", Prentice-Hall of India Pvt.Ltd, 2nd Edition, 2009.*
4. *Behrouz A. Forouzan, "TCP/IP Protocol Suite", Tata McGraw-Hill Publishing Company Limited, New Delhi, 4th Edition, 2010.*
5. *Michael J.Donahoo, Kenneth L.Calvert, "TCP/IP Sockets in C - Practical Guide for Programmers", Morgan Kauffman, 2nd Edition, 2009.*

20MCAE303 - MOBILE COMPUTING

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Describe wireless and mobile computing systems and analyze the architecture- functions and emerging techniques in GSM*

CO2 : *Understand the issues and techniques used in the design of MACfor Wireless communication.*

CO3 : *Explain the structure and components for Mobile IP and Mobility Management*

CO4 : *Describe the types and functionalities of transport and application layer services for wireless communication*

CO5 : *Develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.*

INTRODUCTION TO MOBILE COMPUTING

Introduction to MC- novel applications- limitations- and architecture. GSM : Mobile services- System architecture- Radio interface- Protocols- Localization and calling- Handover- Security- and New data services-Layouts, views and resources. **(8)**

WIRELESS MOBILE APPLICATION AND MEDIUM ACCESS CONTROL

Wireless Application Protocol - Introduction - protocol architecture - WDP - WTLS - WTP - WSP - WML - WML Script - WAE - WTA. Motivation for a specialized MAC (Hidden and exposed terminals- Near and far terminals)- SDMA- FDMA- TDMA- CDMA. **(10)**

LAYERS

Mobile Network Layer : Mobile IP - Goals- assumptions- entities and terminology - IP packet delivery - registration - optimizations - Dynamic Host Configuration Protocol (DHCP). Mobile Transport Layer- Traditional TCP- Indirect TCP- Mobile TCP- Transmission /time-out freezing- Selective retransmission- Transaction oriented TCP. **(9)**

ENHANCING ANDROID MOBILE APPLICATIONS

Android development environment -user interface - Application fundamentals - Extending the applications-preparing the working environment-adaptive layouts-adapters-localization-custom views-debugging the user interface-material design-Intents-observer patterns-fragments-files-accessibility-activity-themes and styles-Background tasks-Connecting to internet-preferences-alarms-broadcast receivers-notification-widgets-transferring data efficiently-publishing app. **(10)**

SECURITY SERVICES

Security and system permissions - multiple form factors - sensors - google cloud messaging- monetizing app - content resolvers and providers - fragment programming - security services-processes and threads-recycler view **(8)**

TOTAL : 45

REFERENCES

1. *Raj Kamal, “Mobile Computing”, 3rd Edition, Oxford University Press, 2018.*
2. *JochenSchiller, "Mobile Communications", Addison-Wesley, Second Edition, 2014.*
3. *Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2016*
4. *William Stallings, "Wireless Communications and Networks", 2nd Edition, Prentice Hall of India, Pearson Education, 2015.*
5. *Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt.Ltd, New Delhi, 2017.*

20MCAE304 - WIRELESS NETWORKS

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Study about wireless network basics, architecture, protocol stack and standards.*

CO2 *: Understand the working of wireless medium access control layer and network layer.*

CO3 *: Design and implement wireless network environment using wireless network protocols and standards.*

CO4 *: Analyze different routing protocols in mobile ad-hoc network.*

CO5 *: Conversant with advanced wireless networks 3G, 4G and 5G and their architecture.*

Wireless Network and LAN technologies: Introduction- Frequencies for Radio Transmission - Signals - Antennas - Signal Propagation-Multiplexing - Modulation - Wireless LAN technologies: Infrared, UHF narrow band, spread spectrum- IEEE 802.11: System Architecture. **(9)**

Medium Access Control Layer : Motivation for a specialized MAC - SDMA - FDMA - TDMA - Fixed TDM, Classical Aloha, Slotted Aloha, Carrier Sense Multiple Access, Demand Assigned Multiple Access, PRMA, Reservation TDMA, Multiple Access with Collision Avoidance, Polling, Inhibit Sense Multiple Access- CDMA - Spread Aloha Multiple Access- Comparison **(9)**

Network Layer : Mobile IP - Session Initiation Protocol - Mobile Ad-hoc Network: Characteristics - Classification of routing protocols - Table driven Routing Protocol - OLSR - Source-initiated On-demand Routing Protocol - DSR - Hybrid Routing Protocols - ZRP. **(8)**

Wireless Wide Area Networks : Overview of UMTS Terrestrial radio access network - UMTS core network architecture : 3G - MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC, SMS-IWMSC, Firewall, DNS, DHCP- High Speed Downlink Packet Access (HSDPA) - LTE network: Architecture and Protocol. **(10)**

4G and 5G Networks : 4G vision - Features and challenges - Applications of 4G - Introduction and Roadmap To 5G: Historical trend and evolution of LTE technology to beyond 4G - 5G use cases and System Concepts - 5G Architecture - Small cells for 5G mobile networks - IoT: relation to 5G. **(9)**

TOTAL : 45

REFERENCES

1. *Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education,2014.*
2. *Vijay K Garg, "Wireless Communication and Networking", First Edition, Elsevier, 2011.*
3. *Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons, Ltd, 2015.*

20MCAE305 - AD HOC NETWORKS

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Describe unique issues in ad-hoc networks and MAC protocols and their classifications*

CO2 : *Discuss challenges in designing routing and transport protocols for ad-hoc networks*

CO3 : *Demonstrate familiarity with common wireless sensor node architecture and the organization of MAC protocols developed for WSN.*

CO4 : *Demonstrate knowledge of routing in WSN and to analyze and classify wireless mesh networks.*

CO5 : *Develop simple routing solutions for ad-hoc- WSN and mesh networks.*

AD-HOC MAC

Introduction - Issues in Ad-hoc Wireless Networks. MAC Protocols - Issues- Classifications of MAC protocols- Multi channel MAC & Power Control MAC Protocol. **(9)**

AD-HOC NETWORK ROUTING & TCP

Issues - Classifications of routing protocols-Hierarchical and Power aware. Multicast routing - Classifications: Tree based- Mesh based. Ad-hoc Transport Layer Issues. TCP over Ad-Hoc- Feedback based- TCP with explicit link- TCO-Bus- Ad-Hoc TCP- and Split TCP. **(9)**

WSN - MAC

Introduction - Sensor Network Architecture- Data dissemination- Gathering. MAC Protocols - Self -organizing- Hybrid TDMA/ FDMA and CSMA based MAC **(9)**

WSN ROUTING- LOCALIZATION & QOS

Issues in WSN routing - OLSR- AODV- Localization - Indoor and Sensor network Localization. QoS in WSN **(9)**

MESH NETWORKS

Necessity for Mesh Networks - MAC enhancements - IEEE 802.11s Architecture - Opportunistic routing - Self configuration and Auto configuration - Capacity Models - Fairness- Heterogeneous Mesh Network -Vehicular Mesh Networks. **(9)**

TOTAL : 45

REFERENCES

1. *C. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks : Architectures and Protocols", Pearson Education, 2008.*
2. *Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers, 2004.*
3. *C.K.Toh, "Ad Hoc Mobile Wireless Networks : Protocols and Systems", 2nd Edition, Pearson Education, 2002.*
4. *Thomas Krag and Sebastin Buettrich, "Wireless Mesh Networking", O'Reilly Publishers, 2007 .*
5. *Charles E.Perkins, "Ad Hoc Networking", Addison Wesley, 2000.*

20MCAE401 - ORGANIZATIONAL BEHAVIOR

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Given a case study, analyze the behavior of the individual.*

CO2 : *Given a case study, analyze the behavioral pattern of group interaction in organization*

CO3 : *Given a scenario in an organization assess the attitude and personality of the individuals in the organization.*

CO4 : *Given a business problem form groups and finds a solution to the problem.*

CO5 : *Given a problem in an organization, apply emotional intelligence and solve the problem.*

INTRODUCTION TO ORGANIZATIONAL BEHAVIOR

Concept- Nature- Characteristics- Conceptual Foundations and Importance- Models of Organizational Behavior- Management Challenge- A Paradigm Shift- Relationship with Other Fields- Organizational Behavior : Cognitive Framework- Behavioristic Framework and Social Cognitive Framework **(8)**

PERCEPTION AND ATTRIBUTION

Concept- Nature- Process- Importance. Management and Behavioural Applications of Perception. Attitude: Concept- Process and Importance- Attitude Measurement. Attitudes and Workforce Diversity. Personality: Concept- Nature- Types and Theories of Personality Shaping- Personality Attitude and Job Satisfaction.

Learning : Concept and Theories of Learning. **(10)**

MOTIVATION

Concepts and Their Application- Principles- Theories- Employee Recognition- Involvement- Motivating a Diverse Workforce. Leadership: Concept- Function- Style and Theories of Leadership-Trait- Behavioural and Situational Theories. Analysis of Interpersonal Relationship- Group Dynamics: Definition- Stages of Group Development- Group Cohesiveness- Formal and Informal Groups- Group Processes and Decision Making- Dysfunctional Groups. **(10)**

ORGANIZATIONAL POWER AND POLITICS

Concept- Sources of Power- Distinction Between Power- Authority and Influence- Approaches to Power- Political Implications of Power: Dysfunctional Uses of Power. Knowledge Management & Emotional Intelligence in Contemporary Business Organisation.

ORGANIZATIONAL CHANGE

Concept- Nature- Resistance to change- Managing resistance to change- Implementing Change- Kurt Lewin Theory of Change. **(8)**

CONFLICT

Concept- Sources- Types- Functionality and Dysfunctionality of Conflict- Classification of Conflict Intra- Individual- Interpersonal- Intergroup and Organizational- Resolution of Conflict- Meaning and Types of Grievance and Process of Grievance Handling. Stress: Understanding Stress and Its Consequences- Causes of Stress- Managing Stress. Organizational Culture: Concept- Characteristics- Elements of Culture- Implications of Organisation culture- Process of Organisational Culture. **(9)**

TOTAL : 45

REFERENCES

1. *Newstrom John W., "Organizational Behaviour: Human Behavour at Work", Tata Mc Graw Hill- 12th Edition, 2017.*
2. *Luthans Fred, "Organizational Behaviour", Tata McGraw Hill, 3rd Edition, 2019.*
3. *Judge and Stephen P.Robbins,"Organizational Behavior", Pearson, 13th Edition, 2020.*
4. *Ace simpson, stewart Clegg, "Positive Organizational Behaviour- A reflective approach", Taylor & Francis, 5th Edition, 2020.*

20MCAE402 - PRINCIPLES OF MANAGEMENT

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Describe the principles of management.*

CO2 : *Prepare a decision tree for a given statement.*

CO3 : *Given a business plan, specify the management functions (planning- organizing- controlling and evaluating)*

CO4 : *Construct the organizational chart for given company.*

CO5 : *Prepare a flow chart of the selection process of a given company.*

MANAGEMENT

Concept- Nature- Importance- Management : Art and Science- Management as a Profession- Management Vs. Administration- Management Skills- Levels of Management- Characteristics of Quality Managers. Evolution of Management: Early contributions- Taylor and Scientific Management- Fayol's Administrative Management- Bureaucracy- Hawthorne Experiments and Human Relations- Social System Approach- Decision Theory Approach. Business Ethics and Social Responsibility: Concept- Shift to Ethics- Tools of Ethics. **(9)**

INTRODUCTION TO FUNCTIONS OF MANAGEMENT

Planning :Nature- Scope- Objectives and Significance of Planning- Types of Planning- Process of Planning-Barriers to Effective Planning- Planning Premises and Forecasting- Key to Planning- Decision Making. Organizing: Concept- Organisation Theories- Forms of Organisational Structure- Combining Jobs: Departmentation- Span of Control- Delegation of Authority- Authority & Responsibility- Organisational Design. **(11)**

STAFFING

Concept- System Approach- Manpower Planning- Job Design- Recruitment & Selection- Performance Appraisal Directing: Concept- Direction and Supervision Motivation: Concept- Motivation and Performance- Theories Of Motivation- Approaches for Improving Motivation- Pay and Job Performance- Quality of WorkLife- Morale Building. **(9)**

LEADERSHIP

The Core of Leadership: Influence- Functions of Leaders- Leadership Style- Leadership Development **(2)**

Communication : Communication Process- Importance of Communication- Communication Channels-Barriers to Communication. Controlling: Concept- Types of Control- Methods: Pre-control: Concurrent Control: Post-control- An Integrated Control System- The Quality Concept Factors affecting Quality- Developing a Quality Control System- Total Quality Control- Pre-control of Inputs- Concurrent Control of Operations. Post Control of Outputs. Change and Development: Model for Managing Change- Forces for Change- Need for Change- Alternative Change Techniques- New Trends in Organisational Change. **(7)**

Training and Development : Need for training- advantages of training programme- Types of training programmes- Training methods- Selection of a training method- Evaluation of training and development- Training practices in India. **(7)**

TOTAL : 45

REFERENCES

1. *Robbins S.P., Coulter Mary & Niharika Vohra, "Management", 10th Edition, Pearson Education, 2019.*
2. *S.A. Sherlekar, "Ethics in Management", Himalayan Publishing Company, 2016.*
3. *H.R. Appannaiah, G Dinakar, H.A. Bhaskar, "Principles of Management", 6th Edition, Himalaya, 2019.*
4. *Dr. L.M. Prasad, "Principles and practise of management", 10th Edition sultan chand & sons, 2020.*

20MCAE403 - ACCOUNTING AND FINANCIAL MANAGEMENT

L	T	P	C
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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Prepare books of accounts and verify correctness using trial balance, for any business organization.*

CO2 : *Prepare statements of final accounts to ascertain the profit,forany trading or manufacturing organization.*

CO3 : *Perform cost estimation and determine the optimum cost/price/profit for a firm using Cost Sheet, CVP analysis and Marginal Costing Techniques.*

CO4 : *Prepare financial statements using ratio analysis, budgeting, working capital management, capital budgeting and budgetary control techniques and present facts to assist in strategic decision making, given a set of investment options for a business.*

CO5 : *Develop software solutions to automate a given accounting, costing or financial process, using MS-Excel.*

FINANCIAL ACCOUNTING

Introduction : Accounting Concepts, Principles and Conventions - basic accounting procedures - Journal and Ledger, Trial Balance. **(15)**

FINAL ACCOUNTS

Manufacturing and Trading Account - Profit and Loss Account - Balance Sheet. Final accounts with adjustments - Working with excel worksheets for automating Final Accounts. Depreciation. Type - Straight Line Method - Written-Down Value Method, Sinking Fund Method - Preparation of Depreciation Account **(15)**

COST ACCOUNTING

Methods and Techniques of Cost Accounting - Classification of Cost - Material Cost, Labour Cost, Overheads, Fixed and Variable Costs, Cost-Volume-Profit Analysis - Marginal Costing and Decision Making. **(9)**

FINANCIAL MANAGEMENT

Objective and scope of Financial Management - Analysis and Interpretation of Financial Management Ratio Analysis - financial system - Working Capital Management - Capital Investment Decision Through Pay-back Period Method - Average Rate of Return - Internal Rate of Return - Cost of Capital - Discounted Cash Flow Analysis by using Spread Sheet. **(12)**

BUDGETING AND BUDGETARY CONTROL

Types of budgets - Preparation of various functional budgets - Preparation of cash budget - Flexible budget - Advantages of Budgeting and budgetary control **(9)**

TOTAL : 60

REFERENCES

1. *M. C. Shukla, T. C. Grewal,S. C. Gupta , "Financial Accounting I", Sultan Chand & Sons, Paperback, 2019.*
2. *Maheshwari S.N., Dr Suneel K. Maheshwari, CA Sharad K. Maheshwari, "Principles of Management Accounting", Sultan Chand & Sons, 2021.*

3. *R L Gupta & V K Gupta, "Principles and Practice of Accountancy", S.Chand & Co.,Ltd., Paperback 2019.*
4. *Jain S.P. & Narang K.L., "Advanced Accountancy - Principles of Accountancy Vol 1", Kalyani Publishers, Paperback 2018.*
5. *Sashi K. Gupta & R.K Sharma, Neeti Gupta "Management Accounting", Kalyani Publishers, 2014.*
6. *Khan M.Y. and Jain P.K., "Financial Management", Tata McGraw Hill, Paperback 2017.*

20MCAE404 - E-COMMERCE

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Specify Infrastructural requirements & Business models for an e-commerce start up. (From the prespective of Indian Businesses)*

CO2 : *Analyze different types of e marketing and e advertising stategies and e-payment alternatives commonly used in the industry and summarize the relative merits in Indian socio economic scenario.*

CO3 : *Discuss trends in CRM- SCM and Knowledge Management using web technologies and point out the suitable adaptations for a medium scale e-commerce firm in India.*

CO4 : *Appraise the impact of different types of mobile and wireless technologies on success of e- commerce in India.*

CO5 : *Understand ERP and EDI technologies can transform the Indian Business environment into paperless, cashless, easy-to-manage and regulated, with the use of cloud and open source technologies.*

INTRODUCTION

History - Early Business Information Interchange Efforts - Emergence of internet- WWW. E-Commerce - Advantages- Disadvantages - BAM Models - Transition to E-Commerce in India- E-Transmission Challenges- The Information Technology Act 2000 - Business Models - Enabling Technologies of WWW. Social Networks- Auctions- Portals: Social networks and online communities Online auctions - E-commerce portals. **(7)**

ELECTRONIC MARKETING- SECURITY AND PAYMENT

Traditional Marketing - Web Presence Goal - Browsing Behavior Model - Online Marketing- E-Advertising- Trends- E-branding- Strategies. E- Security - Internet Security- E-business Risk Management Issues- Information Security Environment in India. E-Payment - Concerns in Internet Banking- Digital Payment Requirements- Token Based E-Payment Classification- E-Cash- Cheque Payment- Risk and E-Payment. **(8)**

CRM- SCM & SKM

E-CRM Solutions - Business Touch Points - Case Studies. Supply Chain - The new way- e-logistics- Fulfilling Customer's Needs- Smart Chains Smarter Gains. Real Time Benefits and Strategies - Advantages. Knowledge as Key Business Asset- Changes in - Global Business Economy- Technology. Knowledge - Definition- Management - Knowledge Management- Data Warehousing and Data Mining. Virtual value chain - 7 Dimensions - E-Commerce Strategy - planning E-Commerce Project. **(10)**

MOBILE COMMERCE AND TECHNOLOGIES

E-Business Portals. What? - Issues - Wireless- Cellular- Wireless Spectrum. - Success Stories. Technologies - mobile commerce- WAP Wireless Generations. Portals - Different Types- benefits- features. Requirements for Intell. **(10)**

ERP & EDI

Introduction -ERP and E2RP - Business Problems- New Paradigm- Drivers - Business processes and supporting processes. Architecture- Implementation- ERP Processes. ERP - Cloud and Open Sources.EDI - Concepts and Technology. **(10)**

TOTAL : 45

REFERENCES

1. *P.T. Joseph S.J, "E-Commerce - An Indian Perspective", PHI Learning Private Limited, 4th Edition, 2012.*
2. *Kenneth C. Laudon, "E-Commerce : Business - Technology - Society", 4th Edition, Pearson, 2012.*
3. *Sandeep Desai, Abhishek Srivastava, "ERP to E2RP - A Case Study Approach", Eastern Economy Edition, PHI Learning Pvt. Ltd., 2013.*
4. *Kamalesh K. Bajaj, Debjani Nag, "E-Commerce - The Cutting Edge of Business", McGraw Hill Education (India) Private Limited, 2nd Edition, 2005.*
5. *Ravi Kalakota- Marcia Robinson, "E - Business 2.0 - Roadmap for Success", Addison Wesley Professional, 2001.*

20MCAE405 - DECISION MAKING

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PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Critically discuss different theories and theoretical perspectives in leadership - negotiation and decision making.*

CO2 : *Evaluate models to describe how leaders are perceived (leadership style)-analyse a leader's decision-making and role in negotiations.*

CO3 : *Analyse how decision-making and strategies in negotiations affect a leader's perception*

CO4 : *Use decision making tools to quantitatively analyse its impacts in a given situation*

CO5 : *Apply programmed and non-programmed decisions to effectively manage uncertainty*

INTRODUCTION TO DECISION MAKING

Basic concepts of decision making - The art of decision management- Fundamentals of Decision Making - The strategy pyramid. The DM portfolio- drivers of poor decision management- The ten cardinal decision issues and reviews- rationalistic versus evolutionary strategic decision making- Players in a decision- Representation of decision problem. **(9)**

STRATEGIC DECISION ANALYSIS

Introduction to strategic decision analysis - The decision analysis cycle- Sensitivity analysis- Expert and stakeholder opinions- Risk analysis- Public perception and risk communication- Deliberative democracy and public participation- Good heuristics for decision analysis- Negotiation and bargaining. **(9)**

RATIONAL DECISION MAKING

The Importance and Limitations of Rational Decision Making: Limited or "bounded" rationality. The Decision Process- Quantitative and qualitative factors- marginal analysis- cost effective analysis. **(9)**

DECISION ANALYSIS & UNCERTAINITY

Modelling Uncertainity- utility model- risk attitude- Subjective Expected Utility (SEU) modelling- Decision Tress and Influence diagrams. Programmed and Non-Programmed Decisions- the Uncertainty Problem: deal with unknowns. The Madness and wisdom of crowds. **(9)**

INFORMATION AND COMMUNICATION

Negotiation-Information to support decisions-Framing and Communicating Decisions. **(9)**

TOTAL : 45

REFERENCES

1. *French- Simon. Maule- John. & Papamichail- Nadia, "Decision Behaviour- Analysis and Support", New Delhi: Cambridge University Press, 2010.*
2. *James M. Kouzes, Barry Z.Posner, John Wiley & Sons "The Leadership challenge, How to make Extraordinary things happen in organizations", 2016.*
3. *J.Edward Russo and Paul J.H. Shoemaker "Winning decisions : getting it right the first time", Special markets, Currency books, 1st Edition, 2002.*
4. *Mark Koscinski, "Decision Making Essentials", 2nd Edition, Vibrant Publishers, 2020*
5. *Pankaj Garg, "Mastering the Art of Decision Making", 4th Edition, Notion Press, 2020*

20MCAE406 - ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Highlight the characteristics of a successful entrepreneur.*

CO2 : *Understand the role of entrepreneurship in the economic development of a country.*

CO3 : *Formulate the business plans for an efficient and successful \ business.*

CO4 : *Justify the need for developing rural entrepreneurship and agripreneurship in India.*

CO5 : *State the economic factors influencing the emergence and development in country.*

ENTERPRENEURSIP

Entrepreneur - Types of Entrepreneurs - Difference between Entrepreneur and Intrapreneur - Entrepreneurship in Economic Growth- Factors Affecting Entrepreneurial Growth. **(9)**

MOTIVATION

Major Motives Influencing an Entrepreneur - Achievement Motivation Training- Self Rating - Business Games- Thematic Apperception Test - Stress Management - Entrepreneurship Development Programs - Need - Objectives. Rural entrepreneurship and agri-preneurship development **(9)**

BUSINESS

Small Enterprises - Definition- Classification - Characteristics- Ownership Structures - Project Formulation - Steps involved in setting up a Business - identifying- selecting a Good Business opportunity- Market Survey and Research- Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies. **(9)**

FINANCING AND ACCOUNTING

Need - Sources of Finance- Term Loans- Capital Structure- Financial Institution- Management of working Capital- Costing- Break Even Analysis- Taxation - Income Tax- Excise Duty - Sales Tax. **(9)**

SUPPORT TO ENTREPRENEURS

Sickness in small business - Concept- Magnitude- Causes and Consequences- Corrective Measures - Business Incubators - Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion- Diversification- Joint Venture- Merger and Sub Contracting. **(9)**

TOTAL : 45

REFERENCES

1. *Khanka. S.S., "Entrepreneurial Development", S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.*
2. *Donald F Kuratko, "Entrepreneurship Theory Process and Practice", Cengage Learning, 9th Edition, 2014.*
3. *Hisrich R D, Peters M P, "Entrepreneurship", Tata McGraw-Hill, 8th Edition, 2013.*
4. *Poornima M Charantimath "Entrepreneurship Development And Small Business Enterprise", Pearson Publication, Paper Back, 2006.*

20MCAE407 - PRINCIPLES OF ENVIRONMENTAL SCIENCE

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Predict the values of biodiversity for the development*

CO2 : *Design the methods for the prevention of environmental pollution and solid waste management.*

CO3 : *Ilustrate the use of alternate energy resources for growing energy needs*

CO4 : *Classify the environmental segments, the causes for its deterioration, he measure taken for its prevention and the need for sustainable development.*

CO5 : *Identify the threats to environment, social issues related to it, the necessity for environmental legislation, sustainable development and the applications of bio technology and green chemistry for environmental protection.*

ENVIRONMENTAL CHEMISTRY

Chemistry and the Environment - Environmental segments - Composition and Characteristics of Atmosphere, Hydrosphere, Lithosphere, and Biosphere: Chemical species and particulates present in the environment - reactions occur in the atmosphere. Photochemical smog. Impact of man on the environment. Impact of Environment upon humans. **(9)**

ECOSYSTEMS AND BIODIVERSITY

Concepts of an ecosystem : types, structure and functions of the ecosystem. Food chains, food webs and ecological pyramids. Biodiversity: Definition - Genetic, species, ecosystem and landscape diversities - India as a mega diversity nation - Hot spots of biodiversity. Importance of biodiversity - loss of biodiversity - causes of reduction in biodiversity. Conservation of biodiversity - restoration of biodiversity. **(9)**

ENVIRONMENTAL POLLUTION

Sources, causes, effects and management of Air, Water, Soil, Marine, Noise and Radioactive pollution. Sources of Solid, Hazardous, Biomedical and Chemical wastes. Solid Waste Disposal and treatment **(9)**

ENERGY AND ENVIRONMENT

Energy resources - Growing energy needs - renewable and non-renewable energy sources - use of alternate energy sources - Solar, Wind, Tidal, Geothermal and OTEC - (Principles only) merits and limitations. **(3)**

SOCIAL ISSUES AND THE ENVIRONMENT

Sustainable development - Urban Population - problems related to energy - Water Conservation. Rainwater harvesting - Environment Ethics - Green house effect, Global warming, climate change, Nuclear hazards and accidents. Issues involved in enforcement of environment legislation - precautionary principle - polluter pays principle - the Beneficiary pays principle - role of an Individual in Environment protection - Environment (Protection) Act - Air (Prevention and Control of Pollution) Act. Water (Prevention andControl of Pollution) Act. Wildlife Protection Act and Forest (Conservation)Act. **(9)**

BIOTECHNOLOGY AND GREEN CHEMISTRY

Biotechnology and its applications in environmental protection - Bioinformatics - Bioremediation. Biological purification of contaminated air. Green chemistry for clean technology: Significance of green chemistry - Basic components of Green chemistry. Industrial applications of green chemistry. Green fuels - e-green Propellants and Biocatalysts. **(6)**

TOTAL : 45

REFERENCES

1. *Dara, S.S. "A Text Book of Environmental Chemistry and Pollution Control", S. Chand and Company Ltd, 8th Revised Edition, 2008.*
2. *Kaushik, A. and Kaushik, C.P. "Environmental Science and Engineering", 2nd Edition, New Age International (P) Limited Publishers, 2006.*
3. *Dr. Raghavan Nambiar, K. "Text Book of Environmental Studies", Scitech Publications (India) Pvt. Ltd, Chennai, 2007.*
4. *Benny Joseph, "Environmental Studies", Tata McGraw Hill Publishing Company Ltd, 2008.*
5. *Surinder Deswal and Anupama Deswal, "A Basic course in Environmental Studies" Dhanpat Rai and Co. (P) Ltd, 2006.*

20MCAEL01 - MOBILE APPLICATION DEVELOPMENT LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Use the components of Android development environment for mobile application development*

CO2 *: Design GUI forms using layouts,views, event handling, notifications and content providers in Android studio.*

CO3 *: Implement database applications using SQLite and perform CRUD operations*

CO4 *: Develop mobile applications that make use of camera and media player in Android.*

CO5 *: Use location based services, network services and graphics to develop innovative mobile apps.*

CONCEPTS TO BE COVERED

1. Android Development Environment
   Download and Install SDK and ADT
   Working of Eclipse and Android Emulator
2. Generic UI development
   Views and View groups
   Event Handling and Listeners
   Layouts and spinner
3. Storing and Retrieving Data
   Android storing and retrieving data using SQL file
   Working with content provider
4. Notification and Alarms
   Action Bars-Menus-Dialogs
   Notifications and Toast
5. Camera and Media player
   Camera Application
   Media player and media recorder
6. Location Based Services
   Finding locations and Tracking Movement
   Map based activity and Proximity alerts
7. Communication via Network and Web
   SMS and MMS
   Bluetooth and WI-FI
8. Graphics and Animation
   Different shapes of different colours
   Moving from one direction to another
   Tweened animation

20MCAEL02 - GRAPHICS AND MULTIMEDIA LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Design graphical primitives using algorithms*

CO2 *: Develop 2D Transformations.*

CO3 *: Design interactive graphics applications.*

CO4 *: Design objects and layers for scene in animation.*

CO5 *: Develop animated application software.*

CONCEPTS TO BE COVERED COMPUTER GRAPHICS

1. Primitive Algorithms
   Line - Bresenham- DDA- Midpoint. Circle - Midpoint- Trigonometric Ellipse - Midpoint- Trigonometric
2. Polygon- Polygon Filling.
3. Transformations - 2D Translations- Scaling- Rotation

MULTIMEDIA AND ANIMATIONS

1. Flash Programming (OR) Maya
2. Creating Layers- Symbol objects- effects for objects
3. Creating scene by combining objects and layers
4. Creating Animations using various technologies
5. Creating Interactive Animation.
6. Adding audio to animations.
7. Creating small animation projects.

20MCAEL03 - INTERNET OF THINGS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Choose the required sensor and perform calibration, for a given requirement.*

CO2 *: Devise interface circuit for connecting a chosen sensor to Galileo board.*

CO3 *: Develop software for Galileo board to interact with the sensor to meet requirements.*

CO4 *: Develop software to interact(send/receive data) with Web/Application server located in the Internet.*

CO5 *: Use data analytics tool to analyze the data collected and present the report to the end user.*

CONCEPTS TO BE COVERED

1. Programs for exploring the features of Contiki such as protothreds- timers- networking primitives by using Cooja simulator.
2. Developing applications using Galileo board- exploiting all features of the board.
3. Application on wireless sensor networks
4. NesC Programming language
5. WSNs Projects of the SENSES Lab
6. A simple application blink

20MCAEL04 - DATA ANALYTICS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Understand the basics in R programming in terms of constructs, control statements, string functions.*

CO2 *: Able to perform different exploratory analysis for the real time dataset.*

CO3 *: Identify and apply appropriate regression models for the given dataset.*

CO4 *: Apply text analysis methods to analyze unstructured data.*

CO5 *: Represent the analysis results using different visualization methods such as charts, tables etc.*

CONCEPTS / TOOLS TO BE COVERED

1. Basic constructs of R Programming
2. Descriptive and Exploratory Analysis
3. Data Visualization - Histogram, Bar Charts, Text Tables, Line Charts, Scatter Plots, Gantt Bar, Charts, Pie Charts, Box Plots, Packed Bubble Charts.
4. Linear Regression
5. Multiple Linear Regression
6. Logistic Regression
7. Program involving Regular Expressions
8. Text Pre-processing with TF-IDF
9. Forecasting time series using ARIMA model.
10. Sentiment Analysis of Social Media Data
11. Customer Churn Detection

20MCAEL05 - DATA MINING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Learn to use open source data mining tools such as Weka and/Rapidminer and build data mining applications using these tools.*

CO2 : *Select appropriate data pre-processing techniques to be applied on standard datasets various domains such as healthcare, finance, insurance etc and prepare the data for the mining process based on the analysis goal.*

CO3 : *Apply association rule mining techniques to derive useful and new pattern information from the given datasets.*

CO4 : *Apply classification algorithms to classify a given dataset and derive useful and new insights from the dataset.*

CO5 : *Represent the analysis results using different visualization methods such as charts, graphs etc.*

CONCEPTS / TOOLS USED

1. Apply pre-processing techniques on datasets downloaded from Internet under different domains.
2. Apply core data mining techniques on different datasets like Iris, Cancer, Accidents etc.
   a) Association Rule mining algorithms such as Apriori, FP Tree and other algorithms.
      Compare the results.
   b) Classification algorithms - Decision Tree
   c) Clustering algorithms - K-Means, K-Medoids
3. Application of text mining algorithms.
4. Use different data visualization techniques to display the mined results and derive inference from them. Shiny tool can be used apart from the usual data mining tools.

20MCAEL06 - GPU AND PARALLEL PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : LABORATORY

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Learn the basics of CUDA programming.*

CO2 *: Implement data transfer from host to device and vice-versa.*

CO3 *: Develop CUDA code to perform operations on large arrays.*

CO4 *: Implement the concepts of shared memory both static and dynamic*

CO5 *: Develop parallel programming solutions for small real world applications using CUDA/GPU*

CONCEPTS TO BE COVERED

1. Querying device properties
2. Handling CUDA errors
3. Host-Device Synchronization: Copying data between host and device
4. Measuring data transfer times
5. Simple expression evaluation for kernel launch
6. Vector addition
7. Reversing arrays using shared memory Static and Dynamic
8. Matrix Operations
9. Any real time application development like image processing, machine learning etc.

   Recommended Software: CUDA C/C++ or CUDA Python

REFERENCE

1. https://developer.nvidia.com/blog/even-easier-introduction-cuda/

20MCAEL07 - IMAGE PROCESSING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Implement the mathematical transforms necessary for image processing.*

CO2 *: Apply various enhancement and segmentation techniques.*

CO3 *: Apply image restoration process on different noises using filters.*

CO4 *: Execute various transforms and filtering on any digital image.*

CO5 *: Solve real life problems using image processing.*

CONCEPTS TO BE COVERED

1. Display of Grayscale Images.
2. Histogram Equalization.
3. Filtering in frequency domain.
4. Display of color images.
5. Conversion between color spaces.
6. Non-linear Filtering.
7. Edge detection using Operators.
8. DFT of images.
9. DWT of images.
10. Apply any segmentation technique on a digital image.

20MCAEL08 - WEB FRAMEWORKS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Build a robust framework to support daily development needs*

CO2 *: Create dynamic web sites and web applications*

CO3 *: Create data models using MongoDB and ExpressDB*

CO4 *: Build components and bind data to it*

CO5 *: Develop single page applications with the front end facilities in the stack*

CONCEPTS / TOOLS TO BE COVERED

1. Installing and setting up the framework, environment
2. Server side Node.js. and Express

   Add a model with Test for the model,

   Add properties,

   Add Controller,

   Add Route,

   Add Categories,

   Add Functionality

   Add Authentication.
3. MongoDB - Working with basic Shell Commands,List the database, collections and category collections. Create category, Create Category with different schema Update and delete Category
4. AngularJS Creating the first module,Creating Angular UI Bootstrap,Working with Angular Directives, Add functionality for controller, route and View. Unit Testing and end to end testing in AngularJS

20MCAEL09 - NATURAL LANGUAGE PROCESSING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Apply basic algorithms in the area of Natural Language Processing.*

CO2 *: Perform morphological analysis on text.*

CO3 *: Apply techniques for syntactic analysis.*

CO4 *: Use algorithms at semantics level and resources of natural language data-corpora.*

CO5 *: Apply techniques for information extraction.*

CONCEPTS TO BE COVERED

Topics will include (but are not restricted to) machine translation, sequence tagging, constituent and dependency parsing, information extraction, semantics.

1. Language Models
2. Machine Translation
3. Morphological and Syntactical analysis
4. Text Classification
5. Sequence Tagging
6. Constituency Parsing
7. Dependency Parsing
8. Information Extraction
9. Machine Comprehension
10. Text Summarization

20MCAEL10 - SOCIAL NETWORK ANALYSIS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Input data, represent social networks as a graph and apply visualization techniques.*

CO2 *: Visualize network datasets.*

CO3 *: Perform different network measurements.*

CO4 *: Build and implement social network designs.*

CO5 *: Apply social network theory to social network datasets.*

CONCEPTS TO BE COVERED

1. Data Management
2. Network Visualization
3. Cohesion, centralization and core-periphery
4. Node-level measurements
5. Statistical measurements, multivariate
6. Creating sub-groups
7. Ego-networks
8. Personal networks
9. Triad analysis, roles and equivalence
10. Testing hypotheses

20MCAEL11 - NETWORK PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 : *Understand the key protocols that support the communication.*

CO2 : *Develop and implement connection-oriented and connection-less communication using Socket API*

CO3 : *Develop and implement concurrent and iterative servers and analyze their functionality*

CO4 : *Apply advanced programming techniques such as Broadcasting, Multicasting and networking between client and server.*

CO5 : *Develop and implement simple network applications using NS-2 for a given set of requirements and demonstrate its working.*

CONCEPTS TO BE COVERED

1. Basic Network commands
2. Connection oriented one-way communication
3. Connection oriented two-way communication
4. Connection less one-way communication
5. Connection less two-way communication
6. Iterative and Concurrent Server Implementation
7. Broadcasting using UDP
8. Develop a mail client
9. Develop a DHCP client/server communication
10. Develop a DNS client/server communication
11. Multicast Communication using UDP
12. Applications using TCP/IP Protocols
13. Simulation of TCP and UDP communication using NS-2
14. Networking between different machines.

20MCAEL12 - DIGITAL MARKETING LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

Upon completion of the course students will be able to

CO1 *: Generate market context with practical needs of digital marketing.*

CO2 *: Develop conversational interfaces with customers using connection oriented/connectionless services.*

CO3 *: Analyse a web site and its traffic using tools*

CO4 *: Understand the methods of optimizing the website for search engines.*

CO5 *: Know the improved latest technologies for efficient marketing*

CONCEPTS TO BE COVERED

1. Customer, Content and Conversation Management
2. Improve visits for a web site
    a. Meta element keywords (Search Engine Optimization)
    b. Push advertisement
    c. Email marketing
3. Analysing a web site using tools
4. Page ranking methods
5. Develop android app
6. Chat bot facilities / Voice Automation Facilities

20MCAB11- BASICS OF DATA STRUCTURES

L	T	P	C
1	0	0	0

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

BASIC CONCEPTS

System Life Cycle - Algorithm Specification - Data Abstraction - Primitive Data Structures - Iterative and Recursive algorithms - Performance Analysis - best case - worst case - average case complexities - Notations. **(3)**

ARRAYS

Array as an Abstract Data Type (ADT) - Polynomial ADT - Sparse Matrix ADT - Representation of Multidimensional Arrays - String ADT. **(3)**

STACKS AND QUEUES

Stack ADT - Queue ADT - Mazing Problem - Evaluation of Expressions - Multiple Stacks and Queues. **(3)**

LINKED LISTS

Pointers - Singly Linked Lists - Dynamically Linked Stacks and Queues. **(3)**

SEARCHING AND SORTING

Searching and List Verification - Insertion Sort - Quick Sort. **(3)**

TOTAL : 15

REFERENCES

1. *Ellis Horowitz, Sartaj Sahni, Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press, 2nd Edition, 2008.*
2. *Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures, A Pseudocode Approach with C", Cengage Learning, 2nd Edition, 2007 .*
3. *Yashavant P. Kanetkar, "Data Structures through C", BPB Publications, 2nd Edition, 2003.*
4. *Seymour Lipschutz, "Data Structures with C", Schaum's Outline Series, McGraw Hill Publications, 2nd Edition, 2014.*

20MCAB12 - PROGRAMMING IN C

L	T	P	C
1	0	0	0

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

ARRAYS AND POINTERS

Array manipulation: single, two and multi dimensional arrays. declaration, assignment and accessing using index values. Algorithms using arrays. Matrix operations, sort, search and applications using arrays. Pointers - Declaration. Accessing pointers. Pointers and Arrays. **(4)**

RECURSIVE FUNCTIONS

Recursive Function basic need for it. Declaration, Definition and Calling. Parameter passing - Local variables in recursive functions - Applications of recursive functions - Real time applications **(3)**

STRUCTURES, UNION AND ENUMERATION

Structure definition, declaration and using structures in programs. Pointers and structures. Structured arrays - creation and manipulation. Linked structures - Creation and manipulation. Applications of Linked Structures. Enumerations. **(4)**

FILE AND ERROR HANDLING

File concept - File opening in various modes and closing of a file - Reading from a file - Writing onto a file. Preprocessor: Conditional Compilation directives - Macros - Command Line Arguments. **(4)**

TOTAL : 15

REFERENCES

1. *Herbert Schildt, "C - The Complete Reference, McGraw Hill", 4h Edition, 2017.*
2. *R.G. Dromey, "How to solve it by Computer", Pearson Education, 5th Edition, 2007.*
3. *Kernighan B.W. and Ritchie D.M., "C Programming Language (ANSI C)", Paperback-1, Pearson Education, 2015.*
4. *Yashawant Kanetkar, "Let us C", BPB, 16th Edition, 2018.*
5. *Terrence W Pratt, "Programming language: Design and Implementation", Prentice Hall of India, 4th Edition, 2001.*

20MCAB13 - COMPUTER HARDWARE AND ORGANIZATION

L	T	P	C
1	0	0	0

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

BASIC STRUCTURE OF COMPUTERS

Computer Types, Functional unit, Basic OPERATIONAL concepts, Bus structures, Software, Performance, multiprocessors and multi computers. Data Representation. Fixed Point Control memory, Address sequencing, microprogram example and control, Basic concepts semiconductor RAM memories. Read-only memory Computer Fundamentals. **(3)**

COMPUTER HARDWARE

History and Generations of Computer, Description of Different parts of a Computer and System Software and Application Software, Learn and apply basic safety procedures, Assemble a personal computer in accordance with configuration, Performing installation of operating system and other application, Usage of relevant tools and diagnostic techniques Configure Internet and Email, Perform routine, The software and Hardware parts, Preliminary information of hardware components. **(3)**

PREVENTIVE MAINTENANCE

Perform repairs to personal computers, The different types of Operating Systems and its importance, Complete information computer configuration activities, How to assemble the computer according customer requirements in a real environment, How to install computer Software, devices drivers as well as configuration of peripheral devices, How to install and configure networking devices setting and applications, How to configure internet and email configuration according to the requirements, How to diagnose, repair and maintain the computer according to the standards. Identifying, using, and connecting hardware components and devices. **(3)**

INPUT-OUTPUT ORGANIZATION

Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access, Input -Output Processor (IOP) Serial communication; Introduction to peripheral component, Interconnect (PCI) bus. Introduction to standard serial communication protocols like RS232, USB, IEEE1394. **(3)**

PIPELINE, VECTOR & MULTI PROCESSORS

Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors, Characteristics or Multiprocessors, Interconnection Structures, Interprocessor Arbitration. InterProcessor Communication and Synchronization Cache Coherance. Shared Memory Multiprocessors. **(3)**

TOTAL : 15

REFERENCES

1. *Carl Hamacher, Zvonks Vranesic, SafeaZaky, "Computer Organization", Vth Edition, McGraw Hill. 2016.*
2. *M.Moris Mano, "Computer Systems Architecture" IIIrd Edition, Pearson/PHI 2017.*
3. *Morris Rosenthal "The Laptop Repair Workbook: An Introduction to Troubleshooting and Repairing Laptop Computers", 2nd Edition, PHI, 2016.*
4. *Jyotika Deshmukh, "A text book of Computer Hardware and Networking", Prentice Hall, 4th Edition, 2019.*
5. *Richand M. Roberts "Computer Service & Repair, 4th Edition, PHI, 2019.*

20MCAB21 - BASICS OF INTERNET

L	T	P	C
1	0	0	0

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

INTRODUCTION

Internet Today - The WWW - History - Resources - Architecture - Client / Server Technology - Accessing the Web: Browsers, its features, extension, plugins, Services by google to the web. **(2)**

INTERNET AND RESOURCES

The network technology - Network Addresses - Protocols - URL - format - accessing the web. Resources: The Web pages, applications, database and attachments. MIME types. Applications:- Intermediaries - agents - monitors - resource identifiers - Data Exchange by commercial applications. **(2)**

TECHNOLOGIES

Static & Dynamic Page Development: HTML, DHTML, CSS, XML, - Versions and Standards - Scripting languages - Java Script - accessing the tags and web content using java script. Script Event Programming. Web Server - Accessing the Server - HTTP methods - Requests/Response. Server Page Development: JSP. Servlet Technologies. **(4)**

WEB BACKEND

Web database: XML, Structure - tags, attributes. XSD - Resource standards. Exchange data using XSD format. XSD and SOAP technologies. Connecting to databases on both client and Server Side. **(4)**

INTERNET SECURITY

Fire Wall - Setting up the firewall security, Data exchange security: Encryption/ Decryption standards. Threats and VIRUS. How to Save? Security Methods. **(3)**

TOTAL : 15

REFERENCES

1. *Harvey Deitel, Abbey Deitel, "Internet and World Wide Web How To Program", Fifth Edition, Pearson, 2012.*
2. *John R. Vacca, "Cyber Security and IT Infrastructure Protection", Paperback, Elsevier Science, 2013.*

20MCAB22 - SOFTWARE PROJECT MANAGEMENT

L	T	P	C
1	0	0	0

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

Introduction to Software Project Management : Introduction Software Project Management Importance, Project definition, Software Projects versus Other Types of Project, Contract Management and Technical Project Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some Ways of Categorizing Software Projects, Project Charter, Stakeholders, Setting Objectives, Project Management Life Cycle, Traditional versus Modern Project Management Practices. **(3)**

Project Evaluation and Programme Management : Introduction, Business Case, Project Portfolio Management, Evaluation of Individual Projects, Risk Evaluation, Programme Management, Managing the Allocation of Resources within Programmes, Strategic Programme Management, Creating a Programme Management. **(3)**

Project Planning Selection and managing resource : Introduction to Step Wise Project Planning, Software Processes and Process Models, The Waterfall Model, Software Prototyping, Managing People in Software Environments: Introduction, Selecting the Right Person for the Job, Working in Teams: Introduction, Becoming a Team, Decision Making, Organization and Team Structures, Coordination Dependencies, Dispersed and Virtual Teams, Communication Genres, Communication Plans, Leadership. **(3)**

Software Effort Estimation and Risk Management : Introduction, Estimates methodology, The Basis for Software Estimating, Software Effort Estimation Techniques, Bottom- up Estimating, The Top-down Approach and Parametric Models, Cost Estimation, Staffing Pattern, Introduction, Risk, Categories of Risk, Risk Management Approaches, A Framework for Dealing with Risk, Risk Identification, Risk Assessment, Risk Planning. **(3)**

Software Quality management and Project Closeout : Introduction, The Place of Software Quality in Project Planning, Importance of Software Quality, Defining Software Quality, Software Quality Models, ISO 9126, Product and Process Metrics, Product versus Process Quality Management, Quality Management Systems, Process Capability Models, Techniques to Help Enhance Software Quality, Testing, Software Reliability, Quality Plans.Introduction, Reasons for Project Closure, Project Closure Process, Performing a Financial Closure, Project Closeout Report. **(3)**

TOTAL : 15

REFERENCES

1) *Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 6th Edition, Tata Mcgraw Hill, 2017.*
2) *Shailesh Mehta "SPD Project Management and Tools & Technologies - An overview", PHI, 1st Edition, 2016.*
3) *Walker Royce, "Software Project Management", 1st Edition, Addison Wesley/Pearson, 2015.*
4) *Rober K.Wysocki, "Effective Software Project Management", 2nd Edition, Wiley Publication, 2016.*
5) *Gopalaswamy Ramesh, "Managing Global Software Projects", 3rd Edition, McGraw Hill Education (India), 2019.*

20MCAB23 - OBJECT ORIENTED PRINCIPLES AND PROGRAMMING IN C++

L	T	P	C
1	0	0	0

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

INTRODUCTION

Object Oriented Principles - Key concepts of object oriented programming - Object identification- Software Complexity - The Object model - Classes and Objects - Classification. **(1)**

BASIC FACILITIES IN C++

Overview of C++ - Types and Declarations - Arrays, Pointers, Structures, References and Functions - Function Overloading - Name spaces - Source Files and Programs. **(2)**

ABSTRACT DATA TYPE IN C++

Class - Class members and Access control - Constructors- Static members - Default copy constructor - this pointer - Inline function definition - Concrete classes - Destructors - new and delete. **(3)**

OPERATOR OVERLOADING

Operator Functions - Binary and Unary Operators - Member and Non Member Operators - Friend Functions - Function call - Increment and Decrement - A String class. **(3)**

INHERITANCE

Derived Classes - Class Hierarchies - Virtual Functions - Abstract classes. **(3)**

EXCEPTION HANDLING AND LIBRARY CLASSES

Grouping of exceptions - Catching exceptions - Exceptions that are not errors - Uncaught Exceptions - Standard exceptions - The standard library - I/O streams - File streams. **(3)**

TOTAL : 15

REFERENCES

1. *Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison Wesley, 2013.*
2. *Herbert Schildt, "The Complete Reference C++", 6th Edition, Tata McGraw Hill, 2013.*
3. *Stanley B Lippman, Jove Lajoie, and Barbara Moo, "C++ Primer", 5th Edition, Addison Wesley, 2012.*

COIMBATORE INSTITUTE OF TECHNOLOGY

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

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

DEPARTMENT OF COMPUTER APPLICATIONS

MASTER OF COMPUTER APPLICATIONS

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2020 - 2021 and onwards)

INDEX

S.No	Contents	Page No.
1.	Vision and Mission of the Institute	1
2.	Vision and Mission of the Department of Computer Applications	2
3.	Programme Educational Objectives (PEOs)	3
4.	Programme Outcomes (POs)	4
5.	Subjects of Study	5
6.	Syllabus for Semester - I	9
7.	Syllabus for Semester - II	20
8	Syllabus for Semester - III	32
9.	Syllabus for Semester - IV	38
10.	Electives	41
11.	Bridge Course Syllabus for Non - Computer Science Students	104

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. To make the students more active in using basic engineering and technology of the course by deep teaching learning method
2. To train the students to create new product development procedures by agile based learning and master the operation of systems engineering
3. To inculcate the ethics on realizing the importance of engineering, technology development and research on society and their future

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the ERTS programme will be able to fulfil all of the following Programme Educational Objectives for the curriculum :

1. The engineers of Embedded and Real Time Systems possess technical and professional knowledge to design and develop systems.
2. The engineers acquire skills to provide optimal solutions for the challenges in the industry.
3. The graduates practice high ethical and technical standards and contribute for the advancement of society through scientific research.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAM OUTCOMES (POs) AND PROGRAM SPECIFIC OUTCOMES

POs	PO Statements
PO1	An ability to independently carry out research / investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document
PO3	An ability to design system solutions meeting the techno commercial and socio - economic needs

PSOs	PSO Statements
PSO1	An ability to select appropriate techniques to modernize the existing infrastructure in line with the industry standards
PSO2	An ability to apply concepts in Engineering analysis and design

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Curriculum from the Academic Year 2019 - 2020 onwards

Under Choice Based Credit System

Specialization : Embedded And Real Time Systems

Semester I

Course Code	Course Name	L	T	P	C	Category
19MA11	Linear Algebra and Stochastic Processes	4	0	0	4	FC
19MER11	Real Time Operating Systems	3	1	0	4	PC
19MER12	Embedded Processors	3	0	0	3	PC
19MER13	Wireless Communication Sensors	3	0	0	3	PC
19MA14	Electromagnetic Interference and Compatibility	3	0	0	3	PC
	ELECTIVE I	3	0	0	3	PE
19MER14	Embedded Processors Laboratory	0	0	4	2	PC
	Total				**22**	

Semester II

Course Code	Course Name	L	T	P	C	Category
19MA21	Automation and Industrial Internet of Things	3	0	0	3	PC
19MA22	Robotics Technology and Intelligence	3	0	0	3	PC
19MER21	Embedded System Design using FPGA	3	0	0	3	PC
	ELECTIVE II	3	0	0	3	PE
	ELECTIVE III	3	0	0	3	PE
	ELECTIVE IV	3	0	0	3	PE
19MER22	FPGA based Embedded System Design Laboratory	0	0	4	2	PC
19MAEE01	Feasibility Report Preparation	0	0	4	2	EEC 1
	One Credit Course				1	OCC1
	TOTAL				**23**	

Semester III

Course Code	Course Name	L	T	P	C	Category
	ELECTIVE V	3	0	0	3	PE
	ELECTIVE VI	3	0	0	3	PE
	OPEN ELECTIVE I	3	0	0	3	OE
	One Credit Course				1	OCC 2
	TOTAL				**10**	

Semester IV

Course Code	Course Name	L	T	P	C	Category
19MER41	PROJECT - DISSERTATION	0	0	36	18	EEC2
	TOTAL				**18**	

TOTAL CREDITS: 73

(**Note :** FC - Foundation Course; PC - Professional Core; PE - Professional Elective; OC - Open Elective; EEC - Employability Enhancement Course; OCC - One Credit Course)

LIST OF PROFESSIONAL ELECTIVES

Course Code	Course Name	L	T	P	C	Category
	EMBEDDED CONTROL OF INDUSTRIAL SYSTEMS					
19MERE01	Intelligent Controllers for Power Quality Enhancement	3	0	0	3	PE
19MERE02	Embedded Control of Industrial Drives	3	0	0	3	PE
19MERE03	Design of Green Transportation System	3	0	0	3	PE
19MERE04	Embedded Sensors Networks	3	0	0	3	PE
	ARCHITECTURE AND PROGRAMMING					
19MERE05	Modeling and Design of Embedded Systems	3	0	0	3	PE
19MERE06	Multicore Architecture	3	0	0	3	PE
19MERE07	System Simulation and Modeling	3	0	0	3	PE
	ELECTRONIC SYSTEM DESIGN					
19MAE10	Digital System Design and Testing	3	0	0	3	PE
19MAE11	Synthesis and Optimization of Digital Circuits	3	0	0	3	PE
19MAE12	Computer Vision	3	0	0	3	PE
19MAE13	High Performance Computer Architecture	3	0	0	3	PE
	EXPERT SYSTEMS					
19MAE14	Cryptography and Block Chain Technologies	3	0	0	3	PE
19MAE15	Augmented Reality	3	0	0	3	PE
19MAE16	Data science & Analytics	3	0	0	3	PE
19MAE17	Network Virtualization	3	0	0	3	PE
19MAE18	Soft Computing	3	0	0	3	PE
19MAE19	Edge Computing	3	0	0	3	PE
19MAE20	Computer Security	3	0	0	3	PE

LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Name	L	T	P	C	Category
1	19MEROE01	Design of Green Transportation System	3	0	0	3	OE
2	19MEROE02	Embedded Sensor Networks	3	0	0	3	OE
3	19MAOE04	Digital System Design and Testing	3	0	0	3	OE
4	19MAOE05	Data Science & Analytics	3	0	0	3	OE

LIST OF ONE CREDIT COURSES*

S.No.	Course Code	Course Name	C	Category
1	19MAOC01	Essential of Research	1	OCC
2	19MAOC02	Data analysis in EXCEL	1	OCC
3	19MAOC03	Educational Technology	1	OCC
4	19MAOC04	Industrial IoT on Google cloud platform	1	OCC
5	19MAOC05	Behavioral Psychology	1	OCC
6	19MAOC06	Battery Management Systems	1	OCC
7	19MAOC07	Communication Network for IoT	1	OCC
8	19MAOC08	Digital Twin Technology	1	OCC

* One Credit Courses opted from Industry / NPTEL / Institute / Department

19MA11 - LINEAR ALGEBRA AND STOCHASTIC PROCESSES

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

COURSE OBJECTIVES

The goal of this course is for students

- *To acquire sound knowledge of techniques in explaining the fundamental concepts of Linear Algebra and their role in modern mathematics and applied contexts.*
- *To Apply Linear and Nonlinear Problems will be applied by them in the process field related to modern engineering.*
- *To inculcate an idea of probability in differential physical problems.*
- *To enrich the concepts of stochastic process those are vital for the study of Electrical engineering fields.*
- *To incorporate the ideas of special random process that is imperative for the effective understanding of electrical engineering fields.*

COURSE OUTCOMES

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

CO1 : *Assimilate the ideas of Linear Algebra and an ability to apply them.*

CO2 : *Improve the facility in Linear and Nonlinear Programming problems.*

CO3 : *Fluency in Applied Probability using standard distribution methods, including the ability to find distribution for the given natural problems.*

CO4 : *Establish the knowledge about stochastic processes.*

CO5 : *Demonstrate accurate and efficient use of special random processes.*

LINEAR ALGEBRA

Vector spaces - Subspaces - Basis and Dimension - Linear transformation - Rank and Nullity - Inner product space - Gram Schmidt process - Least square problems. **(12)**

LINEAR AND NONLINEAR PROGRAMMING PROBLEMS

Linear Programming Problems - Simplex method - Big M technique - Duality - Simple Problems Game Theory - Non linear programming problems - Graphical Solution - Kuhn - Tucker conditions with nonnegative Constraints. **(12)**

APPLIED PROBABILITY

Probability - Axioms - Conditional Probability - Baye's theorem - One and Two dimensional random variables - Expectation - Conditional expectation - Correlation - Probability Distributions - Binomial, Poisson, Uniform Exponential, Normal and Weibulll distributions - Chebyshev's inequality - Central limit theorem. **(12)**

STOCHASTIC PROCESSES

Classification of random processes - Strictly and wide sense stationary processes - Ergodic process - Auto correlation - Cross correlation - Properties and problems - Power spectral density functions. **(12)**

SPECIAL RANDOM PROCESSES

Markov process - Poisson process - Gaussian process - Linear time invariant systems - Linear system with random inputs - Auto correlation and cross correlation functions of input and output. **(12)**

TOTAL : 60

TEXT BOOKS

1. *Gilbert Strang, "Introduction to Linear Algebra", Fifth Edition (2016), Wellesley - Cambridge Press.*
2. *Hamdy A. Taha, "Operations Research : An Introduction", Tenth edition (2019), Pearson Education.*
3. *Roy D.Yates and David J Goodman, "Probability and Stochastic Processes" - A friendly Introduction for Electrical and Computer Engineers, John Wiley & Sons, New Delhi, (2014).*

REFERENCES

1. *David C Lay, "Linear Algebra and its applications" ,Pearson Education, Seventh Edition (2014)*
2. *KantiSwarup, P.K. Gupta and Man Mohan, "Introduction to Management science :Operations Research" Sultan Chand and Sons Publishers, Nineteenth Edition (2017)*
3. *Maurice Sasieni, Arthur Yaspan, "Operations Research: Methods and Problems", Literary Licensing, LLC, United states, (2013).*
4. *Sheldon M. Ross, "Introduction to Probability models", Academic Press, Eleventh Edition(2014)*
5. *Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", CRC Press, Taylor & Francis Group, Fourth Edition(2018).*

19MER11 - REAL TIME OPERATING SYSTEMS

L	T	P	C
3	1	0	4

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To hone the students in problem solving, and to study the issues related to the design and analysis of systems with Real - time constraints and to learn the features of Real time OS.

COURSE OUTCOMES

CO1 : *The students can develop the knowledge about Schedulability analysis.*

CO2 : *The students can apply various real time algorithms in Real - time programming environments.*

CO3 : *The students can improve the Knowledge about real time communication and databases.*

CO4 : *The students can implement the RTOS development tools in real time systems.*

REAL TIME SYSTEMS

Introduction to real time computing - Concepts; Example of real - time applications - Structure of a real time system - Characterization of real time systems and tasks - Hard and Soft timing constraints - Design Challenges - Performance metrics - Prediction of Execution Time : Source code analysis, Micro - architecture level analysis, Cache and pipeline issues - Programming Languages for Real - Time Systems. **(9+3)**

KERNEL STRUCTURES

Real time OS - Threads and Tasks - Structure of Microkernel - Time services - Scheduling Mechanisms Communication and Synchronization - Event Notification and Software interrupt. **(9+3)**

SCHEDULING

Task assignment and Scheduling - Task allocation algorithms - Single - processor and Multiprocessor task scheduling - Clock - driven and priority - based scheduling algorithms - Fault tolerant scheduling. **(9+3)**

COMMUNICATION AND NETWORKING

Real Time Communication - Network topologies and architecture issues - protocols - contention based, token based, polled bus, deadline based protocol, Fault tolerant routing. RTP and RTCP. **(9+3)**

PRIORITIES AND ISSUES

Real time Databases - Transaction priorities - Concurrency control issues - Disk scheduling algorithms - Two phase approach to improve predictability. **(9+3)**

TOTAL : 60

TEXT BOOK

1. *C.M. Krishna, Kang G. Shin - " Real Time Systems", International Edition, McGraw Hill Companies, Inc., New York, 1997.*

REFERENCES

1. *Philip A. Laplante, "Real Time Systems Design and Analysis - An Engineers Handbook", IV Edition - IEEE Press, IEEE Computer Society Press, 2012.*
2. *Jean J Labrosse, "MicroC/OS - II the Real Time Kernel" II Edition, CMP Books, 2002.*

19MER12 - EMBEDDED PROCESSORS

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To provide an exposure to the students on microcontrollers, their architecture and choose appropriate microcontroller for a real time application. To impart a thorough understanding about the programming techniques.

COURSE OUTCOMES

The students can

CO1 : *learn to develop the hardware for embedded system application based on the processors.*

CO2 : *Incorporate suitable microcontroller along with appropriate interfacing circuits and implement the same for an application with software programs.*

CO3 : *Explore the features of the microcontrollers and provide apt solutions for any embedded application.*

PIC MICROCONTROLLER - ARCHITECTURE

PIC Architecture - RISC Architecture - Program Memory Organization - Branch, Call and Time Delay Loop - PIC I/O Port Programming - AL Instructions and Programs - PIC Bank Switching, Table Processing, Macros and Modules - PIC Configuration Registers - PIC Hardware Connection - ROM Loaders. **(9)**

PIC INTERFACING

Timer Programming Timers 0 and 1 - Programming Timers 2 and 3 - Serial Port Programming - Interrupt Programming - Erasing and Writing to Flash - Reading and Writing Data to EEPROM - Standard and Enhanced CCP Modules - Compare Mode Programming - Capture Mode Programming - PWM Programming - ECCP Programming. **(9)**

ARM ARCHITECTURE

ARM7TDMI Programmers Model - Processor Modes - Program Status Registers - Vector Table - Assembler Rules and Directives - Predefined Register Names - Macros - Assembler Operators - Literals - Load and Store Instructions Operand Addressing - Endianness - ARM rotation Scheme - Loading Constants and Addresses into Registers. **(9)**

ARM PROGRAMMING

Data processing operations - Loops and Branches - LUT - Jump tables - Binary Searches - LDM/STM Instruction Full/Empty Ascending/Descending Stacks - Subroutines - Passing Parameters: In Registers, By Reference, On The Stack - ARM APCS - Exception Handling - Memory Mapped Peripherals - LPC2104 - LPC 2132 - Thumb Instruction Set - Thumb Programmers Model - Thumb Branch Instructions - Thumb Data Processing instructions - Thumb single register data transfer - Thumb multiple register data transfer instructions Thumb implementation. **(9)**

EMBEDDED APPLICATIONS

ADC, DAC and sensor interfacing - LCD and Keyboard Interfacing - calculator with keypad - Relays and Optoisolators - Stepper Motor Interfacing - DC Motor Interfacing - PWM motor control with CCP - DC Motor Control with ECCP **(9)**

TOTAL : 45

REFERENCES

1. *Muhammad Ali Mazidi, "PIC Microcontrollers and Embedded Systems Using Assembly and C for PIC18", Pearson Education, 2016.*
2. *William Hohl, "ARM Assembly Language", CRC Press, Second Edition, 2015.*

3. *John B. Peatman, "Design with PIC microcontrollers", Pearson Education, Singapore - 1998.*
4. *Andrew Sloss, Dominic Symes, and Chris Wright, "ARM System Developer's Guide Designing and Optimizing System", the Morgan Kaufmann Series, 2004.*
5. *Steve Furber,"ARM System - on - Chip Architecture", Addison - Wesley Professional; II Edition 2000.*
6. *ARM Architecture Reference manual, ARM Limited,2014.*

19MER13 - WIRELESS COMMUNICATION SENSORS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To expose the students to different channel models, analyse the errors in channels during wireless communication and study the different sensor network simulators

COURSE OUTCOMES

At the end of the course the students will be able to:

CO1 : *To understand the different parameters and channels in wireless communication, analyse the channel for errors and codes to control errors*

CO2 : *To design the wireless system that are highly time bounded with reduced noise and improved efficiency*

CO3 : *To incorporate certain sensor network developing tools and understand the underwater and video sensing networks*

PATH LOSS, SHADOWING AND MULTIPATH CHANNEL MODELS

Free - Space Path Loss, Two - Ray Model, Simplified Path Loss, Shadow Fading, Path Loss and Shadowing, Cell Coverage Area, Time - Varying Channel Impulse, Narrowband fading models, Autocorrelation, Cross Correlation, and Power Spectral Density, Envelope and Power Distributions, Level Crossing Rate and Average Fade Duration, Wideband Fading Models, Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum and Channel Coherence - Capacity in AWGN, Flat Fading, Selective Fading Channels. **(9)**

BER ANALYSIS OF WIRELESS CHANNELS & ERROR CONTROL CODING

Error Probability for BPSK, QPSK and QAM in AWGN Channel, BER analysis of Fading Channels. Linear block codes - Polynomial representation of codes - Cyclic codes - Convolutional codes - Viterbi decoding algorithm - Other decoding methods of convolutional codes, Galois fields, BCH codes, Reed Solomon codes, Interleaving and Concatenated codes, Turbo codes, Low - Density Parity - Check codes. **(9)**

WIRELESS SYSTEM DESIGN

Cellular System Design, Frequency Reuse in Cellular Systems, Co - channel Interference and its impacts, Erlang - D formula, Trunking efficiency, MIMO, Receiver Sensitivity, Link Budget, Noise Figure, Radio Planning, Wireless Communication System Design Flow, Design Considerations - High Level View of Wireless Communication Systems, 4G Physical Layer Systems, Case Studies from 4G Communication System. **(9)**

WIRELESS, UNDERWATER AND VIDEO SENSOR NETWORKS

Sensor actor co - ordination problem, hierarchical sensor actor co - ordination mechanism, underwater WSN applications, Difference between USN and Terrestrial sensor network, USN protocol stack, MAC design, vector based routing design, hardware prototype design, software design and system testing, Panoptes, Cyclops, VSN calibration. **(9)**

SENSOR NETWORK SIMULATORS AND CASE STUDIES

Basic WSN energy model, simulation based energy modeling, Giomosim - sensor sim, TOSSIM, power TOSSIM, power state module and analysis tools, MATLAB simulation of airport baggage handling system, Tele healthcare (ECG sensor and RF communication hardware) - light control(illumimots sensor and calibration) **(9)**

TOTAL : 45

REFERENCES

1. *Haesik Kim, "Wireless Communications System Design", John Wiley & Sons, 2015*
2. *Andreas F Molisch , "Wireless Communications", John Wiley & Sons, 2012*
3. *K.J. Ray Liu, Beibei Wang, "Wireless AI : Wireless, Sensing, Positioning, IOT and communications", Cambridge University Press, 1st Edition, 2019.*
4. *Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia , New Delhi, 2009*
5. *David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.*
3. *Sitharama Iyengar S, Nandan Parmeshwaran, Balkrishnan N and Chuka D, "Fundaments of Sensor Network Programming, Applications and Technology", John Wiley & Sons, 2011.*
4. *Fei Hu and Xiaojun Cao, "Wireless Sensor Networks Principles and Practice", CRC Press, 2010.*

19MA14 - ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C
3	0	0	3

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To learn the concepts, coupling principles, control and measurement techniques involved in the field of Electromagnetic Interference and Compatibility.

COURSE OUTCOMES

CO1 : *At the end of the course, student will acquire knowledge in the Real - world EMC design constraints and make appropriate tradeoffs to achieve the most cost - effective design that meets all requirements.*

CO2 : *Student can able to design electronic systems and high speed Printed Circuit boards without Errors or problems related to electromagnetic compatibility.*

CO3 : *Student can understand the Measurement techniques for emission and about EMC standards.*

EMI/EMC CONCEPTS

Concepts of EMI and EMC - Definitions and Units of parameters - Electromagnetic environment - Mechanisms of EMI generation - Practical experiences and concerns - Natural and Nuclear sources of EMI: Celestial Electromagnetic Noise, Lightning Discharge, Electrostatic Discharge, Electromagnetic Pulse - EMI from apparatus and circuits: Noise from Relays and Switches, Nonlinearities in circuits. **(9)**

EMI COUPLING PRINCIPLES

Conducted, radiated and transient coupling - Common ground impedance coupling - Common mode and ground loop coupling - Differential mode coupling - Near field cable to cable coupling - Field to cable coupling - Power mains and Power supply coupling - Cross talk in transmission lines - Transients in transmission lines. **(9)**

EMI CONTROL TECHNIQUES

Shielding - Filtering - Grounding - Electrical Bonding - EMI Suppression Cables - EMC connectors - Isolation transformer - Transient suppressors and Surge Suppression Devices. **(9)**

EMC DESIGN OF PCBS

Component selection and mounting; Choice of resistors, inductors, capacitors, diodes, integrated circuits and voltage regulators, PCB trace impedance - Routing - Crosstalk control - Zoning - Grounding - VIAs connection - Line terminations. **(9)**

EMI MEASUREMENTS AND STANDARDS

Open area test site Measurements - Measurement Precautions - Anechoic Chamber - TEM cell - Reverberating Chamber, GTEM cell - Comparison of test facilities - Civilian standards: CISPR, FCC, EN - Military standards: MIL 461/462. **(9)**

TOTAL : 45

REFERENCES

1. *V.P.Kodali,"Engineering EMC principles, Measurements and Technology", IEEE Press, Network, Wiley - Blackwell, Second Edition,2016.*
2. *Clayton R. Paul, "Introduction to Electromagnetic compatibility "John Wiley & Sons, 2014.*
3. *David A. Weston, "Electromagnetic compability: Methods, Analysis, Circuits and Measurements" 3rd Edition, CRC Press,Septrmber 29, 2016.*
4. *Henry W.Ott,"Noise Reduction Techniques in Electronics System", John Wiley and Sons,Newyork,1998.*
5. *Bernhard Keiser,"Principles of Electromagnetic Compatibility", Artech house, 3rd Edition,1994.*
6. *DonR.J. White Consultant Incorporate, "Handbook of EMI/EMC - Vol I - 1985",John Wiley and Sons, Newyork, 1988.*

19MER14 - EMBEDDED PROCESSORS LABORATORY

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

Students can obtain a thorough understanding about the architecture and interfacing techniques of microcontroller.

COURSE OUTCOMES

CO1 : *Students can interface peripheral devices with embedded processors.*

CO2 : *Students can choose appropriate microcontroller for the design specification with reference to a real time problem.*

CO3 : *Students can troubleshoot embedded based hardware devices*

LIST OF EXPERIMENTS

1. Interface matrix keypad with microcontroller and display the key pressed on seven segment display.
2. Microcontroller based analog signal interface with LCD display.
3. Signal Generation - PWM, saw tooth, triangle waveform using microcontroller.
4. Analog sensor Interfacing and display the sensor input using microcontroller.
5. Serial communication of data using microcontroller.
6. Speed Control of Stepper Motor using microcontroller.
7. Implementation of Traffic Control System using microcontroller.
3. Modeling Microwave Oven
4. Chopper based motor speed Control using microcontroller.
5. Design of Microcontroller based motor speed control:
   i) Changing the Firing Angle
   ii) Thyristor Control
   iii) Commutation
6. Design and experimental execution of a microcontroller based smart solar tilting system.
7. Modeling of an semi - automatic and fully automatic washing machine.
8. Congestion - free elevator control using microcontroller.
9. Interfacing computer system with IoT2040 Gateway and some basic commands used in IoT2040 Gateway in linux.
10. Sending analog value from IoT2040 Gateway to thing speak cloud and monitoring from thing speak account using internet.

19MA21 - AUTOMATION AND INDUSTRIAL INTERNET OF THINGS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective of this course is to acquaint students with sound knowledge base and skill sets to develop the necessities of Industrial internet of things based automation system design including automated process, assembly, control, communication and security with the modern cutting edge innovative technologies through Career Focus Areas as required by the smart manufacturing in industries.

COURSE OUTCOMES

CO1 : *Get a understanding of what all is required for IoT and industrial automation Components.*

CO2 : *Understand the architecture, emerging industrial infrastructure and challenges involved in deployment of IoT based industrial automation*

CO3 : *Understand the concepts, programming and hardware design of Programmable Logic Controllers for smart automation and also discuss the network standards, interfacing and communication techniques.*

CO4 : *Design and develop a suitable IIoT controller for automated system involving for smart manufacturing.*

CO5 : *Discuss the fundamental requirements of process control systems and describe the architecture of various distributed control systems of IIoT and analysis the security issues and applications of IIoT in DCS*

INDUSTRIAL AUTOMATION: SENSORS, ACTUATORS AND SCADA

History and evolution of automation: Plants to Parts - Plant Layout - Types of automation - Transducer: Sensor and Actuator - Sensors - Types of sensors, sampling, analog to digital conversion, selection criteria of sensor and ADC - Data acquisition, storage and analytics - Real time analytics - Actuators - Types - Characteristics - Control of Actuators - Analog & Digital I/O Modules, SCADA System and RTU - IEDs - Analysis of Automated Flow Lines - material handling function - Automated Storage Systems - Product identification system: Barcode, RFID etc., - Concept of Data, Information, Knowledge and Wisdom - Understanding fundamental nuances between IoT and Big data - Usage of IoT data in various business domains. **(9)**

INDUSTRIAL INTERNET OF THINGS

Concept and definitions - Embedded Systems - Computer Networks - M2M (Machine to Machine Communication) - Internet of Everything (IoE) - Machine Learning - Distributed Computing, - Artificial Intelligence - Industrial automation - Interoperability - Identification - localization - Communication, Software Defined Assets - Understanding IT and OT convergence: Evolution of IIoT - OT Components: Industrial control system, PLC, SCADA, DCS - IT Components: Hardware - Software - People ,Processes IIoT Adoption - Market statistics, early adopters, Roadmap - Business opportunities: Product + Service model - Development, deployment and monetization of applications as service - Use cases **(9)**

PROGRAMMABLE LOGIC CONTROLLERS AND INDUSTRIAL COMMUNICATION SYSTEMS

Introduction - Relay logic - Block diagram of PLCs - hardware design - Logic Functions - Input & Output Modules - Programming of PLC Systems - Timer & Counter Instructions - Typical PLC Programming Exercises for Industrial Applications - smart PLCs

Principles of interface, serial interface and its standards - parallel interfaces and buses - Characteristic features of industrial networks - Low level networks and their features - Field bus architecture - Use of field buses in industrial plants, functions, international standards, performance - HART network - PROFIBUS - PA: Basics, architecture, model, network design and system configuration - MODBUS - CAN BUS - Wireless Sensor Area Networks - Sensor nodes - WSN communication technologies - Bluetooth, zig bee and Wi - Fi - Cellular communication and LPWAN technologies - Applications. **(9)**

DESIGN AND DEVELOPMENT OF IIOT SYSTEMS

IIoT reference architectures - Standardization initiatives - Interoperability issues - Industrial Internet Reference Architecture from Industrial Internet Consortium (IIC) - IIoT design considerations - Architectures Device, Network and Cloud - Centralized vs. distributed architectures - Networks, communication technologies and protocols - Industry 4.0: Smart factory initiative - Product, process and people integration - Smart factories and cyber physical systems - Design principles - Challenges. **(9)**

DISTRIBUTED CONTROL SYSTEMS AND APPLICATIONS

Functional Requirements, Configurations - Distributed Control Systems - IIoT in DCS - Industrial cloud platforms - Industrial Gateways - Commercial Gateways solutions from Intel, Cisco - Cloud based Gateway solutions - Industrial IoT security - Industrial IoT and Security - Standards and Best practices - Common vulnerabilities - Remote health monitoring of the plant - Attack surfaces - Cyber security for Industrial Control Systems.

Automation, Control and IIoT Applications in Petroleum Refineries - Cement Plant - Thermal Power Plant - Pharmaceutical Industries - Steel plant - Water Treatment Plant - Automobile Industries - Smart Energy Management. **(9)**

TOTAL : 45

REFERENCES

1. *M.P.Grover, "Automation, Production Systems and Computer Integrated Manufacturing" Pearson Education Limited, New Delhi, 2015.*
2. *Clarence W. De Silva, "Sensors and actuators : Control System Instrumentation" CRC Press, 2007*
3. *Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things" Academic Press, I Edition, June 2016.*
4. *Cuno Pfster, "Getting Started with the Internet of Things" Published by O'Reilly Media, Inc.2011.*
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7. *Frank D.Petruzella, "Programmable Logic Controllers", second Edition, Mc Graw Hill, 2008*
8. *John W.Webb and Ronald A. Resis, "Programmable Logic Controllers", Prentice Hall of India Pvt.Ltd., New Delhi, 2009*
9. *Junaid Ahmed Zubairi and Athar Mahboob, "Cyber Security Standards, Practices and Industrial Applications: Systems and Methodologies" Information Science Reference (an imprint of IGI Global), USA, 2012.*
10. *S. M. Muyeen and Saifur Rahman, "Communication, Control and Security Challenges for the Smart Grid" The Institution of Engineering and Technology, London, United Kingdom, 2017.*
11. *Hasan Derhamy, "Architectural Design Principles for Industrial Internet of Things" Doctoral Thesis, Industrial Electronics, Lule?a University of Technology, New Zealand, 2009.*
12. *Krishna Kant, "Computer - Based Industrial Control", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.*

19MA22 - ROBOTICS TECHNOLOGY AND INTELLIGENCE

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce the fundamentals of robotics, analysis and control of industrial robots with intelligence.

COURSE OUTCOMES

CO1 : *They will be able to work with variety of sensors in Robotic systems.*

CO2 : *They will be able to analyze the components of any Robotics system.*

CO3 : *They are able to study the applications of Robotics in industries.*

INTRODUCTION

Robotics - basic components - classification - specifications, Robotic sensors - proximity and range sensors, ultrasonic sensor, touch and slip sensor. Vision system - image processing and analysis - data reduction, segmentation, feature extraction and object recognition. Robotic drives and actuators - electric, hydraulic, pneumatic - selection. **(9)**

ROBOT END EFFECTORS AND TRAJECTORY PLANNING

End effectors - classification - mechanical, magnetic, vacuum and adhesive grippers. Gripper force analysis and gripper design. Work space analysis and motion analysis - pick and place operation, continuous path motion, interpolated motion, and straight line motion - manipulator kinematics - kinematic equation using homogeneous transformation and robot dynamics. **(9)**

ROBOT CONTROL

Control of robot manipulator - state equations - constant solutions - linear feedback systems, single - axis PID control - PD gravity control - computed torque control, variable structure control - impedance control. **(9)**

ROBOT INTELLIGENCE AND TASK PLANNING

Artificial Intelligence - techniques - state space - search problem reduction - predicate logic means and end analysis - problem solving - robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics. **(9)**

INDUSTRIAL ROBOTICS

Robot cell design and control - cell layouts - multiple robots and machine interference - work cell design - Work cell control - interlocks - error deduction and recovery - work cell controller - robot cycle time analysis. Safety in robotics, Applications of robot and future scope. **(9)**

TOTAL : 45

REFERENCES

1. *Fu, K.S., Gonzalez RC., and Lee C.S.G., "Robotics Control, Sensing Vision and Intelligence", McGraw Hill, 1987.*
2. *Robert J Schilling, "Fundamentals of Robotics: Analysis and Control", Prentice Hall of India, New Delhi, 2013.*
3. *Deb. S. R, "Robotics Technology and Flexible Machine Design", Tata McGraw Hill, 2010.*
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5. *Richard D Klafter Thomas A.Chmielewski and Michael Negin, "Robotic Engineering: An Integrated approach", Prentice Hall of India, New Delhi, 2010.*

6. *Nagrath I.J., Mittal R.K., "Robotics and Control", Tata McGraw Hill, Sixth reprint, 2007.*
7. *Corke, Peter, "Robotics, Vision and Control Fundamental Algorithms in MATLAB", Springer, 2017.*
8. *Siciliano, Bruno, Khatib, Oussama, "Springer Handbook of Robotics", Springer, 2016*
9. *Mark R Miller, Rex Miller, "Robots and Robotics: Principles, Systems, and Industrial Applications", McGraw - Hill Education, 2017*
10. *Kevin M. Lynch and Frank C. Park, "Modern Robotics: Mechanics, Planning, and Control", Cambridge University Press,* 2017

19MER21 - EMBEDDED SYSTEM DESIGN USING FPGA

L	T	P	C
3	0	0	3

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

Students can understand the concepts of FPGA and the need for FPGA in embedded systems.

COURSE OUTCOMES

CO1 : *Students can learn the concepts of FPGA.*

CO2 : *Students can design embedded system with appropriate FPGA based on applications*

CO3 : *Students can write Verilog code for combinational and sequential logics*

CO4 : *Students can design a communication module using Verilog.*

CO5 : *Students can design a motor control module using Verilog*

FPGA ARCHITECTURE AND OVERVIEW

Embedded system design flow - Robot Control System - Digital Design Platforms - Microprocessor based Design - Single - chip Computer/Microcontroller - based Design - Application Specific Standard Products (ASSPs) - Design Using FPGA - robotic rover application - FPGA Devices - FPGA and CPLD - Architecture of a SPARTAN - 3ETM FPGA - Floor Plan and Routing - Timing Model for a FPGA - FPGA Power Usage. **(9)**

EMBEDDED SYSTEM DESIGN

FPGA - based Embedded Processor - Design Re - use Using On - chip Bus Interface - Creating a Customized Microcontroller - Robot Axis Position Control - FPGA - based Signal Interfacing and Conditioning - Motor Control Using FPGA - Case Studies for Motor Control - Prototype Using FPGA - FPGA Design Test Methodology. **(9)**

VERILOG CONSTRUCTS

VLSI Design flow - behavioral style, the dataflow style, and structural style - Data types - Constants - Assignment Statement - Operators - Conditional Expressions - Statement types - Vector operations - Bit selects - Functions - Gate level modeling. **(9)**

VERILOG MODELING COMBINATIONAL CIRCUITS

Combinational logic - Adders - Multiplexers - Decoders - Comparator - Parity Generators - ALU - Three state gate - UART model. **(9)**

VERILOG MODELLING SEQUENTIAL CIRCUITS

Modelling Latches and Flip flops - - Sequential logic - Memory - Registers - Counters - Modeling FSM design Synchronous and Asynchronous - Shift Register - Test bench verification. Stepper motor control, servo motor control. **(9)**

TOTAL : 45

REFERENCES

1. *Rahul Dubey, "Introduction to Embedded System Design Using Field Programmable Gate Arrays" Springer - Verlag London Limited, 2009*
2. *John F. Wakerly, Digital Design Principles and Practices", Pearson Education, Asia, III Edition, 2003.*
3. *Blaine Readler, "Verilog by Example: A Concise Introduction for FPGA Design", Full Arc Press,2011.*
4. *J. Bhasker, "A Verilog HDL Primer, Third Edition Hardcover", Star Galaxy Publishing; 3rd Edition, 2005.*
5. *M. Rafiquzzaman, Stevan A. McNinch, "Digital Logic with an Introduction to Verilog and FPGA Based Design", Wiley, 1st Edition, 2019.*

19MER22 - FPGA BASED EMBEDDED SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	4	2

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

Students can design and demonstrate logical operation in embedded system with FPGA.

COURSE OUTCOMES

CO1 : *Students can learn the concepts of FPGA programming and implementation.*

CO2 : *Students can design logical relations to be implemented in FPGA based on applications*

CO3 : *Students can write Verilog code test it on FPGA for combinational and sequential logics*

CO4 : *Students can design and demonstrate communication module in FPGA based system using Verilog.*

CO5 : *Students can design and demonstrate motor control module in FPGA based system using Verilog*

LIST OF EXPERIMENTS

Language : Verilog

Software : Xilinx

FPGA Board : Spartan 3E, Spartan 6

1. Encoders and decoders
2. Adders
3. Counters and shift register
4. Wallace Multiplier
5. 4 - bit ALU
6. Quadrature Encoder Interface
7. UART module
8. Control of dc servo motor
9. Control of stepper motor
10. Capture module

19MAEE01 - FEASIBILITY REPORT PREPARATION

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

This course will focus on research proposal writing covering the objective, problem formulation, solution, methodology, budget and outcome.

COURSE OUTCOMES

CO1 : *To understand the research grants that will fit with organization's strategies and capabilities, and develop systems for continuously identifying the best prospects.*

CO2 : *To recognize the importance of secondary and internal research in the planning process and data, according to that each method of research is recognized. And will be able to budget appropriately for a given project.*

CO3 : *To write professional grant proposals for corporate, private foundations and government grants in a way to maximize the chance of getting approved.*

COURSE CONTENTS

This course will include the following areas:

1. Philosophy and process of conducting needs assessment
2. Parts of a proposal: Introduction, Problem Statement, Goals and Objectives, Methodology
3. Public and private funding sources: Foundation and public perspectives
4. Development of strategic program plan
5. Solutions
6. Literature review focused on evidence to support program
7. Budgeting
8. Building an effective grant writing team: collaboration and how it works
9. Submitting the grant proposal

REFERENCES

1. *Soraya M. Coley, Cynthia A. Scheinberg, "Proposal Writing Effective Grantsmanship for Funding", SAGE Publications, Fifth Edition, 2016*
2. *Dr. Beverly A. Browning, "Grant Writing For Dummies", John Wiley & Sons, 5th Edition, 2014.*

19MERE01 - INTELLIGENT CONTROLLERS FOR POWER QUALITY ENHANCEMENT

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective of this course is to provide with overall understanding of various power quality phenomenon, definitions, their origin, industrial survey, monitoring, international standards and mitigation methods. It also includes various compensation techniques and to develop intelligent controllers for power quality mitigations applicable to various custom power devices.

COURSE OUTCOMES

CO1 : *Understand the real causes of the power quality; distinguish between various categories of power quality problems and their impacts on performance and their economics.*

CO2 : *Apply the knowledge of mathematics, and modern technological tools to solve the harmonics generation and other power quality issues in the power distribution networks and to develop an intelligent control algorithm for effective mitigation.*

CO3 : *Introduce to apply economical solution techniques for power quality migration, various compensation methods using dedicated embedded controllers*

QUALITY OF POWER DELIVERY AND CONVENTIONAL MITIGATION METHODS

Electric Power Quality - State of the Art on Power Quality - Classification of Power Quality Problems - Causes of Power Quality Problems - Effects of Power Quality Problems on Users - Classification of Mitigation Techniques for Power Quality Problems - Equipments Used to Enhance Power Quality - Power Quality Standards - Power Quality Monitoring - Future Directions and Opportunities for Power Quality Enhancement: Power Quality Sensitivity - Utility Based Versus Customer Based Correction - Interconnection Standards - Power Quality Performance Requirements and Validation. **(8)**

SHUNT COMPENSATION

Passive and Active Shunt Compensation - Classification of Passive and Active Shunt Compensators - Principle of Operation and design of Passive Shunt Compensators - Introduction to Custom Power Devices - DSTATCOMs - Classification of DSTATCOMs - Generating Reference Currents Using Instantaneous PQ Theory - Principle of Operation, Control, design and analysis of DSTATCOMs - Development of embedded controller for DSTATCOM. **(9)**

SERIES COMPENSATION

Passive and Active Series Compensation - Classification of passive and Active Series Compensators - Principle of Operation and design of Passive Series Compensators - Dynamic Voltage Restorer(DVR) - Rectifier Supported DVR - DC Capacitor Supported DVR - DVR Structure: Output Feedback Control of DVR using embedded controller. **(9)**

UNIFIED POWER QUALITY CONDITIONER

UPQC Configurations - Principle of Operation and Control of Unified Power Quality Compensators - Analysis and Design of Unified Power Quality Compensators - Modelling, Simulation, and Performance of UPQCs **(7)**

HARMONIC MITIGATION

Nonlinear Loads - Classification of Nonlinear Loads - Harmonic Propagation in the power systems and its effects - mitigation of harmonics - passive filters - limitations.

Active Power Filters - Shunt and Series Active Filters - Classification - Principle of Operation and Control of Shunt and Series Active Power Filters - Analysis and Design of shunt and Series Active Power Filters

Hybrid Power Filters - Classification of Hybrid Power Filters - Principle of Operation and Control of Hybrid Power Filters - Analysis

and Design of Hybrid Power Filters

Development intelligent controller for active and hybrid power filters. **(12)**

TOTAL : 45

REFERENCES

1. *Bhim Singh, Ambrish Chandra and Kamal Al - Haddad, "Power quality problems and mitigation techniques" John Wiley and Sons Ltd, 2015*
2. *Arindam Ghosh and Gerard Ledwich "Power Quality Enhancement Using Custom Power Devices" Springer International Edition, 2011.*
3. *Math H. J. Bollen, "Understanding Power Quality Problems, Voltage Sags and Interruptions" Wiley India Pvt. Ltd. - new Delhi, 2011.*
4. *E. Acha, V.G.Agelidis, O.Anaya - Lara, T.J.E. Miller, "Power Electronic Control in Electrical Systems" Newnes an Imprint of Elsevier, 2006.*
5. *Grzegorz Benysek, "Improvement in the Quality of Delivery of Electrical Energy using Power Electronics Systems" Springer - Verlag London Limited 2007.*
6. *Math H. J. Bollen, "Understanding Power Quality Problems, Voltage Sags and Interruptions" Wiley India Pvt. Ltd. - new Delhi, 2011.*
7. *E. Acha, V.G.Agelidis, O.Anaya - Lara, T.J.E. Miller, "Power Electronic Control in Electrical Systems" Newnes an Imprint of Elsevier, 2006.*
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19MERE02 - EMBEDDED CONTROL OF INDUSTRIAL DRIVES

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To facilitate the students to understand the impact of electric drives with embedded systems in the control of modern industries and to afford innovative solutions by addressing their needs.

COURSE OUTCOMES

At the end of the course the students will be able to:

CO1 : *Understand the models, new innovations required Electro - Mechanical systems via a roadmap - driven development process as required by modern industries.*

CO2 : *Improve the embedded software development skills required for industrial drive systems*

CO3 : *Develop an innovation attitude for the design, modeling, and development industrial drives systems.*

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 - Evaluation of microcontrollers for motor control - Selection of suitable control device for drives. **(9)**

DC MOTOR DRIVES

Introduction to DC - motor drives - speed control of DC motor drive with controlled rectifiers and choppers - speed control using inner current loop and outer speed loop - design of current loop with pole - zero cancellation - simulation of DC drives - Embedded controller based implementation of DC drives - converter structure - modes of operation - control variable algorithm - initialization of ADC/Timers/Interrupts - voltage/ current sensing and comparison - PWM signal generation - Case study. **(9)**

INDUCTION MOTOR DRIVES

Induction Motor Drives: Reference frame theory - transformation of variables from stationary to arbitrary reference frame - 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 drives: system components - sensors - controllers - current/speed measurements - scaling operation - control algorithm of speed measurement during high - speed/low speed regions - development of closed loop control block - Case study. **(9)**

SYNCHRONOUS MOTOR DRIVES

Open loop VSI fed drive and its characteristics - Self control - Torque control - Torque angle 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 - Case study. **(9)**

SPECIAL MACHINES DRIVES

Switched Reluctance Motor drive: Fundamentals and control of SRM drives - open loop and closed control - Closed loop torque and speed control - Implementation of speed control algorithm using TMS 320F28335 processor.

Brush less DC Motor Drives: Principals of operation - torque generation - open loop and closed control of BLDC drive - Case study.

Stepper Motor Drives: Types and basic operation - stepper motor drive system - Implementation of control algorithm using MC68HC11E9 Microcontroller.

Introduction FPGA based implementation for Electric Drive Systems **(9)**

TOTAL : 45

REFERENCES

1. *Bose B K, "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt. Ltd, New Delhi, 2014.*
2. *Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 2008.*
3. *R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives" CRC Press, Taylor & Francis Group, 2010.*
4. *Richard Valentine, "Motor Control Electronics Handbook" McGraw Hill, New York, 2006.*
5. *Hamid A. Taliyat, Steven Campbell, "DSP - Based Electromechanical Motion Control", SRS Press, 2004*
6. *G.K. Dubey, "Power Semiconductor Controlled Drives" John Wiley and Sons, New York, 1999.*
7. *G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, edition, 2010.*
8. *Vedam Subramaniam,"Electrical Drives and Applications", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.*
9. *Qian Cheng & Lei Yuan, "Vector Control of an Induction Motor based on a DSP", Master of Science Thesis, Chalmers University of Technology, Sweden, 2011.*
10. *Data Manual of "TMS320 F 28335 Digital Signal Controllers", released by Texas Instruments (2012) available in http:www/ti.com/DSC.*
11. *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.*
12. *M.N.Cirstea,et.al, "Neural and Fuzzy Logic Control of Drives and Power Systems" Newnes - An imprint of Elsevier Science, Oxford, 2012.*

19MERE03 / 19MEROE01 - DESIGN OF GREEN TRANSPORTATION SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective of this course is to provide and develop a detailed description of green transportation engineering, sustainability assessment, environmental benefits, alternate fuel based vehicle design, economic aspects of electric vehicle, legislative compliances, performance analysis and real time safety issues.

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1 : *Understand the complexity of an automobile system as a whole unit and to define the functionalities of various components in electric/hybrid/plug-in hybrid vehicles.*

CO2 : *Introduce the components of elective vehicles such as electric motors, batteries and power converters and able to design their industrial models as a sub system of complete transportation.*

CO3 : *Design solar PV and fuel cell based electric vehicles according to the international standards and to perform various testing on the vehicle to serve up for the society and environment.*

INTRODUCTION

Introduction to alternate vehicles - limitations in conventional vehicles-Vehicle classification and architecture - hybrid electric vehicles - plug-in hybrid electric vehicles --need for electric vehicles- vehicle dynamics -propulsion power - velocity and acceleration performance -Roll over - Yaw control-Well to Tank (WTT) and Tank to Wheel (TTW) energy transport - tire-road force mechanics - power train configurations -tractive effort- sizing methodology of power train components -vehicle braking system -EV design considerations- research challenges in electric vehicle - electric vehicle market analysis. **(8)**

ARCHITECTURE OF EV AND ITS COMPONENTS

Functional blocks of EV System-Motor drives - brushless DC motors -permanent magnet synchronous machines - switched reluctance machines - multi quadrant operation-Battery based energy storage: Introduction to battery - electrical and thermal parameters -types of battery- battery efficiency and capacity - electric circuit and empirical modelling of battery systems - charging and discharging performance - heavy duty traction batteries-super capacitors-Power converters: DC-DC converters - non-isolated and isolated DC-DC converters - DC-AC converters-PWM control -Motoring and regenerative braking - design of closed loop control-Types of charging stations-specifications-Design of Level 1 and Level 2 and Level 3 charging stations-comparison **(12)**

SOLAR PV BASED EV DESIGN

Modelling of PV system - solar-sun related parameter estimation - irradiation measurement on moving vehicle - array temperature distribution - charge controllers - MPPT algorithm - up hill motoring operation-Downhill regenerative operation -power converter topologies - high efficiency micro controllers for power converters - closed loop motor control - design example of solar PV based electric vehicle. **(9)**

FUEL CELL BASED EV DESIGN

Introduction to fuel cell- basic fuel cell structure and characteristics - Fuel cell types and comparison - electric circuit model of fuel cell - conventional and advanced hydrogen storage system - fuel cell processing technology and transportation -fuel cell emission - Design example of fuel cell based electric vehicle: Selection of FC stack - FC controller - power converters - battery pack and motors - safety issues for hydrogen based electric vehicles. **(9)**

EV- PERFORMANCE AND SAFETY ISSUES

Electric vehicle verses IC engine vehicle comparison: efficiency comparison - pollution comparison - capital and operating cost comparison -GHG emission -emission standards and comparison - United Nations Framework Convention on Climate Change

(UNFCCC) - Kyoto protocol -UNFCCC Paris climate change summit (COP 21) - legislation and standardizations for electric vehicles - Initiatives of Government of India:National Electric Mobility Mission Plan (NEMMP) 2020-FAME-I & II- EV performance testing-safety requirements of electric vehicles. **(7)**

TOTAL : 45

REFERENCES

1. *Ali Emadi, MehrdadEhsani, "Vehicular Electric Power Systems" Marcel Dekker, Inc., New York, 2014.*
2. *Iqbal Hussain, "Electric & Hybrid Vehicles - Design Fundamentals", Second Edition, CRC Press, 2011.*
3. *SandeepDhameja, "Electric Vehicle Battery Systems" Newnes, an imprint of Elsevier, 2013.*
4. *J.M. Miller, "Propulsion Systems for Hybrid Vehicles", Institution of Electrical Engineers (IEE), London, UK, 2004.*
5. *R. Stone and J.K. Bell, "Automotive Engineering Fundamentals", SAE International, Warrendale, PA, 2004.*
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7. *Eric ForstaThacher, "A Solar Car Primer - A guide to the design and construction of solar-powered racing vehicles", Springer International Publishing Switzerland, 2015.*
8. *Hybrid and electric vehicle solutions guide - released by Texas Instruments, 2011 available in www.ti.com/hev.*
9. *Indian vehicle emission standards: https://www.dieselnet.com/standards/in/2wheel.php*
10. *Zero Emission Vehicles (ZEVs):Towards a Policy Framework https://niti.gov.in/writereaddata/files/document_publication/EV_report.pdf*
11. *National Electric Mobility Mission Plan (NEMMP) 2020-https://dhi.nic.in/writereaddata/Content/NEMMP2020.pdf.*

19MERE04 / 19MEROE02 - EMBEDDED SENSOR NETWORKS

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce the basic concepts of Embedded Sensor Networks, the current, diverse research on sensor networks in a comprehensive manner and expose the fundamental issues in designing and analyzing sensor network information processing systems.

COURSE OUTCOMES

The students will gain knowledge

CO1 : *About information processing techniques with the architecture of different layers in a sensor network*

CO2 : *About the communication subsystem, sensor tasking and control, and data management.*

CO3 : *About various platform to implement WSN.*

INTRODUCTION

Over view of sensor networks - Constraints and Challenges - Advantages of sensor networks - Sensor Network Applications - Collaborative Processing - Key definitions in sensor networks - Tracking scenario - Problem formulation - Sensing model - Collaborative Localization - Bayesian Estimation - Distributed representation and interference of states - Tracking multiple objects - State Space Decomposition - Data Association - Sensor models - performance comparison and metrics. **(9)**

NETWORKING SENSORS

Key assumptions - Medium access control - A survey of MAC protocols for WSN - S - MAC Protocol - IEEE 802.15.4 standard and Zig Bee - Energy efficient design of wireless sensor nodes - General Issues Geographic, Energy - Aware Routing - Unicast Geographic Routing - Routing on a curve - Energy Minimizing Broadcast - Energy Aware Routing to a Region - Attribute based routing - Directed Diffusion - Rumor RoutingGeographic Hash table. **(9)**

INFRASTRUCTURE ESTABLISHMENT

Topology control - Clustering - Time synchronization - Clocks and Communication Delays - Interval MethodsReference Broadcasts - Localization and Localization Services - Ranging Techniques - Range Based Localization Algorithms - Location Services - Task driven sensing - Role of sensor nodes and UtilitiesInformation based Sensor Tasking - Sensor Selection - IDSQ - Cluster leader based Protocol - Sensor tasking in tracking relations - Joint Routing and Information aggregation - Moving Centre of Aggregation - Multistep Information Aggregation - Multistep Information Directed Routing - Sensor Group Management. **(9)**

SENSOR NETWORK DATABASE

Sensor Database Challenges - Querying the physical environment - Query Interfaces - Cougar Sensor Database - Probabilistic Queries - In - network aggregation - Query Propagation and Aggregation - Tiny DB Query Processing - Query processing Scheduling and Optimization - Data centric storage - Data indices and range queries - Distributed Hierarchical aggregation - Multi resolution Summarization - Partitioning the summaries - Fractional Cascading - Locality Preserving Hashing - Temporal data - Data Aging - Indexing Motion Data. **(9)**

SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware - Sensor network programming challenges - Node level software platforms Operating system Tiny OS - Node level simulators - State centric programming - Applications - Core challenges - Research directions - Tiered architectures - Distributed signal processing - Monitoring and Debugging - Security and Privacy. **(9)**

TOTAL : 45

REFERENCES

1. *Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks An Information Processing Approach", Mogan Kaufmann Publishers, 2004.*
2. *Ian F. Akyildiz, Mehmet Can Vuran, " Wireless Sensor Networks" John Wiley, 2011.*
3. *Yingshu Li, My T. Thai,Weili Wu, " Wireless Sensor Networks and Applications" Springer 2008*
4. *Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.*
5. *C.S. Raghavendra, Krishna M. Sivalingam and TaiebZnati, "Wireless Sensor Networks Springer Publishers, 2006.*

19MERE05 - MODELING AND DESIGN OF EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To model, design, analyze and verify an Embedded system and to understand the concepts of cyber physical systems in Embedded systems

COURSE OUTCOMES

Students will be able to

CO1 : *Understand the design process and distinguish various state machine models*

CO2 : *Design various models, analyze and verify Embedded systems related to its physical processes*

CO3 : *Analyze the designed models quantitatively*

INTRODUCTION

Cyber Physical Systems as Embedded Systems - Applications - The Design Process - Modeling Dynamic behaviour - Continuous dynamics and discrete dynamics. **(9)**

STATE MACHINES

Composition of State Machines - Concurrent Composition - Hierarchical State Machines - Concurrent Models of Computation - Structure of Models - Synchronous - Reactive Models - Dataflow Models of Computation - Timed Models of Computation - automatic model based test generation from UML state machine **(9)**

DESIGN OF EMBEDDED SYSTEMS

Embedded Processors - Types of Processors - Parallelism - Memory Architectures - Memory Hierarchy - Memory Models - Input and Output - I/O Hardware - Sequential Software in a Concurrent World - The Analog/Digital Interface **(9)**

ANALYSIS AND VERIFICATION

Invariants and Temporal Logic - Invariants - Linear Temporal Logic Equivalence and Refinement - Models as Specifications - Type Equivalence and Refinement - Language Equivalence and Containment - Simulation - Bisimulation - Reachability Analysis and Model Checking - Open and Closed Systems - Reachability Analysis - Abstraction in Model Checking - Model Checking Liveness Properties **(9)**

QUANTITATIVE ANALYSIS

Problems of Interest - Programs as Graphs - Factors Determining Execution Time - Basics of Execution Time Analysis - Other Quantitative Analysis Problems. **(9)**

TOTAL : 45

REFERENCES

1. *E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems - A Cyber - Physical Systems Approach", I Edition (**www.** LeeSeshia.org), 2011.*
2. *Axel Jantsch," Modeling Embedded Systems and SoC's: Concurrency and Time in Models of computation", morgan khaufman publishers,2001*
3. *Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Morgan Kaufman Publishers, 2004.*
4. *David E Simon, "An embedded software primer", Pearson Education Asia, 2001.*
5. *Justyna Zander, Ina Schieferdecker, Pieter J. Mosterman," Model - Based Testing for Embedded Systems", CRC press,2012*

19MERE06 - MULTI CORE ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

Understand the challenges in parallel & multi thread processing and execution of the various processes

COURSE OUTCOMES

Students will be able to

CO1 : *Learn various processes within multicore capabilities*

CO2 : *Understand different memory organization and the protocols*

CO3 : *Develop a programming model for open MP and MPI Programming*

SUPERSCALAR PROCESSORS

Mutlicore drivers & challenges - Fundamentals of Superscalar Processor Design, Introduction to Multicore Architecture - memory hierarchy design - Chip Multiprocessing, homogeneous Vs heterogeneous design - SMP - Multicore Vs Multithreading. **(9)**

MEMORY ORGANIZATION

Shared memory architectures - synchronization - Memory organization - Cache Memory - Cache Coherency Protocols - Basic cache optimizations - Design of Levels of Caches. **(9)**

MULTICORE PROGRAMMING MODEL

Shared memory model - message passing model - transaction model - Open MP and MPI Programming - task scheduling algorithm for multi core processor. **(9)**

POWERPC ARCHITECTURE

RISC design - PowerPC ISA - PowerPC Memory Management - Power 5 Multicore architecture design - Power 6 Architecture - RISC exceptions(synchronous, asynchronous precise, imprecise). **(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 - Shared memory model - message passing model - transaction model - Open MP and MPI Programming. - Threading API for Microsoft Win 32/MFC thread API **(9)**

TOTAL : 45

REFERENCES

1. *"Multi - Core Programming Increasing Performance through Software Multi - threading", Shameem Akhter Jason Roberts, Intel PRESS*
2. *Hennessey & Paterson, "Computer Architecture A Quantitative Approach", Harcourt Asia, Morgan Kaufmann, 1999.*
3. *Joseph JaJa, Introduction to Parallel Algorithms, Addison - Wesley, 1992.*
4. *IBM Journals for Power 5, Power 6 and Cell Broadband engine architecture.*
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, 2000.*
7. *Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability and Programmability" McGrawHill, 1993*

19MERE07 - SYSTEM SIMULATION AND MODELING

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To understand the concepts of simulation of a system and modeling to learn its behaviour.

COURSE OUTCOMES

CO1 : *Students can understand the concepts in simulation*

CO2 : *Students can develop a model to represent the system and to test for functionality.*

CO3 : *Students can learn various methods to determine the performance of a system.*

SYSTEM AND SYSTEM ENVIRONMENT

Concept of a system - continuous and discrete systems - models of a system - modeling approaches - advantages and disadvantages of simulation systems - steps in simulation study - point estimates, confidence interval. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, simulation examples. **(9)**

MATHEMATICAL MODELS

Statistical Models - Concepts - Distribution - exponential, Poisson, Uniform, Weibull - Empirical distribution - Normal distribution - building on empirical distribution - rejection method - Queuing Models - Characteristics - Notation - Queuing Systems - Markovian Models - Markovian - Non Markovian models - Discrete and Continuous time Markov Chains - Markov reward models - Semi Markov models - Markov regenerative models. **(9)**

RANDOM NUMBERS AND RANDOM VARIATE GENERATION

Properties of random numbers - Generation of pseudo - random numbers Techniques for generating random numbers - Tests for Random Numbers - Random - Variate Generation: Inverse transform technique; Acceptance Rejection technique; Special properties. **(9)**

ANALYSIS OF SIMULATION DATA

Data Collection - Identifying the distribution with data - Parameter estimation - Goodness of Fit Tests - Fitting a non - stationary Poisson process - Selecting input models without data - Output analysis for terminating simulations - Output analysis for steady - state simulations. **(9)**

VERIFICATION, CALIBRATION, VALIDATION AND OPTIMIZATION

Model Building - Verification of Simulation Models - Calibration and Validation of Models - Validation of Model Assumptions - Validating Input - Output Transformations - optimization via Simulation. **(9)**

TOTAL : 45

REFERENCES

1. *Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete - Event System Simulation, 5th Edition, Pearson Education, 2010.*
2. *Lawrence M. Leemis, Stephen K. Park: Discrete - Event Simulation: A First Course, Pearson Education, 2006.*
3. *Averill M. Law: Simulation Modeling and Analysis, 4th Edition, Tata McGraw - Hill, 2007.*
4. *Geoffrey Gordon, "Systems Simulation", 2nd Edition, Prentice Hall, India, 2002.*

19MAE10 /19MAOE04 - DIGITAL SYSTEM DESIGN AND TESTING

L	T	P	C
3	0	0	3

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVES

- *To realize and design hazard free circuits and to familiarize the practical issues of sequential circuit Design.*
- *To gain knowledge about different fault diagnosis, testing methods and to estimate the performance of digital systems*
- *To analyze synchronous and asynchronous sequential circuits*

COURSE OUTCOMES

CO1 : *With the knowledge of state table and flow table students can design a synchronous and asynchronous sequential circuit after applying state and flow table minimization technique.*

CO2 : *The students can diagnose a digital circuit for faults using suitable testing methods.*

CO3 : *The students can design the digital system using VHDL*

SEQUENTIAL CIRCUIT DESIGN

Analysis of clocked synchronous sequential circuits and modeling - State diagram, state table, state table assignment and reduction - design of synchronous sequential circuits - design of iterative circuits - ASM chart and realization using ASM. **(9)**

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN

Analysis of asynchronous sequential circuit - flow table reduction - races - state assignment - transition table and problems in transition table - design of asynchronous sequential circuits - Static, dynamic and essential hazards - data synchronizers - mixed operating mode asynchronous circuits - designing vending machine controller. **(9)**

FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS

Fault table method - path sensitization method - Boolean difference method - D algorithm - Tolerance techniques - The compact algorithm - Fault in PLA - Test generation - DFT schemes - Built in self test. **(9)**

SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES

Programming logic device families - Designing a synchronous sequential circuit using PLA/PAL - Realization of finite state machine using PLD - FPGA - Xilinx FPGA - Xilinx 4000. **(9)**

SYSTEM DESIGN USING VHDL

VHDL operators - Arrays - concurrent and sequential statements - packages - Data flow - Behavioural - structural modeling - compilation and simulation of VHDL code - Test bench - Realization of combinational and sequential circuits using HDL - Registers - counters - sequential machine - serial adder - Multiplier - Divider - Design of simple microprocessor. **(9)**

TOTAL : 45

REFERENCES

1. *Charles H.Roth Jr "Fundamentals of Logic Design" Thomson Learning 2004.*
2. *Nripendra N Biswas "Logic Design Theory" Prentice Hall of India, 2001.*
3. *Parag K.Lala "Fault Tolerant and Fault Testable Hardware Design" B S Publications, 2002.*
4. *Parag K.Lala "Digital system Design using PLD" B S Publications, 2003.*
5. *Charles H Roth Jr."Digital System Design using VHDL" Thomson learning, 2004.*
6. *Douglas L.Perry "VHDL programming by Example" Tata McGraw Hill, 2006.*

19MAE11 - SYNTHESIS AND OPTIMIZATION OF DIGITAL CIRCUITS

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVES

- *To understand the compilation techniques for hardware models, Architectural - level synthesis and optimization, including scheduling, resource sharing.*
- *To know the Logic - level synthesis and optimization techniques for combinational and synchronous sequential circuits.*
- *To gain a knowledge in Library binding algorithms*

COURSE OUTCOMES

The students can:

CO1 : *Design a microelectronic circuit applying the suitable scheduling and resource sharing techniques.*

CO2 : *Implement a two, multiple level sequential logic circuit after optimization*

CO3 : *Implement circuit with specific cell libraries*

CIRCUITS AND MODELS

Microelectronics - Microelectronic Design Styles - Design of Microelectronic Circuits - Computer - Aided Synthesis and Optimization - Computer - Aided Simulation - Computer - Aided Verification Testing and Design for Testability - Graphs - Undirected Graphs - Directed Graphs - Perfect Graphs - Combinatorial Optimization - Decision and Optimization problems Algorithms - Tractable and Intractable Problems - Fundamental Algorithms - Graph Optimization Problems and Algorithms - The Shortest and Longest Path Problems **(9)**

ARCHITECTURAL - LEVEL SYNTHESIS AND OPTIMIZATION

Hardware Modeling - Structural, Behavioral Hardware Languages, HDLs Used for Synthesis, Abstract Models Compilation and Behavioral Optimization. Architectural Synthesis - Area and Performance Estimation - Strategies for Architectural Optimization - Data - Path Synthesis - Control - Unit Synthesis - Synthesis of Pipelined Circuits. **(9)**

SCHEDULING ALGORITHMS

Scheduling without Resource Constraints - Scheduling with Resource Constraints - Scheduling Algorithms for Extended Sequencing Models - Scheduling Graphs with Alternative Paths - Scheduling Pipelined Circuits - Resource Sharing and Binding: Sharing and Binding for Resource - Dominated Circuits - Sharing and Binding for General Circuits - Concurrent Binding and Scheduling - Resource Sharing and Binding for Non - Scheduled Sequencing Graphs - The Module Selection Problem - Resource Sharing and Binding for Pipelined Circuits - Sharing and Structural Testability. **(9)**

LOGIC - LEVEL SYNTHESIS AND OPTIMIZATION

Two - Level Combinational Logic Optimization: Logic Optimization Principles - Operations on Two - LevelLogic Covers - Algorithms for Logic Minimization - Symbolic Minimization and Encoding Problems - Minimization of Boolean Relations - Multiple - Level Combinational Logic Optimization: Models and Transformations for Combinational Networks - The Algebraic Model - Boolean Model - Synthesis of Testable Networks - Rule - Based Systems for Logic Optimization Sequential Logic Optimization: Sequential Circuit Optimization Using State - Based Models - Sequential Circuit Optimization Using Network Models - Implicit Finite - State Machine Traversal Methods. **(9)**

CELL - LIBRARY BINDING

Problem Formulation and Analysis - Algorithms for Library Binding - Covering Algorithms Based on Structural Matching - Covering Algorithms Based on Boolean Matching - Covering Algorithms and Polarity Assignment - Concurrent Logic Optimization and

Library Binding - Testability Properties of Bound Networks - Specific Problems and Algorithms for Library Binding - Look - Up Table FPGA's - Anti - Fuse - Based FPGA - Rule - Based Library Binding - Comparisons of Algorithmic and Rule - Based Library Binding - State of the Art and Future Trends: Synthesis Systems - Growth of Synthesis in the Near and Distant Future. **(9)**

TOTAL: 45

REFERENCES

1. *Giovanni De Micheli, "Synthesis and optimization of Digital Circuits", Tata McGraw - Hill, 2017*
2. *John Paul Shen, Mikko H. Lipasti, "Modern processor Design", Tata McGraw Hill, 2013.*

19MAE12 - COMPUTER VISION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce the fundamentals of image formation, major ideas and techniques of computer vision and pattern recognition for standstill and moving objects.

COURSE OUTCOMES

At the end of the course the student will be able to

CO1 : *Understand the basic concepts of image formation and segmentation techniques*

CO2 : *Obtain the mathematical model of the given camera*

CO3 : *Construct a 3D model from the captured images.*

CO4 : *Apply different pattern recognition on the images and do comparative study analysis.*

CO5 : *Realize the concepts of motion analysis for human motion and moving objects.*

IMAGE FORMATION

Overview and State - of - the - art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing, Image representation and modeling. **(9)**

IMAGE SEGMENTATION

Region Growing, Edge Based approaches to segmentation, Graph - Cut, Mean - Shift, MRFs, Texture Segmentation; Object detection, Image filtering, Image as vectors. **(9)**

CAMERA MODELS

Camera geometry - Epipolar Geometry, Depth estimation and multi camera views, Camera calibration, calibrated 3D reconstruction, Stereo & Multi - view Reconstruction. **(9)**

PATTERN RECOGNITION

Clustering: K - Means, K - Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un - supervised, Semi - supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non - parametric methods. Face Detection. **(9)**

MOTION ANALYSIS

Human and computer vision - Human Motion Recognition, Background Subtraction and Modeling, Optical Flow, KLT, Spatio - Temporal Analysis, Dynamic Stereo; Motion parameter estimation. Shape from X - Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges. **(9)**

TOTAL : 45

REFERENCES

1. *Manas Kamal Bhuyan, " Computer Vision and Image Processing : Fundamentals and Applications", CRC Press, 1st Edition, 2019.*
2. *E.R. Davies, "Computer Vision : Principles, Algorithms, Applications, Learning", Academic press, 2017.*
3. *Richard Szeliski, Computer Vision: Algorithms and Applications, Springer - Verlag London Limited 2011.*

4. *Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.*
5. *Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.*

19MAE13 - HIGH PERFORMANCE COMPUTER ARCHITECTURE

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

The objective is to make the student understand and appreciate the fundamental issues and tradeoffs involved in the design of high performance computers.

COURSE OUTCOMES

CO1 : *The learner is exposed to the concepts of Pipelining and Parallelism*

CO2 : *The students learn the issues in memory organization and optimization methods.*

CO3 : *Students appreciate the need for Vector processing and RISC Architecture*

PROCESSOR DATA PATH

Introduction - CPU Performance factors - Evaluating CPU Performance - Building a Data path - Multicycle Implementation - Exceptions - Microprogramming **(9)**

PIPELINING

Overview of pipelining - Pipelined Data path - Data Hazards - Forwarding - Branch Hazards - Dynamic Branch Prediction - Pipeline using HDL - Advanced Pipelining - Pentium 4 Pipeline **(9)**

PARALLELISM

Classes of computers - Trends - Dependability - Quantitative principles - Instruction Level Parallelism - Reducing Branch Cost - Dynamic scheduling - Hardware based speculation - Advanced Speculation - Limitations of ILP for Realizable Processors. **(9)**

MEMORY HIERARCHY DESIGN

Basics of Cache - Measuring performance - Optimization of Cache performance - Virtual Memory - Page faults - TLB - Protection with virtual memory **(9)**

VECTOR PROCESSING AND RISC ARCHITECTURE

Vector Processor: Architecture - Issues - Effectiveness of Compiler Vectorization - Vector performance. RISC Architecture: Survey of RISC Architectures - SPARC, PA - RISC **(9)**

TOTAL : 45

REFERENCES

1. *David A. Patterson, John J. Hennessy, "Computer Organization and Design - The Hardware / Software Interface", Third Edition, Morgan Kaufmann Publishers, 2005.*
2. *John J. Hennessy, David A. Patterson, "Computer Architecture - A Quantitative Approach", Fourth Edition, Morgan Kaufmann Publishers, 2006.*
3. *Carl Hamachar, Zvonco Vranesic and Safwat Zakv, "Computer Organization", McGraw Hill, 2002.*
4. *Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", McGraw Hill International Edition, Singapore 2000.*

19MAE14 - CRYPTOGRAPHY AND BLOCK CHAIN TECHNOLOGIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

PREREQUISITE

Expertise In Programming, Basic Knowledge Of Computer Security, Cryptography, Networking, Concurrent Or Parallel Programming, Computer Systems Security.

COURSE OBJECTIVE

To provide exposure to the students on Cryptography and Block Chain Technologies and their real time applications

COURSE OUTCOMES

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

CO1 : *Understand the basics of cryptography and Block chain Technologies*

CO2 : *Understand the concepts of Symmetric key cryptography, Public key cryptography, Digital signatures and hash functions.*

CO3 : *Understand the structure of a block chain and its advantages over a simple distributed database.*

CO4 : *Understand the concepts of Ethereum and Smart Contracts and to compare them with bitcoin scripting.*

CO5 : *Apply the concepts of cryptography and Block chain Technologies in various fields.*

INTRODUCTION

Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Technologies Borrowed in Block chain - hash pointers, consensus, byzantine fault - tolerant distributed computing, and digital cash. **(9)**

CRYPTOGRAPHY

Cryptography - Brief history, and goals of cryptography, Symmetric - key cryptography, Public - key cryptography, Digital Signatures - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, Hash functions, Collision resistant hash, public key crypto, verifiable random functions, Zero - knowledge systems. **(9)**

BLOCK CHAIN 1.0

Bit coin block chain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bit coin consensus, Bit coin scripting language and uses. **(9)**

BLOCK CHAIN 2.0

Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, using smart contracts to enforce legal contracts, comparing Bit coin scripting vs. Ethereum Smart Contracts (9)

APPLICATIONS

Internet of Things, Medical Record Management System, Domain Name Service and future of Cryptography and Block chain **(9)**

TOTAL : 45

REFERENCES

1. *Draft version of "S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.*
2. *Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.*
3. *Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).*
4. *DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper. 2014. • Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts*

19MAE15 - AUGMENTED REALITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

To acquire knowledge about augmented reality and to realize its benefits and features in various fields

COURSE OUTCOMES

By the end of the course the student will be able to

CO1 : *Understand the concept of augmented reality*

CO2 : *Effectively design and benefits of AR.*

CO3 : *Incorporate of Geo - location with AR*

CO4 : *Apply AR for real - time applications*

INTRODUCTION TO AUGMENTED REALITY

Augmented Reality History - Definition of Augmented Reality - Augmented Reality features - Mixed Reality Continuum - MAR Market, Actors and Value Chain - MAR System Architecture - mobile AR for android and iOS - Application vs. Browser. **(8)**

AUGMENTED REALITY CONCEPTS AND HARDWARE

Two - Step Process of Augmented Reality Applications - Augmented Reality Hardware - Sensor - Roles of Sensors - Tracking - processor - Processor System Architectures - display - Stationary visual displays - Visual displays that move with the participant's head - Visual displays that move with the participant's hand or other parts of his or her body - other sensory displays - Haptics - Smell (Olfaction) - Other Senses - Stereo Displays - Display - Characteristics of Displays - Techniques. Computer Graphics - Dimensionality - Depth Cues - Registration and Latency. **(10)**

AUGMENTED REALITY DIMENSION AND INTERACTION

Introduction to3D objects in ARAF - advanced 3D modeling technique - Vuforia Overview: Interface, Navigation, Terminology, Image Targeting, Custom Images - Recognition process with Vuforia - Use of Vuforia descriptor in ARAF - Real World - Manipulation - Navigation - Mobile Augmented Reality. **(9)**

AUGMENTED REALITY WITH GEOLOCATION

Create an AR Quiz using the authoring tool - Geolocation in ARAF - A basic example: Image PROTO - Enriching a prototype: add user interaction - Map PROTO - MapMarker PROTO - MapOverlay PROTO - MapPlayer PROTO - An example of a functional map in ARAF. **(9)**

APPLICATION

Pokemon GO and its effect on AR & Augmented Reality Gaming - Survey of Current AR Games - ARKit GPS Template - Augmented Reality Wearable Survey of Augmented Reality Wearables, AR for Medical and Psychotherapy Bio - sensing and AR with the server - The future of augmented reality. **(9)**

TOTAL : 45

REFERENCES

1. *Augmented Reality: Principles & Practice - 12 Oct 2016 by Schmalstieg / Hollerer*
2. *Jetzt bewerten, "Virtual Reality & Augmented Reality in Industry", Springer, 2nd Edition, 2009.*

19MAE16 / 19MAOE05 - DATA SCIENCE AND ANALYTICS

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To introduce and explore the decision making based on analysis of acquired data

COURSE OUTCOMES

By the end of the course the student will be able to

CO1 : *Acquire knowledge about the need for data science and analytics*

CO2 : *Understanding of data analysis algorithms*

CO3 : *Need for data visualization*

INTRODUCTION

Data Science : - Data Types - Big Data Overview - Different Data Structures - Data architecture - Data acquisition - Data analysis - Descriptive Analysis - Predictive Analysis - Prescriptive Analysis - Data Visualization Charts - Data archiving - Data Analytics Lifecycle Phase : - Discovery - Data Preparation - Model Planning - Model Building - Communicate Results - Operationalize - Global Innovation Network and Analysis **(9)**

PROBABILITY AND STATISTICS

Application towards Data Analysis - Bayes' Theorem - Random Variables - Probability Density Functions - Properties of Distributions: - Binomial, Poisson, Uniform, Exponential, Normal, Chi - Square, T and F - Introduction to Sampling and Hypothesis **(9)**

TIME SERIES ANALYSIS

Overview of Time Series Analysis - Hypothesis test - Variance and Correlation analysis - Simple Linear Regression - Forecasting Techniques - Auto Regressive Moving Average (ARMA) model - Auto Regressive Integrated Moving Average (ARIMA) Model - Getting to know MapReduce - MapReduce Execution Pipeline - Runtime Coordination and Task Management - MapReduce Application **(9)**

DATA ANALYSIS

Introduction to Artificial Intelligence, Introduction to Machine Learning, and Deep Learning in Data Science - Clustering - K - means - Association Rules - Apriori Algorithm - Validation and Testing - Classification - Decision Trees - Naïve Bayes - Diagnostics of Classifiers **(9)**

BASIC DATA ANALYTIC METHODS USING R

Basic Data Analytics using R - R Graphical User Interfaces - Data Import and Export - Attribute and Data Types - Descriptive Statistics - Exploratory Data Analysis - Visualization Before Analysis - Visualizing a Single Variable - Examining Multiple Variables - Data Exploration Versus Presentation. **(9)**

TOTAL : 45

REFERENCES

1. *U. Dinesh Kumar, " Business Analytics", Wiley, 2018*
2. *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data ", EMC Education Services John Wiley & Sons, 2015*
3. *Lars Nielsen, " A Simple Introduction to Data Science", New Street Communications, LLC, 2015*

19MAE17 - NETWORK VIRTUALIZATION

L	T	P	C
3	0	0	3

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To understand the concepths of virtualization and its feature in the design of Virtual Machine products.

COURSE OUTCOMES

Students will be able to

Understand about Computing Virtualization tools, applications and techniques.

CO1 : *Understand Server virtualization and virtualization platform.*

CO2 : *Understand the technologies of Virtualization and Network virtualization.*

CO3 : *Understand the concepts of virtualization storage.*

CO4 : *Study the virtual machine products*

OVERVIEW OF VIRTUALIZATION

Basics of Virtualization - Virtualization Types - Desktop Virtualization - Network Virtualization Server and Machine Virtualization - Storage Virtualization - System - level or Operating Virtualization - Application Virtualization - Virtualization Advantages - Virtual Machine Basics - Taxonomy of Virtual machines - Process Virtual Machines - System Virtual Machines - Hypervisor - Key Concepts. **(9)**

NETWORK CONSOLIDATION

Hardware Virtualization - Virtual Hardware Overview - Server Virtualization - Physical and Logical Partitioning - Types of Server Virtualization - Business cases for Server Virtualization - Uses of Virtual server Consolidation - Planning for Development - Selecting server Virtualization Platform. **(9)**

NETWORK VIRTUALIZATION

Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design - WAN Architecture - WAN Virtualization - Virtual Enterprise Transport Virtualization - VLANs and Scalability - Theory Network Device Virtualization Layer 2 - VLANs Layer 3 VRF Instances Layer 2 - VFIs Virtual Firewall Contexts Network Device Virtualization - Data - Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation - Ipsec L2TPv3 Label Switched Paths - Control - Plane Virtualization - Routing Protocols - VRF - Aware Routing Multi - Topology Routing. **(9)**

VIRTUALIZING STORAGE

SCSI - Speaking SCSI - Using SCSI buses - Fiber Channel - Fiber Channel Cables - Fiber Channel Hardware Devices - iSCSI Architecture - Securing iSCSI - SAN backup and recovery techniques - RAID - SNIA Shared Storage Model - Classical Storage Model - SNIA Shared Storage Model - Host based Architecture - Storage based architecture - Network based Architecture - Fault tolerance to SAN - Performing Backups - Virtual tape libraries. **(9)**

VIRTUAL MACHINES PRODUCTS

Xen Virtual machine monitors - Xen API - VMware - VMware products - Vmware Features - Microsoft Virtual Server - Features of Microsoft Virtual Server. **(9)**

TOTAL : 45

TEXT BOOKS

1. *William von Hagen, Professional Xen Virtualization, WroxPublications, January, 2008.*
2. *Chris Wolf, Erick M. Halter, and Virtualization: From the Desktop to the Enterprise, APress 2005.*

3. *Kumar Reddy, Victor Moreno, Network virtualization, Cisco Press, July, 2006.*
4. *James E. Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.*

REFERENCES

1. *Ken gray, Thomas. D. Nadeau Network function virtualization, Morgan Kaufmann, 2016.*
2. *David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.*

19MAE18 - SOFT COMPUTING

L	T	P	C
3	0	0	3

PRE - REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To learn the basic concepts of genetic algorithms, search techniques, fuzzy logic, neural networks, neuro - fuzzy modelling systems, and their applications.

COURSE OUTCOMES

After completing this course the students will be able to

CO1 : *Optimize single objective and multi objective problems using genetic algorithm.*

CO2 : *Apply basics of Fuzzy logic and neural networks*

CO3 : *Apply soft computing techniques to solve a wide variety of real world problems.*

GENETIC ALGORITHMS

Introduction to genetic algorithms (GA) - goals of optimization - differences and similarities between genetic algorithm and traditional methods - schemata - terminology of GA - strings, structure, parameter set - coding - fitness function - data structures - GA operators - algorithm. **(8)**

MODERN SEARCH TECHNIQUES

Simulated annealing - introduction - algorithm - applications. Tabu search - introduction - algorithm - applications. Particle swarm optimization algorithm. AI search algorithm - Predicate calculus - Rules of interference - Semantic networks - Frames - Objects - Hybrid models - Applications. **(9)**

FUZZY LOGIC

The concept of uncertainty and associated solutions - fuzzy sets - basic properties and characteristics of fuzzy sets - fuzzy set operations - fuzzy reasoning - applications of fuzzy logic - Fuzzy matrices - Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making. **(9)**

ARTIFICIAL NEURAL NETWORKS

Basics of artificial neural networks (ANN) - characteristics of ANN - models of neuron - topology - basic learning laws - types. Kohenon self organizing network - back propagation network - learning curves - applications of ANN to engineering problems - Hopfield network. **(9)**

NEURO - FUZZY MODELLING

Neuro - Fuzzy modelling - adaptive neuro - fuzzy inference systems, neuro - fuzzy controller - feedback control, expert control, back propagation through time and real - time recurrent learning, reinforcement learning control, gradient - free optimization - Classification and Regression Trees - Data clustering - Evolutionary computation. **(10)**

TOTAL : 45

REFERENCES

1. *N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.*
2. *Dr.S.NSivanandam and Dr.S.N.Deepa, "Principles of SoftComputing", 2nd Edition, Wiley - India, 2011.*
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4. *Timothy J.Ross, "Fuzzy Logic with Engineering applications", Wiley; 4th Edition, 2016.*

5. *Goldberg, D.E., "Genetic Algorithms in Search, Optimization, and Machine Learning", Addison - Wesley, 1989.*
6. *LaureneFausett, "Fundamentals of Neural Networks", Prentice Hall, 1994.*
7. *Jang J.S.R., Sun C.T. and Mizutani E, "Neuro - Fuzzy and Soft computing", Prentice Hall 1998.*
8. *Fred Glover, Manuel Laguna, "Tabu Search", Kluwer Academic Publishers, 1997.*
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10. *S.Rajasekaran and A.Vijayalakshmi Pai, "Neural networks, Fuzzy logic and Genetic algorithms", Prentice Hall of India Ltd, New Delhi, 2017.*
11. *Nils J.Nelsson, "Artificial Intelligence - A New Synthesis", HarcourtAsia Ltd., 1998.*

19MAE19 - EDGE COMPUTING

L	T	P	C
3	0	0	3

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

To provide an in - depth and comprehensive knowledge of the Edge Computing fundamental issues, technologies, applications and implementations.

COURSE OUTCOMES

CO1 : *The Students can articulate the main concepts, key technologies, strengths, and limitations of edge computing and the possible applications for state - of - the - art edge computing*

CO2 : *The students can identify the architecture and infrastructure of edge computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.*

CO3 : *The students can understand the core issues of edge computing such as security, privacy, and interoperability.*

INTRODUCTION

History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems - System models for Distributed and cloud computing - Software environments for distributed systems and clouds. **(9)**

EDGE RESOURCES

Introduction to Edge Computing - issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data - storage. Virtualization concepts - Types of Virtualization - Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs. **(9)**

NETWORKS AND SERVICES

Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, and Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies - Anything as a service (XaaS). **(9)**

PROGRAMMING

Programming and Software Environments - Parallel and Distributed Programming paradigms - Programming on Amazon AWS and Microsoft Azure - Programming support of Google App Engine - Emerging Cloud software Environment. **(9)**

STANDARDS AND PRIVACY

Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta - data - Cloud Reliability and fault - tolerance - Edge Security, privacy, policy and compliance - Edge federation, interoperability and standards. **(9)**

TOTAL : 45

REFERENCES

1. *Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier - 2012*
2. *Barrie Sosinsky, "Cloud Computing Bible" John Wiley & Sons, 2010*
3. *Tim Mather, SubraKumaraswamy, and ShahedLatif, Cloud Security and Privacy an Enterprise Perspective on Risks and Compliance, O'Reilly 2009*

19MAE20 - COMPUTER SECURITY

L	T	P	C
3	0	0	3

PRE - REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OBJECTIVE

The purpose of this course is to underlying concepts and foundations of computer security, basic knowledge about security - relevant decisions in designing IT infrastructures, techniques to secure complex systems and practical skills in managing a range of systems, from personal laptop to large - scale infrastructures.

COURSE OUTCOMES

After completing this course the students will be able to

CO1 : *Able to identify security risks and take preventive steps*

CO2 : *Investigate cybercrime and collect evidences*

CO3 : *Able to use knowledge of forensic tools and software*

DIGITAL SECURITIES

Introduction, Types of Attacks, Digital Privacy, Online Tracking, Privacy Laws, Types of Computer Security risks (Malware, Hacking, Pharming, Phishing, Ransomware, Adware and Spyware, Trojan, Virus, Worms, WIFI Eavesdropping, Scareware, Distributed Denial - Of - Service Attack, Rootkits, Juice Jacking), Antivirus and Other Security solution, Password, Secure online browsing, Email Security, Social Engineering, Secure WIFI settings, Track yourself online, Cloud storage security, IOT security, Physical Security Threads **(9)**

ONLINE ANONYMITY

Anonymous Networks - Tor Network, I2P Network - Freenet - Darknet - Anonymous OS - Tails - Secure File Sharing - VPN - Proxy Server - Connection Leak Testing - Secure Search Engine - Web Browser Privacy Configuration - Anonymous Payment **(9)**

CRYPTOGRAPHY AND SECURE COMMUNICATION

Cryptographic Functions - Types - Digital Signature - The Difference Between Digital Signatures and Electronic Signatures - Cryptographic Systems Trust Models - Cryptographic Key generation Using Gpg4win/gpg4usb - Disk Encryption - Windows Bit Locker and Open Source Tools - Multitask Encryption Tools - Attacking Cryptographic Systems, Countermeasure - Securing Data in Transit - Cloud Storage Encryption - DNS Traffic and Email communication - Secure IM and video calls **(9)**

NETWORK DEFENSES

Network defense tools - Secure protocols - Firewalls - VPNs, Tor, I2P, - Intrusion Detection and filters - Host - Based IDS vs Network - Based IDS - Dealing with unwanted traffic - Denial of service attacks. - Mobile platform security models - Android, iOS Mobile platform security models - Detecting Android malware. **(9)**

SECURITY RISK MANAGEMENT

Introduction - Risk Management - Information Security - Risk Assessment - Information Security Risk Assessment - Case Studies - Risk Assessment in Practice - The Trusted Computing Architecture - Introduction to Trusted Computing - TPM Provisioning - Exact Mechanics of TPM. **(9)**

TOTAL : 45

REFERENCES

1. *William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th Edition, 2010.*
2. *Michael T. Goodrich and Roberto Tamassia, Introduction to Computer Security, Addison Wesley, 2011.*
3. *William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th Edition, 2010.*
4. *Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2001.*

COIMBATORE INSTITUTE OF TECHNOLOGY

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

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M.E. EMBEDDED AND REAL TIME SYSTEMS

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2019 - 2020 and onwards)

INDEX

S.No	Contents	Page No.
1	Vision and Mission of the Institute	1
2	Vision and Mission of the Department	2
3	Programme Educational Objectives (PEOs)	3
4	Programme Outcomes (POs) and Programme Specific Outcome (PSOs)	4
5	Curriculum	5
6	Syllabi For Semester I	8
7	Syllabi For Semester II	17
8	Professional Electives / Open Electives	24

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 the institute 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 MECHANICAL ENGINEERING

VISION, MISSION AND PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
FOR
BACHELOR OF MECHANICAL ENGINEERING

The Vision of the Department of Mechanical Engineering is :

To become one of the best mechanical engineering departments in the country within the next decade, in preparing engineers capable of working innovatively and creatively towards a better world.

The Mission of the Department of Mechanical Engineering is :

- Impart sound knowledge through effective teaching-learning methods.
- Prepare students to address current and impending challenges facing the country.
- Create and nurture an environment for fostering innovation and research.

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF MECHANICAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The student will :

PEO1 : Acquire fundamental knowledge and expertise necessary for successful professional practice in mechanical engineering and allied fields, and for higher studies.

PEO2 : Attain and demonstrate essential technical skills to identify, analyze and solve complex problems and design issues in mechanical engneering.

PEO3 : Possess a professional attitude as an individual or a team member with consideration for societal, ethical and environmental factors, and display motivation for life-long learning.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF MECHANICAL ENGINEERING

PROGRAMME OUTCOMES (POs)

The students will be able to :

S No.	Program Outcomes
1.	Engineering knowledge : Apply the knowledge of mathematics, science, engineering fundamentals, and Mechanical engineering to the solution of complex engineering problems.
2.	Problem analysis : Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.	Design/development of solutions : Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4.	Conduct investigations of complex problems : Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.	Modern tool usage : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6.	The engineer and society : Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7.	Environment and sustainability : Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.	Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.	Individual and teamwork : Function effectively as an individual, and as a member or leader in diverse team, and in multidisciplinary settings.
10.	Communication : Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.	Project management and finance : Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	Life-long learning : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes :

The students will be able to

1. Apply principles of mechanical engineering and physical sciences to model, analyze, design and select appropriate materials and manufacturing processes to create engineering solutions (products, systems, or processes) during their Mini-Project and Thesis Project Work.
2. Work with contemporary technologies through multi-pronged opportunities such as industry linked One Credit Courses, In-plant Training, and Internships together with a Fast-tracked curriculum.
3. Participate in team hackathons and develop critical thinking skills via hands-on-experience in research experiments to become an entrepreneur or initiate a start-up.

COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

Curriculum from the Academic Year 2019 - 2020 and onwards

SUBJECTS OF STUDY

Semester III

Course Code	Course Name	L	T	P	C	Category
19MEM31	Ordinary and Partial Differential Equations	3	1	0	4	BSC
19ME31	Engineering Thermodynamics	3	1	0	4	PCC
19ME32	Engineering Mechanics for Mechanical Engineers	3	1	0	4	PCC
19ME33	Fluid Mechanics and Machinery	3	0	0	3	PCC
19ME34	Embedded Processor Architecture and Programming	3	0	0	3	ESC
19HSS01	Science of Creativity and Professional Ethics	1	1	0	1	HS
19MEL35	Computer Aided Machine Drawing - I	0	0	2	1	PCC
19MEL36A / 19MEL36B	Fluid Mechanics & Machinery Laboratory / Electrical Machines & Drives and Embedded Systems Laboratory	0	0	2	0.5	PCC
	One Credit Course - Elective I	1	0	0	1	EEC
19HOC31	Communication Skills for Engineers - I*	0	0	2	1	EEC
	TOTAL CREDITS				**22.5**	

Semester IV

Course Code	Course Name	L	T	P	C	Category
19ME41	Applied Thermodynamics	3	1	0	4	PCC
19ME42	Strength of Materials	3	1	0	4	PCC
19ME43	Mechanics of Machines	3	1	0	4	PCC
19ME44	Materials Engineering	3	0	0	3	PCC
19ME45	Manufacturing Processes - I	3	0	0	3	PCC
19MEL46	Computer Aided Machine Drawing - II	0	0	2	1	PCC
19MEL36A / 19MEL36B	Fluid Mechanics & Machinery Laboratory / Electrical Machines & Drives and Embedded Systems Laboratory	0	0	2	0.5	PCC

19MEL47A / 19MEL47B	Material Characterization and Testing Laboratory / Manufacturing Processes Laboratory	0	0	2	0.5	PCC
	One Credit Course - Elective II	1	0	0	1	EEC
19HOC41	Communication Skills for Engineers - II*	0	0	2	1	EEC
	TOTAL CREDITS				**22**	

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

Semester V

Course Code	Course Name	L	T	P	C	Category
19ME51	Heat and Mass Transfer	3	1	0	4	PCC
19ME52	Design of Machine Elements	3	1	0	4	PCC
19ME53	Manufacturing Processes - II	3	0	0	3	PCC
19ME54	Metrology and Quality Control	3	0	0	3	PCC
19ME55	Operations Research	3	1	0	4	HS
	Elective 1	3	0	0	3	PEC
19MEL47A / 19MEL47B	Material Characterization and Testing Laboratory / Manufacturing Processes Laboratory	0	0	2	0.5	PCC
19MEL56A / 19MEL56B	Applied Thermal Sciences Laboratory / Dynamics and Metrology Laboratory	0	0	2	0.5	PCC
	One Credit Course - Elective III	1	0	0	1	EEC
19INT51	Internship - I	0	0	0	1	EEC
19ME67	Mini Project	0	0	3	0	EEC
19HOC51	Employability and Personality Development Skills - I*	0	0	2	1	
	TOTAL CREDITS				**25**	

Semester VI

Course Code	Course Name	L	T	P	C	Category
19ME61	Refrigeration and Air-conditioning	3	0	0	3	PCC
19ME62	Finite Element Analysis	3	1	0	4	PCC
19ME63	Design of Transmission Systems	3	1	0	4	PCC
19ME64	Computer Aided Engineering	3	1	0	4	PCC
	Elective 2	3	0	0	3	PEC
19MEL56A / 19MEL56B	Applied Thermal Sciences Laboratory / Dynamics and Metrology Laboratory	0	0	2	0.5	PCC
19MEL65	CAD / CAM Laboratory	0	0	2	1	PCC
	One Credit Course - Elective IV	1	0	0	1	PCC
19INT61	Internship - II	0	0	0	1	EEC
19ME67	Mini Project	0	0	3	3	EEC
19HOC61	Employability and Personality Development Skills - II*	0	0	2	1	
	TOTAL CREDITS				**25.5**	

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

Semester VII

Course Code	Course Name	L	T	P	C	Category
19ME71	Control Theory and Mechatronics	2	0	2	3	PCC
19ME72	Quality Engineering and Management	3	0	0	3	PCC
	Elective 3	3	0	0	3	PEC
	Elective 4	3	0	0	3	PEC
	Elective 5	3	0	0	3	OEC
	Elective 6	3	0	0	3	OEC
19ME73	Project Work Phase - I	0	0	6	3	EEC
	TOTAL CREDITS				**21**	

Semester VIII

Course Code	Course Name	L	T	P	C	Category
	Elective 7	3	0	0	3	PEC
	Elective 8	3	0	0	3	PEC
19ME81	Project Work Phase - II	0	0	10	5	EEC
	TOTAL CREDITS				**11**	

Semester 1	20
Semester 2	19
Semester 3	22.5
Semester 4	22
Semester 5	25
Semester 6	25.5
Semester 7	21
Semester 8	11
Total Credits	**166**

List of Professional Elective Courses (PEC)

STREAM : MATERIALS AND DESIGN

Course Code	Course Name	L	T	P	C
19MEE01	Composite Materials	3	0	0	3
19MEE02	Design for Manufacturing and Assembly	3	0	0	3
19MEE03	Design of Jigs and Fixtures	3	0	0	3
19MEE04	Mechanical Behaviour of Materials	3	0	0	3
19MEE05	Machine Tool Design	3	0	0	3
19MEE06	Mechanical Vibrations and Control	3	0	0	3
19MEE07	Tribology	3	0	0	3
19MEE08	Experimental Stress Analysis	3	0	0	3
19MEE09	Fluid Power Control Systems	3	0	0	3
19MEE10	Sensor Technology	3	0	0	3
19MEE11	Smart Materials	3	0	0	3
19MEE12	Non-Destructive Evaluation and Imaging	3	0	0	3
19MEE13	Automotive Electronics and Power Train Systems	3	0	0	3
19MEE14	Bio-materials	3	0	0	3
19MEE15	Micro and Nano Electro-mechanical Systems	3	0	0	3

STREAM : THERMAL SCIENCES

Course Code	Course Name	L	T	P	C
19MEE16	Solar Energy Technology	3	0	0	3
19MEE17	Gas Dynamics and Space Propulsion	3	0	0	3
19MEE18	Computational Fluid Dynamics	3	0	0	3
19MEE19	Alternative Energy Conversion Techniques	3	0	0	3
19MEE20	Advanced Fluid Mechanics	3	0	0	3
19MEE21	Advanced Thermodynamics	3	0	0	3
19MEE22	Cryogenics	3	0	0	3
19MEE23	Combustion and Internal Combustion Engines	3	0	0	3
19MEE24	Energy Conservation and Waste Heat Recovery	3	0	0	3
19MEE25	Design of Heat Exchangers	3	0	0	3
19MEE26	Turbo machines	3	0	0	3
19MEE27	Power Plant Engineering	3	0	0	3

STREAM : MANUFACTURING AND MANAGEMENT

Course Code	Course Name	L	T	P	C
19MEE28	Industrial Psychology	3	0	0	3
19MEE29	Work System Design	3	0	0	3
19MEE30	Total Productivity Management	3	0	0	3
19MEE31	Plant Layout and Material Handling	3	0	0	3
19MEE32	Project Management	3	0	0	3
19MEE33	Rapid Prototyping	3	0	0	3
19MEE34	Advanced Welding Technology	3	0	0	3
19MEE35	Advanced Foundry Technology	3	0	0	3
19MEE36	Supply Chain Management	3	0	0	3
19MEE37	Quantity Production Methods	3	0	0	3
19MEE38	Production Planning and Control	3	0	0	3
19MEE39	Lean and Agile Manufacturing	3	0	0	3
19MEE40	Production and Operations Management	3	0	0	3
19MEE41	Smart Manufacturing	3	0	0	3
19MEE42	Manufacturing Planning and Cost Estimation	3	0	0	3
19MEE43	Manufacturing Systems Management	3	0	0	3

ONE CREDIT COURSES (ELECTIVES) OFFERED

Course Code	Course Name	Category	L	T	P	C
19MEOC01	MATLAB Programming*	OC	1	0	0	1
19MEOC02	Non-Destructive Evaluation	OC	1	0	0	1
19MEOC03	Advanced Industrial Automation Systems*	OC	1	0	0	1
19MEOC04	Recent Trends in Quality	OC	1	0	0	1
19MEOC05	Foundry Practice and Procedures	OC	1	0	0	1
19MEOC06	Basics of Automotive Electrical Systems*	OC	1	0	0	1
19MEOC07	Design Thinking - A Primer	OC	1	0	0	1
19MEOC08	Aircraft Maintenance*	OC	1	0	0	1
19MEOC09	Inspection and Quality Control in Manufacturing*	OC	1	0	0	1
19MEOC10	Constitution of India	OC	1	0	0	1
19MEOC11	Biology for Engineers	OC	1	0	0	1
19MEOC12	Human Values	OC	1	0	0	1
19MEOC13	E-Commerce Security*	OC	1	0	0	1
19MEOC14	Innovation and Entrepreneurship	OC	1	0	0	1
19MEOC15	3-D Scanning Technology	OC	1	0	0	1

* Employability enhancement courses

COIMBATORE INSTITUTE OF TECHNOLOGY

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LIST OF OPEN ELECTIVES

DEPARTMENT OF CIVIL ENGINEERING

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

DEPARTMENT OF MECHANICAL ENGINEERING

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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

DEPARTMENT OF INFORMATION TECHNOLOGY

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

DEPARTMENT OF CHEMICAL ENGINEERING

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

DEPARTMENT OF MATHEMATICS

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

DEPARTMENT OF PHYSICS

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

DEPARTMENT OF CHEMISTRY

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

DEPARTMENT OF HUMANITIES

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

SEMESTER - III

19MEM31 - ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO 1 *: Solve field problems in engineering involving PDEs.*

CO 2 *: Formulate and solve problems involving random variables.*

CO 3 *: Apply statistical methods for analyzing experimental data.*

ORDINARY DIFFERENTIAL EQUATIONS (ODE)

Higher order ODE with constant coefficients, Euler and Legendre Linear Homogeneous ODEs, Method of variation of parameters, Solution of Simultaneous ODEs with constant coefficient. **(15)**

PARTIAL DIFFERENTIAL EQUATIONS (PDE)

Formation of PDE, Solution of I order Non-linear PDE (standard types only), Solution of I order Linear (Lagrange) Equations, Solution of higher order homogeneous PDEs, Classification of homogeneous II order PDEs. **(15)**

BOUNDARY VALUE PROBLEMS- I

Initial and boundary conditions, Solution of 1 dimensional wave equation by variable separable method, D'Alembert's solution for 1 dimensional wave equation, Solution of 1 dimensional steady and unsteady state Heat diffusion equation by variable separable method. **(15)**

BOUNDARY VALUE PROBLEMS- II

Two-dimensional steady state heat (Laplace) equation in Cartesian and Curvilinear coordinates. **(15)**

SPECIAL FUNCTIONS

Bessel functions: Generating function, recurrence formulae, Bessel integral, orthogonal property and Bessel expansion of arbitrary function.

Legendre Polynomials: Rodrigues formula, values, Orthogonality, generating functions, recurrence formulae and expansion of function as Legendre Polynomials. **(15)**

TOTAL : 60

TEXT BOOKS

1. *Grewal, B S, Higher Engineering Mathematics, 44th edition, Khanna Publishers, 2018.*
2. *Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2018.*

REFERENCES

1. *N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2019.*
2. *Alan Jeffrey, Advanced Engineering Mathematics, Academic Press, 2018.*
3. *Riley K F and M P Hobson, Foundation Mathematics for the Physical Sciences, Cambridge University Press, 2017.*

19ME31 - ENGINEERING THERMODYNAMICS

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Apply concepts of energy conservation to open and closed systems.*

CO2 : *Arrive at benchmark performances of heat engines and refrigerator / heat pump and compute entropy changes.*

CO3 : *Depict various thermodynamic processes on property diagrams, estimate properties of mixtures and quantify deviation from ideal gas behavior.*

CO4 : *Calculate changes in properties during different ideal gas processes.*

BASIC CONCEPTS OF THERMODYNAMICS

Basic Concepts-Macroscopic & Microscopic approach, Concept of Continuum, Thermodynamic system & control volume, Thermodynamic properties, quasi-static process, Thermodynamic Equilibrium. Temperature - Zeroth law of thermodynamics - Temperature scales. Pressure measurement - Barometer.

Energy and Work transfer - Forms of energy - forms of work transfer - point and path function.

Pure Substances- phases of pure substances - property diagrams - Property tables - Ideal gas equation of state - Compressibility factor - Vander Waals equation of state - vapor pressure and phase equilibrium.**(15)**

FIRST LAW OF THERMODYNAMICS

First of Law of Thermodynamics applied to Non-flow Systems - Ideal gas processes - Vapor processes. Flow Systems - Mass balance (Continuity equation) - Energy balance (Steady Flow Energy Equation) - Some Steady flow Engineering Devices **(15)**

SECOND LAW OF THERMODYNAMICS

Thermal Energy Reservoir-Cyclic Heat Engine, Refrigerator and heat pump -Second Law statements - PMM-2 -reversibility and irreversibility - Causes of irreversibility - Types of irreversibility - Carnot Cycle - Reversed Carnot Cycle - Carnot's Theorem - Absolute Thermodynamic Temperature Scale. **(15)**

ENTROPY AND EXERGY

Entropy - Clausius Theorem - Inequality of Clausius - Entropy of Isolated system - Third law of Thermodynamics - Tds relations - Entropy change of liquids and solids - Entropy change of ideal gases.

Exergy - Reversible work and Irreversibility - Second law efficiency- Exergy change of non-flow system - Exergy change of flow stream. **(15)**

THERMODYNAMIC RELATIONS AND IDEAL GAS MIXTURES

Thermodynamics Relations - Gibbs and Helmholtz Functions, Maxwell Relations, Joule Kelvin effect, Clausius Clapeyron equation.

Ideal Gas Mixtures-Mass and Mole Fractions, Dalton's Law of partial pressures, Amagat-Leduc law of additive volumes -Properties of Ideal Gas mixture. **(15)**

TOTAL : 60

TEXT BOOKS

1. *Yunus A. Cengel, Introduction to Thermodynamics and Heat Transfer, McGraw-Hill Companies, Inc., 2nd Edition, 2017.*
2. *C. P. Kothandaraman and Domkundwar, A Course in Thermodynamics (Thermal Engineering), DhanpatRai and Co. Ltd., 2018.*
3. *Nag P K., Engineering Thermodynamics, Tata McGraw Hill, 2019.*
4. *Mahesh M. Rathore, Thermal Engineering, Tata McGraw Hill, 2018.*

REFERENCES

1. *Van Wylen, Fundamentals of Thermodynamics, John Wiley and Sons, 9th Edition, 2018.*
2. *Jones and Dugan, Engineering Thermodynamics, Prentice Hall of India, 2018.*
3. *https://nptel.ac.in/courses/112/104/112104113/*

19ME32 ENGINEERING MECHANICS FOR MECHANICAL ENGINEERS

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Analyze the effect of forces on rigid bodies in equilibrium.*

CO2 *: Compute the first and second moment of inertia for simple and composite geometries.*

CO3 *: Apply concepts of energy conservation and virtual work to predict stability of equilibrium.*

CO4 *: Analyze translatory and rotary motions and examine the frictional and gyroscopic effects.*

CO5 *: Examine free and forced vibrations in damped and undamped systems.*

RIGID BODY EQUILIBRIUM

Rigid body equilibrium in space- Analysis of force and moments of system - Analysis of trusses- Method of section and joints, beams - Cables, frames and machine bodies. **(9)**

SYSTEM OF PARTICLES

First moment of mass/area of simple geometry using first principles - Centre of Mass of composite sections. Second moment of mass/area of standard geometry - Ring, disc, sphere - Parallel and perpendicular axis theorem- Moment of Inertia for composite sections and geometries. **(9)**

ENERGY CONSERVATION AND CONCEPTS OF VIRTUAL WORK

Principle of virtual work - Virtual displacements of rigid bodies, degrees of freedom - Systems with friction - mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. **(12)**

KINEMATICS OF PARTICLES

Analysis of translatory and rotary motions- Displacement- Velocity- Acceleration for motion in straight line- Projectile- Circular motion - Newton's law of motion- Rate of change of momentum/angular momentum - Impulse- Collision- Elastic and Inelastic. Rotation about a fixed axis - Absolute and relative velocity- Instantaneous center of rotation - Effects of friction in rolling- Rolling with and without slipping. Gyroscope- gyroscopic couple in automobile, aircrafts and ships - grinding mills. **(15)**

MECHANICAL VIBRATIONS

Analysis of Free vibration of damped 1 DOF system - Newton's II law and Energy Method - equivalent springs and dashpots - damped frequency - Logarithmic decrement - Forced vibration - harmonic excitation - forced and motion transmissibility - resonance - vibration isolation with and without damper - whirling of shafts - critical speed of shaft - longitudinal and transverse vibration - Free torsional vibration of two and three rotor system with geared systems. **(15)**

TOTAL : 60

TEXT BOOKS

1. *F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II, - Dynamics, 12th Edition, Tata McGraw Hill, 2019.*
2. *Irving H. Shames, Engineering Mechanics, 4th Edition, Prentice Hall, 2018.*

REFERENCES

1. *R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 14th Edition, 2017.*
2. *Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, Oxford University Press, 2019.*
3. *S. S. Bhavikkatti, Engineering Mechanics, New age international, 2019.*
4. *https://nptel.ac.in/courses/112/106/112106286/*

19ME33 - FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO 1 *: Explain fluid properties, apply principles of manometry and analyze stability of floating bodies.*

CO 2 *: Develop conservation equations of mass, momentum and energy for non-reactive fluid flows.*

CO 3 *: Deduce Non-dimensional numbers using Buckingham's Pi theorem and explain similarity laws.*

CO 4 *: Analyze laminar boundary layer over a flat plate and distinguish between laminar and turbulent flows.*

CO 5 *: Estimate head loss through pipes and explain velocity measurement using venturimeter, orifice meter and Pitot tubes.*

CO 6 *: Analyze turbines using velocity diagrams.*

FLUID PROPERTIES AND FLUID STATICS

Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies. **(7)**

GOVERNING EQUATIONS OF FLUID MOTION; DIMENSIONAL ANALYSIS

Control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Euler & Bernoulli's Equations; Buckingham's Pi theorem - applications - similarity laws and models. **(11)**

LAMINAR BOUNDARY LAYER AND ELEMENTARY TURBULENT FLOW

Viscous flow of incompressible fluids, boundary layers, elementary turbulent flow. **(10)**

FLOW LOSSES AND MEASUREMENT

Flow through pipes, head losses in pipes, bends and fittings. Flow & velocity measurement - venturi, orifice, pitot tubes. **(6)**

FLUID MACHINERY

Classification of Fluid Machines, Euler Turbomachine equation, Velocity triangles, Centrifugal Pumps - working principle and performance; Rotary Pumps - classification; Reciprocating pump - working principle, Pelton, Francis and Kaplan Turbines - Working Principle and Performance. **(11)**

TOTAL : 45

TEXT BOOKS

1. *Fox R W, Mc Donald A and Pritchard, Introduction to Fluid Mechanics, Wiley, 2018.*
2. *F. M. White, Fluid Mechanics, 8th Edition, McGraw Hill India, 2019.*

REFERENCES:

1. *Muralidhar, K. and Biswas, G., Advanced Engineering Fluid Mechanics, Alpha science international limited, 3rd Edition, New Delhi, 2018.*
2. *Bansal, R. K., A textbook of Fluid Mechanics and Hydraulic Machines, Lakshmi Publications, 9th edition (revised), 2018.*
3. *John. M. Cimbala and Yunus A. Cengel, Fluid Mechanics: Fundamentals and Applications, 4th Edition, McGraw-Hill, 2019.*
4. *https://nptel.ac.in/courses/112/104/112104117/*
5. *https://nptel.ac.in/courses/112/105/112105206/*
6. *https://nptel.ac.in/courses/112/104/112104118/*

19ME34 - EMBEDDED PROCESSOR ARCHITECTURE AND PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Distinguish between RISC and CISC processors.*

CO2 *: Use the programmer's model and outline the architecture of the ARM processor.*

CO3 *: Choose the ARM instructions for performing data transfer, data processing and control operations.*

CO4 *: Develop assembly language programs for arithmetic and data acquisition applications.*

CO5 *: Write the assembly language program to control the speed of the dc motor and stepper motor.*

INTRODUCTION

Introduction to CPU: ALU and control unit - instruction set design - Complex Instruction Set Computer (CISC) -Reduced Instruction Set Computer (RISC) architecture - advantages and disadvantages. **(9)**

ARM ARCHITECTURE

ARM Programmer's model - registers - ARM memory organization - load-store architecture -ARM instruction set - ARM exceptions - ARM development tools. **(9)**

ARM ASSEMBLY LANGUAGE PROGRAMMING

Data processing instructions - types of operands - data transfer instructions - addressing modes - control flow instructions -branch - conditional branch instructions - subroutine and return instructions - writing simple assembly language programs. **(9)**

ARM ORGANIZATION

3-stage pipeline organization - 5-stage pipeline organization - ARM instruction execution - data processing instructions - data transfer instructions - branch instructions - adder - ALU functions - barrel shifter - multiplier -data path layout. **(9)**

TYPICAL APPLICATIONS

Interfacing examples - LED - Analog to Digital converters - Digital to Analog converters - stepper motor - seven segment display - PWM based speed control. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Steve Furber, ARM System-on-Chip Architecture, Pearson Education Limited, 2018.*
2. *Andrew Sloss, ARM System Developer's Guide, Morgan Kaufmann Publishers, 2017.*

REFERENCES

1. *David E. Simon, An Embedded Software Primer, Pearson Education Asia, 2017.*
2. *Raj Kamal, Embedded Systems Architecture, Programming and Design, Tata McGraw Hill, 2017.*
3. *Jonathan W. Valvano, Introduction to ARM Cortex - M Microcontrollers, 5th Edition, 2017.*
4. *ARM Architecture reference manual, 2018.*
5. *https://nptel.ac.in/courses/106/105/106105193/*

19HSS01 - SCIENCE OF CREATIVITY AND PROFESSIONAL ETHICS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of course, students will be able to

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

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

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

LIFE FORCE, CONCIOUSNESS AND EVOLUTION OF UNIVERSE

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

YOGA AND ITS BENEFITS

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

HARMONY IN LIFE, INTROSPECTION AND HUMAN VALUES

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

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

TOTAL: 15

TEXT BOOKS

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

REFERENCES

1. *Sadhguru, "Body the Greatest Gadget and Mind is your Business", Diamond Pocket Books Pvt. Ltd, Isha Foundations, 2013.*
2. *Swami Vivekananda and Swami Nikhilananda, "Karma Yoga and Bhakti Yoga", 2nd Edition, Ramakrishna Vivekananda Publications, 2008.*
3. *Mike W. Martin and Roland Schinzinger,"Ethics in Engineering", 4th Edition McGraw Hill, NewYork, 2005.*
4. *M. Govindarajan, S. Natarajan, V.S. Senthilkumar, "Engineering Ethics", 1st Edition, Prentice Hall of India, 2009.*

19MEL35 - COMPUTER AIDED MACHINE DRAWING - I

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Create drafting practices using basic commands to draw the component.*

CO2 : *Construct and edit models using commands (object controlling commands, hatching and blocks) in drafting.*

CO3 : *Specify text, use commands for geometric dimensioning and system variables for the mechanical drawing.*

CO4 : *Develop the orthographic projections of mechanical components.*

CO5 : *Create isometric drawings and use advanced drawing commands, script files and plotting commands for creation of mechanical components.*

CONTENT

Introduction to AutoCAD - Drafting practice using basic commands - Practice to use, edit and modify commands - Advanced editing commands - object controlling commands, hatching and blocks-Creating Text and Inquiry Commands & Geometric Dimensioning and System Variables- Isometric Drawings, Advanced Drawing Commands, Script Files and Plotting Commands- Creation of 2D sectional drawing.

1. Drawing of Simple machine components.
2. Drawing orthographic views of simple blocks.
3. Drawing isometric views of simple blocks.
4. Drawing of 2D assembled machined components.

CONVENTIONS & SECTION VIEWS

BIS / ISO code of practice for engineering drawing - conventional for materials, hole types, internal and external threads, thread types, undercuts, grooves, chamfers, fillet radii and keyways. Conventions of various machine components. Sections - types of sectional views, sectioning.

REFERENCES

1. *CIT, VRET Training Centre Manual, AutoCAD Level-I, (Preliminary Level). 2019.*
2. *Prof. Sham Tickoo, AutoCAD 2017 for Engineers and Designers, Dream Tech Press, 2017.*
3. *George Omura, Mastering AutoCAD 2019 and AutoCAD LT 2019, Wiley India Pvt. Ltd, 2019.*
4. *http://www.nptelvideos.in/2012/12/computer-aided-design.html*

19MEL36A - FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	2	0.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Determine the coefficient of discharge of flow measurement devices - venturimeter, orifice meter, notches and mouthpiece using Bernoulli's equation.*

CO2 : *Experimentally estimate major and minor losses in pipelines.*

CO3 : *Prove Bernoulli's theorem experimentally.*

CO4 : *Experiment on centrifugal pump, reciprocating pump, jet pump and submersible pump to evaluate their performances.*

CO5 : *Experiment on Pelton wheel and Francis turbine to evaluate their performances.*

CO6 : *Summarize experimentation, analyze results and deduce conclusions. Synthesize reports of experiments in accordance with standards.*

LIST OF EXPERIMENTS

1. Venturimeter - Determination of coefficient of Discharge.
2. Pipe friction - Determination of coefficient of Friction.
3. Minor losses - Determination of coefficient of Losses.
4. Determination of coefficient of discharge - Rectangular notch, Orifice & Mouth piece.
5. Bernoulli's Theorem - Verification.
6. Performance test on - Centrifugal pump, Reciprocating pump, Jet pump & submersible pump, Pelton wheel, Francis turbine.

REFERENCE

1. *Fluid mechanics laboratory Manual, Department of Civil Engineering, CIT, 2018.*
2. *https://eerc03-iiith.vlabs.ac.in/*
3. *https://www.vlab.co.in/ba-nptel-labs-civil-engineering*

19MEL36B - ELECTRICAL MACHINES AND DRIVES AND EMBEDDED SYSTEMS LABORATORY

ELECTRICAL MACHINES & DRIVES LABORATORY

L	T	P	C
0	0	2	0.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

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

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

CO3 : *Demonstrate 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 using converters and chopper fed drive and also to demonstrate the speed control of AC motors 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 using drive.*

LIST OF EXPERIMENTS

1. Load test on single phase Alternator.
2. Load test on three phase squirrel cage IM.
3. AC voltage controller for fan motor speed control.
4. Load test on single phase Capacitor start IM.
5. Speed control of three phase induction motor using AC drive.

REFERENCE

1. Electrical Drives and Controls laboratory manual, Department of Electrical Engineering, CIT, 2018.

EMBEDDED SYSTEMS LABORATORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Develop simple programs for ARM Processor*

CO2 *: Analyze the input and output modules working through ARM development platform*

CO3 *: Experiment with display devices- LED & LCD using ARM Processor*

CO4 *: Test the stepper motor setup for different step angle rotation using ARM processor*

CO5 *: Develop programs for interfacing various devices with ARM Processor*

LIST OF EXPERIMENTS WITH ARM PROCESSOR

1. Display interfacing (LED, 7 segment LED and LCD).
2. Temperature sensor interfacing.
3. Stepper motor interfacing.
4. Interrupt programming.
5. DC Motor interfacing.

REFERENCES

1. *Embedded processor architecture and programming laboratory Manual, Department of Electrical Engineering, CIT, 2018.*
2. *Jonathan W. Valvano, Introduction to ARM Cortex - M Microcontrollers", 4th edition, 2017.*
3. *Joseph Yiu, A Definitive guide to the ARM Cortex-M0, Newnes, 2018.*

19HOC31 - COMMUNICATION SKILLS FOR ENGINEERS - I

L	T	P	C
0	0	2	1

COURSE OUTCOMES

The student will be able to

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

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

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

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

PERSONALITY DEVELOPMENT

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

VERBAL COMMUNICATION

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

BUSINESS COMMUNICATION

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

PUBLIC SPEAKING

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

REFERENCES

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

SEMESTER - IV

19ME41 - APPLIED THERMODYNAMICS

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Determine thermodynamic state points in an Otto or Diesel cycle, using air-standard assumptions, to calculate the performance parameters of IC engines under specified operating conditions.*

CO2 : *(i) Compare the performance of single-stage and multi-stage compressors (isothermal compression) of specified clearance, with and without inter-cooling; (ii) Calculate the power requirements for a specified free air delivery and pressure ratio.*

CO3 : *Analyze the performance of ideal and non-ideal gas turbine cycles with one or more of the following modifications: regeneration, inter-cooling, and reheating, for specified operating conditions.*

CO4 : *(i) Analyze and compare the performance of an ideal and a non-ideal Rankine cycle and its modifications (regeneration, reheat, or a combination of reheat and regeneration) using steam tables or Mollier chart. (ii) Analyze steam flow through nozzles*

CO5 : *Use psychrometric chart or relations to estimate changes in enthalpy and humidity during sensible heating, cooling, humidification and dehumidification processes, for specified air-conditioning requirements.*

I. C. ENGINES

Air Standard Otto, Diesel and Dual Cycles - Efficiency, mean effective pressure. Testing and performance of internal combustion engines. **(15)**

RECIPROCATING COMPRESSORS

Working principle - equations for shaft work and efficiencies - effect of clearance on volumetric efficiency. Working principle of multistage reciprocating compressors, inter-cooler, optimum intermediate pressure in a two stage compressor and performance of multi stage compressor. **(15)**

GAS POWER CYCLES

Gas Turbine Cycles - ideal and actual Brayton cycle - open and closed cycle gas turbines - modifications in Brayton cycle - regeneration - compressor inter-cooling - turbine reheat. **(15)**

STEAM POWER CYCLES and STEAM NOZZLES

Ideal and actual Rankine cycle - superheat - reheat - regeneration. Steam nozzles - Application of steady flow energy equation, effect of friction. Pressure compounding and Velocity compounding of turbines (descriptive treatment only). **(15)**

PSYCHROMETRY

Atmospheric air - Psychometric Properties - Dry Bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation -Adiabatic Saturation, Carrier's Equation - Psychrometric chart. **(15)**

TOTAL : 60

TEXT BOOKS

1. *Mahesh M Rathore, Thermal Engineering, Tata McGraw-Hill, 2018.*
2. *Kothandaraman C. P. and Domkundwar, Thermodynamics and Thermal Engineering, Dhanpat Rai and Sons, 2018.*
3. *Rajput R. K., Thermal Engineering, Laxmi Publications, 10th Edition, 2018.*

REFERENCES

1. *Nag P.K., Engineering Thermodynamics, 5th Edition, Tata McGraw-Hill, 2019.*
2. *Richard E. Sonntag, Claus Borgnakke, Gordon J. Van Wylen, Fundamentals of Thermodynamics, 9th Edition, Wiley, 2018.*
3. *Ganesan V., Internal Combustion Engines, Tata McGraw-Hill, 2017.*
4. *Mathur M. L. and Sharma R. P., Internal Combustion Engines, Dhanpat Rai and Sons, 2018.*
5. *https://nptel.ac.in/courses/112/103/112103275/*

19ME42 - STRENGTH OF MATERIALS

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Recognize various types of loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components.*

CO2 : *Evaluate the strain and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.*

DEFORMATION IN SOLIDS

Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations - strain energy - proof resilience- volumetric, linear and shear strains-toughness and elastic recovery- principal stresses and principal planes- Mohr's circle. **(15)**

SHEAR FORCE AND BENDING MOMENTS - STRESSES IN BEAMS

Transverse loading on beams- shear force and bending moment diagrams - singularity functions - simply supported and overhanging beams, cantilevers. Theory of bending of beams - bending stress distribution - neutral axis, shear stress distribution for different loadings. **(15)**

DEFLECTION OF BEAMS

Differential equations of elastic curve - Deflection by integration - singularity functions - deflection by superposition, Maxwell's reciprocal theorems. **(15)**

TORSION

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. **(15)**

STRESS IN CYLINDERS, SHELLS AND COLUMNS

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure, critical load of long and slender columns, short columns, eccentric loading of different columns with end conditions. **(15)**

TOTAL : 60

TEXT BOOKS

1. *R. Subramanian, Strength of Materials, Oxford University Press, 2018.*
2. *Rattan S S, Strength of Materials, 3rd Edition, Tata McGraw Hill, 2017.*

REFERENCES

1. *Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2017.*
2. *Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw-Hill Publishing Co. Ltd., New Delhi 2017.*
3. *https://nptel.ac.in/courses/112/107/112107146/*
4. *https://nptel.ac.in/courses/105/105/105105108/*
5. *https://nptel.ac.in/courses/112/106/112106141/*

19ME43 - MECHANICS OF MACHINES

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: To understand the kinematics and rigid-body dynamics of kinematically driven machine components.*

CO2 *: To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.*

CO3 *: To be able to design some linkage mechanisms and cam systems to generate specified output motion.*

CO4 *: To understand the kinematics of gear trains.*

FUNDAMENTALS OF MECHANISMS

Kinematic links -Pairs - Lower and Higher pairs - Degrees of freedom, mobility-Grubbler's equation. Grashof's law - Kinematic inversions of four bar chain and slider crank chains. Study of Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms. **(9)**

KINEMATIC AND DYNAMIC ANALYSIS OF MECHANISMS

Displacement, velocity and acceleration analysis of four bar and slider crank mechanisms - loop closure equations - instantaneous center of rotation - graphical method (not for examination) - Coriolis component of acceleration. Dynamic equivalence of two mass systems- static force analysis - dynamics of four bar mechanism - slider crank - piston effect, crank effect. **(15)**

CAMS AND FOLLOWERS

Classification - Displacement diagrams - Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions - specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers. **(9)**

GEARS AND GEAR TRAINS

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack and pinion gears, epicyclic and regular gear train kinematics. **(15)**

BALANCING OF MASSES

Balancing - masses in single and multiple planes, reciprocating masses - primary and secondary forces and moment balancing - multi-cylinder in-line and V-engines - direct and reverse crank methods. **(12)**

TOTAL : 60

TEXT BOOKS

1. *Thomas Bevan, Theory of Machines, 3rd Edition, CBS Publishers & Distributors, 2019.*
2. *Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2018.*

REFERENCES

1. *Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2019.*
2. *Ghosh A. & Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 2018.*
3. *https://nptel.ac.in/courses/112/104/112104121/*
4. *https://nptel.ac.in/courses/112/105/112105268/*
5. *https://nptel.ac.in/courses/112/106/112106270/*

19ME44 - MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Identify crystal structures for various materials and understand the defects in such structures.*

CO2 *: Explain how to tailor material properties of ferrous and non-ferrous alloys.*

CO3 *: Quantify mechanical integrity and failure in materials.*

CRYSTAL STRUCTURE AND IMPERFECTIONS

Unit cells, Metallic crystal structures - Density computation, Polymorphism and Allotropy. Imperfection in solids: Point, line and volume defects.

Dislocations and strengthening mechanisms -characteristics of dislocation - slip systems - dislocation by twinning. Grain size reduction - solid solution strengthening and strain hardening - recovery - recrystallization and grain growth. **(9)**

ALLOYS AND PHASE DIAGRAMS

Constitution of alloys and phase diagrams - constitution of alloys - solid solutions - substitutional and interstitial. Phase diagrams, isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions. Iron-carbon equilibrium diagram. Classification of steel and cast iron - microstructure, properties and application. **(8)**

HEAT TREATMENT

Heat Treatment - full annealing, stress relief, recrystallisation and spheroidizing - normalising, hardening and tempering of steel. Isothermal transformation diagrams - cooling curves superimposed on CCR diagram. Hardenability - Jominy end quench test - austempering, martempering. Case hardening, carburizing, nitriding, cyaniding, carbonitriding - flame and induction hardening, Ageing. **(9)**

FERROUS AND NON-FERROUS MATERIALS

Ferrous and nonferrous metals - effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels - HSLA. Grey, white, malleable, spheroidal, graphite, alloy cast-iron. Copper and copper alloys, Aluminium and its alloys, Nickel and its alloys, titanium and its alloys, super alloys: Ni based, Fe based and Co based, Maraging steels, Bearing alloys, Metal matrix composites, preparation, properties and applications. **(10)**

NON-METALLIC MATERIALS

Non-metallic materials - polymers, types of polymer, commodity and engineering polymers. Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE polymers. Urea and phenol formaldehydes. Engineering Ceramics - properties and applications of Al2O3, SiC, Si3N4, PSZ etc. Fibre and particulate reinforced composites and resin plastics. **(9)**

TOTAL : 45

TEXT BOOKS

1. *W. D. Callister, Materials Science and Engineering-An Introduction, 6th Edition, Wiley India, 2018.*
2. *Agarwal B.K., Introduction to Engineering Materials, Tata McGraw-Hill Publishing Company, New Delhi, 25th reprint, 2018.*

REFERENCES

1. *Avner S. H., "Introduction to Physical Metallurgy", Tata McGraw-Hill Publishing Company, New Delhi, 2nd Edition, 2017.*
2. *Lakhtin Y., Weinstein N., "Engineering Physical Metallurgy", University Press of the Pacific, 2017.*
3. *Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice - Hall of India, 2018.*
4. *V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 2017.*
5. *https://nptel.ac.in/courses/113/102/113102080/*
6. *https://nptel.ac.in/courses/112/106/112106293/*
7. *https://nptel.ac.in/courses/113/106/113106032/*

19ME45 - MANUFACTURING PROCESSES - I

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

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

CO1 *: Prepare a pattern, riser, and gating system to produce grey cast iron castings using sand molds. Assess solidification process in steel castings in terms of pouring times and cooling times, and predict directional solidification and grain growth during cooling.*

CO2 *: Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.*

CO3 *: Compute blanking forces, design punches and dies, and develop process plans for making sheet metal products.*

CO4 *: Assess the suitability of using SMAW, GMAW, GTAW, SAW to weld ferrous alloys, and examine the effect of residual stresses and distortion.*

CO5 *: Perceive the basics of Powder metallurgy and application of powder metallurgy*

CO6 *: Classify different plastic molding processes, Extrusion of Plastic and Thermoforming.*

METAL CASTING PROCESS

Patterns- Pattern materials, types of pattern, Pattern allowances-types of molding sand and its properties, mold sand composition- Core making-Methods of sand testing- gating and risering System- Melting Practices: cupola, Induction furnaces construction and operations- Casting cleaning and casting defects-Inspection methods. Special casting processes: Investment casting process, Die casting process, shell molding process-centrifugal casting process-CO2 Process. **(9)**

BULK DEFORMATION PROCESSES

Hot working and cold working of metals-Forging processes-Open, impression and closed die forging-types of Forging machines-Typical forging operations-Swaging-Rolling of metals-Types of rolling mills-Flat strip rolling- Shape rolling operations-Defects in rolled parts-principle of rod and wire drawing-Tube drawing-Principles of extrusion-Types of Extrusion-hot and cold extrusion - Equipments used. **(9)**

SHEET METAL PROCESSES

Sheet metal characteristics-Typical shearing operations, bending and drawing operations, blanking, piercing, punching, trimming, etc. -formability of sheet metal-test methods of formability-Presses for sheet metal working, Elements of a simple die; punch and die clearances; Progressive, compound and combination dies and Blanking force Calculations. Special forming methods: Explosive forming, electromagnetic forming, electro hydraulic forming, composite molding. **(9)**

METAL JOINING PROCESSES

Fusion welding processes-Types of Gas Welding-Fuel Gases, Oxy-Acetylene Welding Equipment-Flame characteristics- Filler and Flux materials, Electric-Arc Welding, Electrodes, Coated electrode designation for manual metal arc welding, Carbon Arc Welding, Inert-Gas Shielded Arc Welding, Tungsten Inert-Gas Welding (TIG), Gas Metal-Arc Welding (GMAW), Submerged Arc-Welding (SAW), Other Arc-Welding Processes, Resistance Welding-Welding Defects. Basic principles of Thermit Welding, Laser Beam welding, Electron Beam Welding, Friction welding, Friction stir welding and Ultrasonic welding. **(9)**

POWDER METALLURGY

Definition-Advantages, Disadvantages/Limitations of powder metallurgy-Applications of powder metallurgy-Manufacture of parts by powder metallurgy-Production of metal powders-Blending of metal powders-pressing or compaction of metal powders-sintering-finishing operations. **(4)**

PLASTIC PROCESSING

Processing of plastics: General aspects-Plastic processing methods-compression moulding-Transfer moulding-Injection moulding-Expandable bead moulding- rotomoulding-blow moulding-Extrusion-Thermoforming. **(5)**

TOTAL : 45

TEXT BOOKS

1. *Rao, P. N., "Manufacturing Technology 4e (Vol. 1&2)", Tata McGraw Hill 2017.*
2. *Kalpakjian, S. and Schmid, S. R, "Manufacturing Engineering and Technology" 8th Edition, Pearson Education, 2018.*

REFERENCES

1. *Groover, M. P., "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons Inc.,2015.*
2. *R. K. Rajput "A Textbook of Manufacturing Technology: Manufacturing Processes", 3rd edition, Laxmi publications, 2018.*
3. *https://nptel.ac.in/courses/112/107/112107144/*

19MEL46 - COMPUTER AIDED MACHINE DRAWING - II

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Construct the Surface Modelling and the User Coordinate System for a given component*

CO2 *: Practice Viewports, Model space, Paper space and Layouts.*

CO3 *: Develop Blocks Attributes and External Reference for the mechanical component.*

CO4 *: Develop Menus, Macros and Advanced Rendering and Animation.*

CO5 *: Practice limits, fits, tolerance and also geometrical tolerance.*

CONTENT

Surface Modelling and the User Coordinate System (WCS, UCS) - Solid Modelling, Viewports, Model space, Paper space and Layouts - Blocks Attributes and External Reference - Menus, Macros and Advanced Rendering and Animation.

1. 3D surface modelling of machine components - Part Drawing
2. 3D surface modelling of machine components Assembly Drawing
3. 3D Solid Modelling of a given component - Model 1
4. 3D Solid Modelling of a given component - Model 2
5. Creating line types

LIMITS, FITS AND TOLERANCES

Limits, fits and tolerances - fundamental of deviations - shaft and hole terminology - representation of tolerances on drawing, calculation of minimum and maximum clearance and allowance, selection of fits - representation of fits. Geometric tolerance - uses, types of form and position tolerances, symbols - geometric tolerances. Surface finish symbols - surface roughness and textures.

REFERENCES

1. *CIT, VRET Training Centre Manual, AutoCAD Level-I, (Preliminary Level), 2019.*
2. *Prof. Sham Tickoo, AutoCAD 2017 for Engineers and Designers, Dream Tech Press, 2017.*
3. *George Omura, Mastering AutoCAD 2019 and AutoCAD LT 2019, Wiley India Pvt. Ltd, 2019.*
4. *http://www.nptelvideos.in/2012/12/computer-aided-design.html*

19MEL47A - MATERIAL CHARACTERIZATION AND TESTING LABORATORY

L	T	P	C
0	0	2	0.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Evaluate grain size, morphology, microstructure and microhardness of metals and alloys.*

CO2 *: Estimate hardness and conduct impact tests on specimens.*

CO3 *: Perform tension, shear, torsion and deflection tests on a given specimen.*

LIST OF EXPERIMENTS

1. Evaluation of grain size, morphology, distribution of the reinforcement in copper metal matrix composites.
2. Evaluation of microstructure and microhardness of the friction stir welded steel and aluminium alloy.
3. Evaluation of microstructure of the post weld heat treated SMA welded mild steel.
4. Measurement of hardness of the quenched sample using Jominy End Quench Test Apparatus.
5. Tension & Shear test on mild steel rod.
6. Hardness test - Brinell & Rockwell.
7. Impact test on metals (Izod and Charpy tests)
8. Test on helical spring.
9. Deflection test on wooden beams (simply supported and cantilever)
10. Torsion test on mild steel rod.

REFERENCES

1. *Strength of Materials Laboratory Manual, Department of Civil Engineering, CIT, 2018.*
2. *Rajput R.K, "Strength of Materials", S.K. Kataria and Sons, New Delhi, 2018.*
3. *I.S: 3495 Part I to IV, "Methods of Test for Burnt Clay Building Bricks", Bureau of Indian Standards, New Delhi, 2017.*
4. *Materials and Metallurgy Laboratory Manual, Department of Mechanical Engineering, CIT, 2019.*
5. *https://nptel.ac.in/courses/113/106/113106034/*
6. *https://nptel.ac.in/courses/115/103/115103030/*

19MEL47B - MANUFACTURING PROCESSES LABORATORY

L	T	P	C
0	0	2	0.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Identify suitable mold making process and pattern to perform Packing Gland, Bracket, Stepped Pulley, Bend Pipe, Loose Piece and Square Box patterns.*

CO2 : *Demonstrate Principle and operations of a center lathe to produce cylindrical components of ferrous metals (mild steel) and apply threading process to generate external V - threads and find the pitch, speed and feed of center lathe.*

CO3 : *Apply taper turning process and create a conical shape component made of ferrous and nonferrous metals using center lathe and create a contour shape like concave and convex shapes on cylindrical components of ferrous and non-ferrous using center lathe.*

CO4 : *Perform Butt Joint, Lap joint, T Joint, and Corner Joint in mild steel of 3 mm thickness using welding process, also prepare WPS for different joints.*

CO5 : *Calculate cutting parameters and generate a spur gear and helical gear of ferrous metals using a milling/gear hobbing machine.*

CO6 : *Calculate cutting parameters and generate different shapes using special purpose machines.*

LIST OF EXPERIMENTS

1. Determine the Grain size, Permeability and Compressive Strength of the Moulding Sand.
2. Prepare green sand mould using a solid pattern/ split pattern.
3. Prepare green sand mould using loose piece patterns.
4. Prepare "Butt Joint / lap joint" using MMAW Process and prepare a welding procedure specification (WPS Sheet) & report on post weld inspection.
5. Prepare a WPS Sheet for making "T Joint/ Corner Joint" using TIG/MAG welding Process and perform visual inspection to identify welding defects on weld bead.
6. Prepare a lap Joint on the given work pieces using spot welding equipment.
7. Prepare a component by Lathe machine using operations like Plain, Step Turning and chamfering and Calculate the machining time.
8. Machine a tapered surface in a cylindrical object using any one taper turning method, create a hole and make Convex / concave profile on it. Prepare a dimensional inspection report for the component produced.
9. To produce a spur gear and helical gear using a universal milling machine / gear hobbing machine. Prepare a dimensional inspection report for the component produced.
10. To create holes and make threads by tapping using a drilling machine also make a square keyway using a slotting machine. Prepare a dimensional inspection report for the component produced.
11. To make a cube, stepped slide, male and female stepped slide, angular slide and curve slide using a shaping machine. Prepare a dimensional inspection report for the component produced.
12. To machine a square, a pentagon, a hexagon, and a triangular head using a vertical milling machine. Prepare a dimensional inspection report for the component produced.

19HOC41 - COMMUNICATION SKILLS FOR ENGINEERS - II

L	T	P	C
0	0	2	1

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the student will be able to

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

CO2 : *Construct grammatically correct sentences.*

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

SELF EVALUATION

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

VERBAL AND LOGICAL RESONING

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

GRAMMAR

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

PRESENTATION TECHNIQUES

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

REFERENCES

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

SEMESTER - V

19ME51 - HEAT AND MASS TRANSFER

(Use of approved HMT data book is permitted)

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Deduce and estimate heat transfer rate for one dimensional steady and unsteady state heat transfer problems with relevant boundary and initial conditions.*

CO2 : *Choose appropriate empirical correlations for convective heat transfer to determine the values of heat transfer coefficients and calculate heat transfer rates.*

CO3 : *Calculate the radiation heat exchange between gray surfaces in non-participating media*

CO4 : *Classify phase change heat transfer processes and draw analogy between heat and mass transfer mechanisms.*

CO5 : *Design a heat sink for a given heat duty and convective heat transfer coefficient*

CO6 : *Analyze heat exchangers using LMTD and Effectiveness-NTU methods*

CONDUCTION

Introduction - Modes of Heat Transfer - General Heat Conduction Equation for constant thermophysical properties (2-D) - One dimensional heat flow through composite walls, cylinders and spheres (with and without heat generation) - Effect of variable thermal conductivity - insulation - critical thickness. Unsteady heat conduction - lumped parameter analysis, Unsteady heat conduction with spatial variation - plane wall (problems using Heisler charts) - Infinite solids (Qualitative Treatment). **(12)**

CONVECTION

Forced Convection - Flow over flat plate - hydrodynamic boundary layer and thermal boundary layer - Velocity distribution flow through pipes- heat transfer coefficient - heat transfer rate calculation using empirical correlations.

Free Convection - Vertical surfaces - Horizontal surfaces - heat transfer coefficient - heat transfer rate calculation using empirical correlations. **(12)**

RADIATION

Mechanism -types of surfaces - Stefan Boltzmann's law - Emissivity-absorptivity - reflectivity - transmissivity - emissive power - Kirchhoff's Law - shape factor for simple geometries -Radiation heat exchange between gray surfaces surrounded by non-participating media - Radiation shields. **(12)**

BOILING, CONDENSATION AND MASS TRANSFER

Boiling - Pool Boiling and Flow Boiling Regimes, Condensation - Filmwise and drop wise condensation.

Introduction to mass transfer - Modes of mass transfer - Fick's Law - Diffusion mass transfer - Equimolar counter diffusion, Analogy between heat and mass transfer **(12)**

HEAT SINKS, HEAT EXCHANGERS AND HEAT PIPES

Heat sinks - Applications - Construction & types, One-dimensional extended surface analysis - component performance parameters -Effectiveness and Efficiency - Design for a heat duty. Heat exchangers - Classification of Heat exchangers - LMTD and Effectiveness NTU Methods - Parallel, Counter and Cross flow, Multi passes flow - fouling factor. Heat pipes (Qualitative treatment) - Introduction, classification and applications. **(12)**

TOTAL : 60

TEXTBOOKS

1. *Yunus A Cengel and Afshin J Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", 5th Edition, McGraw Hill Education, 2015.*
2. *P.K. Nag, "Heat and Mass Transfer", 3rd Edition, Tata McGraw Hill Co., 2011.*

REFERENCES

1. *Frank P Incropera, "Principles of Heat and Mass Transfer", John Wiley and Sons (Asia) Ltd., 2013.*
2. *Amir Faghri, "Heat Pipe Science and Technology", 2nd edition, Global Digital Press, 2016.*
3. *C.P.Kothandaraman and S.Subramanyan, "Heat and Mass Transfer Data Book", New Age International Publishers, 2008.*
4. *Mahesh M Rathore, "Engineering Heat and Mass Transfer", 2nd Edition, Laxmi Publications, 2015.*
5. *J P Holman, "Heat Transfer", Tata McGraw Hills Education,10th Edition, 2010.*
6. *https://nptel.ac.in/courses/112/101/112101097/*

19ME52 - DESIGN OF MACHINE ELEMENTS

(Use of approved design data book is permitted)

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Calculate a suitable size for a specified machine element to withstand a given load and permissible stress conditions (Normal , Shear , torsional combination of normal and shear stresses) using Principal stresses, Theories of failure, Fatigue failure (Soderberg, Goodman and Gerbers equations).*

CO2 : *Design using factor of safety and permissible stresses, and provide a drawing of a power transmission shaft, Flange, Hub, and Key for a Rigid and Flexible coupling to transmit specified power and torque.*

CO3 : *Design a spring (compression, co-axial, Leaf) or a flywheel for various applications (Railway buffer spring, Automobile suspension, Toys, Punching machine) to store energy and prevent unwanted shock and vibrations.*

CO4 : *Design metric bolts, rivets and welded joints (diameter, size and thickness) for centrally, axially and eccentrically loaded, unsymmetrical sections, to withstand specified loads.*

CO5 : *Design and choose a suitable bearing (ball, roller, or journal) for standard specified loads (axial and radial load) and specified life.*

DESIGN FUNDAMENTALS FOR MACHINE ELEMENTS

Introduction to design process-factors influencing in machine design - principles of standardization, selection of materials - types of stresses, factor of safety., theories of failure. Stress concentration, fluctuating stresses, fatigue failure, fatigue limit, S-N curves, Soderberg, Goodman and Gerber equations, combined stress. **(12)**

DESIGN OF SHAFTS AND COUPLINGS

Forces on shafts due to gears, belts and chains - design of shafts based on strength, torsional rigidity and critical speed. Design of square and taper key - use of standards - design of rigid coupling, flexible flange couplings, and applications. **(12)**

DESIGN OF ENERGY STORING ELEMENTS

Helical spring and leaf spring - stresses and deflection in round wire helical springs - accounting for variable stresses - concentric springs. Design of leaf springs - stress and deflection equation - design of flywheel - fluctuation of speed - energy stored - stresses in rims and arms for engines and punching machines. **(12)**

DESIGN OF JOINTS

Joint strength equations, efficiency, design of riveted joints - joints of uniform strength, eccentrically loaded riveted joints, design of longitudinal and circumferential boiler joints Welded joints - strength of welds, centrally loaded, unsymmetrical sections, axially loaded and eccentrically loaded joints -design of bolted joints. **(12)**

DESIGN OF BEARINGS

Design of hydrodynamic and hydrostatic bearings - effect of friction under uniform pressure and wear conditions - torque calculations - theory of lubrication, McKee's equation, Sommerfeld number - static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings. Design of rolling contact bearings. Introduction to needle and air-thrust bearings. **(12)**

TOTAL : 60

TEXT BOOKS

1. *Robert L Mott., "Mechanical Elements in Mechanical Design", 6th Edition, Macmillan Publishing Co., London, 2018*
2. *V. B. Bhandari, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Publishing Ltd., New Delhi, 2017.*

REFERENCES

1. *Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 7th Edition, Wiley, 2019*
2. *https://nptel.ac.in/courses/112/105/112105124/*
3. *https://nptel.ac.in/courses/112/105/112105125/*
4. *https://nptel.ac.in/courses/112/106/112106137/*
5. *NPTEL courses: http://nptel.iitm.ac.in/courses.php - web and video resources on "Dynamics of Mechanical System/ Design of Machine Elements /Machine Design".*

HAND BOOK

1. *PSG, "Design Data Book", Kalaikathir Achagam Publishers, 2020.*

19ME53 - MANUFACTURING PROCESSES - II

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Calculate cutting force, tool life of single point and multi point tools, illustrate cutting tool geometry and chip formation, in orthogonal metal cutting process.*

CO2 : *Illustrate operation such as Turning, Facing, Threading, Knurling and Grooving on Centre Lathe and special purpose lathes.*

CO3 : *Demonstrate and Produce a component using boring, shaping, planning, drilling, milling, sawing and broaching machines.*

CO4 : *Demonstrate the proper setups, uses, and operations associated with the grinding machine, its accessory devices and illustrate gear manufacturing and forming.*

CO5 : *Choose and apply advanced machining processes (Chemical Machining, Electro-Chemical Machining, Grinding, Wire EDM, Laser, Electron Beam Machining, Water and Abrasive Jet Machining) to produce components from hard and smart materials.*

THEORY OF METAL CUTTING

Introduction: material removal processes: Nomenclature of a single point cutting tool, mechanics of metal cutting, orthogonal and oblique cutting, Mechanism of chip formation, Types of chips Use of chip breaker in machining, Machining forces and Merchant circle diagram (MCD), Cutting tool materials-Thermal aspects-tool wear and tool life, surface finish, cutting fluids. **(9)**

CENTRE LATHE AND SPECIAL PURPOSE LATHES

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, Capstan and turret lathes automats single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism. **(9)**

SPECIAL MACHINE TOOLS

Reciprocating machine tools: shaper, planer, slotter. Milling: types, milling cutters, operations. Hole making: drilling Introduction, Reaming, Boring, Tapping Other Hole-Making Operations- Sawing machine: hack saw, band saw, circular saw-Broaching machines: broach construction push, pull, surface and continuous broaching machines. Work holding devices-Concept of Jigs and Fixtures and its applications. **(9)**

ABRASIVE PROCESSES AND GEAR MANUFACTURING

Abrasive processes: Introduction-Grinding wheel: Designations and selection, types of grinding machines cylindrical grinding, surface grinding, Centreless grinding Grinding Process parameters- honing, lapping, super finishing, polishing and buffing, - Gear cutting, forming, generation, shaping, hobbing. **(9)**

ADVANCED MACHINING PROCESSES

Need for Advanced machining processes, Electric-Discharge Machining (EDM) -Electrochemical Machining-Ultrasonic Machining-chemical Machining-Laser Beam machining, Abrasive Water Jet machining (AWJM), electron Beam Machining (EBM), Ion Beam Machining (IBM), Plasma Arc Machining (PAM)-Equipments- Process- Process Parameters and Machining Characteristics, Applications, Limitations - Nanofabrication - Micromachining - Economics of Advanced Machining Processes. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Rao, P. N., "Manufacturing Technology 4e (Vol. 1&2)", Tata McGraw Hill 2017.*
2. *Kalpakjian, S. and Schmid, S. R, "Manufacturing Engineering and Technology" 8th edition, Pearson Education, 2018.*

REFERENCES

1. *Groover, M. P., "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons Inc., 2015.*
2. *R. K. Rajput "A Textbook of Manufacturing Technology: Manufacturing Processes", 3rd edition, Laxmi publications, 2018.*
3. *https://nptel.ac.in/courses/112/105/112105126/*

19ME54 - METROLOGY AND QUALITY CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Handle various linear and angular measuring instruments and design plug and ring gauges*

CO2 : *Demonstrate various measurements in elements of screw thread and gear thread tooth parameters using floating carriage micrometer, gear tooth vernier caliper*

CO3 : *Illustrate surface finish measurements and interferometry principles using different types of stylus probe instruments, interferometers, projectors and microscopes*

CO4 : *Demonstrate various SQC tools and analyse the data statistically to interpret various control charts and decide upon the action to be taken for controlling quality*

CO5 : *Practice the concepts of sampling, constructing OC curves and reliability evaluation for inspection and quality control*

INTRODUCTION TO METROLOGY

Basic concepts, importance of metrology, standards of measurement, concepts of limits, fits & tolerances, precision and accuracy, sources of errors, linear measuring instruments - advantages & limitations of commonly used precision instruments. Angular measuring instruments - Slip gauges, comparators, dial indicator, calibration, Interchangeability, Taylor's principle, design of plug and ring gauges. **(9)**

THREAD AND GEAR METROLOGY

Elements of screw thread, errors in threads, measurement of major diameter, minor diameter, effective diameter, pitch - floating carriage micrometer. Elements of gear, measurement of tooth thickness (constant chord method), gear tooth vernier, Measurement of pitch, profile errors and total composite errors of gears. **(9)**

SURFACE FINISH MEASUREMENTS AND INTERFEROMETRY

Surface topography - definitions, CLA, Ra, RMS, Rz values and their interpretation, measurement of surface finish stylus probe instruments - Talysurf profilometer and Tomlinson surface meter. Interferometry - principle, types of interferometers - Michelson, Twyman Green Specialisation of Michelson, NPL flatness Interferometers, The Pitter NPL gauge - laser interferometer. Optical projectors and microscopes. **(9)**

STATISTICAL QUALITY CONTROL AND CONTROL CHARTS

SQC, Seven QC tools, chance causes and assignable causes, case studies on application of SQC. Probability distributions - binomial, poisson, geometric, hyper geometric, poisson as an approximation to binomial, normal as an approximation to binomial, Need for control charts, analysis of patterns of control charts, control charts for variables - X bar and R chart, control charts for attributes - p, np, C charts, evaluation of process capability. **(9)**

ACCEPTANCE SAMPLING AND RELIABILITY:

Sampling Inspection - concepts of acceptance sampling, sampling plans - simple - double - multiple and sequential sampling plans, Operating Characteristic (OC) curves - construction, average outgoing quality level, average total inspection, producer risk and consumer risk. Reliability - definition, Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), types of failure, failure rate, evaluation of reliability-series, parallel and series-parallel device configurations. Redundancy and improvement factors evaluations. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Montgomery, D. C. "Introduction to Statistical Quality Control", 8th edition, John Wiley & Sons, 2018.*
2. *Mahajan, M, "A Textbook of Metrology", Dhanpat Rai & Sons, New Delhi, 2010.*

REFERENCES

1. *Gupta, I. C, "Textbook of Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 2018.*
2. *Jain, R. K. "Engineering Metrology", 21st edition Khanna Publishers, New Delhi, 2018.*
3. *https://nptel.ac.in/courses/112/106/112106179/*
4. *https://nptel.ac.in/courses/112/104/112104250/*

19ME55 - OPERATIONS RESEARCH

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

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 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 modelling.*

CO6 *: Apply Monte-Carlo simulation technique to solve simple and real time problems.*

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. **(6)**

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. **(6)**

TRANSPORTATION AND ASSIGNMENT

Formulation of Transportation Problem, Initial Feasible Solution Methods, Optimality Test, Degeneracy in Transportation Problem; Assignment Problem, Hungarian Method, Travelling Salesman Problem. **(6)**

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. **(6)**

INVENTORY AND MODELS

Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, Newsboy Problem. **(6)**

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. (8)

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. **(7)**

Total : 60

TEXT BOOKS

1. *Taha, H. A, "Operations Research - An Introduction",10th Edition, Pearson, 2017.*
2. *Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", 10th Edition, Tata McGraw Hill, 2015.*

REFERENCES

1. *Michael W. Carter, Camille C. Price, Ghaith Rabadi, Operations Research Practical Introduction, 2nd Edition, CRP Press, 2019*
2. *Mittal, K. V. and Mohan, C. "Optimization Methods in Operations Research and Systems Analysis", 4th Edition, New Age,2016.*
3. *S. S. Rao, "Engineering Optimization: Theory and Practice", 5th Edition, John Wiley & Sons, 2019.*
4. *https://nptel.ac.in/courses/111/107/111107128/*
5. *https://nptel.ac.in/courses/112/106/112106134/*

19MEL56A - APPLIED THERMAL SCIENCES LABORATORY

L	T	P	C
0	0	2	0.5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Identify and explain components and mechanisms of IC engines.*

CO2 *: Conduct performance tests on IC engines, reciprocating compressors and refrigeration systems.*

CO3 *: Evaluate performance of refrigeration system*

CO4 *: Estimate heat transfer parameters - radiant factor, emissivity, free and forced convection heat transfer coefficients*

CO5 *: Estimate thermal conductivity of different solids*

CO6 *: Conduct performance tests on pin-fin and heat exchangers*

LIST OF EXPERIMENTS

1. Construction of Port timing (2S) and Valve timing (4S) diagrams for a single-cylinder engine.
2. Performance test on four stroke multi-cylinder petrol engine (MPFI).
3. Heat balance test on four stroke single-cylinder diesel engine.
4. Determination of volumetric efficiency of reciprocating air compressor.
5. Viscosity of lubricating oil - Redwood viscometer.
6. Performance test on vapor compression refrigeration system.
7. Determination of Radiant Factor and Emissivity using Stefan Boltzmann Apparatus
8. Determination of Convective heat transfer coefficient in Free and Forced Convection
9. Determination of Thermal Conductivity in Composite walls, Insulation Sheets and Insulation Powder
10. Unsteady state Heat Transfer Analysis
11. Determination of Heat Transfer in Pin-Fin
12. Performance Analysis of Plate Heat Exchanger, and Shell and Tube Heat Exchanger

REFERENCES

1. *Thermal Engineering Laboratory Manual, Department of Mechanical Engineering, CIT, 2015.*
2. *Heat Transfer Laboratory Manual, Department of Mechanical Engineering, CIT, 2019.*
3. *Frank P Incropera, "Principles of Heat and Mass Transfer", John Wiley and Sons (Asia) Ltd., 2013.*
4. *C.P.Kothandaraman and S.Subramanyan, "Heat and Mass Transfer Data Book", New Age International Publishers, 2008.*

19MEL56B - DYNAMICS AND METROLOGY LABORATORY

DYNAMICS LABORATORY

L	T	P	C
0	0	2	0.5

ASSESSMENT : PRACTICAL

DYNAMICS LABORATORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Model and analyze the mechanism to evaluate the position, velocity and acceleration using MATLAB.*

CO2 *: Demonstrate the working principle of gyroscope, governor and cam.*

CO3 *: Examine the balancing of reciprocating mass.*

CO4 *: Inspect the critical speed of the shaft under the given load conditions.*

CO5 *: Determine the vibration response of different systems.*

LIST OF EXPERIMENTS

1. Kinematic and Dynamic analysis of a four bar and slider crank mechanism using MATLAB.
2. Study of gyroscopic couple using motorized gyroscope apparatus.
3. Determination of the whirling speed of a shaft using whirling of shafts demonstrator.
4. Using universal vibration apparatus,

a. Determining the radius of gyration of a compound pendulum;

b. Determining the radius of gyration of a body using bifilar suspension;

c. Determining the radius of gyration of a body using tri-filar suspension;

5. Experiment on different types of cam and followers.
6. Determination of the controlling force at a given speed, sensitiveness at given limits of lift and governor effort and power of various types of governors.
7. Study on balancing of reciprocating mass.
8. Determination of vibration response using free and forced vibration test.

REFERENCES

1. *Mechanisms and Machines Laboratory manual, Department of Mechanical Engineering, CIT, 2015.*
2. *http://mdmv-nitk.vlabs.ac.in/*
3. *http://mm-nitk.vlabs.ac.in/*
4. *Kinematics and Dynamics of Mechanical Systems, Second Edition: Implementation in MATLAB® and SimMechanics® 2nd Edition, Kindle Edition by Kevin Russell, Qiong Shen, Rajpal S. Sodhi, 2019.*

METROLOGY LABORATORY

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Find angular measurement to set work piece for a desired angle with the help of angle gauges, bevel protractor, sine bar, and slip gauges for inclined components*

CO2 : *Calculate various gear tooth parameters like tooth thickness, pitch, profile errors and total composite errors of a given spur gear using gear tooth Vernier caliper.*

CO3 : *Measure screw thread elements - major diameter, minor diameter, effective diameter and pitch using floating carriage micrometer, tool maker's microscope and profile projector for a given threaded component.*

CO4 : *Interpret and analyse data for P-chart, X bar chart and R chart for given specifications and comment on the nature of the process.*

LIST OF EXPERIMENTS

1. Measurement of angle (taper rod/piece) using sine bar and slip gauges.
2. Measurement of external taper angle using slip gauges and Rollers.
3. Calibration of dial gauge using dial tester.
4. Measurement of gear tooth thickness using gear tooth vernier caliper.
5. Measurement of thread parameters using profile projector.
6. Measurement of thread elements using Tool maker's microscope.
7. Measurement of screw thread parameters using three wire method (Floating Carriage Micrometer).
8. Draw P chart for given specifications and comment on the nature of the process.
9. Draw X and R chart for given specifications and comment on the nature of the process

REFERENCES

1. *Metrology laboratory Manual, Department of Mechanical Engineering, CIT, 2015.*
2. *https://nptel.ac.in/courses/112/104/112104250/*
3. *https://nptel.ac.in/courses/112/106/112106179/*

19HOC51 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - I

L	T	P	C
0	0	2	1

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, students will be able to

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

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

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

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

VERBAL APTITUDE

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

PROFESSIONAL COMMUNICATION

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

THE ART OF SPEAKING

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

NON-VERBAL COMMUNICATION

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

REFERENCES

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

SEMESTER - VI

19ME61 - REFRIGERATION AND AIR CONDITIONING

(Use of approved refrigeration charts and Psychrometric Charts is permitted)

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Perform basic calculations related to various refrigeration cycles and air conditioning processes.*

CO2 : *Differentiate between various types of refrigeration systems.*

CO3 : *Apply Psychrometry principles.*

CO4 : *Analyze thermodynamic processes occurring inside compressors and condensers and expansion devices used in refrigeration systems .*

AIR CYCLE REFRIGERATION

Review of thermodynamic principles of refrigeration. Bell Coleman air refrigeration - Aircraft cycle - simple, bootstrap and regenerative cycle analysis - COP calculation. **(4)**

REFRIGERANT SELECTION

Properties, Eco-friendly refrigerants, Selection of Refrigerants. Advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics **(2)**

VAPOUR COMPRESSION REFRIGERATION SYSTEM

T-s and P-h charts - analysis - Performance of systems under varying operating conditions. Multi-stage refrigeration working principles, Analysis. **(8)**

BALANCING OF COMPONENTS

Condensers - Air cooled, water cooled and evaporative condensers. Evaporator - flooded, dry expansion, shell and tube and double pipe. Compressors - reciprocating, rotary and centrifugal types. Expansion devices - capillary and TEV. **(8)**

VAPOUR ABSORPTION SYSTEMS

Ammonia - water systems, three fluid systems. Water - lithium bromide system - Comparison - Steam jet refrigeration, solar refrigeration. **(8)**

AIR CONDITIONING

Psychrometric processes - use of psychrometric chart - Bypass factor - air conditioning cycles - winter, summer and year round air conditioning systems - effective temperature - comfort conditions, Troubleshooting of Air-conditioning systems. **(8)**

AIR CONDITIONING SYSTEMS

Duct design (theoretical treatment) - economic considerations, methods - air distributing systems - humidification - air cleaning - controls - window air conditioners. **(7)**

TOTAL: 45

TEXT BOOKS

1. *Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., Third Edition, 2007.*
2. *Domkundwar and Arora, "A course in Refrigeration and Air Conditioning", Dhanpat Rai and Co. (P) Ltd., 2007.*

REFERENCES

1. *Arora C.P., "Refrigeration and Air Conditioning". Tata MC Graw Hill Publishing Company Ltd., New Delhi, 2010.*
2. *Roy J. Dossat, "Principles of Refrigeration", Prentice Hall of India Pvt. Ltd., 2005.*
3. *Thipse S.S., "Refrigeration and Air Conditioning", Jaico Publishing House, 2006.*
4. *Stoecker W.F. and Jones J.W., "Refrigeration & Air Conditioning", McGraw Hill Book Company, 1985*
5. *ASHRAE-Fundamental volume, ISHRAE Handbook*
6. *https://nptel.ac.in/courses/112/107/112107208/*

19ME62 - FINITE ELEMENT ANALYSIS

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Solve governing differential equations of physical problems up to fourth order using variation and weighted residual methods with two and three parameter trial solutions.*

CO2 *: Generate finite element equation and solve simple 1D structural problem of bars, beams and trusses subjected to static loads using finite element method*

CO3 *: Formulate finite element model and solve 2D structural engineering problems under plane stress, planes strain and axisymmetric conditions, with and without numerical integration*

CO4 *: Develop finite element model for eigenvalue problems and determine the natural frequencies of longitudinal, transverse and torsional vibrations of 1D bar and cantilever and simply supported beams subjected to static loads*

CO5 *: Create finite element equation and analyse 1D and 2D conduction and convection heat transfer problems of composite walls and fins, and fluid flow problems in uniform cross section pipes and in porous media of variable cross section pipes.*

CO6 *: Create finite element model, analyse and interpret the results for real life problems such as structural, thermal, dynamic and fluid flow using ANSYS software*

BASICS OF FINITE ELEMENT METHOD

Introduction -Continuum and discrete modeling - Initial Value Problems and boundary value problems - Energy methods - Variational approach - Rayleigh-Ritz method - Weighted Residual Method: Least squares, Collocation method, Galerkin methods - Strong and weak forms - Solving boundary value problems using finite element method. **(9)**

ONE-DIMENSIONAL ANALYSIS

Degree of freedom - steps in FEA - discretization of domain - linear and quadratic shape functions - natural coordinate system- derivation of element stiffness matrix for elasticity and thermal strain problems - assembly of equations - applying boundary conditions - solution and post processing - solving problems for elastically deforming bars - Extension of bar elements to solve truss problems - beam elements and problems. **(9)**

TWO-DIMENSIONAL ANALYSIS

Plane strain, plane stress and axi-symmetric analysis - Global and natural coordinates, shape functions for higher order formulations -Jacobian matrices and transformations - CST and LST elements - Four node quadrilateral elements - Isoparametric elements - element stiffness matrices and assembly -Numerical integration - Gaussian quadrature-Problems. **(9)**

APPLICATION TO HEAT TRANSFER AND FLUID MECHANICS

One dimensional heat transfer element - application to one-dimensional heat transfer problems- Applications to simple heat transfer problems in 2- Dimension - Application to simple problems in fluid mechanics in 1-D. **(9)**

DYNAMIC ANALYSIS AND COMPUTER IMPLEMENTATION

Dynamic Analysis - Equation of Motion - Mass & damping matrices - Free Vibration analysis - Natural frequencies of Longitudinal, Transverse and torsional vibration - Introduction to transient field problems. Computer implementation of FEM - Preprocessing- Solution - Post-processing, solution convergence, h-type, p-type methods. **(9)**

(FOR INTERNAL EVALUATION)

Use of commercial FEA packages like ANSYS, Abaqus FEA to solve real-life problems - Development of one-dimensional finite element code using C/FORTRAN/MATLAB for elastically deforming axially loaded bars - heat transfer across a bar - fluid flow through pipes.

Total : 60

TEXT BOOKS

1. *Fish, J and T. Belytschko, 'A first Course in Finite Elements', John Wily Sons, 2007.*
2. *Seshu. P., 'Textbook of Finite Element Analysis' Prentice Hall of India, 2012.*

REFERENCES

1. *Reddy, J.N., 'Introduction to Finite Element Method', 4th Edition (Indian edition), Tata McGraw-Hill Education, 2020*
2. *Daryl L. Logan., 'A First Course in the Finite Element Method', 6th Edition, 2016*
3. *Rao S.S., 'The Finite Element Method in Engineering' 6th Edition, Elsevier ,2019.*
4. *Krishnamoorthy. C., 'Finite Element Analysis: Theory and Programming' 2nd edition, Tata McGraw-Hill Education, 2017.*
5. *Senthil S and R. Panneerdhass, 'Finite Element Analysis' Lakshmi publications, 2016.*
6. *https://nptel.ac.in/courses/112/104/112104193/*
7. *https://nptel.ac.in/courses/112/104/112104116/*

19ME63 - DESIGN OF TRANSMISSION SYSTEMS

(Use of approved design data book is permitted)

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Analyze stresses in belts and select suitable 'V' belt and Narrow 'V' belts and chains for the given power to be transmitted*

CO2 *: Analyze forces acting on the spur, helical, straight and spiral bevel gears and design gear drives based on strength and wear considerations for the given power to be transmitted*

CO3 *: Design pair of worm gears*

CO4 *: Construct ray and kinematic diagram and able to design constant mesh multi speed gear reducer upto 18 speeds*

CO5 *: Analyze forces in power screws and design power screws for screw jack and lathe for the given power to be transmitted.*

CO6 *: Design single plate, multi-plate clutches and internal expanding shoe brakes for automotive applications*

DESIGN OF BELT AND CHAIN DRIVES

Belt - Types, belt materials, stresses in belts, condition for maximum power transmission, selection of V belts for the given power and velocity ratio, Selection of Classical (3V, 5V and 8V types) and Narrow V belts (SPZ, SPA, SPB, SPC types). Chain - Types, Geometric relations, polygonal effect, selection of transmission chain and sprockets, silent chains, chain lubrication. **(9)**

DESIGN OF SPUR, HELICAL AND BEVEL GEARS

Spur gear - Terminology, gear materials, force analysis, design of spur gear based on strength and wear considerations. Helical gear - terminology, force analysis, pressure angle in the normal and transverse planes, equivalent number of teeth, design of helical gear based on strength and wear considerations. Bevel gear - terminology, virtual number of teeth, force analysis, design of straight bevel gears. Buckingham's equation for dynamic load; surface strength and durability; heat dissipation; design for strength and wear. **(9)**

WORM GEARS AND MULTI SPEED GEAR BOX

Worm gear - Terminology, materials, force analysis, thermal considerations, efficiency, design of worm gears. Gearbox- Geometric progression, step ratio, ray diagram, Kinematic diagram, Design of sliding mesh gear box, constant mesh gear box, speed reducer unit; Variable speed gearbox; Fluid couplings, Torque converters for automotive applications. **(9)**

POWER SCREWS

Forms of threads, terminology, torque requirement - lifting/lowering load, self-locking screw, efficiency, square and trapezoidal threads, collar friction, design of power screws for screw jack, lathe, selection of ball screw. **(9)**

DESIGN OF CLUTCHES AND BRAKES

Clutches - role of clutches, classification, design of single plate, multiple plate and cone clutches. Brakes - Role of brakes, types, self-energizing brakes, design of internal expanding shoe brakes, calculation of heat generation and heat dissipation in brakes. **(9)**

Total : 60

TEXT BOOKS

1. *Bhandari V.B., "Design of Machine Elements", 3rd edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2016*

REFERENCES

1. *Darle W Dudley, "Hand Book of Practical Gear Design", CRC Press, Florida, 2015*
2. *Robert L Norton, "Machine Design - An Integrated Approach", Pearson Education, New Delhi, 2015*
3. *https://nptel.ac.in/courses/112/106/112106137/*
4. *https://nptel.ac.in/courses/112/105/112105234/*

HAND BOOK

PSG, "Design Data Book", KalaikathirAchagam Publishers, 2020.

19ME64 - COMPUTER AIDED ENGINEERING

L	T	P	C
3	1	0	4

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Write algorithms to generate primitives of line, circle and ellipse and visualize them in graphical display devices (raster & random scan systems).*

CO2 *: Set up transformations to translate, rotate, scale, shear and reflect 2-D and 3-D objects under specified conditions. Generate clipping algorithms used in a CAD system for viewing a 2-D entity. Will be able to generalize the visible surface detection methods (scan line, depth sorting, etc.) for viewing a 3-D entity.*

CO3 *: Derive equations of Hermite, Bezier and B-Spline curves, Bezier and B-Spline surfaces in explicit, implicit and parametric representations for curve and surface modelling and creation.*

CO4 *: Specify different process planning techniques (variant and generative) to manufacture a product using CNC machines. Will be able to set-up Flexible Manufacturing Systems and Group Technology (coding system) concepts for product variety.*

CO5 *: Apply MRP-I, MRP-II, Shop floor control, scheduling techniques and data acquisition system for enhancing the effective utilization of the men, machine, materials etc.*

INTRODUCTION

Introduction- Need and Scope of Computer Aided Design, Fundamental of CAD and CAE, computer graphics-Application areas, Hardware and software- overview of graphics systems, video-display devices, and raster-scan systems, random scan systems, graphics monitors and workstations and input devices. Interactive hardware/software techniques, Output primitives- Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives, Scan line polygon fill algorithm, boundary fill and flood-fill algorithms. File format DXF & DXB. **(9)**

2D GEOMETRICAL TRANSFORMATIONS OF ENTITIES

2-D geometrical transforms - Translation, scaling, rotation, reflection and shear transformations. Matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems. 2-D viewing- The viewing pipeline, viewing coordinate reference frame. Window to viewport coordinate transformation, viewing functions. Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland - Hodgeman polygon clipping algorithm. **(7)**

GEOMETRICAL REPRESENTATION

Curve representation, parametric representation, and analytical curve -Line-circle-ellipse, spline representation. Hermite curve, Bezier curve and B-Spline curves, Bezier and B-Spline surfaces. Basic illumination models, polygon - rendering methods.3-D Object Representation - Polygon surfaces, quadric surfaces. **(7)**

3D - GEOMETRICAL TRANSFORMATIONS

3-D Geometric transformations- Translation, rotation, scaling, reflection and shear transformations, composite transformations. Visible surface detection methods- Classification, back-face detection, depth buffer, scan-line, depth sorting, BSP-tree methods, area subdivision and octree methods. **(7)**

COMPUTER AIDED MANUFACTURING (CAM)

Introduction to CNC, DNC and adaptive control systems-types and features-FMS, types and characteristics-Group Technology-coding system-types and structure-design table and decision trees-implementation procedures, Automated Process Planning-structure-information, operation, types. **(8)**

COMMUNICATION, INFORMATION AND PRODUCTION MANAGEMENT SYSTEM

Materials Requirement Planning (MRP), MRP-II, Scheduling and its importance, management of systems-shop floor control system, networking, data acquisition system, supervisory and hierarchical computer system. **(7)**

Total : 60

TEXT BOOK

1. *Mikell P. Groover and Emory Jimmers W., "CAD/CAM", Pearson Education., 2013*

REFERENCES

1. *NPTEL courses http//nptel.iitm.ac.in/courses.php- web and video resources on Computer Aided Design and Manufacturing. https://nptel.ac.in/courses/112/104/112104031/*
2. *https://nptel.ac.in/courses/112/104/112104252/*

19MEL65 - CAD/CAM LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Produce a 3-D component drawing using basic and advanced levels of modeling techniques in software.*

CO2 : *Assemble mechanical engineering components, check for interference and simulate the assembly mechanism.*

CO3 : *Generate CNC programs for a given component as per part drawing by integrating through CNC turning and machining center.*

CO4 : *Use a real time CNC turning and machining center with Fanuc software to produce components of simple shape.*

CO5 : *Select the advanced manufacturing technology solution for a particular application*

EXPERIMENTS ON CAD

1. Creation of 2D drawing for a given component using various commands in the software.
2. Modeling of various profiles using extrude, revolve, sweep, pattern, helical and Rib features through basic commands.
3. Design of equation-based curves using modeling software.
4. Assemble machine components; explore mechanisms with constraints using modeling software.
5. Generate part drawings having various sectional views from assembly drawing and list out the Bill of Materials (BOM) for manufacturing.

EXPERIMENTS ON CAM

1. Study of CNC turning and machining center - specification and part programming codes for various operations.
2. Programming and simulation of CNC turning center - its operation such as step, taper, profile and thread turning using Fanuc software.
3. Programming and simulation of CNC machining center-its operation such as linear interpolation, circular interpolation, mirror and pocketing operation using Fanuc software.
4. Study on abrasive water jet machining process - working principles, operation, effect of process parameters and application.
5. Study on additive manufacturing machine- working principles, operation, effect of process parameters and application.

REFERENCES

1. *CAD/CAM Laboratory Manual, Department of Mechanical Engineering CIT.*
2. *https://nptel.ac.in/courses/112/104/112104252/*

19HOC61 - EMPLOYABILITY AND PERSONALITY DEVELOPMENT SKILLS - II

L	T	P	C
0	0	2	1

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, students will be able to

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

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

CO3 *: Manage conflicts in a professional manner*

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

CORPORATE ETIQUETTE

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

LEADERSHIP AND TEAM MANAGEMENT

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

STRESS AND CONFLICT MANAGEMENT

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

GROUP DISCUSSION AND INTERVIEW SKILLS

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

REFERENCES

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

SEMESTER - VII

19ME71 - CONTROL THEORY AND MECHATRONICS

L	T	P	C
2	0	2	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the student will be able to:

CO1 : Explain control systems and the mathematical approach of designing them.

CO2 : To select suitable control systems for mechanical actuators.

CO3 : To explain electrically controlled mechanical actuators and methods of controlling

CO4 : To design and integrate electronics components with various mechanical machines for better performance

MODELING IN TIME DOMAIN

Review of Laplace transformation, Basic system models, closed loop and open loop control systems, Mathematical modelling of mechanical systems , Dynamic responses of system, Natural and forced response, Linear system, , blocks diagram representation and reduction, Transient and steady state Response Analysis, system transfer function, First & Second order Systems, types of input. **(8)**

MODELING IN THE FREQUENCY DOMAIN

Frequency response for first order and second order systems, Stability Analysis, Phase Lead and Phase Lag in Sinusoidal Response, Stability of control systems, poles/ zeros, complex plane, Routh- Hurwitz criterion, Bode Diagrams, Polar Plots, Gain margin, Phase margin **(8)**

ROOT-LOCUS TECHNIQUE

Root-Locus Plots - General Rules for Constructing Root Loci, Typical sketches of root locus plots, Root locus approach to control system design **(6)**

CONTROLLER DESIGN

Proportional, integral, derivative, PI, PD and PID controllers, Pneumatic Controllers, Hydraulic Controllers, Electronic Controllers **(6)**

SENSORS AND ACTUATORS

Introduction - Adaptive control with optimization, Adaptive control with constraints, Application of Adaptive control in Machining operations. Types of inspection methods and equipment, CMM, Types, methods of CMM control, Machine vision- Introduction, image acquisition, and image processing applications of machine vision. **(8)**

PROGRAMMABLE LOGICAL CONTROLLERS

Programmable logic controllers, basic structure, selection of PLC, Ladder Diagram, latching circuit, timers, internal relays and counters, shift register, master and jump controls. **(6)**

APPLICATIONS TO MECHATRONICS SYSTEM DESIGN

Review of applications of control in Machine tools, and Control of pick and place robot **(3)**

TOTAL: 45

TEXT BOOK

1. *W. Bolton, "Mechatronics", Pearson Education Asia, New Delhi, 6th edition, 2015.*
2. *A. NagoorKani, "Control Systems", RBA Publications, 3rd edition, 2017.*

REFERENCES

1. *Shetty Devdas and Richard A Kolk, "Mechatronics System Design", Cengage Learning, New Delhi, 2nd edition, 2010.*
2. *Katsuhiko Ogata, "Modern Control Engineering, Pearson, 5th edition, 2015.*

19ME72 - QUALITY ENGINEERING AND MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: Outline the quality engineering system with various types of evaluation of loss function.*

CO2 *: Analyze the characteristics and schedules in preventive maintenance along with various quality tools.*

CO3 *: Design on-line quality control system for various production environments by considering feedback and various process control parameters.*

CO4 *: Define quality management axioms and implement Deming philosophy along with action plans.*

CO5 *: Demonstrate and implement various quality management tools.*

QUALITY ENGINEERING AND LOSS FUNCTION

Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service. Derivation - loss function for products/system- justification of improvements- loss function and inspection- quality evaluations and tolerances-N type, S type, L type. **(9)**

QUALITY ENGINEERING AND TPM

Preventive Maintenance (PM) schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools-fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems. **(9)**

ON-LINE QUALITY CONTROL

On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems- measurement error and process control parameters. **(9)**

QUALITY MANAGEMENT

Definitions of the terms - quality planning, quality control, quality assurance, quality management, total quality management as per ISO 8402 - overview on TQM - the TQM axioms - Commitment - scientific knowledge - involvement Consequences of total quality. Six sigma, Cp, Cpk, Ppk Deming's fourteen points on quality management - five DDs - implementing the Deming philosophy - action plan - the Deming cycle - Case study. **(9)**

TECHNIQUES IN QUALITY MANAGEMENT

Kaizen and innovation - the kaizen management practices - Total Quality Control (TQC) -- small group activities - quality circles - Comparison of Kaizen and Deming's approach with illustration. Affinity diagram - brainstorming - cause and effect analysis -checklist- flow charts - Pareto analysis - quality costing - Quality Function Deployment (QFD) - Training of quality - self managing teams. **(9)**

TOTAL: 45

TEXT BOOKS

1. *De Feo J A and Barnard WW, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, New Delhi,2005.*
2. *Krishnamoorthi, K.S and Ram Krishnamoorthi. V. "A First Course in Quality Engineering: Integrating Statistical and Management Methods of Quality, CRC Press, 2nd Edition, 2016*

REFERENCES

1. *Kaniska Bedi, "Quality Management", Oxford University Press, Chennai, 2007.*
2. *Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.*
3. *Taguchi G, Elsayed E A and Hsiang, T.C.,"Quality Engineering in Production Systems", Mc-Graw-HillBook company, Singapore, 1989.*
4. *Deming W E, "Out of the Crisis", MIT Press, Cambridge, MA, 1982.*
5. *Juran J M and Juran on "Leadership for Quality" An Executive Handbook, The Free Press, New York,1989.*
6. *Salor J.H., "TQM-Fleld Manual," McGraw Hill, New York, 1992.*
7. *Crosby P.B., "Quality is Free," McGraw Hill, New York, 1979*
8. *Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996.*
9. *LogotheticsN ., "Managing for total quality - From Deming to Taguchi and SPC", Prentice hall Ltd, New Delhi, 1997.*
10. *Juran J.M &Gryna F.M., "Quality Planning and Analysis - From Product development through use",TataMcGrawHill Publishing Limited, new Delhi, 3rd Edition , 1995*
11. *https://nptel.ac.in/courses/110/104/110104080/*

COURSE CONTENTS FOR ELECTIVES IN MATERIALS AND DESIGN STREAM

19MEE01 - COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Develop a particulate or fiber reinforced PMC, MMC, and CMC materials for the application of Aerospace, Automobile, medical and Civil Engineering Structures.*

CO2 : *Choose the most appropriate manufacturing process for fabricating thermosetting and thermoplastic polymer matrix composites reinforced with particulate and fiber.*

CO3 : *Examine the effect of reinforcement volume/weight percentage and select a suitable manufacturing process for MMC.*

CO4 : *Select a processing method and to create Ceramic matrix materials for the given application*

CO5 : *Analyze the failure modes, reliability and fatigue behavior of composite materials*

INTRODUCTION

Composite materials- general characteristics - need for composites - classification based on matrix - polymer matrix composites (PMC), metal matrix composites (MMC), ceramic matrix composites (CMC), classification based on reinforcement - particulate composites, fiber reinforced composites, laminar composites - types of fibers - smart materials - types and characteristics -material selection process - applications related to aerospace, automobile, medical, bridge and other civil engineering structures. **(8)**

POLYMER MATRIX COMPOSITES

Thermosetting and thermoplastic resins - Functions & properties of matrix - types & properties of reinforcement materials, role and selection of reinforcement materials, PMC processes - hand layup process, bag molding process, compression molding, reaction injection molding, resin transfer molding, pultrusion process, filament winding, injection molding process - fiber reinforced plastics, glass fiber reinforced plastics. **(8)**

METAL MATRIX COMPOSITES

Types of metal matrix composites - characteristics - advantages and limitations of MMC- effect of reinforcement - volume fraction - rule of mixtures - processing of MMC - vacuum hot pressing, powder metallurgy process, liquid metal infiltration, compo casting, squeeze casting. **(7)**

CERAMIC MATRIX COMPOSITES

Ceramic matrix materials - properties - advantages - limitations - Processing - Hot pressing, liquid infiltration technique, Lanxide Process, in situ chemical reaction techniques - Interface in CMCs - Applications. **(7)**

GEOMETRICAL ASPECTS AND ANALYSIS

Characteristics of fiber filled lamina - volume fraction and weight fraction - woven roving, in-plane random fibers - fiber orientation- void - fiber orientation during flow, failure theories - laminate design consideration - stress analysis of laminated composite beams, plates and Shells - vibration and stability analysis - reliability of composites - finite element method of analysis - analysis of Sandwich Structures. **(8)**

FATIGUE AND CREEP IN COMPOSITE MATERIALS

Fatigue - S-N curves - Fatigue behaviors of CMCs - Fatigue of particle and whisker reinforced composites - Hybrid composites- Thermal fatigue - Creep. **(7)**

TOTAL: 45

TEXT BOOKS

1. *Mallick P.K., "Fiber-Reinforced Composites: Materials, Manufacturing and Design", 3rd edition, CRC Press, 2019.*
2. *Agarwal B.D., Broutman L.J. and Chandrashekhara K, "Analysis and Performance of Fiber Composites", 4th edition, John Wiley and Sons, New York, 2017.*

REFERENCES

1. *Chawla, Krishan K, "Composite Materials Science and Engineering", 4th Edition, Springer, 2019.*
2. *Hull D., and Clyne T. W, "An Introduction to Composite Materials", Cambridge University Press, 3rd Edition, 2019.*
3. *Matthews F.L., and Rawlings R.D, "Composite Materials: Engineering and Science", Cambridge : Elsevier Science, 2014*
4. *https://nptel.ac.in/courses/112/104/112104168/*
5. *https://nptel.ac.in/courses/112/104/112104229/*
6. *https://nptel.ac.in/courses/112/104/112104221/*

19MEE02 - DESIGN FOR MANUFACTURING AND ASSEMBLY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Design mechanical parts for use in a flexible automation system for the increased effectiveness and to automate assembly of existing design.*

CO2 : *Design such a system with no errors and defects so that they can be used for subsequent assembly and subassembly.*

CO3 : *Implement newer approaches for the better form design with the help of knowledge on positional tolerances.*

CO4 : *Design the components suitable for various manufacturing processes such as welding, casting, machining.*

CO5 : *Identify and design components according to standards.*

INTRODUCTION

Methodologies and tools, design axioms, design for assembly and evaluation. **(3)**

DFM APPROACH

Minimum part assessment - Taguchi method. Robustness assessment, manufacturing process rules, failure mode effect analysis, value analysis. Design for minimum number of parts, development of modular design, Poka Yoke principles. **(8)**

GEOMETRIC ANALYSIS

Process capability, feature tolerance, geometric tolerance, surface finish, tolerance grades. Analysis of tapers, screw threads, probability to tolerances. **(8)**

FORM DESIGN

Redesign of castings based on parting line consideration, minimizing core requirements, redesigning cast numbers using weldments, use of welding symbols. **(9)**

DESIGN FOR ASSEMBLY

Selective assembly, deciding the number of groups, control of axial play, grouped datum systems - types, geometric analysis and applications - design features to facilitate automated assembly. **(9)**

TRUE POSITION THEORY

Virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges. Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Harry Peck, "Design for Manufacture", Pitman Publications, 1983.*
2. *Matousek, "Engineering Design - A Systematic Approach", Blackie & Son Ltd., London, 1999.*
3. *Palaniyappan Kailasam, "Geometric Dimensioning and Tolerancing", Prolotek Technologies Private Limited, Bangalore, 2018.*

REFERENCES

1. *https://nptel.ac.in/courses/107/103/107103012/*
2. *https://nptel.ac.in/courses/112/101/112101005/*
3. *https://nptel.ac.in/courses/112/106/112106249/*

19MEE03 - DESIGN OF JIGS AND FIXTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Understand the basics of jigs and fixtures and its principle*

CO2 : *Design appropriate locating systems to arrest the possible degrees of freedom exhibited by the component.*

CO3 : *Suggest and design appropriate clamping for specified operations.*

CO4 : *Design appropriate Jig for given component for efficient and effective manufacturing.*

CO5 : *Design and develop appropriate fixture for a given component.*

INTRODUCTION

Objectives of tool design - Functions and Advantages of Jigs and Fixtures- Difference between Jigs and Fixtures - Basic elements of Jigs and Fixtures - Fool Proofing - Types of jigs and Fixtures- materials for jigs and fixtures - Degrees of freedom - 3-2-1 principle of location - Essential features of jigs and fixtures - General Design Principles - Design steps, Economics of jigs and fixtures. **(9)**

LOCATING AND CLAMPING PRINCIPLES

Principles of location - Basic rules for locating - Locating methods and devices - pins and stud locators, V-locators, bush locators and nest locators - Redundant location - Standard parts-Principles of clamping - clamping devices - mechanical actuation clamps - Pneumatic and hydraulic actuation clampings - magnetic clamps- spherical clamping operation. **(9)**

ANALYSIS OF CLAMPING FORCES

Analysis of clamping force - strap clamp, toggle clamp, cam operated clamp and screw clamp. Limit and fits, types of tolerance -Geometric dimensioning - Tolerance and error analysis. **(9)**

DRILL BUSHES AND DRILL JIGS

Drill bushes - materials for drill bushes, design principles for drill bushings, types of drill bushes - type of drill bushes - clearance.

Drill jigs - Types of jigs-Post, Turnover, Channel, latch, box, pot, angular post jigs - Indexing jigs - Pneumatic and hydraulic operated drill jig-chip control - Common defects in jig design - Design and development of jig for given component **(9)**

FIXTURES

Fixture - design principles - types of fixtures - Design of boring fixtures, milling fixtures, turning fixtures, Broaching fixtures, Grinding fixtures, Welding fixtures -consideration for welding fixtures - Assembly and Inspection fixtures - Modular fixturing systems- Air operated fixtures. Design and development of fixture for a given component.

Assembly drawings of a simple jig or fixture using computer software AUTOCAD or any other CAD software

TOTAL: 45

TEXT BOOKS

1. *Joshi, P.H., "Jigs and Fixtures", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 3rd Edition, 2017.*
2. *Cyril Donaldson, George H. Lecain, GooldV. C and JoyjeetGhose., "Tool Design", Tata McGraw Hill, 5th edition, 2017.*

REFERENCES

1. *ASTME, "Handbook of Fixture design"*
2. *Goroshkin A.K., "Jigs and Fixtures Handbook", MIR Publishers, Moscow*
3. *M. H. A. Kempster., "Introduction to Tool Design and Jigs and Fixtures", 2013*
4. *Venkataraman. K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2015.*
5. *ASTME, "Fundamentals of Tool Design", Prentice Hall of India.*
6. *PSG, "Design Data Book", Kalaikathir Achagam Publishers, 2020*

19MEE04 - MECHANICAL BEHAVIOR OF MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *demonstrate an understanding of the mechanical properties and behaviour of materials.*

CO2 : *Explain concept of linear elastic fracture mechanics and estimate the effects of cracks in material and structure.*

CO3 : *Identify engineering problem in using plastic deformation, fatigue, fracture and creep*

CO4 : *Asses and describe the mechanism loading to failure when provided with a failure example.*

ELASTICITY

Limit of elastic response: uniaxial and multiaxial, Mechanisms in crystalline materials: dislocations, twins, and APBs, Mechanisms in non-crystalline materials, Strengthening via microstructure, environment, and physical size **(15)**

CREEP

Time-dependent plasticity, Deformation mechanism maps of elasto-plasticity. **(10)**

FRACTURE

Evolution of fracture models: ultimate failure, Microstructural mechanisms of fracture strengthening. **(10)**

FATIGUE

Failure below fracture stress: insidious failure, Empirical fatigue models, Microstructural mechanisms of prolonged fatigue lifetime **(10)**

TOTAL : 45

TEXTBOOKS

1. *Dieter, G.E., "Mechanical Metallurgy", 3rd Edition, McGraw-Hill, 2017.*
2. *Davis. H. E., Troxell G.E., Hauck.G. E. W., "The Testing of Engineering Materials", 4th Edition, McGraw-Hill, 2015.*

REFERENCES

1. *Honey combe R. W. K., "Plastic Deformation of Materials", Edward Arnold Publishers, 1984.*
2. *Suryanarayana, A. V. K., "Testing of Metallic Materials", Kindle Edition, BSP BOOKS Publisher, 2020.*
3. *https://nptel.ac.in/courses/113/106/113106101/*
4. *https://nptel.ac.in/noc/courses/noc22/SEM1/noc22-mm04/*

19MEE05 - MACHINE TOOL DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Develop the conceptual design, manufacturing framework and systematic analysis of design problems on the machine tools.*

CO2 : *Apply the design procedures for different types of design problems such as gearbox design, guide way design, shaft loading and its associated parts, rolling bearings, die design and jigs and fixtures and so on.*

CO3 : *Design, develop, and evaluate cutting tools and work holders for a manufactured product.*

INTRODUCTION

General requirement of machine tool design, techno-economic prerequisites. **(9)**

DESIGN OF CUTTING TOOLS

Cutting tool materials, properties, classification, selection, tool wear, tool life. Single point tools: nomenclature, types and styles, design and manufacture of tools in HSS and carbides, tools for turning, boring, shaping, planning and slotting operations, form tools, tools and holders for CNC applications. Multipoint cutters, nomenclature, classification and selection, construction methods, design and manufacture of drills, reamers, taps, dies, thread chasers, milling cutters, broachers, hobs and gear shaping cutters. **(9)**

MACHINE TOOLS

Kinematics structure & mechanical, hydraulic and electrical drives, design of hydrostatic, hydrodynamic and antifriction guideways, design of spindles, design of speed box and feed box, stepped and step less regulations of speed and feed diagram, ray diagram, layout of spindles drive and feed drive in machine tools, machine tool structures, design of bed, heard stock, spindle supports and power screws, machine tool dynamics. **(9)**

JIGS AND FIXTURES DESIGN

Applications in manufacturing, principle of location & clamping, types of locators and clamps, design of jigs and fixtures, selection of materials. **(9)**

DIE AND PUNCH DESIGN

Applications in manufacturing, design of various types of dies, selection of materials for casting and forging dies. **(9)**

TOTAL: 45

TEXT BOOKS

1. *Mehta, N. K., Machine Tool Design & Numerical Control, McGraw Hill, New Delhi, 2017.*
2. *Cyrill Donoldson .V. C, Tool Design, 4th Edition, Tata McGraw Hill, 2017.*

REFERENCES

1. *Pandey, P.C. and Singh, C.K., Production Engineering Sciences, Standard Publishers, 7th Edition, New Delhi (2013).*
2. *Basu, S. K. and Pal, D.K., Design of Machine Tools, Oxford & IBH Publishing Co Pvt.Ltd, 2018.*
3. *Ranganath, B.J., Metal cutting and tool design, Vikas Publishing House Pvt.Ltd., New Delhi 2018.*
4. *Sen, G.C. and Bhattacharya, A., Machine Tools, New Central Book Agency, 2015.*

19MEE06 - MECHANICAL VIBRATIONS AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Develop mathematical models of dynamical systems with a single degree of freedom to determine their response to harmonic, transient and impulse loads.*

CO2 : *Develop mathematical models of dynamical systems with multiple degrees of freedom to calculate natural frequencies and mode shapes.*

CO3 : *Determine the natural frequencies and mode shapes of continuous systems such as strings in transverse vibrations, bars in longitudinal vibrations, and circular shafts in torsional vibrations using analytical and numerical methods.*

CO4 : *Evaluate the severity of vibration and choose a suitable vibration isolation system, perform static and dynamic balancing, and design suitable vibration absorber systems*

FUNDAMENTALS OF VIBRATION

Introduction - Sources of vibration - Mathematical models - Displacement, velocity and acceleration - Single degree of freedom systems - Vibration isolation. Vibrometers and accelerometers - Response to arbitrary and non- harmonic Excitations - Transient Vibration - Impulse loads. **(9)**

TWO DEGREE OF FREEDOM SYSTEM

Introduction - Undamped and damped free vibrations - Forced Vibration with Harmonic Excitation System- Coordinate Couplings and Principal Coordinates. **(8)**

MULTI-DEGREES OF FREEDOM SYSTEM AND CONTINUOUS SYSTEM

Multi Degrees of freedom system - Influence coefficients - Natural frequencies and mode shapes - Modal analysis of undamped, damped and forced vibrations - Matrix inversion method - Continuous System: Vibration of String, longitudinal vibration of bars and torsional vibration of circular shafts. **(10)**

MULTI-DEGREES OF FREEDOM SYSTEM AND NUMERICAL METHODS

Approximate Methods - Rayleigh's method, Dunkerley method, Stodola's method, Rayleigh-Ritz method, Method of matrix iterations and Holzer Methods - Natural frequencies for multi-rotor systems - geared systems. **(9)**

VIBRATION CONTROL

Specification of Vibration Limits - Vibration severity standards - Vibration as condition Monitoring tool - Vibration Isolation methods - Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber - Damped Vibration absorbers- Control by Design Modification - Active Vibration Control. **(9)**

TOTAL: 45

TEXT BOOKS

1. Rao S S, "Mechanical Vibrations", 6th Edition, Pearson Education, 2018.

2. Grover G K, "Mechanical Vibrations ", Nem Chand and Brothers, 8th Edition, Roorkee, 2018.

REFERENCES

1. *Ambekar A G, "Mechanical Vibrations and Noise Engineering", PHI Learning Pvt. Ltd., 2006.*
2. *https://nptel.ac.in/courses/112/107/112107088/*
3. *https://nptel.ac.in/courses/112/107/112107087/*
4. *https://nptel.ac.in/courses/112/104/112104040/*
5. *https://nptel.ac.in/courses/112/103/112103111/*

19MEE07 - TRIBOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Understand the basic concepts and measurement methods of friction and wear*

CO2 *: Know the influence of structure of the bearing and the nature of fluid flow on the loads that can be supported.*

CO3 *: Understand the modeling of elasto-hydrodynamic lubrication as infinite and finite structures.*

INTRODUCTION

Fundamentals and History of tribology, Interdisciplinary Approach, Economic Benefits. **(6)**

FRICTION

Causes of friction - Theories of Friction - Sliding and Rolling Friction, laws of friction, Friction properties of metallic and non-metallic materials - Friction instability - measurement methods. **(8)**

WEAR

Types of wear-Mechanism of wear - testing methods - wear resistant materials -Wear debris analysis - wear reduction methods- wear measurements **(8)**

LUBRICATION AND LUBRICANTS

Importance of lubrication - Boundary Lubrication - mixed lubrication - solid lubrication - Hydrostatic and Hydrodynamic lubrication - Elastohydrodynamic lubrication - Lubricants - Types, and properties of lubricants - Additives - Selection of Lubricants - Lubricants standards **(9)**

FLUID FILM LUBRICATION

Fluid mechanics concepts, Equations of Continuity and Motion, Generalized Reynolds Equation with Compressible and Incompressible Lubricants **(8)**

APPLICATION OF TRIBOLOGY

Introduction, Rolling Contact Bearings, Gears, Journal Bearings - Finite Bearings **(6)**

TOTAL: 45

TEXT BOOK

1. *Ludema K.C., "Friction, Wear, Lubrication: A Textbook in Tribology", 2nd Edition, CRC Press, 2018.*

REFERENCES

1. *Gwidon Stachowiakand Andrew Batchelor., "Engineering Tribology", Butterworth-Heinemann., 4th Edition, 2016.*
2. *Bharat Bhusan, "Introduction to Tribology", 2nd edition, A John Wiley & Sons, 2013*
3. *Shigley J.E., Mischke C.R., "Mechanical Engineering Design", Tata McGraw - Hill Publishing Company Limited, 2019.*
4. *https://nptel.ac.in/courses/112/102/112102015/*
5. *https://nptel.ac.in/courses/113/108/113108083/*
6. *https://nptel.ac.in/courses/112/102/112102014/*
7. *http://www.nptelvideos.in/2012/12/tribology.html*

19MEE08 - EXPERIMENTAL STRESS ANALYSIS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Demonstrate experimental methods commonly used in solid mechanics*

CO2 : *Apply the principles and techniques of strain gauge measurement*

CO3 : *Demonstrate the techniques of photo elastic measurements*

CO4 : *Analyze experimental data and develop appropriate logical conclusions based on comparisons to theoretical results and other experimental evidence.*

INTRODUCTION

Optical Methods Work as Optical Computers- Stress, Strain and Displacement Fields- Physical Principle of Strain Gauges and Photoelasticity - Introduction to Brittle Coatings and Holography- Hologram Interferometry, Speckle Methods - Introduction to Shearography, TSA, DIC and Caustics - Fringe Patterns - Richness of Qualitative Information - Multi-Scale Analysis in Experimental Mechanics- Selection of an Experimental Technique. **(10)**

TRANSMISSION PHOTOELASTICITY

Introduction to Transmission Photoelasticity - Ordinary and Extraordinary Rays - Light Ellipse, Passage of Light Through a Crystal Plate- Retardation Plates, Stress-optic Law- Plane Polariscope- Jones Calculus- Circular Polariscope- Determination of Photoelastic Parameters at an Arbitrary Point - Tardy's Method of Compensation- Calibration of Photo elastic Materials- Fringe Thinning Methodologies- Fringe Ordering in Photoelasticity -Three Dimensional Photoelasticity- Overview of Digital Photoelasticity. **(12)**

PHOTOELASTIC COATINGS AND BRITTLE COATINGS

Introduction to Photo elastic Coatings - Correction Factors for Photo elastic Coatings - Coating Materials, Selection of Coating Thickness, Industrial Application of Photo elastic Coatings - Calibration of Photoelastic Coatings- Analysis of Brittle Coatings. **(5)**

STRAIN GAUGES

Strain Sensitivity of a Strain Gauge, Bridge Sensitivity, Rosettes - Strain Gauge Alloys, Carriers and Adhesives - Performance of Strain Gauge System - Temperature Compensation, Two wire and Three-wire Circuits - Strain Gauge Selection - Bonding of a Strain Gauge - Soldering, Accounting for Transverse Sensitivity Effects - Correction Factors for Special applications- Special Gauges. **(10)**

OTHER STRESS ANALYSIS TECHNIQUES

Moiré fringe method- Non-destructive testing - Types - Dye penetrate methods, Radiography, X-ray and Gamma ray -X-ray fluoroscopy - Penetrameter- Magnetic particle method Introduction to lasers in NDT - Ultrasonic flaw detection. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Dalley and Riley, "Experimental Stress Analysis", 4th Edition, College House Enterprises, LLC., 2005.*
2. *Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 2009.*

REFERENCES

1. *https://nptel.ac.in/courses/112/106/112106068/*
2. *https://nptel.ac.in/courses/112/106/112106247/*
3. *https://nptel.ac.in/courses/112/106/112106198/*

19MEE09 - FLUID POWER CONTROL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 *: 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.*

FLUID POWER SYSTEMS AND FUNDAMENTALS

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids - General types of fluids - Fluid power symbols. Basics of Hydraulics laws. **(3)**

FLUID POWER DRIVES

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump, construction and working of pumps - pump performance - Variable displacement pumps. Hydraulic motors - principle of working, calculation of discharge, power and efficiency. Fluid Power Actuators: Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, double acting special cylinders - tandem - Rodless - Telescopic. Cushioning mechanism. Rotary actuators. **(8)**

FLUID POWER ELEMENTS

Construction of Control Components: Director Control valve - 3/2 way valve - 4/2 way valve - Shuttle valve- check valve -pressure control valve - pressure reducing valve, sequence valve, Flow control valve -Fixed and adjustable, electrical control solenoid valves, Relays. Ladder diagram Accumulators and Intensifiers: Types of accumulators - Accumulators circuits, sizing of accumulators, intensifier - Applications of Intensifier - Intensifier circuit. **(9)**

BASIC HYDRAULIC CIRCUITS

Design of Hydraulic circuits - speed control, sequencing circuits, regenerative circuits, unloading circuits. Design and application of hydraulic circuits of machine tool, press, Mobile hydraulic and other industrial applications. **(8)**

PNEUMATIC SYSTEMS AND COMPONENTS

Pneumatic Components: Properties of air - Compressors - Filter, Regulator, Lubricator Unit - Pneumatic system, pneumatic components - pressure - flow - direction controls valves, Air control valves, Quick exhaust valves, pneumatic actuators. **(3)**

PNEUMATIC CIRCUITS DESIGN

Design of pneumatic circuits for automation, selection and specification of circuit components, sequencing circuits, cascade, and karnaugh - Veitch map method - Regenerative, speed control, synchronizing circuits. **(8)**

ELECTRO PNEUMATICS AND PLC CIRCUITS

Use of electrical timers, switches, solenoid, relays, proximity sensors etc. electro pneumatic sequencing Ladder diagram - PLC- elements, functions and selection - PLC programming - Ladder and different programming methods - Sequencing circuits. **(6)**

TOTAL : 45

TEXT BOOKS

1. *Anthony Esposito, "Fluid power with applications", 7th edition, Kindle Edition, Pearson, 2013*
2. *Majumdar S.R., "Oil Hydraulics - Principles and Maintenance", Tata McGraw-Hill, 2017.*
3. *Andrew Parr, "Hydraulics and Pneumatics - A technician's and engineer's Guide", 3rd edition,Jaico Publishing House, 2011.*

REFERENCES

1. *John Watton., "Fundamentals of Fluid Power Control", 1st Edition, Cambridge University Press, 2014.*
2. *https://nptel.ac.in/courses/112/106/112106175/*
3. *https://nptel.ac.in/courses/112/106/112106300/*
4. *https://nptel.ac.in/courses/112/105/112105047/*

19MEE10 - SENSOR TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Understand the various principles of sensing technology.

CO2 : Identify the various sensors and derive its characteristics.

CO3 : Select the sensors for various industrial applications.

CO4 : Understand and analyse the various signals.

CO5 : Design and develop a sensing method and signal conditioning for simple application.

SENSORS FUNDAMENTALS AND CHARACTERISTICS

Sensors and Transducer: Definition, Principles, Classification, static and dynamic characteristics - Electrical, Mechanical, Thermal, Optical and Chemical characterization - Errors in Measurements: Gross errors, Systematic errors and its estimation, Statistical analysis of Random errors. **(9)**

PHYSICAL PRINCIPLES OF SENSORS

Introduction to physical principle of sensor, Resistive potentiometer, Strain gauge, Inductive sensor, Capacitive sensor, Thermal sensor, Magnetic sensor, Radiation sensor. **(6)**

SENSOR TYPES AND APPLICATIONS

Introduction to types of sensor, Flow rate sensors, Pressure sensors, Temperature sensors, Oxygen sensors, Torque and position sensors, Static pressure sensors, fluid velocity sensor, airflow direction sensor, Air speed measuring sensor. **(12)**

SIGNALS

Review of Laplace and Fourier Transforms, Signals: Definition, Classifications, Standard test signals, Periodic signal, (Complex form representation, Line spectra), Aperiodic signals, Bandwidth, Modulated signals (Amplitude, Frequency and Angle modulation), Sampled data: Pulse modulation, Pulse code modulation. **(12)**

SIGNAL PROCESSING CIRCUITS

Introduction, DC power supplies, Sampling circuits: Diode-bridge linear gate, shunt transistor gate, Distinction between sample and hold(SH) and track and hold(TH) circuits, SH using two op-amps,SH using one op-amp.Digital to Analog and Analog to Digital Converters. **(6)**

TEXT BOOKS

1. *Patranabis, "Sensors and Transducers", 2nd edition, PHI learning private limited, 2013*
2. *D.V.S.Murty, Transducers and Instrumentation, 2nd edition, PHI learning private limited, 2011*

REFERENCES

1. *A.K. Sawney and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai& Co, New Delhi, 2017.*
2. *J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer. Fifth Edition,2014.*
3. *https://nptel.ac.in/courses/108/108/108108147/*

19MEE11 - SMART MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

On Completion of the course, the students should be able to:

CO1 *: Analyze the various types of smart materials.*

CO2 *: Evaluate the characteristics of smart material for different domains.*

CO3 *: Analyze and select a smart material according to the requirement.*

INTRODUCTION AND HISTORICAL PERSPECTIVE

Smart materials -The principal ingredients of smart materials - Generation of smart materials - Diverse areas of smart materials - Primitive functions of smart materials - System intelligence- components and classification of smart structures, common smart materials and associated stimulus-response, Application areas of smart systems - Wolff's law, Magnetostrictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect. **(9)**

PIEZOELECTRIC MATERIALS

Electrostriction - Pyroelectricity - Piezoelectricity -Piezoelectric effect direct and converse-Industrial piezoelectric materials - PZT - PVDF - PVDF film - Properties of piezoelectric materials - Piezoceramics, Piezopolymers - Bimorphs - SAW filters. Piezeoelctric Strain Sensors, Accelerometers, Active Fibre Sensing. **(9)**

SHAPE - MEMORY (ALLOYS) MATERIALS

Shape memory alloys (SMA) - Nickel - Titanium alloy (Nitinol) - Materials characteristics of Nitinol - Thermoelastic martensitic transformations -SMA memorization process, Shape memory effect (SME), One way and two-way SME, training of SMAs, Functional properties of SMAs - Applications of SMA - SMA fibers - Micro robot actuated by SMA - Satellite antenna applications. **(9)**

ELECTRO-RHEOLOGICAL AND MAGNETORHEOLOGICAL FLUIDS

Bingham-body model - Newtonian viscosity and non-Newtonian viscosity - Principal characteristics of electro rheological and magnetorheological fluids - The electrorheological phenomenon - Charge migration mechanism for the dispersed phase -Magnetorheological effect Applications of electrorheological and magnetorheological fluids. **(9)**

SMART POLYMERS AND HYDROGELS

Thermally responsive polymers, Electroactive polymers microgels, Synthesis, Properties and Applications, Protein-based smart polymers, pH-responsive and photo-responsive polymers, Self-assembly, Molecular imprinting using smart polymers, Drug delivery using smart polymers

Hydrogel: Synthesis, Fast responsive hydrogels, Molecular recognition, Smart hydrogels as actuators, Controlled drug release, Hydrogels in microfluidics. **(9)**

TOTAL : 45

TEXT BOOK

1. *M. V. Gandhi and B.S. Thompson, Smart Materials and Structures, Chapman and Hall, London, 1st Edition, 1992.*
2. *K. Otsuka, C.M. Wayman (Eds.), Shape Memory Materials, Cambridge University Press, 1998.*

REFERENCES

1. *I. Galaev, B. Mattiasson (Eds.), Smart Polymers: Applications in Biotechnology and Biomedicine, 2nd Edition, CRC Press, 2008.*
2. *N. Yui, R. J. Mrsny, K. Park (Eds.), Reflexive Polymers and Hydrogels: Understanding and Designing Fast Responsive Polymeric Systems, CRC Press, 2004.*

19MEE12 - NON-DESTRUCTIVE EVALUATION AND IMAGING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Assess fractured surfaces using Vision, lighting, Visual perception, direct and indirect method for simple parts like pipes and tubes.

CO2 : Examine the surface related failures upto 0.08 mm using liquid penetrant and magnetic particle testing, prepare the workpiece after testing using solvent removable, water washable.

CO3 : Specific type of material (ferromagnetic, Paramagnetic materials) and failure, a student will be able to determine the testing parameters (direct / alternative currents, surface strength, Depth of penetration, Direct pulsating current) with the help of Circular magnetization techniques, right hand rule field and Prods technique.

CO4 : Analyze the subsurface failure of metal using ultrasonic inspection technique with the help of echo method, through transmission method, resonance method, contact testing, immersion testing and couplants.

CO5 : Safely diagnose the internal failures of material by radiography technique using Radio isotopic sources, radiographic cameras, X-ray sources and industrial X-ray tubes.

CO6 : Predict the subsurface defects and anomalies of materials including composites by means of heat sensitive paints/ papers and thermally quenched phosphors liquid crystals.

FUNDAMENTALS NON-DESTRUCTIVE EVALUATION & IMAGING.

Introduction -Modes of failure - Types of fractures - Fundamentals of Visual Testing -Vision, lighting, material attributes environmental factors, Visual perception, direct and indirect methods. **(5)**

LIQUID-PENETRANT AND MAGNETIC PARTICLE INSPECTION TESTING

Principles - types and properties of liquid penetrants - developers- advantages and limitations of various methods - Preparation of test materials - Application of penetrants to parts, removal of surface penetrants, post cleaning - selection of penetrant method - solvent removable, water washable. Theory of magnetism - ferromagnetic, Paramagnetic materials -characteristics of magnetic fields - magnetization by means of direct and alternating current - surface strength characteristics - Depth of penetration factors, Direct pulsating current typical fields, advantages - Circular magnetization techniques, field around a strength conductors, right hand rule field - Prods technique, current. **(10)**

RADIOGRAPHIC TESTING AND RADIATION SAFETY

Geometric exposure principles-Influence coefficients -Radioisotopic sources - types and characteristics- Production and processing of radioisotopes - radiographic cameras - X-ray sources generation and properties- industrial X-ray tubes - target materials and characteristics.

Film Radiography: X-ray film - structure and types for industrial radiography -sensitometric properties - use of film, characteristic curves (H & D curve) - latent image formation on film - X-ray and gamma ray exposure charts.

Special Radiographic Techniques: Principles and applications of Fluoroscopy/Real-time radioscopy - advantages and limitations - recent advances, intensifier tubes, vidicon tubes. **(10)**

ULTRASONIC INSPECTION

Principles of Acoustics: Nature of sound waves, wave propagation - modes of sound wave generation - Various methods of ultrasonic wave generation - Ultrasonic Inspection Methods, Equipment/Materials: Principle of pulse echo method, through transmission method, resonance method - Advantages, limitations - contact testing, immersion testing, couplants - Data presentation A, B and C scan displays, comparison of contact and immersion method. Recent advances in ultrasonic testing, Ultrasonic imaging, Synthetic Aperture Focussing Techniques (SAFT), Time of Flight Diffraction (TOFD), Signal Analysis, Artificial Intelligence, Neural Network, Fuzzy logic, Guided waves ultrasonic testing. **(10)**

THERMOGRAPHY

Principles of Thermography - Contact and non-contact inspection methods - Heat sensitive paints - Heat sensitive papers - thermally quenched phosphors liquid crystals - techniques for applying liquid crystals - calibration and sensitivity - other temperature sensitive coatings -non contact thermography inspection - Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Introduction to advanced Non-destructive Evaluation techniques - Acoustic emission inspection, Leak Testing. **(10)**

TOTAL: 45

TEXT BOOKS

1. *Prasad J and Krishnadas Nair C.J. "Non-Destructive Test and Evaluation of Materials", 2nd Edition, McGraw Hill Education, 2017*

REFERENCES

1. *American Society for Metals, Non-Destructive Inspection and Quality Control: Metals hand Book, Vol-11, 8th Edition, Metals park Oh, 1976.*
2. *Peter J. Shull, "Non-destructive Evaluation: Theory, Techniques, and Applications", CRC Press, 2002.*
3. *Chuck Hellier, "Handbook of Nondestructive Evaluation, Second Edition", McGraw Hill Professional, 2012.*
4. *https://nptel.ac.in/courses/113/106/113106070/*

19MEE13 - AUTOMOTIVE ELECTRONICS AND POWER TRAIN SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Know the various electrical and electronics systems of the engine.*

CO2 *: Describe the powertrain parts performance and manufacturing parameters.*

CO3 *: Assemble and Disassemble the engine parts.*

C04 *: Match the characteristics of the customer, the vehicle and the engine.*

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines. **(9)**

SENSORS AND ACTUATORS

Classification of sensors, sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors and relay. **(9)**

ELECTRONIC ENGINE CONTROLS

Concept of an electronic engine control system, electronic fuel injection - throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics - engine control module and powertrain control module. **(9)**

LIGHTING SYSTEM

Insulated and earth return system, details of head light and side light, LED lighting system, headlight dazzling and preventive methods. Horn, wiper system and trafficator fuses, cables, connectors and selection. Multiplexing and demultiplexing, Immurements cluster and tell-tales. **(9)**

OVERVIEW OF POWER TRAIN

Mobility, automobiles and systems, engine characteristics, classification, efficiencies, parameters, engine and systems, driveline, HVAC, etc. Emission requirements, thermodynamic principle review, well to wheel efficiency, efficiency improvements, engine dismantling & assembly. **(9)**

TOTAL : 45

TEXTBOOKS

1. *M.L.Mathur & R.P.Sharma, Internal Combustion Engines, Dhanpat Rai Publications (P) Ltd., 2018.*
2. *Robert Bosch, "Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive" Springer Vieweg , Plochingen, Germany, 2014*

REFERENCES

1. *William B Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", The Boulevard, Langford Lane, Kidlington, Oxford, 2017.*
2. *James D Halderman, "Automotive Electricity and Electronics" 5th Edition, Pearson, 2016.*
3. *A l Santini, "Automotive Electricity and Electronics" Delmar Learning, 2016.*
4. *https://nptel.ac.in/courses/107/106/107106088/*

19MEE14 - BIO-MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Identify the suitable material for human implants and perform mechanical and tribological characterization.*

CO2 : *Carry out experiments for biomaterials, metals, ceramics polymers, micro/nano Surface modification, micro/nano fabrication to find the tensile strength and microstructure (SEM, AFM) evaluation (bonding , particle dispersion, size of the particle , internal defects).*

CO3 : *Choose a bio compact material for an orthopaedic joint.*

CO4 : *Develop successful implants (biological, mechanical, morphological Compatibility) for dental and bone applications.*

CO5 : *Estimate the percentage of reinforcement (particle, fiber, laminates) to increase the strength (tensile, flexural, bending, fatigue, wear, and corrosion) under specified constraints (density) for human implants.*

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. **(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)**

MATERIALS FOR ORTHOPAEDIC 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 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 - CoCr-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)**

BIOMATERIAL APPLICATIONS

Applications in Medicine, Biology, and Artificial Organs - Cardiovascular Medical Devices - Extracorporeal Artificial Organs - Orthopedic Implants - Dental Implantation - Bioadhesive - Ophthalmologic 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. *Joon. B. Park and Joseph D. Bronzino 'Bio Materials - Principles and Applications', CRC press, 2013.*

REFERENCES

1. *Park J. B. and Lakes R.S., 'BioMaterials - An Introduction', Plenum Press, New York, 2012.*
2. *J. L. Ong, Mark R. Appleford, Gopinath Mani., 'Introduction to Biomaterials: Basic Theory with Engineering Applications', Cambridge University Press, UK, 2014.*
3. *https://nptel.ac.in/courses/113/104/113104009/*
4. *https://nptel.ac.in/courses/102/106/102106057/*

19MEE15 - MICRO AND NANO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Grain a knowledge of basic approaches for micro/nano system design*

CO2 : *Gain a knowledge of state-of-the-art lithography techniques for micro/nanosystems*

CO3 : *Learn new materials, science and technology for micro/nanosystem applications*

CO4 : *Understand materials science for micro/nano system applications*

CO5 : *Understand state-of-the-art micromachining and packaging technologies*

CO6 : *Develop experience on micro/nanosystems for power and energy applications*

CO7 : *Have a good vision to the future of micro/nano technology*

INTRODUCTION AND SCALING

MEMS and microsystems - development of MEMS technology - MEMS future and applications, microsystems and microelectronics - MEMS challenges - scaling - scaling in geometry, rigid body dynamics, electrostatic forces, electromagnetic forces, electricity, fluid mechanics, heat transfer. **(7)**

MATERIALS FOR MEMS

Introduction - substrates and wafer - silicon substrate - crystal structure, miller indices, properties - silicon compounds - silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon - gallium arsenide - quartz - piezoelectric crystals - polymers - polymers for MEMS, conductive polymers. **(7)**

FABRICATION PROCESS

Physical Vapour Deposition (PVD) - evaporation, sputtering - Chemical Vapour Deposition (CVD) - etching process - wet chemical etching, plasma etching, Ion milling - patterning - lithography, lift off process - wafer bonding - silicon fusion bonding, anodic bonding- annealing - chemical mechanical polishing - doping - diffusion, implant. **(12)**

MEMS TECHNOLOGIES AND PACKAGING

Bulk micromachining - Isotropic and anisotropic etching, wet etchants, etch stop, dry etching, comparison of wet and dry etching - surface micromachining - Introduction, process, associated problems - LIGA Process and electroplating - Integration of electronics and MEMS technology - packaging - post fabrication process, package selection, die attach, Wire bond and Sealing. **(12)**

NEMS TECHNIQUES AND APPLICATIONS

Introduction to NEMS and its architecture - carbon nanotube electronics - modeling - introduction, analysis and simulation - simulation of Actuators, FET, Pressure transducer - applications and future challenges. **(7)**

TOTAL : 45

TEXT BOOKS

1. *James J Allen, "Micro Electro Mechanical System Design", CRC Press - Taylor & Francis, New York, 2005.*
2. *Tai Ran Hsu, "MEMS and Microsystems, Design, Manufacture and Nanoscale Engineering", John Wiley & Sons, New Jersey. 2008.*

REFERENCES

1. *Tai Ran Hsu, "MEMS and Microsystems: Design & Manufacture", McGraw Hill Education. 2017.*
2. *G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre "Micro and Smart Systems", Wiley India Pvt Ltd, 2019.*
3. *Vijay K. Varadan, Vinoy. K.J, Gopalakrishnan.S, "Smart material Systems and MEMS: Design and Development Methodologies", John Wiley & Sons, New York, 2011.*
4. *https://nptel.ac.in/courses/112/106/112106222/*
5. *https://nptel.ac.in/courses/117/105/117105082/*

COURSE CONTENTS FOR ELECTIVES IN THERMAL SCIENCES STREAM

19MEE16 - SOLAR ENERGY TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Calculate earth-sun angles and determine solar radiation on the earth's surface*

CO2 *: Analyze the performance of solar collectors with its optical properties*

CO3 *: Apply solar thermal conversion principles for different applications*

CO4 *: Calculate solar cell output voltage for solar photovoltaic system*

CO5 *: Analyze the performance and life cycle cost for hybrid solar systems*

SOLAR RADIATION

Properties of sunlight - Absorption by the atmosphere -Solar time - Earth-sun geometry - Calculation of solar irradiance at earth surface - Measuring instruments. **(9)**

SOLAR COLLECTORS

Types of solar collectors - Thermodynamic description of solar collectors - Optical properties of solar collectors and technologies for fabrication. **(9)**

SOLAR THERMAL APPLICATIONS

Solar liquid and air heating - Solar active and passive space heating - Solar thermal power plants - Solar pond - Solar cookers - Solar furnace - Storage of solar thermal energy. **(9)**

SOLAR CELL SYSTEMS

Solar cells and modules -System components and their functions - Calculating output and dimensioning of solar cell systems - Concentrated sunlight and solar power (CSP) - Properties of optical concentration systems - Overview of the different components in a CSP system and their functions. **(9)**

HYBRID SYSTEMS AND COST ANALYSIS

Combinations of solar thermal and solar cell systems. Overview of different applications. Financial Analysis, Life Cycle Costing, Environmental Analysis. **(9)**

TOTAL: 45

TEXTBOOKS

1. *Sukhatme S. P.and Nayak J. K. , "Solar Energy", McGraw Hill, New Delhi, 4th edition, 2017.*
2. *Garg H.P. and Prakash J., "Solar Energy: Fundamentals & Applications", Tata McGraw Hill, New Delhi, 2012.*

REFERENCES

1. *Duffie J. A. and Beckman W. A., "Solar Engineering of Thermal Processes", John Wiley & Sons Inc., New York, 4th edition, 2013.*
2. *Tiwari G.N. and Suneja S., "Solar Thermal Engineering System", Narosa Publishing House, New Delhi, 2016.*
3. *Rai G.D., "Solar energy Utilization", Khanna Publishers, New Delhi, 2002.*
4. *T. Bhattachariya, "Terrestrial solar Photovoltaic", Narosa Publishers, New Delhi, 2008*

19MEE17 - GAS DYNAMICS AND SPACE PROPULSION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Determine geometric design parameters required to accelerate or decelerate an isentropic flow for a given type of nozzle or diffuser, operating under specified conditions*

CO2 : *Analytically estimate the length of a one-dimensional constant area duct to achieve desired changes in properties via the effects of friction and heat transfer*

CO3 : *Analytically evaluate changes in physical properties when a normal shock occurs in one-dimensional constant area or variable area ducts*

CO4 : *Analyze flow through different components of aircraft and rocket propulsion systems using principles of thermodynamics*

INTRODUCTION OF COMPRESSIBLE FLOWS, AND NORMAL SHOCK WAVES

Compressibility of fluids - Compressible and incompressible flows - Acoustic wave propagation speed - Mach number - Sonic, stagnation states -Governing equations of one-dimensional, isentropic, and steady flows, normal shock waves - Normal shock solution - T-s and p-v diagrams - Further insights into the solution. **(9)**

RAYLEIGH FLOW, AND FANNO FLOW

Governing equations of Rayleigh flow, Fanno flow-T-s and p-v diagrams - Thermal choking -Friction choking -Solution procedures. **(8)**

QUASI-ONE-DIMENSIONAL FLOWS, OBLIQUE SHOCK WAVES

Governing equations of quasi-one-dimensional flow- Impulse function and thrust - Area-velocity relation - Geometric choking - Area-Mach number relation- Mass flow rate-Convergent, convergent-divergent nozzles- Interaction between nozzle flow, Fanno flow, and Rayleigh flows.

Oblique shock waves - Mach number at entry and exit, deflection angle. **(12)**

AIRCRAFT PROPULSION SYSTEMS

Aircraft propulsion - Jet engines - energy flow, study of turbojet engine components - diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines - thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbojet engine, ram jet engine. **(8)**

ROCKET PROPULSION SYSTEMS

Rocket propulsion - Types of rocket engines and propellants - thrust equation - effective jet velocity - specific impulse - rocket engine performance. **(8)**

TOTAL: 45

TEXT BOOK

1. *Yahya S. M., "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", New Age International (P) Ltd., 3rd Edition, 2017.*

REFERENCES

1. *John D. Anderson, "Modern Compressible Flow: With Historical Perspective", McGraw Hill India, 3rd Edition, Noida, 2017.*
2. *Robert D. Zucker, Oscar Biblarz, "Fundamentals of Gas Dynamics", Wiley, 3rd Edition, New Jersey, USA, 2019.*
3. *Philip Hill, Carl Peterson, "Mechanics and Thermodynamics of Propulsion", Pearson, 2nd Edition, New Delhi, 2011.*
4. *Jack D. Mattingly, Keith M. Boyer, "Elements of Propulsion: Gas Turbines and Rockets,"American Institute of Aeronautics& Astronautics, 2nd Edition, USA, 2016.*
5. *H. I. H. Saravanamuttoo, H. Cohen, G. F. C. Rogers, Paul Straznicky, A. C. Nix, "Gas Turbine Theory," Pearson, 7th Edition, New Delhi, 2019.*
6. *https://nptel.ac.in/courses/112/106/112106166/*

19MEE18 - COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Demonstrate ability to use the Finite-Volume Method to analyze one-dimensional and two-dimensional problems in 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.; Judge the correctness of the numerical solutions;*

RECOGNIZE 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, Classification of PDEs and Physical Significance **(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. *Suhas V. Patankar, "Numerical Heat Transfer and Fluid Flow", Ane Books Pvt. Ltd. New Delhi, 2017.*
2. *John D, Anderson, Jr., "Computational Fluid Dynamics - The basics with Applications", McGraw Hill, New Delhi, 9th reprint, 2015.*

REFERENCES

1. *Versteeg H.K. and Malalasekara W., "An Introduction to Computational Fluid Dynamics - The Finite Volume Method", Pearson Education, 2nd Edition, England, 2007.*
2. *Ghoshdastidar P.S., "Computer Simulation of Flow and Heat Transfer", Tata McGraw Hill, New Delhi, 1999.*
3. *Muralidhar K., Sundararajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.*
4. *Chung T.J., "Computational Fluid Dynamics", Cambridge Univ. Press, New York, 2002.*
5. *Titus Petrila and Damian Trif., "Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics", Springer, Boston, 2005.*
6. *https://nptel.ac.in/courses/112/105/112105045/*
7. *https://nptel.ac.in/courses/112/105/112105254/*

19MEE19 - ALTERNATIVE ENERGY CONVERSION TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *(i) Analyze heat transfer in solar energy systems (focusing and non-focusing type) used in heating applications and electricity generation via solar thermal power plants. (ii) Analyze direct electricity generation technique by a solar photo-voltaic system.*

CO2 : *Derive the expression for maximum possible electrical energy conversion from available wind energy for horizontal axis and vertical axis wind mills.*

CO3 : *Choose the type of conversion technique (biochemical and thermo-chemical) required to produce desired bio-fuels using available biomass.*

CO4 : *Analyze nuclear fission reactors with its control for electrical energy generation using heavy water nuclear power plant.*

CO5 : *Analyze energy conversion efficiency of geothermal energy conversion systems, OTEC, tidal power plants, wave energy generators, MHD generators, thermo-electric systems, thermionic systems and fuel cells for electrical energy generation*

ENERGY CONSUMPTION PATTERN

Commercial and non-commercial energy sources - study of global energy availability. Energy consumption pattern in India and growth rate, total energy concept, total energy installations. **(3)**

SOLAR SYSTEMS

Solar Radiation - properties, measurement. Solar Collectors - focusing, non-focusing - solar thermal systems - storage systems - photovoltaic conversion systems- case studies. **(9)**

WIND POWERED SYSTEM

Principle of wind energy conversion, power coefficient, site selection, horizontal and vertical axis wind mills - comparison - design of wind turbines. **(9)**

BIOENERGY

Bio energy sources - Photosynthesis and origin of biomass - biochemical and thermochemical conversion techniques - anaerobic digestion, fermentation - different biogas plants - applications. **(6)**

NUCLEAR PLANTS

Nuclear energy - Energy from fission and fusion, Fission reactor types, Reactor control - Heavy water reactor plants - Indian Scenario. **(9)**

NON CONVENTIONAL PLANTS

Geothermal energy conversion systems - OTEC - Tidal Power systems - wave energy generators -MHD systems. Thermo electric, thermionic systems, fuel cells. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Rai G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2007.*
2. *Sukhatme S.P., "Solar Energy", Tata McGraw Hill, 2nd Edition, 2007.*

REFERENCES

1. *Culp, "Principle of Energy Conversion", Tata McGraw Hill, 2005.*
2. *Magal, "Solar Power Engineering", Tata McGraw Hill, 2005.*
3. *Ashok V Desai, "Non-Conventional Energy", Wiley Eastern Ltd., New Delhi, 2002.*
4. *Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 3rd Edition, 2012.*

19MEE20 - ADVANCED FLUID MECHANICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Evaluate fluid velocities, accelerations, strain rates, stresses, and forces due to fluid stresses; Distinguish between incompressible and compressible flows*

CO2 : *Formulate problems using governing equations and obtain solutions for viscous flows in pipes and channels*

CO3 : *Distinguish between potential flows and rotational flows; Apply complex-variable theory to analyze and model some simple ideal flows*

CO4 : *Use boundary layer principles to analyze viscous flows over flat plates; Compute drag forces in laminar and turbulent flows*

FUNDAMENTALS AND GOVERNING EQUATIONS OF FLUID MOTION

Definition and properties of Fluids, Fluid as continuum, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics. Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler equations, Bernoulli's Equation. **(9)**

EXACT SOLUTIONS OF NAVIER-STOKES EQUATIONS

Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows**(9)**

POTENTIAL FLOWS

Stream function and Velocity potential function, Circulation, Irrotational vortex, Basic plane potential flows: Uniform stream; Source and Sink; Vortex flow, Doublet, Superposition of basic plane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lift theorem; Concept of lift and drag. **(9)**

LAMINAR BOUNDARY LAYERS

Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Approximate Methods, Flow separation, Entry flow into a duct. **(9)**

TURBULENT FLOWS

Introduction, Fluctuations and time-averaging, General equations of turbulent flow, Turbulent boundary layer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtl mixing hypothesis, Turbulence modeling. **(9)**

TOTAL: 45

TEXTBOOKS

1. *Frank M. White, "Fluid Mechanics", Tata McGraw-Hill, Singapore, 7th edition, 2011.*
2. *Muralidhar K. and Biswas G., "Advanced Engineering Fluid Mechanics", 2nd Edition, Narosa,2005.*

REFERENCES

1. *Batchelor G.K., "An Introduction to Fluid Dynamics", Cambridge University Press, 2000.*
2. *Robert Fox W., Alan McDonald T., "Introduction to Fluid Mechanics", 6th Edition, John Wiley & Sons, 2003.*
3. *Frank M. White, "Viscous Fluid Flow", Third Edition, McGraw-Hill Series of Mechanical Engineering, 2017.*
4. *John D. Anderson Jr., "Modern Compressible Flow with Historical Perspective", 3rd edition McGraw-Hill, 2002.*
5. *Schlichting H., "Boundary Layer Theory", 7th edition, Springer Verlag, 2014.*
6. *Tennekes H. and Lumley J.L., "A First Course in Turbulence", The MIT Press, 1972.*

19MEE21 - ADVANCED THERMODYNAMICS

(Use of Property Tables is permitted)

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Apply Maxwell's relations; Derive expressions for basic thermodynamic property relationships; Evaluate changes in thermodynamic properties*

CO2 : *Apply ideal gas, van der Waals and Redlich-Kwong equations of state to analyze thermodynamic processes undergone by various gases*

CO3 : *Analyze multi-component mixtures of ideal gases or real gases using various mixture models*

CO4 : *Apply First Law and Second Law principles to evaluate combustion-related processes and compute lost work*

THERMODYNAMIC PROPERTY RELATIONS

Some mathematical theorems, Fundamental postulate of thermodynamics, Fundamental equations of thermodynamics for simple compressible systems, TdS relations, Maxwell relations, Relations for cp and cv, Relationships for calculating changes in internal energy, enthalpy and entropy, Joule-Thompson coefficient. **(9)**

REAL GAS BEHAVIOR

Real gas equations of state (EOS) e.g. van der Waals, Redlich-Kwong EOS, Determination of EOS model constants from critical point data, Property relationships for real gases, Ideal gas vs. real gas mixtures, Dalton and Amagat models, Mixture rules for real gas mixtures, Entropy of mixing, problems.**(9)**

MULTI-COMPONENT SYSTEMS

Chemical work, Fundamental equations of thermodynamics for multi-component systems, Maxwell relations, Chemical work and chemical potential, Partial molar properties, Gibbs-Duhem equation. **(9)**

AVAILABILITY AND EXERGY

Available Energy, Available Energy referred to cycle, Reversible work, Irreversibility, Availability functions for closed and open systems, Availability of exergy balance, Quality of Energy, Degradation of exergy, II law efficiency, Applications to various thermodynamic processes. **(9)**

REACTIVE SYSTEM

Degree of reaction, Heat of reaction, Combustion process, Enthalpy of formation, First-law analysis of reacting systems, Enthalpy and internal energy of combustion, Adiabatic flame temperature, Second law analysis of reacting systems.

TOTAL: 45

TEXT BOOKS

1. *Nag P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, 2019.*
2. *Claus Borgnakke, Richard E. Sonntag, "Fundamentals of Thermodynamics", 8th Edition, International Student Version, Wiley, 2013.*

REFERENCES

1. *Jones J. B., Dugan R. E., "Engineering Thermodynamics", Indian Edition, PHI Learning Private Limited, 1996.*
2. *Michael Graetzel & Pierre Infelta, "The Bases of Chemical Thermodynamics", Overseas Ed., Overseas Press India Pvt. Ltd., 2006.*
3. *Dhar P. L., "Engineering Thermodynamics - A Generalized Approach", Elsevier, New Delhi, 2008.*
4. *Kenneth Wark, "Advanced Thermodynamics for Engineers", McGraw-Hill, 1995.*
5. *Dittman R.H., Zemansky M.W., "Heat and Thermodynamics", 8th Edition, Tata McGraw-Hill, 2011.*
6. *Bejan A., "Advanced Engineering Thermodynamics", 4th Edition, John Wiley, 2016.*

19MEE22 - CRYOGENICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Analyze different gas liquefaction systems and estimate their figure of merit*

CO2 *: Examine refrigeration systems used for above and below 2K and evaluate their performance parameters.*

CO3 *: Calculate the theoretical number of plates in rectification columns used for gas separation.*

CO4 *: Compare and choose appropriate system for measurement of temperature, pressure, flow rate, fluid quality, and liquid level at cryogenic temperatures.*

CO5 *: Design inner and outer vessels for cryogenic storage for given parameters of volume,pressure and material.*

CO6 *: Calculate pump-down time for a vacuum system. Choose appropriate insulation for a given cryogenic system and estimate the heat transfer rate through the insulation.*

PREREQUISITE

Insight on Cryogenics-Basics, Properties of Cryogenic fluids Historical Development of Cryogenic Treatment

GAS LIQUEFACTION SYSTEM

System performance parameters - ideal system, liquefaction systems - simple Linde - Hampson, Claude systems - systems for neon, hydrogen and helium. **(9)**

CRYOGENIC REFRIGERATION SYSTEM

Claude refrigerator - Philips refrigerator, Solvay, Gifford-Mc Mahon refrigerators - magnetic cooling - magnetic refrigerators systems. **(9)**

SEPARATION AND PURIFICATION SYSTEMS

Theoretical plate calculations of air columns - air separation systems - Linde double column systems - Argon, Neon, Hydrogen and Helium separation systems - Gas purification methods. **(9)**

MEASUREMENT SYSTEMS

Temperature, pressure, flow rate, fluid quality, liquid level measurement systems. **(9)**

STORAGE AND APPLICATIONS

Cryogenic fluid storage systems - vacuum technology - applications of cryogenics.Benefits of cryogenic treatment-Wear resistance, Stress Relieving, Hardness **(9)**

TOTAL : 45

TEXT BOOKS

1. *Randal F. Barron, "Cryogenic Systems", Oxford University Press, 1985.*
2. *Thomas M. Flynn, "Cryogenic Engineering", 2nd Edition, Taylor and Francis, 2005.*

REFERENCES

1. *Mamata Mukhopadhyay, "Fundamentals of Cryogenic Engineering", Prentice Hall of India, 2010.*
2. *Peter Kittel, "Advances in Cryogenic Engineering", Plenum Press, 1998.*
3. *Cryogenic Technology, Materials, Process and equipment, Resource Material, IIT Kharaghpur.*
4. *Guglielmo Ventura and Lara Risegari, "The art of Cryogenics - Low Temperature Experimental Techniques", Elsevier, 2008.*
5. *Guy K. White, "Experimental Techniques in Low Temperature Physics", Clarendon Press, Oxford, 1987.*
6. *https://nptel.ac.in/courses/112/101/112101004/*

19MEE23 - COMBUSTION AND INTERNAL COMBUSTION ENGINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Apply principles of thermodynamics and chemical engineering to combustion and formulate governing equations for the same.*

CO2 : *Distinguish between different types of flames.*

CO3 : *Distinguish between air standard cycles and actual cycles, identify the parameters causing the difference, and quantify the same..*

CO4 : *Develop simplified models of combustion in I.C. engines.*

CO5 : *Construct, explain and present indicated diagrams for I.C. engines.*

THERMODYNAMICS OF COMBUSTION, CHEMICAL KINETICS AND REVIEW OF TRANSPORT EQUATIONS

Properties of mixtures - Combustion stoichiometry - Heating values - Adiabatic flame temperature - Nature of combustion chemistry - Elementary reaction rate - Simplified models of combustion chemistry, Review of mass transfer - Conservation equations of mass, species, momentum and energy - Normalized form of conservation equations - Transport properties. **(12)**

PREMIXED FLAMES AND DIFFUSION FLAMES

Physical processes - Flammability limits and flame quenching - Minimum energy for sustained ignition and flame propagation -turbulent premixed flames - Structure of non-premixed laminar free jet flames - Burke-Schumann jet diffusion flame - Turbulent jet flames - Condensed fuel fires. **(9)**

DROPLET EVAPORATION AND COMBUSTION

Droplet vaporization in convective Flow - Droplet combustion - Initial heating of a droplet - Droplet diffusion, Spray Combustion. **(6)**

FUEL-AIR CYCLE AND ACTUAL CYCLES

Fuel air cycle - Variation of specific heat - Dissociation and chemical equilibrium loss - Comparison of p-v diagram - thermal efficiency and fuel consumption - effect of variables - Actual cycle - Heat loss factor - Time loss factor - Exhaust blow-down. **(9)**

COMBUSTION IN I.C. ENGINES

Auto-ignition and effect of pressure on auto-ignition - Piloted ignition, Normal and abnormal combustion in CI and SI engines - Octane rating - Gasoline direct injection - CRDI, GDI, GDCI, , EDICI, Microwave Ignition - Cetane rating - Homogeneous charge compression ignition engine(HCCI) - Simplified two-zone model of engine combustion. **(9)**

TOTAL : 45

TEXT BOOKS

1. *McAllister S., Jyh Yuan Chen and Fernandez-Pello A.C., "Fundamentals of Combustion Processes", Springer, New York, 2013.*
2. *Heywood J.B., "Internal Combustion Engines Fundamentals", 2nd Edition, McGraw Hill, 1989.*

REFERENCES

1. *Williams F.A., "Combustion Theory - The Fundamental Theory of Chemically Reacting Flows", 2nd Edition, The Benjamin- Cummings Publishing Company, 1985.*
2. *Turns S.R., "An Introduction to Combustion - Concepts and Applications", 3rd Edition, McGraw Hill, 2011.*
3. *El-Mahallawy F. and Habik S.E., "Fundamentals and Technology of Combustion", Elsevier Science, 2002.*
4. *https://nptel.ac.in/courses/112/104/112104033/*
5. *https://nptel.ac.in/courses/112/106/112106299/*

19MEE24 - ENERGY CONSERVATION AND WASTE HEAT RECOVERY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Identify the demand supply gap of energy in Indian scenario*

CO2 : *Carry out energy audit of an industry/Organization.*

CO3 : *Apply energy conservation techniques in thermal systems*

CO4 : *Apply energy conservation techniques in electrical systems*

CO5 : *Implement waste heat recovery technologies in the industries*

INTRODUCTION

Energy Scenario - Basics of Energy and its various forms. Energy Resources Availability in India. Energy consumption pattern. Energy conservation and energy efficiency - needs and advantages. Energy auditing - types, methodologies, barriers. Role of energy manager. **(7)**

INSTRUMENTS FOR ENERGY AUDITING

Instrument characteristics - sensitivity, readability, accuracy, precision and hysteresis. Error and calibration. Measurement of flow, velocity, pressure, temperature, speed, Lux, power and humidity. Analysis of stack, water quality, power and fuel quality. **(9)**

ENERGY CONSERVATION IN THERMAL SYSTEMS

Energy Efficiency in Thermal Utilities - Fuels and Combustion - Boilers - Thermic Fluid Heaters - Steam Systems - Furnaces -Insulation and Refractory - FBC Boilers - Thermal Storage. **(10)**

ENERGY CONSERVATION IN ELECTRICAL SYSTEMS

Energy Efficiency in Electrical Utilities - Electric Motors - Compressed Air System - HVAC and Refrigeration System - Fans and Blowers - Pumps and Pumping System - Cooling Tower. **(10)**

WASTE HEAT RECOVERY SYSTEMS

Introduction - Principles of Thermodynamics and Second Law - sources of waste heat recovery. Waste heat recovery systems -Design Considerations - fluidized bed heat exchangers - heat pipe exchangers - plate heat exchangers - heat pumps - thermic fluid heaters - selection of waste heat recovery technologies. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Chakrabarti, Amlan, "Energy Engineering and Management", PHI Learning Private Limited, 2nd edition, 2019.*
2. *Sengupta Subrata, Lee SS, EDS, "Waste Heat Utilization and Management", Hemisphere, Washington, 1983.*

REFERENCES

1. *Rajan G.G., "Energy Efficiency Optimization", Productivity & Quality Pub. P. Ltd, 2019.*
2. *Meenu Agrawal, "Energy Conservation & Energy Security in India", Kunal Books (Publishers & Dist.), 2013.*
3. *Smith C.B., "Energy Management Principles", Pergamon Press, NewYork, 2nd edition, 2015.*
4. *"Handbook of Energy Audits", 9th Edition, Thumann, Albert, 2013.*
5. *Institute of Fuel, London, "Waste Heat Recovery", Chapman and Hall Publishers, London, 1963.*
6. *Guide book for National Certification Examination for Energy Managers and Energy Auditors(www.energymanagertraining.com).*
7. *https://nptel.ac.in/courses/112/105/112105221/*

19MEE25 - DESIGN OF HEAT EXCHANGERS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the student shall be able to

CO1 : *Apply knowledge of mathematics, science, and engineering principles relevant to area of fluid/ thermal*

CO2 : *Select and apply appropriate models or simulations of the real world and analyze output of models/simulations to provide information for design decisions.*

CO3 : *Perform feasibility analysis and use results to choose candidate solutions and evaluate quality of solutions to select the best once.*

CO4 : *Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, and sustainability*

CO5 : *Select proper models to solve problems using modern software packages, employed as standard tools in the industrial and developmental environment.*

INTRODUCTION

Classification of Heat Exchangers - Heat Transfer Mechanisms - Flow Arrangements - Applications - Selection of Heat Exchangers **(7)**

ANALYSIS OF HEAT EXCHANGER

Introduction - Arrangement of flow paths in Heat Exchangers - Overall heat transfer coefficient - LMTD and - NTU Method for heat exchanger analysis - Heat exchanger design methodology - Variable overall heat Transfer coefficient - Heat exchanger design calculation. **(8)**

FORCED CONVECTION CORRELATIONS FOR SINGLE-PHASE HEAT EXCHANGERS

Introduction - Hydro dynamically developed & Thermally developing laminar flow in smooth circular ducts effect of variable physical properties - laminar flow of liquids and gases in ducts -Turbulent forced convection - Turbulent flow in smooth straight non- circular ducts - Turbulent flow liquid and gases in ducts. **(8)**

SHELL-AND-TUBE HEAT EXCHANGERS

Introduction - Basic components - Basic design procedure of a heat exchanger - Preliminary estimation of unit size -Rating of the preliminary design - Shell and tube -Side heat transfer, pressure drop, heat transfer coefficient -Bell-Delaware method- Design of heat exchanger subject to fouling. **(7)**

HEAT EXCHANGER PRESSURE DROP AND PUMPING POWER

Introduction - Tube-side pressure drop - Circular cross-section tubes - Non circular cross-sectional ducts Pressure drop in tube bundles in cross flow - Pressure drop in helical and spiral coils - Pressure drop in bends and fittings - Pressure drop for abrupt contraction, expansion, and momentum change - pumping Power **(8)**

HEAT EXCHANGERS WITH TWO-PHASE FLOW

Introduction - Characteristic of multiphase flow - Classification of two-phase flow -Evaporator - Condensers - Flow pattern maps for vertical and horizontal in-tube and shell side flows - Thome's flow pattern - Void fraction - dryness fraction. **(7)**

TOTAL: 45

TEXT BOOKS

1. *Ramesh K, Shah and Dusan P. Sekulic, "Fundamental of Heat Exchangers Design", John Wiley & Sons, Inc., 2003.*
2. *Sadik Kakaç, Hongtan Liu , Anchasa Pramuanjaroenkij, "Heat Exchangers: Selection, Rating, and Thermal Design", CRC Press, 2012.*

REFERENCES

1. *Arthur P. Frass, "Heat Exchanger Design ", Second Edition, John Wiley & Sons, New York, 1996.*
2. *T.Taborek, G.F.Hewitt and N.Afgan "Heat Exchangers ", Theory and Practice, McGraw Hill Book Co., 1980.*
3. *Walker, "Industrial Heat Exchangers" - A Basic Guide, McGraw Hill Book Co., 1980.*
4. *Holger Martin, "Heat Exchangers ", Hemisphere Publishing Corporation, London, 1992.*
5. *https://nptel.ac.in/courses/112/105/112105248/*

19MEE26 - TURBO MACHINES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the student shall be able to

CO1 *: Explain the working principle of turbo machines and apply it to various types of machines.*

CO2 *: Analyze energy transfer through velocity triangles.*

CO3 *: Compare the performance of different turbo machines.*

CO4 *: Construct and interpret the performance curves of turbo machines.*

INTRODUCTION

Introduction to Turbo machines - Classification of Turbomachines - Comparison with positive displacement machine - Second Law of Thermodynamics - turbine/compressor work, Nozzle/diffuser work - Fluid equations - continuity, Euler's turbine equation and its components ,Bernoulli's equation and its applications - Dimensionless parameters and their significance - Expansion and compression processes, overall isentropic efficiency, stage efficiency - Reheat Factor, Preheat Factor. **(9)**

ENERGY TRANSFER IN TURBOMACHINES

General analysis of turbomachines - Centrifugal compressor - Axial compressor - Effect of blade discharge - Degree of reaction - velocity triangle for different values of degree of reaction - Analysis of Axial/Radial turbines - Utilization factor. **(8)**

CENTRIFUGAL COMPRESSOR AND PUMPS

Centrifugal Compressor: classification, overall pressure ratio, blade angles, with slip and without slip factor - related problems , diffuser and surging - Centrifugal pumps: Manometric head, suction head, delivery head, and pressure rise, efficiency, slip, priming, cavitations and NPSH. **(7)**

AXIAL FLOW COMPRESSOR

Introduction - Velocity triangle - work done - work done factor - flow coefficient - pressure coefficient - overall pressure ratio - degree of reaction - related problems **(7)**

STEAM TURBINES

Classification - single stage impulse turbine, blade efficiency, stage efficiency, compounding - need for compounding, impulse staging, maximum utilization factor for multistage with equiangular blades, effects of blades and nozzle losses. Reaction turbine, maximum blade efficiency. **(8)**

HYDRAULIC TURBINES

Classification - Pelton, Francis and Kaplan turbines - unit quantities, Velocity triangles, power, efficiency, design parameters, different blade speeds. **(6)**

TOTAL : 45

TEXT BOOKS

1. *S.M. Yahya, Turbines, Compressors and Fans,4th Edition, Tata Mcgraw Hill, 2017.*
2. *Venkanna B.K., "Fundamental of Turbomachinery", PHI Learning, 2009*

REFERENCES

1. *Dennis G. Shepherd , "Principles of Turbomachinery", Macmillan Pub Co ,1961*
2. *Brunoeck, "Fans; design and operation of centrifugal, axial-flow, and cross-flow fans", Pergamon Press, 1973.*
3. *https://nptel.ac.in/courses/101/101/101101058/*
4. *https://nptel.ac.in/courses/112/106/112106200/*

19MEE27 - POWER PLANT ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Identify a suitable hydro-electric power plant from the run-off details available.*

CO2 : *Select suitable components for a thermal power plant based on the requirements specified.*

CO3 : *Compare different power plants and choose the relevant one based on the environment and available resources.*

CO4 : *Sketch hydrographs, flow duration curves and load curves for the details specified.*

HYDROLOGY & HYDRO-ELECTRIC POWER PLANT

Rainfall & Run - off measurements - Hydrographs - Flow duration curves - Mass curves and storage - Hydro-electric power plant - classification - Site selection considerations - Selection and Governing of Turbines **(9)**

THERMAL POWER PLANT

General Layout - Site selection considerations - Coal handling and storage - Stokers - Burners - Ash handling and dust collection systems - mechanical dust collectors - electrostatic precipitators - Draught and its types - Chimneys. **(9)**

NUCLEAR & DIESEL POWER PLANT

Nuclear energy - Isotopes - Radioactivity - Radioactive decay - Nuclear fission and fusion - Nuclear reactors - Types - Site selection considerations - Nuclear waste - effects - radioactive waste disposal system. Diesel Power Plant - Layout and components - comparison of diesel with thermal power plants. **(9)**

POWER PLANT ECONOMICS

Terms and Factors - Tariffs - Economics of Power Generation -Load curves - Ideal and Realized load curves - Effect of variable loads - Energy economics - Total and net energy - EROEI - Metrics for energy economics - Payback period - return on investment - net present value - levelized cost of energy - input output analysis. **(9)**

ENERGY STORAGE & NON-CONVENTIONAL POWER GENERATION

Energy Storage - Pumped Hydro - Compressed Air Energy Storage - Flywheels - electrochemical - magnetic - thermal - chemical energy storage. Non Conventional Power Generation - MHD - Thermionic Power Generation - Thermoelectric Power Generation - Fuel Cells - Geothermal energy - Hydrogen energy**(9)**

TOTAL : 45

TEXTBOOKS

1. *Domkundwar S, "Power Plant Engineering", Dhanpat Rai and Sons, 2016.*
2. *Sharma P C, "Power Plant Engineering", S K Kataria and Sons, 2019.*

REFERENCES

1. *Nag P K, "Power Plant Engineering", 4th Edition, Tata McGraw Hills Publications, 2017.*
2. *Nagpal G R, "Power Plant Engineering", Khanna Publishers, 2002.*
3. *Morse F P, "Power Plant Engineering", Affiliated East West Press Ltd, 2003.*
4. *https://nptel.ac.in/courses/112/107/112107291/*

COURSE CONTENTS FOR ELECTIVES
IN MANUFACTURING AND MANAGEMENT STREAM

19MEE28 - INDUSTRIAL PSYCHOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Analyze the behavior of individuals and groups in organizations in terms of the key factors that influence organizational behavior.*

CO2 : *Assess the potential effects of organizational level factors (such as structure, culture and change) on organizational behavior.*

CO3 : *Critically evaluate the potential effects of important developments in the external environment (such as globalization and advances in technology) on organizational behavior.*

CO4 : *Analyze organizational behavioral issues in the context of organizational behavior theories, models and concepts.*

INTRODUCTION TO INDUSTRIAL PSYCHOLOGY

Definitions & Scope. Major influences on industrial Psychology- Scientific management and human relations schools Hawthorne Experiments **(9)**

INDIVIDUAL IN WORKPLACE MOTIVATION AND JOB SATISFACTION

Stress management. Organizational culture, Leadership & group dynamics. Work Environment & Engineering Psychology-fatigue. Boredom, accidents and safety. Job Analysis, Recruitment and Selection. **(9)**

DECISION MAKING BY INDIVIDUALS & GROUPS

Decision making process, individual influences, group decision process. **(9)**

ORGANIZATIONAL CULTURE

Functions of organizational culture, Organizational Socialization, Assessing Cultural Values and Fit, Cross Cultural issues **(9)**

PERSONALITY AND ORGANIZATION

Meaning, Application of Personality theory in organization, traits, Common personality measurement tools **(9)**

TOTAL : 45

TEXTBOOKS

1. *Nelson, Quick and Khandelwal, ORGB: An innovative approach to learning and teaching Organizational Behaviour. A South Asian Perspective, Cengage Learning, 2012*
2. *Luthans, Fred, Organizational Behavior, McGraw Hill 2008*

REFERENCES

1. *Udai Pareek, Understanding Organizational Behavior, Oxford University Press*
2. *Robbins, Stephen, Organizational Behavior, Prentice Hall, India*
3. *https://nptel.ac.in/courses/109/104/109104105/*

19MEE29 - WORK SYSTEM DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.*

CO2 : *Calculate Work Measurement with various types and techniques will be able to apply the time study for job and equipment selection*

CO3 : *Design, implement and improve systems that include people, materials, information, equipment, and energy.*

CO4 : *Compare the operations and using systematic approach to improve the shop floor operations.*

CO5 : *Develop equipment and devices by considering ergonomic factors.*

PRODUCTIVITY

Definition - Reasons for low productivity - Methods to improve productivity - Concept of work study and productivity - Possibility guides - Methods study - Scope of motion and time study- Productivity measurement - Productivity models - Kurosawa structural approach, Lawlor's approach, Gold's approach, Quick Productivity Appraisal approach (QPA), Inter-firm comparison (IFC) -Work methods design. **(9)**

METHOD STUDY

Total work content, Developing methods - Process analysis - Process charts, Process flow charts - Multiple activity charts - Manand machine chart - Two handed process chart - String diagram - Travel chart - Cycle graph - Chrono-cycle graph - Therbligs -Micro motion and memo motion study - Simo chart - Principles of motion economy - Development and installation of new method. **(9)**

WORK MEASUREMENT AND ITS METHODS

Work sampling - Various techniques of work - Measurement of work - Stopwatch time study & its procedure - Job selection -Equipment and forms used for time study - Rating, methods of rating, allowances and their types - Determining time standards from standard data and formulas - Predetermined motion time standards - Work factor system - Methods time measurement, Analytical Estimation. **(9)**

APPLIED WORK MEASUREMENT

Measuring work by physiological methods - Heart rate measurement - Measuring oxygen consumption- Establishing time standards by physiology methods - Methods time measurement (MTM) and its application to production and maintenance -Organization and methods (O&M) - Wage incentive plans. **(9)**

ERGONOMICS

Motion economy- Ergonomics practices - Human factors Engineering - Human performance in physical work under heat, cold, illumination, vibration, noise, pollution, static and dynamic conditions, human body measurement - Layout of equipment - Seat design - Design of controls and compatibility - Environmental control - Vision and design of displays. Design of work space, chair table. **(9)**

TOTAL: 45

TEXT BOOKS

1. *Groover, M. P. Work Systems and the Methods, Measurement, and Management of Work, New Jersey: Pearson Education Inc, 2013.*
2. *Niebel, B. and Freivalds, A. Methods, Standards, and Work Design, 13th Edition, Boston: McGraw-Hill, 2013.*

REFERENCES

1. *Barnes, R.M. "Motion and Time Study", John Wiley and sons, 2002.*
2. *Bridger,R.S. "Introduction to Human Factors and Ergonomics" CRC Press 4th Edition, 2017*
3. *"Introduction to work study", ILO, 3rd edition, Oxford & IBH publishing, 2015.*
4. *Konz, S. and Johnson, S. "Work Design: Industrial Ergonomics", 5th Edition, Holcomb Hathaway.*
5. *Marvin, E., Mundel. And David, L. "Motion & Time Study: Improving Productivity", Pearson Education, 2000.*
6. *Prem Vrat, "Productivity Management- A systems approach", Narosa publishing, 1998.*
7. *Sanders Mark, S. and McCormick Ernert, J. "Human Factors in Engineering and Design", McGraw-Hill Inc, 1993.*
8. *https://nptel.ac.in/courses/112/107/112107249/*

19MEE30 - TOTAL PRODUCTIVITY MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 :

INTRODUCTION OF TPM

Introduction, What is TPM?, From PM To TPM, What is Productive Maintenance, History of TPM, Development of TPM in Japan, Definition of TPM, JIPM and TPM definition, Input/output, 6 Major losses, 5 's' Housekeeping, Reasons for TPM popularity, Eight pillar of TPM, TPM in India, Pitfalls and Cautions before implementing TPM **(9)**

TPM OBJECTIVE : INCREASING OEE

Need for improving Production Efficiency, Need for OEE, Bottlenecks for Equipment Effectiveness, Measuring Equipment Effectiveness, Evaluation of Availability, Performance and Quality Rates, Overall Equipment Effectiveness, OEE for different 106 types of Equipment, 12 Steps for improving OEE, OEE improvement plans, Ideas for OEE improvement, Benefits from increased OEE **(9)**

METHODS OF PLANT MAINTENANCE

Planed, Preventive, Autonomous, Break Down, Replacement and Others Maintenance Methods **(5)**

TPM DEVELOPMENT PROGRAMS

Announcement about TPM launching, TPM Campaign and Education, Formation of TPM Organisation, Evidence of Commitment, Kick-Off of TPM, Improve Equipment and Quality Maintenance, Build Administrative Effectiveness through Office TPM, Safety and Environment, Sustaining TPM Implementation and raising levels, Application procedure for PM Prize **(9)**

EVALUATION OF VARIOUS MAINTENANCE STRATEGIES

Resources-Product, Development, Market, Development-Internal, Development and Expansion-External Diversification and Acquisition **(8)**

PRINCIPLES OF TOTAL PRODUCTIVE MAINTENANCE

Principle of TPM, Quality Maintenance, Research Problem Formulation Text Readings **(5)**

TOTAL : 45

TEXT BOOKS

1. *Masaji Tajiri, Fumio Gotoh, TPM Implementation: A Japanese Approach, 1st Edition, 2014*
2. *Steve Borris, Total Productive Maintenance: Proven Strategies and Techniques to Keep Equipment Running at Maximum Efficiency, McGraw-Hill Education,2006*

REFERENCES

1. *David J. Sumanth, "Total Productivity Management" CRC Press, 1998.*
2. *Campbell, John D. and Reyes-Picknell, James, 2nd Edition: Strategies for Excellence in Maintenance Management, Productivity Press, 2006.*
3. *Leflar, James, Practical TPM: Successful Equipment Management at Agilent Technologies, Productivity Press , 2001.*
4. *Seiichi Nakajima, "Introduction to TPM" ,1989*
5. *Seiichi Nakajima, "TPM Development Program" ,1993.*
6. *Japan Institute of Plant Maintenance, "TPM for Every Operator", Productivity Press,1996.*
7. *Yoshikazi Takahashi, "TPM - Total Productive Maintenance"*
8. *Productivity Management: A Systems Approach - Prem Vrat, G. D. Sardana, B. S. Sahay - Narosa Publishing House, 1998.*

19MEE31 - PLANT LAYOUT AND MATERIAL HANDLING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Identify and analyse the problems in the existing layout/ material handling system and shall be able to the optimize the layout/ material handling system*

CO2 : *Demonstrate their knowledge, techniques and will be able to design an efficient plant layout and material handling systems for a given system.*

CO3 : *Select the appropriate techniques to evaluate the material flow and application of computer aided layout design.*

CO4 : *Understand the scope and importance of material handling systems and Suggest appropriate material handling strategies in the industries.*

CO5 : *Identify, analyze, solve technical problems and successfully complete a comprehensive design project related to material handling in manufacturing fields.*

INTRODUCTION

Objectives and criteria for facilities planning and industrial plant design. **(2)**

PLANT LAYOUT

Plant location - Factors affecting location, selection, application of transportation problems, assignment problems in layout design. **(9)**

TYPES OF PLANT LAYOUT AND LAYOUT PLANNING

Types of manufacturing system - types of plant layout and practical application - preliminary enterprise design activity - design process - factors influencing plant layout - design considerations - steps in planning-safety measures. **(9)**

QUANTITATIVE EVALUATION OF PLANT LAYOUT

Material flow - flow planning criteria, flow possibilities - design of material flow pattern conventional and quantitative techniques for analyzing material flow. Application of computer aided layout design. **(8)**

MATERIAL HANDLING AND ANALYSIS

Organization for material handling - relationship with plant layout - objectives, scope, principle and importance of material handling, selection and replacement of material handling equipment and analysis of handling problems. **(8)**

MATERIAL HANDLING SYSTEMS

Basic material handling systems - types of material handling equipment used for different applications - their selections and characteristics, auxiliary equipments, safety in handling- Ergonomics of material handling equipment. **(9)**

TOTAL : 45

TEXT BOOK

1. *Siddhartha Ray, "Introduction to Materials Handling", New Age International Publishers,2017.*

REFERENCES

1. *Muthur,"Practical Plant Layout", McGraw Hill, New York, 1976.*
2. *Moor, "Plant Layout and Design", McMillan India Ltd., 1978.*
3. *S. C. Sharma, "Plant layout and material handling", Khanna publishers, 2000.*
4. *Richard L Francis, Leon F McGinnis, Jr., and John A. White, "Facility Layout and Location - An Analytical Approach" , Prentice Hall of India (P) Ltd., New Delhi , 2005.*
5. *Choudary.R.B. and Tagore.G.R.N., "Plant Layout and Material Handling", Khanna Publishers, New Delhi, 2005.*
6. *https://www.youtube.com/watch?v=IhGBUcMM-rE*

19MEE32 - PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Demonstrate a project, production systems, project planning, networking and basic scheduling with AOA and AON networks.*

CO2 : *Plan and manage the time effectively by Time/Cost Tradeoffs or Cost Tradeoffs in Projects and to utilize the resources optimally.*

CO3 : *Plan, implement, monitor, control the project with PERT/Cost, to improve the team building and leadership qualities to complete the project in the shortest span of time.*

CO4 : *Assess the performance of a production system and to justify them for new products considering financial constraints.*

CO5 : *Employ management tools like MRP I, MRP II, JIT, Waste elimination techniques to identify, control and eliminate both bottlenecks and constraints in projects.*

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

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 - 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 BOOK

1. *Kerzner H., "Project Management: A Systems Approach to Planning, Scheduling and Controlling", John Wiley & Sons, 11th Edition, 2013.*

REFERENCES

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. *Murthy P.R., "Production and Operations Management", New Age International (P) Ltd. Publishers, 2nd Edition, 2006.*
4. *Mayer R.R., "Production Management", McGraw-Hill, 1968.*
5. *Harding H.A., "Production Management", Macdonald and Evans Ltd, 1974.*
6. *https://nptel.ac.in/courses/110/104/110104073/*

19MEE33 - RAPID PROTOTYPING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Synthesis the right manufacturing technique for manufacture of prototypes.*

CO2 : *Develop an understanding on various additive manufacturing techniques for manufacture of critical and complex geometry products.*

CO3 : *Orient the input files and produce a product using the available rapid prototyping systems in cost effective way.*

CO4 : *Integrate and develop complex geometrical shapes with highest degree of accuracy and surface finish.*

CO5 : *Develop knowledge on the novel application of RP Technologies for future projected product manufacturing.*

INTRODUCTION

Product definition - Engineering Design Process - Product Prototyping and its Impact - Prototype Design and Innovation - Impact on Cost, Quality and Time - Process requirements for Rapid Prototyping - Product Prototyping and Product Development - Prototyping - Virtual and Rapid Prototyping in Product Development **(8)**

PRODUCT PROTOTYPING

Need for Prototyping - Issues in Prototyping - Conducting Prototyping - Design Procedure - Prototype Planning and Management - Product and Prototype Cost Estimation - Fundamentals of Cost Concepts - Prototype Cost Estimation - Cost Complexities - Prototype Design Methods - Prototype Design tools - Morphological Analysis - Functional Efficiency Technique - Paper Prototyping - Selecting a Prototype - Learning from Nature. **(9)**

VIRTUAL PROTOTYPING, MATERIALS SELECTION & RAPID PROTOTYPING

Using Commercial Software for Virtual Prototyping - Prototyping Materials - Material Selection Methods - Rapid Prototyping Overview -Rapid Prototyping Cycle - Rapid Prototyping Procedure- Software for AM- Geometric Modelling techniques- Data interfacing - part orientation and support generation Support structure design - Model slicing and Tool path generation - STL files - Controlling Part Accuracy in STL Format - Slicing the STL File - Case Studies in Design for Assembly. **(10)**

TYPES OF RAPID PROTOTYPING PROCESS

Types of RP Process - Stereolithography - Fused Deposition Modeling - Selective Laser Sintering - 3D Printing Process - PolyJet Technology - Laminated Object Manufacturing - Electron Beam Melting Process- Laser Engineered Net Shaping (LENS) - History -Operation - Materials - Products - Advantages- Limitations - Applications - Relation to Other RP Technologies - (applies to all the process) - Direct Laser Deposition.**(9)**

APPLICATIONS OF RAPID PROTOTYPING

Investment Casting - Sand Casting - Permanent Mould Casting - Direct RP Tooling - Silicone Rubber Tooling - Investment Cast Tooling - Powder Metallurgy Tooling - Desktop Machining - Bio Additive Manufacturing (BAM)- Case Studies on Current Applications of RP- Novel Application of RP Systems - Future Trends of RP Systems. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Chua, Chee Kai & K F Leong, Rapid Prototyping: 3D Printing And Additive Manufacturing Principles And Applications 5th Edition, Bio-Green Books, 2019*
2. *Chua, C.K, Leong, K. F, and Lim C.S., Rapid Prototyping: Principles and Applications, World Scientific 2010.*

REFERENCES

1. *Kai., C.C, Lim, C.S. and Leong, F.K., Rapid Prototyping: Principles and Applications in Manufacturing, Wiley Publication,2008.*
2. *RafiqNoorani (2006), Rapid Prototyping : Principles and Applications, Wiley Julia A McDonald, Chris J Ryall, David I Wimpenny (2001), Rapid Prototyping case book, Wiley.*
3. *Pham. D.T., and Dimov. S.S., "Rapid Manufacturing", Springer Verlag 2001.*
4. *N.Hopkinson, R.J.M, Hauge, P M, Dickens, "Rapid Manufacturing - An Industrial revolution for the digital age", Wiley, 2006*
5. *Cooper, G.K, Rapid Prototyping Technology Selection and Application, Marcel Dekker Inc, USA, 2001.*
6. *Liou, W.F., Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA, 2008.*

19MEE34 - ADVANCED WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Categorize the fusion and solid state welding processes with its working principles, welding set-up, characteristics, heat input and applications to select the process for the fabrication of specified components.*

CO2 : *Predict the percentage of phase in microstructure in steel weldments with respect to cooling rate using TTT & CCT diagrams to obtain better mechanical and metallurgical properties towards reducing residual stresses & distortions in weldments.*

CO3 : *Assess the weldability of ferrous and non-ferrous materials to point out the welding process and welding procedures.*

CO4 : *Design to evolve good welded joint design for joining structural members subjected to static and fatigue loading.*

CO5 : *Differentiate and select the welding systems for engineering components and fulfill the requirements for mass production.*

SPECIAL WELDING PROCESSES

Introduction to advanced welding processes - Electron beam welding - Laser beam welding including hybrid processes - Double pulsed variable polarity GTAW, Ultrasonic welding, Explosion Welding, Electroslag and Electro gas welding, Cold pressure welding, Friction welding processes, Friction stir welding, Dual rotation bobbin tool friction stir welding - Friction stir spot welding, - Electromagnetic pulse welding. **(10)**

HEAT FLOW IN WELDING

Metallurgical effects of heat flow in welding - TTT curve - Continuous cooling transformation diagrams - Development of residual stress, methods of relieving or controlling welding residual stress, types and control of distortion, preheat and post weld heat treatment. **(8)**

WELDABILITY OF FERROUS AND NON - FERROUS ALLOYS

Weldability of carbon and alloy steels, stainless steels, cast irons, copper and its alloys, aluminum and its alloys, titanium and its alloys, Nickel and its alloys. Testing of weldments. **(10)**

WELDING DESIGN

Typical joints for different welding processes, principles of welding joint design and location of joint within the member, evolving good weld design, welding symbol - Blueprint reading, weld design for static and fatigue loading, fracture toughness. **(8)**

AUTOMATION IN WELDING

Welding sequences and classification of processes, manual and semi-automatic, automatic, automated welding - adaptive controls - remote welding, robotic welding - selecting welding system, gravity welding and firecracker welding, underwater welding - wet and dry and micro joining. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Yadav,K.S. Advance Welding Technology, Standard book house, 2018*
2. *Islam Nawaz Ali Hasan, Advanced Welding Technology, Scitech Publications, 2015*

REFERENCES

1. *Parmar.R.S, "Welding Processes and Technology", 3rd Edition, Khanna Publishers, 2013.*
2. *Parmar.R.S, "Welding Engineering and Technology", 2nd Edition, Khanna Publishers, 2013.*
3. *Davis A C, "Welding", Cambridge University Press, 10th Edition, 1996.*
4. *Larry, "Welding - Principles and Applications", Delmar Publisher, New York, 4th Edition, 2007.*
5. *American Welding Society, Welding Handbook - Welding Processes Part 2, Vol. 3, AWS, 2004.*
6. *Zhou Y N, "Microjoining and Nanojoining", Woodhead publishing, 2008.*
7. *Steen W, "Laser Material Processing", Springer-Verlag, 1991.*
8. *Linnert G E, "Welding Metallurgy", Vol. I and II, 4th Edition, AWS, 1994.*
9. *Mishra R S and Mahoney MW, "Friction Stir Welding and Processing", ASM, 2007.*

19MEE35 - ADVANCED FOUNDRY TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Outline the use of foundry in the manufacturing sector and design of patterns for steel and cast iron components.*

CO2 : *Analyze molding materials and methods such as Green sand, dry sand, Carbon dioxide, no bake, shell, Investment casting, die casting, centrifugal casting, and permanent molding for steel and cast iron weighing up to 25 kg.*

CO3 : *Design gates and risers for steel and cast iron components weighing up to 25 kg in weight.*

CO4 : *Compare the operations and operating parameters of crucible, Resistance furnaces for steel and cast iron components weighing up to 25kg in weight.*

CO5 : *Determine the composition, temperature, sand reclamation, moulding machines, foundry layout and mechanization for steel and cast iron components.*

INTRODUCTION TO FOUNDRY AND PATTERN

Introduction foundry as a manufacturing centre and types of foundries. Various aspects of advances in foundry technology, Classification of casting techniques - Types of patterns - Pattern materials - Pattern allowances - Pattern layout, pattern making. **(9)**

MOULDING AND CORE MAKING

Materials: Ingredients, properties, Moulding methods: - Green sand moulding, dry sand moulding, CO2 moulding, no bake moulding, shell moulding, Investment casting, permanent moulding, die casting and centrifugal casting, Cold box and Hot box. No bake processes. **(9)**

GATING AND RISERING SYSTEM

Principles of Gating and risers -their functions - Improvement of yield efficiency - Types - Design principles, design of gating and risering for steels and cast irons. Simple problems in gating and risering for steels and cast irons. **(9)**

MELTING FURNACES

Classification of furnaces - Constructional details - Operation of crucible furnaces, Reverberatory furnaces - Cupola, rotary furnace Core type and coreless type Induction furnaces - Arc furnace (direct and indirect arc furnaces), Resistance furnaces. **(9)**

QUALITY CONTROL AND PRINCIPLES OF MECHANIZATION

Casting defects - Identification, analysis and remedies - Composition control and temperature control. Simple problems in composition control for steels and cast irons, Sand reclamation, moulding machines, foundry layout and mechanization. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ramana Rao T V., "Metal Casting: Principles and Practice", New Age International Publishing Co., New Delhi, 2020.*
2. *Beeley Peter, Foundry Technology, Elsevier Science & Technology, 2015*

REFERENCES

1. *Heine R W., Loper, C.R.Rosenthal, P.C.,"Principles of Metal Casting", Tata-McGraw Hill Publishing Co Ltd, New Delhi, 2005.*
2. *Jain P.L, "Principles of Foundry Technology", Tata McGraw Hill Publishing Co Ltd, New Delhi, 2009.*
3. *Srinivasan N K., "Foundry Engineering", Khanna Tech Publications, New Delhi, 2001.*
4. *ASM Metals Hand Book, Vol 15, "Casting" ASM International, 10th edition, 2008.*
5. *Albert E Barrington, "High Vacuum Engineering", Prentice Hall, 1964. Suggested open source Software Packages - iCAST, Foundry ERP*

19MEE36 - SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

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)**

IT 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, IT in supply chain 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., "Handbook of Supply Chain Management", The St. Lencie Press/ APICS Series on Resource Management, 2000.*

REFERENCES

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.*
8. *https://nptel.ac.in/courses/110/106/110106045/*

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. *Kulkarni S and Sharma A., "Supply Chain Management", Tata McGraw Hill Publishing Company Limited, 2008.*

19MEE37 - QUANTITY PRODUCTION METHODS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Relate and compare various manufacturing systems and suitable levels of production (Job, batch, mass and Quantity) and exploring the possibility of implementing automation in the manufacturing sector.*

CO2 : *Create sequential manufacturing steps for common engineering components and small size products in large volume using different types of engineering production methods.*

CO3 : *Generate Process planning and scheduling techniques for quantity production in automatic lathes and design jigs and fixtures for machining.*

CO4 : *Employ and practice group technology, inspection and quality control methods, computers, and robotics for quantity production.*

CO5 : *Demonstrate quantity production methods for non-traditional manufacturing processes as well as for various ceramic and polymer products.*

INTRODUCTION

Introduction - Engineering production; Aim and objectives, history of progress, definition and requirements. Levels of production; piece, batch, lot, mass and quantity production, mechanization and automation; need, degree and types of automation, Role of automation on industrial production. **(9)**

QUANTITY PRODUCTION METHODS

Classifications and methods - Broad classification of engineering production methods. Major sequential steps in industrial production; performing, semi finishing, treatments finishing and assembly and inspection at different levels. Quantity production methods of common engineering components; metallic rods, bars, plates, sheets, tubes and wire; shafts and spindles. Metallic discs, pulley, rims, clutches and cams; threaded objects; screws, bolt and nuts, and lead screws different types of bearings; gears (teeth); comparison of the methods with respect to process, productivity, product quality and economy automobile parts; engine block, piston, connecting rod and crankshaft. Methods of quantity production of cutting tools and tool inserts. Small size products in large volume; pins, clips, needles, metallic caps of bottles, washers, metallic utensils, chain links, paste tubes and coins; Quantity production by spinning, bulging. **(9)**

QUANTITY PRODUCTION APPLICATIONS

Applications of quantity production-Process planning and scheduling for quantity production in single spindle automatic lathe, transfer machines, CNC machine tools, Design and use of jigs and fixtures in machine shops. **(9)**

QUANTITY PRODUCTION MECHANIZATION

Mechanization of quantity production- Group technology; principle and application in quantity production. Inspection and quality control in quantity production. Computers and robotics in quantity production. **(9)**

QUANTITY METHODS FOR NON-TRADITIONAL PROCESSES

Quantity methods for non-traditional processes- Quantity production by non-traditional manufacturing processes. Methods and systems of quantity production of various ceramic and polymer products of common use. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley & Sons, 4th Edition,2010.*
2. *Kalpakjian S., "Manufacturing engineering and technology", Addison- Wesley Pub. Co, 3rd Edition,2009.*

REFERENCES

1. *Paul Degarmo E., Black J.T. and Ronald A. Kohser, "Materials and Processes in Manufacturing", 11th Edition, 2012.*
2. *Chary S N, "Production and Operations Management", Tata McGraw Hill Publishing Company Limited, 2004.*

19MEE38 - PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Synthesize the elements, processes, and technologies comprising the field of Manufacturing Planning and Control (MPC)*

CO2 : *Develop knowledge on Demand management theories and techniques - forecasting, aggregate and disaggregate planning, capacity management, lot sizing and scheduling.*

CO3 : *Relate Enterprise Resource Planning (ERP) - How MPS decisions are supported by ERP.*

CO4 : *Compare and contrast different inventory models based on product types*

CO5 : *Demonstrate knowledge on material requirement planning.*

FACILITIES LOCATION AND LAYOUT

Introduction - plant location - facilities layout - classification of layout - modular design concepts- facilities layout in manufacturing - layout design procedures - Computerized Relative Allocation of Facilities (CRAFT) - features and benefits of CRAFT. Automated layout design program (ALDEP), Computerized relationship layout planning (CORELAP) **(7)**

FORECASTING

Introduction - forecasting - Techniques - simple averaging method - moving averages - exponential smoothing - SES. Holt's linear method - Holts- Winter trend and seasonality method. Box -Jenkins method - time series - autocorrelation - autoregressive models - moving average models. **(6)**

AGGREGATE PLANNING

Introduction - Linear Decision Rules (LDR) - Alternatives for responding to fluctuation in orders - time sequence of decisions, Cost involved in planning production and employment - mathematical programming models. **(6)**

DISAGGREGATE PLANNING

Introduction - Disaggregation - Master Production Schedule (MPS) - Role of MPS - Inputs / output of MPS - and MPS approach to production strategy. MPS terminology - MPS performance measures - Bill of Materials (BOM) - types. **(6)**

Introduction - measuring Capacity - available capacity. Loads - Planned and unplanned loads. Capacity expansion strategy - Capacity management - capacity control and planning. Capacity Requirement Planning (CRP) - Inputs/ outputs - scheduling strategies -finite vs infinite loads - benefits and Drawbacks of CRP. **(6)**

LOT SIZING RULES

Fixed order quantity (FOQ) - Economic Order Quantity (EOQ) - lot for lot. Fixed period requirements (FPR), Periodic Ordering Quantity (POQ), Least Unit Cost , least total cost, part period balancing, Wagner - Whitin Algorithm. **(6)**

SCHEDULING DECISION RULES

Scheduling techniques - FCFS - EDD - SPT- LIFO- LST- LT. Critical ratio - least change over cost - Single machine sequencing. Two / N - machine scheduling problems - Johnson's algorithm. Job shop scheduling **(6)**

CASE STUDIES (only classroom discussions)

Design of Continuous flow manufacturing systems, Multi agent manufacturing planning and control systems, implementation of Kanban in a process plant, design and implementation of integrated production planning system. **(2)**

TOTAL : 45

TEXT BOOKS

1. *Mukhopadhyay SK., "Production Planning and Control: Text and Cases", Phi Learning, 2nd Edition, 2007.*
2. *D.R. Kiran, "Production planning and control", First Edition, Butterworth-Heinemann - an imprint of Elsevier, 2019*
3. *Stephen N. Chapman, "The Fundamentals of Production Planning and Control", Pearson, 2005.*

REFERENCES

1. *Samson Eilon "Elements of production planning and control", Universal Book Corpn,1984*
2. *Elwood S. Buffa and Rakesh K. Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.*
3. *KanishkaBedi, "Production and Operations Management", Oxford University Press, 2nd Edition, 2007.*
4. *Melynk, Denzler, "Operations Management - A Value Driven Approach", Irwin Mcgrawhill.*
5. *Norman Gaither, Frazier G., "Operations Management", Thomson Learning, 9th Edition IE, 2007.*
6. *https://www.youtube.com/watch?v=9qBZyzjoqAo*

19MEE39 - LEAN AND AGILE MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course the students would

CO1 : *Learn the concepts of Lean, Flexibility, and Agility as applied in automotive manufacturing and supply chain management.*

CO2 : *Acquire the ability to apply tools like Production Line Diagnostics and Value Stream Mapping.*

CO3 : *Understand the best business practices in supply chain management.*

CO4 : *Apply various tools such as 5S, Kanban, JIT and poke yoke in production system*

INTRODUCTION TO LEAN MANUFACTURING

Objectives of lean manufacturing -Key principles and implications of lean manufacturing - Traditional Vs lean manufacturing. **(5)**

LEAN MANUFACTURING CONCEPTS

Value creation and waste elimination- main kinds of waste. Pull production-different models of pull production. Continuous flow-continuous improvement. Kaizen- worker involvement - cellular layout-administrative lean. Toyota Production System. **(8)**

LEAN MANUFACTURING TOOLS AND METHODOLOGIES

5S, Poka Yoke. Team work and team engagement · ABCXYZ method of supply management. JIT, JIS principles and Kanban. Kanban circles. DFMA (Design for Manufacturing and Assembly). Production layout, process and logistic approach. Layout of production cell. Warehouse layout. TOC (Theory of Constraints) principle and DBR (Drum-Buffer-Rope) methods. SMED (Single Minute Exchange of Die) principles. TPM (Total Productive Maintenance) principles. Takt Time, Cycle Time, Target Cycle Time. DTD (Dock to Dock Time). **(12)**

AGILE MANUFACTURING

Definition, business need, conceptual framework, characteristics, and generic features. CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in Agile manufacturing. Cellular manufacturing, concepts, examples. Robust design approach, Approaches to enhance agility in manufacturing. Role of QFD, Managing people in Agile organization, Approaches. Applications of multimedia to improve agility in manufacturing. **(12)**

AGILE SUPPLY CHAIN MANAGEMENT

Principles, IT/IS concepts in supply chain management. Enterprise integration and management in agile manufacturing concepts. Agility, Adaptability. Strategic options in Agile manufacturing. **(8)**

REFERENCES

1. *S N Chary, Production and Operations Management, Tata McGraw-Hill,5th edition, 2012.*
2. *R Panneerselvam, Production and Operations Management, PHI Learning pvt Ltd, 2012.*
3. *Ohio Seichi, Toyota production System, McGraw Hill, 2001.*
4. *Korgaonkar, Just in Time Manufacturing, PHI, 1998.*
5. *Yam Guichi, Total Productive Maintenance, Japanese Institute of Plant Maintenance, Oxford Press, 1994.*
6. *https://nptel.ac.in/courses/112/104/112104188/*
7. *https://www.youtube.com/watch?v=G_0bl6FHo_c*

19MEE40 - PRODUCTION AND OPERATIONS MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.*

CO2 : *Plan and implement suitable materials handling principles and practices in the operations.*

CO3 : *Identify, study, compare, and evaluate alternatives, select and relate with a good supplier by adopting various purchasing methods and inventory controlling techniques.*

CO4 : *Apply various techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level or performance.*

CO5 : *Demonstrate various maintenance schedule techniques for real time applications and identify the waste and the method of controlling and its disposal.*

INTRODUCTION

Introduction - Primary functions - Evolution of POM - Concept of Production - Production System - Production management - Operation system - Operations management - managing global operations - Factors affecting POM - Ways of studying POM - Design and development - Scope of production and operations. **(9)**

MATERIAL HANDLING

Introduction - Objectives - Principles - Selection of material handling equipment - Evaluation of material handling equipment - Guidelines for effective utilization of material handling equipments - Relationship between plant layout and material handling. **(9)**

MATERIALS MANAGEMENT AND AUTOMATION

Functions of Materials Management - Material Planning and Control - Purchasing - Stores Management - Inventory control - Standardization - Simplification - Value Analysis - Ergonomics - JIT - Automation - Types - Computer Integrated Manufacturing - Need for Automation - Automation Strategies - Automated Flow Lines - Automated Guided Vehicles Systems - Automated Storage/Retrieval Systems - Carousel Storage Systems - Carousel Storage Applications. **(9)**

WORK STUDY (Time and Motion study)

Introduction - Productivity - factors influencing productivity, TPM, PPM, Improvement techniques - Work study - Method study - Objectives, procedure involved, selection of the job, techniques - Motion study - Principles and techniques - Work measurement - Objectives and techniques - Time study - steps involves and computation of motion study. **(9)**

MAINTENANCE MANAGEMENT AND WASTE MANAGEMENT

Introduction to Maintenance management - Objectives of Maintenance - Types of Maintenance - Maintenance Planning - Maintenance Scheduling - Maintenance Schedule Techniques - Total Productive Maintenance (TPM) - Waste Management -Reasons for Generation and Accumulation of Obsolete, Surplus and Scrap Items - Identification and Control of Waste - Disposal of Scrap. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Anil Kumar. S and Suresh. N., "Production and Operations Management", New Age international (P) Ltd, 2nd edition, 2008.*
2. *Gupta and Martin Starr., "Production and Operations Management Systems", CRC Press, 2014.*

REFERENCES

1. *K. C. Jain, P. L. Verma, Prabhat Kartikey, "Production and Operations management", Dreamtech press, 2018.*
2. *Jay Heizer, Barry Render, Chuck Munson, Amit Sachan, "Operations Management",12th Edition, 2017.*
3. *Chary S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 3rd Edition, 2008.*
4. *R. Panneerselvam., "Production Planning and Control", PHI Learning, 3rd Edition, 2012.*
5. *Kanishka Bedi, "Production and Operations Management", Oxford University Press, 2nd Edition, 2007.*
6. *https://nptel.ac.in/courses/110/107/110107141/*

19MEE41 - SMART MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Illustrate the basic concepts of industrial revolution.*

CO2 : *Analyze impact of industry 4.0 in manufacturing system.*

CO3 : *Learn components of the industrial internet of things and apply it to control the various things of industry.*

CO4 : *Implement IOT in process automation*

INDUSTRIAL REVOLUTION

Industry 1.0- Industry 2.0 -Industry 3.0 Industry 4.0, Outcomes of the Industrial Revolution. **(3)**

INDUSTRY 4.0

Industry 4.0- Additive Manufacturing Possible -Use Case of 3D Printing -Simulation and Digital Twin - Augmented Reality - Autonomous Robots - Blockchain -Big Data - Cloud. **(7)**

MACHINE2MACHINE (M2M)

M2M Working Business Scenario-Business Challenge -M2M in Aviation - M2M versus IoT -M2M Enhances IIoT. **(5)**

INTERNET OF THINGS (IOT)/INDUSTRIAL INTERNET OF THINGS (IIOT)

Evolution of Internet-Internet of Boffins -Internet of Geeks -Internet of Masses -Mobile Internet -Internet of Things -Some Definitions of IoT-Why IoT - SMART Light Control in Home Using IoT -SMART Soilless Farming in Home Using IoT - Industrial Internet of Things -SMART Light and Temperature Control in Industrial Buildings Using IoT - IoT Versus IIoT -Challenges of IoT - benefits **(7)**

MAJOR COMPONENTS OF IIOT

Components of IIoT -Hardware -Standard Tools -Software Application -Communication Technology - Processing Unit - Cloud - IoT Platforms **(7)**

IIOT STRATEGY AND IMPLEMENTATION

IIoT Strategy Planning - IIoT Implementation Methodology-Layers of IIoT Architecture -Choosing the Correct IIoT Platform. **(7)**

PROCESS AUTOMATION AND LEAN IIOT

Process Automation -Process Automation Importance in Manufacturing Industry- Robotic Process

Automation -Simple Use Case of a Process Automation - Simple Process Automation in Shop floor - Lean IIoT - How Lean is Value Added to Business via IIoT **(9)**

TOTAL : 45

TEXTBOOK

1. *Uthayan Elangovan , "Smart Automation to Smart Manufacturing: Industrial Internet of Things" , Momentum press, LLC, New York ,2019.*
2. *Shoukat Ali, "Smart manufacturing", LAP Lambert Academic Publishing, 2016.*

19MEE42 - MANUFACTURING PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : *Execute manufacturing planning and cost estimation for different products and processes.*

CO2 : *Demonstrate about types of production, production control and its necessity manufacturing planning.*

CO3 : *Calculate and analyse various elements of cost like material cost, labour cost and overhead expenses for different products in the manufacturing environment.*

CO4 : *Explain Distinction between fixed and variable expenses for different machine tools.*

CO5 : *Compute machining time for various production processes in lathe, shaping, grinding machine; Estimation also estimation of losses in forging shops.*

INTRODUCTION

Estimation - importance, aims and functions. Costing - importance, aims and difference between estimation and costing, importance of preparing realistic estimates, estimating procedure and its division. **(8)**

MANUFACTURING PLANNING

Introduction, production, types of production, production control and its necessity, production control enforcement procedure. **(4)**

ELEMENTS OF COST

Material cost - determination. Labour cost, determination of direct cost, expenses, cost of product (Ladder of cost). **(7)**

ANALYSIS OF OVERHEADS

Factory expenses, depreciation, causes of depreciation, methods of depreciation, administration expenses, selling and distribution expenses (overheads), allocation of overhead expenses. **(8)**

COSTING MACHINES AND TOOLS

Distinction between fixed and variable expenses. Fixed overheads and Variable overheads. **(7)**

COST ESTIMATION FOR PRODUCTION PROCESSES

Machining time calculation for turning, drilling, boring, threading, shaping and grinding operations. Forging operations - estimation of losses and operation time. Problems. **(11)**

TOTAL : 45

TEXT BOOKS

1. *Banga. T.R and Sharma. S.C., "Mechanical Estimating and Costing", Khanna Publishers, New Delhi, 2015.*
2. *Narang. G.B.S. and Kumar. V., "Production and Costing", Tata McGraw Hill, New Delhi, 2005.*

REFERENCES

1. *Peter Scalon, "Process planning, Design/Manufacture Interface", Butterworth-Heinemann, 2003.*
2. *Gupta C.B., "Fundamentals of Business Accounting", Sultan Chand and Co., New Delhi, 2003.*
3. *A.K.Gupta, "product design and manufacturing" PHI, 2014.*
4. *Buffa, E.S., "Modern Production/Operations Management", 8th edition, John Wiley sons, 2003.*

19MEE43 - MANUFACTURING SYSTEMS MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 : *Gain knowledge on the manufacturing and management methodologies besides types of manufacturing systems, plan, design layout, material flow and optimize & manufacturing operations.*

CO2 : *Perform Scheduling of tools and machines for improved efficiency and management systems.*

CO3 : *Make cost analysis and get exposure to global manufacturing.*

CO4 : *Develop skills necessary to effectively analyze and synthesize the many interrelationships inherent in complex socio-economic productive systems.*

ESSENTIALS OF A MANUFACTURING SYSTEM

Production and Manufacturing - input and output of a production system. System definition - system design. Modes of production- types of production - mass, batch and job shop - characteristics. Integrated Manufacturing System (IMS) **(9)**

PROCESS SYSTEM FOR MANUFACTURING

Flows in manufacturing system - Material and technology information flow-Logistics. Product Planning and Design - Product Structure Explosion. Process Planning-Process Design, Operation Design and Optimal Routing Design, Line Balancing. Layout Design - Systematic Layout Planning (SLP) - mathematical layout design - Production Flow Analysis. Logistic Planning- Distribution Problems, Manufacturing Optimization-Evaluation of Criteria for Manufacturing Optimization. **(12)**

MANAGEMENT SYSTEMS FOR MANUFACTURING

Managerial Information Flow - Decision Problems in Managerial Information Flow, Aggregate Production Planning - Production Planning - Short Term and Multiple Objective Production Planning, Product Mix and Lot Size Analysis, Material Requirement Planning (MRP), Production Scheduling - Operation Scheduling, Project Scheduling- Inventory System-Multiple Product Inventory Managements - Just In Time (JIT) Production. **(12)**

VALUE AND SOCIAL SYSTEMS FOR MANUFACTURING

Value/Cost flow in manufacturing systems-classification of costs, product cost structure, manufacturing cost, selling price, profit planning and break-even analysis, evaluation of capital investment, social manufacturing systems-strategy and tactics, corporate strategy, manufacturing strategy, global manufacturing-movements towards globalization, international manufacturing. **(12)**

TOTAL : 45

TEXT BOOKS

1. *Katsundo Hitomi, "Manufacturing Systems Engineering", Viva, Low Priced Student Edition, 2nd Edition, 2004.*
2. *G. Srinivasan, IIT Madras, Lecture on Manufacturing systems management, NPTEL course.*

REFERENCES

1. *Donald Bowersox and David Closs, "Logistical Management - The Integrated Supply Chain Processes", Tata McGraw Hill, 2005.*
2. *Tarek Khalil, "Management of Technology", Tata McGraw Hill Pvt. Ltd., 2005.*
3. *https://nptel.ac.in/courses/110/106/110106044/*

ONE CREDIT COURSES

19MEOC01 - MATLAB PROGRAMMING

L	T	P	C
1	0	0	1

COURSE OUTCOMES

The students will be able to do

CO1 *: Themes of data analysis*

CO2 *: Visualization and modeling for engineering problems*

CO3 *: Programs for various mechanical engineering problems.*

MATLAB FUNDAMENTALS

Working with the MATLAB user interface, Entering commands and creating variables **(2)**

VECTORS AND MATRICES

Analyzing vectors and matrices, Visualizing vector and matrix data **(3)**

DATA FILES

Working with data files, Working with data types **(3)**

SCRIPTS AND LOOPS

Automating commands with scripts, Writing programs with branching and loops, Writing functions. **(3)**

APPLICATIONS

Engineering Mechanics, Theory of Machines and Robotics, Mechanical Vibrations and Control Systems using MATLAB. **(4)**

TEXT BOOKS

1. *MATLAB Onramp - MATLAB & Simulink Tutorial, https://in.mathworks.com/learn/tutorials/matlab-onramp.html*
2. *Dan B. Marghitu, Mechanisms and robot analysis with MATLAB, Springer, 2009.*
3. *Rao V. Dukkipati, MATLAB an introduction with applications, New age international private limited, 2010.*

19MEOC02 - NON-DESTRUCTIVE EVALUATION

L	T	P	C
1	0	0	1

ASSESSMENT: THEORY

COURSE OUTCOMES

On Completion of the course, the students should be able to:

CO1 *: Explain the need for Non-Destructive Tests*

CO2 *: List types of NDT and identify the appropriate one for a given sample of material*

INTRODUCTION TO NON-DESTRUCTIVE TESTS (NDT)

Introduction to NDT, Visual Optical methods, Dye penetrant testing, Basic principle, Types of dye and methods of application **(3)**

MAGNETIC PARTICLE TESTING

Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Field indicators, Particle application, Inspection. **(3)**

EDDY CURRENT TESTING

Eddy current testing, Basic principle; Faraday's law, Inductance, Lenz's law, Self and Mutual Inductance. **(3)**

ULTRASONIC TESTING

Ultrasonic testing: Basics of ultrasonic waves, Pulse and beam shapes, Ultrasonic transducers. Test method, Distance and Area calibration Acoustic emission testing: Basic principle, Sources of acoustic emission, Source parameters **(3)**

RADIOGRAPHY

Radiography: X-rays and their properties, X-ray generation, X-ray absorption and atomic scattering. Image formation, Image quality, Digital Radiography, Image interpretation, Radiation Shielding **(3)**

TOTAL : 15

TEXT BOOK

1. *X. P. V. Maldague, Nondestructive evaluation of materials by infrared thermography, Springer-Verlag, 1st edition, (1993).*

REFERENCES

1. *X. P.V. Maldague, Non-Destructive Testing Handbook; Infrared and Thermal Testing, Vol-3, series III, American Society for Non-Destructive Testing, 3rd edition (2001).*
2. *C. N. Jackson and N.Sherlock, Non-Destructive Testing Handbook; Leak Testing , Vol-1, series VI, American Society for Non-Destructive Testing, 3rd edition, (1998).*
3. *R. K.Miller and V.K.Hill, Non-Destructive Testing Handbook; Acoustic Emission Testing, Vol-6, series V, American Society for Non-Destructive Testing, 3rd edition, (2005).*

19MEOC03 - ADVANCED INDUSTRIAL AUTOMATION SYSTEMS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

The students will be able to

CO1 *: Understand various components in an automated system.*

CO2 *: Understand the principle of operation and construction of mechanisms, hydraulic and pneumatic systems*

CO3 *: Understand the microprocessor technology, programming and CNC technology.*

AUTOMATION IN MANUFACTURING

Introduction : Importance of automation in the manufacturing industry. Use of mechatronics. Systems required.

Design of an automated system : Building blocks of an automated system, working principle and examples. **(4)**

MECHANISMS

Electronic cams, indexing mechanisms, tool magazines, and transfer systems. **(2)**

HYDRAULICS AND PNEUMATICS SYSTEMS

Hydraulic systems: hydraulic power pack, pumps, valves. Hydraulic systems: designing of hydraulic circuits.

Pneumatic systems: configurations, compressors, valves, distribution and conditioning. **(4)**

MICROPROCESSOR TECHNOLOGY AND CNC

Microprocessor Technology: signal conditioning and data acquisition, use of microprocessor or microcontroller. Configurations, Working.

CNC technology: basic elements, interpolators and programming. **(5)**

BOOKS AND REFERENCES

1. *HMT Ltd. Mechatronics, Tata McGraw Hill, New Delhi, 1988.*
2. *Bolton, W., "Mechatronics: E lectronic Control Systems in Mechanical and Electrical Engineering", Longman, Singapore,1999.*
3. *Gaonkar, R. S., Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing (India), Delhi, 2000.*
4. *Bradley, D. A., Dawson D., Burd, N. C. and Loader A. J., Mechatronics: Electronics in products and processes, CRC Press, Florida, USA, 2010.*
5. *Parr, A. A., Hydraulics and Pneumatics, Elsevier, 1999.*
6. *Smid, P., CNC Programming Handbook, Industrial Press, New York, USA, 2008.*

19MEOC04 - RECENT TRENDS IN QUALITY

L	T	P	C
1	0	0	1

ASSESSMENT: THEORY

COURSE OUTCOMES

On Completion of the course, the students should be able to:

CO1 *: Explain concepts of Quality and identify Customer requirements*

CO2 *: Explain and apply concepts of Six Sigma for manufacturing/service organization*

INTRODUCTION TO QUALITY

Quality concepts - ISO 9001 - Customer requirements, Quality Tools, Deming awards, TQM **(3)**

QUALITY CONCEPTS IN MANUFACTURING

Just in time (JIT) Concept, Lean Manufacturing, Agile Manufacturing, World Class Manufacturing, Total Productive Maintenance (TPM), Bench Marking, Business Process Re-engineering (BPR) **(6)**

SIX SIGMA - CONCEPT AND IMPLEMENTATION

Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitation **(6)**

TOTAL : 15

TEXT BOOK

1. *Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000), K C Jain and A K Chitale, Khanna Publishers*

REFERENCES

1. *Quality Control & Application, B L Hanson & P M Ghare, Prentice Hall of India.*
2. *Total Quality Management, S. Kumar, Laxmi Publication.*
3. *Statistical Quality Control, M. Mahajan, Dhanpat Rai & Co.*

19MEOC05 - FOUNDRY PRACTICE AND PROCEDURES

L	T	P	C
0	0	2	1

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to:

CO1 : *Demonstrate process variables for molding process and to design gating system for sound casting components.*

CO2 : *Select the variables involved in the casting of ferrous and non-ferrous alloys.*

CO3 : *Explain the inspection techniques for assessing casting quality.*

GATING

Gating system design for pattern design - Method of calculation. **(4)**

MOULDING

Moulding Process set - Alpha set **(1)**

MELTING

Melting process - carbon steel and stainless steel (ASTM A216 and ASTM A351). **(3)**

HEAT TREATMENT

Heat Treatment - for carbon steel and stainless steel **(2)**

QUALITY

Quality - for Carbon steel and stainless steel - Destructive testing - NDT - Final Inspection **(4)**

RECENT DEVELOPMENTS

Recent developments in casting processes **(1)**

TOTAL : 15

NAME OF THE INDUSTRY

KOSO INDIA PRIVATE LIMITED

1/80, Telungalayam Road, Pillayappampalayam, Annur, Coimbatore - 641697

NUMBER OF STUDENTS PER BATCH : 15

19MEOC06 - BASICS OF AUTOMOTIVE ELECTRICAL SYSTEMS

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

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

CO1 : *Know the importance of Electrical standards in automobiles.*

CO2 : *Understand the electronic fuel injection/ignition components and their function.*

CO3 : *Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.*

CO4 : *Diagnose electronic engine control systems problems with appropriate diagnostic tools.*

CO5 : *Analyses the chassis and vehicle safety system*

INTRODUCTION

Evolution of electronics in automobiles. Charging systems: Working and design of charging circuit diagram - Alternators - Requirements of starting system - Starter motors and starter circuits. **(2)**

IGNITION AND INJECTION SYSTEMS

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition - Distribution less ignition - Direct ignition - Spark Plugs. Electronic fuel Control, Petrol fuel injection - Diesel fuel injection. **(4)**

SENSOR AND ACTUATORS IN AUTOMOTIVES

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors - study of fuel injector, exhaust gas recirculation actuators. **(3)**

ENGINE CONTROL SYSTEMS

Control modes for fuel control-engine control subsystems - ignition control methodologies - different ECU's used in the engine management. **(3)**

CHASSIS AND SAFETY SYSTEMS

Traction control system - Cruise control system - electronic control of automatic transmission - antilock braking system - electronic suspension system - working of airbag and role of MEMS in airbag systems - centralized door locking system - climate control of cars. **(3)**

TOTAL : 15

TEXT BOOK

1. *Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2018*

REFERENCES

1. *Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 2015.*
2. *Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 2015.*
3. *Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 2020.*
4. *Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers, 2016*

19MEOC09 - INSPECTION AND QUALITY CONTROL IN MANUFACTURING

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

To know about basic aspects and tools related to inspection and quality control in manufacturing.

INSPECTION

Introduction, Fundamental Concept of Quality, Role of Inspection and Measurement for Quality Control in Manufacturing, Need of Inspection, Inspection types and Principles, Design for Inspection, Destructive Inspection, Testing of Composite Materials. **(3)**

NON-DESTRUCTIVE INSPECTION-I

Visual Inspection, Dye Penetrant Inspection, Magnetic Particle Inspection, Eddy Current Inspection, Ultrasonic Testing. **(3)**

NON-DESTRUCTIVE INSPECTION-II

Acoustic Emission Inspection, Radiography, Leak Testing, Thermographic Non-destructive Testing, Advanced, Non-destructive Techniques, NDT Standards, Safety in NDT. **(3)**

QUALITY CONTROL

Introduction, Aim and functions of quality control, Kaizen and innovation - the Kaizen management practices - Total Quality Control (TQC). **(2)**

QUALITY CONTROL TOOLS

Small group activities - quality circles - Comparison of kaizen and Deming's approach. Affinity diagram - brainstorming - cause and effect analysis -checklist- flow charts - Pareto analysis - quality costing - Quality Function Deployment (QFD) - Training of quality - self managing teams. **(4)**

TOTAL : 15

TEXT BOOKS

1. *"Nondestructive Evaluation and Quality Control", ASM Handbook, Vol. 17 of 9th Edition Metals Handbook.*
2. *Winchell William, "Inspection and Measurement in Manufacturing", Society of Manufacturing Engineers.*
3. *Juran J.M & Gryna F.M., ?Quality Planning and Analysis - From Product development through use, Tata McGrawHill Publishing Limited, new Delhi, 3rd Edition, 1995*
4. *Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996.*

REFERENCES

1. *Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, 1989.*
2. *"Welding Inspection", 3rd Edition, American Welding Society.*
3. *Logothetics N ., Managing for total quality - From Deming to Taguchi and SPC, Prentice hall Ltd, New Delhi, 1997.*
4. *Kaniska Bedi, "Quality Management" Oxford University Press, Chennai, 2007.*

19MEOC10 - CONSTITUTION OF INDIA

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

On Completion of the course, the students should be able to:

CO1 : *Explain the meaning of constitution and salient features of Indian Constitution*

CO2 : *Explain Fundamental Rights, Duties and Discuss Historical Perspectives of Constitutional Amendments.*

CO3 : *Examine Provisions for Emergency*

INTRODUCTION TO CONSTITUTION

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution **(5)**

FUNDAMENTALS, AMENDMENTS AND HISTORICAL PERSPECTIVES

Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India **(5)**

EMERGENCY SITUATIONS

Emergency Provisions : National Emergency, President Rule, Financial Emergency, and Local Self-Government - Constitutional Scheme in India. **(5)**

TOTAL : 15

TEXT BOOKS

1. *Brij Kishore Sharma: Introduction to the Indian Constitution, 8th Edition, PHI Learning Pvt. Ltd.*

19MEOC12 - HUMAN VALUES

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OBJECTIVE

1 *To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence.*

COURSE OUTCOMES

On Completion of the course, the students should be able to:

CO1 : *Explain the need for harmony within self and fellow humans.*

CO2 : *Justify the need for harmony with nature for sustainability.*

HARMONY WITH SELF AND OTHER HUMANS

Harmony in the Human Being - Harmony in Myself - Harmony in the Family and Society- Harmony in Human Relationship **(6)**

HARMONY WITH SELF AND NATURE

Harmony in the Nature and Existence - Whole existence as Co-existence - Implications of the above Holistic Understanding of Harmony on Professional Ethics **(9)**

TOTAL : 15

TEXT BOOKS

1. *B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.*
2. *PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.*

19MEOC13 - E-COMMERCE SECURITY

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To understand, implement and defend against canonical attacks on web security.*

COURSE OUTCOMES

On Completion of the course, the students should be able to:

CO1 *: Explain the need for Web Security, Defense against Web attacks and Security Certificates*

CO2 *: Discuss the protocols for security in web payments*

CO3 *: Explain cryptocurrencies, security threats and regulations.*

INTRODUCTION TO WEB SECURITY

Harmony Web Security - Basic web security model - Web attacks (e.g., SQL injection, XSS, CSRF) and defenses - Session management and user authentication - Certificates and PKI - HTTPS: Design and pitfalls **(6)**

SECURITY IN WEB PAYMENTS

Payments - Legacy payment systems EMV protocol Attacks on EMV Securing CNP transactions and PCI compliance Tokenization **(4)**

CRYPTOCURRENCIES

Cryptocurrencies Early digital currencies Building blocks - The Bitcoin blockchain - Bitcoin mechanics - Bitcoin storage and use - Bitcoin security threats - Regulating cryptocurrencies **(5)**

TOTAL : 15

TEXT BOOK

1. *Bryan Sullivan and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Education, 1st Edition.*

REFERENCES

1. *Narayanan, Bonneau, Felten, Miller, Goldfeder. Bitcoin and Cryptocurrency Technologies : A Comprehensive Introduction, Princeton University Press, 1st Edition.*

19MEOC14 - INNOVATION AND ENTREPRENEURSHIP

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

The students will be able to

CO1 : *Discuss the relationship between innovation and entrepreneurship.*

CO2 : *Recognize societal and environmental needs and propose innovative solutions*

CO3 : *Distinguish between Intrapreneurship, Business and Entrepreneurship and explain the various stages of entrepreneurship.*

INTRODUCTION

Innovation and its Need - Entrepreneurial Stages **(3)**

INNOVATION

Principles of Innovation, Do's and Don'ts - Sources for Innovation, unexpected success and failure, demographics and perception - Motivation for Innovation, Societal and Environmental Needs, Incongruities between perceived and actual customer values and expectations - High-risk High-return Innovation **(6)**

ENTREPRENEURSHIP

Intrapreneurship vs Entrepreneurship - Business vs Entrepreneurship- Entrepreneurial Processes **(6)**

TOTAL : 15

TEXT BOOK

1. *Peter F Drucker, "Innovation and Entrepreneurship", Harper and Row Publishers Inc, USA, 2009.*

REFERENCE

1. *Robert D Hisrich, Michael P Peters and Dean A Shepherd, "Entrepreneurship", Tata Mc Graw Hill, 10th Edition, 2017.*

19MEOC15 - 3-D SCANNING TECHNOLOGY

L	T	P	C
1	0	0	1

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of this course, the students will be able to

CO1 *: Apply the 3-D scanning process in any industrial environment*

CO2 *: Demonstrate the postprocessing skills in 3-D scanning process*

INTRODUCTION OF 3-D SCANNING TECHNOLOGY AND SCANNING DEMONSTRATION

3-D scanner working principle - types of 3-D scanners - technical specification - scanning software interface - applications - scanning demonstration. **(3)**

SOFTWARE INTERFACE

Three zones of software interface - workspace panel - scanned model - 3-D window - control panel - functional menu - new project - open project - save project - file format - scan folder - snapshots or frames of object - solid polygonal model - model parameters - number of polygons - number of vertices - size of model in random access memory - visibility of scanned object on workspace - tool panel - scan - scanning mode - edit - registration algorithms - fusion algorithm - post processing algorithms - align - edges - repair - measures - multi-scan - texture - publish. **(2)**

BASIC PROCESSING

Continuous scanning (auto-align) mode - manual alignment - global registration algorithms - geometry registration algorithm - polygonal modelling - sharp fusion algorithm - small object filter algorithm - mesh simplification algorithm - file formats for exporting model. **(2)**

PRACTICE ON POST-PROCESSING OF SCANNED IMAGE FILES **(8)**

TOTAL : 15

REFERENCES

1. *https://artecgroup.zendesk.com/hc/en-us/articles/201926472-Lesson-1-Installing-Artec-Studio*
2. *https://artecgroup.zendesk.com/hc/en-us/articles/201926482-Lesson-2-Artec-Studio-interface*
3. *https://artecgroup.zendesk.com/hc/en-us/articles/202051201-Lesson-3-Basic-processing*
4. *https://artecgroup.zendesk.com/hc/en-us/articles/201837081-How-to-3D-body-scan-with-Artec-Eva*

OPEN ELECTIVES

19CEOE01 - TOWN PLANNING AND ARCHITECTURE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : interpret the geometric forms and aesthetic qualities of Architecture

CO2 : integrate the various elements of architecture and orientation of buildings

CO3 : describe the development plans and planning regulations

CO4 : incorporate the development control rules in town and country planning

PRINCIPLES OF TOWN PLANNING

Evaluation of planning - Objects of town planning - principles of town planning- origin of towns - growth of towns - origin - direction - various forms of planning **(9)**

ELEMENTS OF ARCHITECTURE

Introduction of architecture - definition - Evaluation of geometric forms - function and history - Sphere, Cube, Pyramid, Cylinder and Cone - aesthetic qualities of Architecture - Proportion, Scale, Balance, Symmetry, Rhythm and axis - Contrast in Form - Harmony. **(9)**

PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS

Factors affecting orientation - Sun-Wind-Rain - Orientation criteria for Indian conditions - Principles governing the theory of planning - Planning of residential buildings. **(7)**

DEVELOPMENT PLAN

Principles of city planning - levels of planning- scope and contents of regional plan, master plan, detailed development plan and structure plan - preparation and implementation - planning of new towns - slum clearance and urban renewal. **(9)**

PLANNING LEGISLATION AND DEVELOPMENT CONTROL RULES

Planning legislation and administration - Tamil Nadu Town and Country Planning Act, Tamil Nadu Housing Board Act, Tamil Nadu slum clearance and Improvement Act. Zoning regulations - sub division regulations - building regulations - Floor Space Index - minimum plot sizes - open spaces - minimum standard dimensions **(11)**

TOTAL : 45

TEXT BOOKS

1. *RangwalaS.C., "Town Planning", Charotar Publishing House, Anand, 2013.*
2. *Francis D.K., Ching, "Architecture Form, Space and Order", Oxford University Press, 2014.*

ONLINE RESOURCES

1. *https://nptel.ac.in/courses/124/107/124107001/*
2. *https://nptel.ac.in/content/storage2/courses/109104047/pdf/lecture40.pdf*

19CEOE02 - CLIMATE CHANGE AND ADAPTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Outline the earth's system which influences the climatic factors of the earth.

CO2 : Infer the evidences and observed changes in the climate and environment on a global scale and in India.

CO3 : Analyse the impacts of climate change on various sectors and the uncertainties over the projected impacts of climate change.

CO4 : Investigate the various adaptation and mitigation options in various sectors and examine the mitigation efforts made in India.

CO5 : Correlate future clean technology and alternate energy options inferred in clean development mechanism.

EARTH'S CLIMATE SYSTEM

Introduction-Climate in the spotlight-The Earth's Climate Machine - Climate Classification - Global wind systems - Trade Wind Systems - Trade Winds and the Hadley Cell - The Weserlies - Cloud formation and Monsoon Rains - Storms and Hurricanes - The Hydrological Cycle - Global Ocean Circulation - EI Nino and its Effect - Green House Gases and Global Warming - Carbon Cycle. **(9)**

OBSERVED CLIMATE CHANGE AND ITS CAUSES

Observation of Climate Change - Changes in pattern of temperature, precipitation and sea level rise - Observed effects of Climate Changes - Patterns of Large Scale Variability - Drivers of Climate Change - Feedbacks - The Montreal Protocol - UNFCCC - IPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India. **(9)**

IMPACTS OF CLIMATE CHANGE

Impacts of Climate Change on various sectors - Agriculture, Forestry and Ecosystem - Water resources - Human Health - Industry, Settlement and Society - Methods and Scenarios - Projected Impacts for different regions - Uncertainties in the Projected Impacts of Climate Change. **(9)**

CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES

Adaptation Strategy/options in various sectors - Water - Agriculture - Infrastructure and Settlement including coastal zones - Human Health - Tourism - Transport - Energy - Key Mitigation Technologies and practices - Energy supply - Transport - Buildings - Industry - Agriculture - Forestry - Carbon sequestration - Carbon Capture and Storage (CCS) - Mitigation Efforts in India and Adaptation funding. **(9)**

CLEAN TECHNOLOGY AND ENERGY

Clean Development Mechanism - Carbon Trading - Examples of future Clean Technology - Biodiesel - Natural Compost - Eco-friendly Plastic - Alternate Energy - Hydrogen - Bio-fuels - Solar Energy - Wind - Hydroelectric Power. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Dash Sushil Kumar, "Climate Change - An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.*
2. *UNIPCC Fifth Assessment Report, 2014.*
3. *Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.*

REFERENCES

1. *Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.*
2. *Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998.*
3. *Jepma, C.J., and Munasinghe, M., Climate Change Policy - Facts, Issues and Analysis, Cambridge University Press, 1998.*
4. *Dash Sushil Kumar, "Climate Change - An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.*

ONLINE RESOURCES

1. *"An Inconvenient truth (2006)"- video*
2. *https://climate.nasa.gov*
3. *https://unfccc.int*
4. *https://environment .gov.au*

19CEOEO3 - METRO SYSTEMS AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Integrate the basic elements of MRTS, BRTS, LRTS and other transportation systems

CO2 : Illustrate the components of metro rail systems

CO3 : Apply the concepts of ITS in the field of Transportation Engineering

PRINCIPLES OF TRANSPORTATION SYSTEMS

Transportation systems in India - various modes of transport - public transport - Intermediate public transport - types - characteristics - other urban transportation modes - drawbacks- various transit systems **(9)**

MRTS

Definition - Mass Rapid Transit System - History of MRTS - Need for MRTS - connectivity in Indian conditions - cities having MRTS - infrastructure - operations - fares and ticketing - case study. **(8)**

BRTS and LRTS

Bus Rapid Transit System - terminology - history -features - performance - cost - drawbacks - Light Rail Transit System - necessity - types - gauge- capacity integration with cycles - comparison to other rail modes **(9)**

METRO RAIL SYSTEMS

History of Metro trains - Need for Metro rail - connectivity in Indian conditions - cities having Metro - construction techniques adopted in Metro Rail stations - Case study - Delhi Metro (DMRC) - Chennai Metro (CMRL) **(10)**

ITS

Definition - Intelligent Transport System - Principles - Application of ITS technologies in various countries - smart transportation - case studies **(9)**

TOTAL : 45

TEXT BOOKS

1. *Pradip Kumar Sarkar, Vinay Maitri, G. J. Joshi ·"Transportation Planning Principles, Practices and Policies", Prentice Hall India Pvt., Limited 2017*
2. *D. Johnson Victor, S. Ponnuswamy, "Urban Transportation Planning, Operation and Management" Tata McGraw-Hill Education, 2012*
3. *Mashrur A. Chowdhury, Adel Wadid Sadek "Fundamentals of Intelligent Transportation Systems Planning" Artech House · 2003*
4. *Sumit Ghosh, Tony S. Lee, "Intelligent Transportation Systems Smart and Green Infrastructure Design, Second Edition" CRC Press · 2010*

ONLINE RESOURCES

1. *https://nptel.ac.in/content/storage2/courses/105101008/downloads/cete_48.pdf*

19CEOE04 - RENEWABLE ENERGY RESOURCES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Infer the current energy scenario and future energy usage in India.

CO2 : Interpret the concepts of solar energy, wind energy, tidal energy and biomass energy.

CO3 : Compare the energy utilization from wind energy, solar energy, biomass energy and tidal energy.

CO4 : Correlate the challenges and problems associated with the use of energy sources.

ENERGY PERSPECTIVES

Conventional and non conventional energies - Energy and sustainable development - Global energy scenario - Energy scenario in India - Energy consumption pattern in rural and urban regions in India - Energy efficiency and economy - Energy losses and its control - Renewable energy potential mapping - Plant load factor **(9)**

SOLAR ENERGY PERSPECTIVES

Concept of solar energy - Solar energy to light and to thermal conversions - Total energy and necessary infrastructure - Units and measurement of solar radiation - Temperature dependent collecting devices and their efficacies - Design aspects - Typical applications: heating, cooling, lighting, power generation and cooking. **(9)**

WIND ENERGY PERSPECTIVES

Wind potential in India - Wind turbines and their types - Merits and demerits - Wind power and appropriate coefficient - Efficiency and performance of wind machines -Energy conversion and storage - Synchronous invertors - Various storage aspects: battery, fly wheel, hydrogen and compressed air. **(9)**

BIOMASS ENERGY PERSPECTIVES

Biomass potential in India - Gobar gas and producer gas - Characteristics of biomass - Operation and design of biogas plants - Objectives, principles and operational aspect of biogassifiers - Pyrolysis and incineration - Power generation from municipal solid waste and industrial Sludges - Application of biodiesel plants - Fuel cells. **(9)**

TIDAL ENERGY PERSPECTIVES

Tidal aspects in coastal India - Tidal energy conversion system: mechanical to electrical and thermal to electrical - Tidal force calculation and power generation - conceptualization and potential of geothermal energy - Geothermal vents. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Sukathme, S.P, Nayak J.K., "Solar Energy", Tata McGraw-Hill Book Co., New Delhi, 2017.*
2. *Rai, G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2010.*
3. *P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.*
4. *Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.*

REFERENCES

1. *Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.*
2. *Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.*
3. *Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.*

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1. *https://swayam.gov.in/nd1_noc20_ge06/preview*
2. *https://swayam.gov.in/nd2_nou20_cs09/preview*

19CEOE05 - PRINCIPLES OF SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Identify the components, factors and environmental issues affecting Sustainable development.

CO2 : Assess the role of International summits, conventions and Environmental aspects on Sustainable development.

CO3 : Interpret the necessity and importance of Indian and International Socio -economical and legal aspects in Sustainability.

CO4 : Illustrate the different strategies to achieve Sustainable development.

CO5 : Assess the role of Life cycle Assessment, Cleaner Production and Sustainable Chemistry to achieve sustainable development.

CONCEPTS OF SUSTAINABLE DEVELOPMENT

Sustainable development- Evolution of Environmental awareness and Sustainable development, global Sustainable development goals -components and factors affecting Sustainable development-Demographic dynamics and sustainability- Environmental issues and crisis- ozone layer depletion, global warming and climate change **(9)**

ENVIRONMENTAL ASPECTS

International Environmental summits, conventions and agreements-Tiwari committee recommendation - Role of Pollution Control Board - Transboundary issues - Ecological indicators- Ecological foot print- Carbon foot print - Basic concept of Environmental impact assessment **(9)**

SOCIO ECONOMIC AND JUDICIAL ASPECTS

UN Sustainable development policies through trade- World Trade Organization-International monetary fund and World bank - Circular Economy and Sustainable Development - Socio economic policies for sustainable Development- Role of Judiciary in Sustainable Development - Major Environmental Cases in India - Development of Environmental Policies in India - Environment Protection Act, 1986 - EIA notification 2006 - National Conservation Strategy and Policy Statement on Environment and Development, 1992 - Policy Statement for the Abatement of Pollution, 1992 - National Environment Policy, 2006. SDG India Index - Baseline Report 2018 **(9)**

STRATEGIES FOR SUSTAINABLE DEVELOPMENT

Economic growth and Sustainable Development - Resource depletion and resource protection- - Internet of things and Sustainable Development - Sustainable Management of Forest, Land, water- Natural Disaster management- case studies. **(9)**

CLEANER PRODUCTION, LIFE CYCLE ASSESSMENT - GREEN/SUSTAINABLE CHEMISTRY

Cleaner Production, definition, aim, application-Generic process of Cleaner Production Assessment- Life cycle Assessment - definition, necessity and elements- ISO Environmental standards- Environmental Audit -Green Chemistry - twelve Principles of Green Chemistry - case studies. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ramakrishnan, P. S., "Ecology and Sustainable Development", National Book Trust, New Delhi, 2001*
2. *Paul Robbins, John Hintz, and Sarah A. Moore, "Environment and Society: A Critical Introduction", Wiley-Blackwell, 2014*
3. *Bimal N. Patel and Ranita Nagar, "Sustainable Development and India", Oxford University Press, 2018.*

REFERENCES

1. *Nick Hanley, Jason F. Shogren and Ben White, "Environmental Economics in Theory and Practice", Macmillan Publishers, UK, 1997*
2. *Tietenberg T. and Lynne Lewis, "Environmental and Natural Resource Economics", Harper Collins, Routledge, 2016*
3. *Kirkby, J.O., Keefe, P., and Timberlake, "Sustainable Development", Earthsean Pub., London, 2001*

ONLINE RESOURCES

1. *https://nptel.ac.in/courses/107/103/107103081/*

19CEOE06 - DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After successful completion of the course, student will be able to

CO1 : Identify natural and manmade disasters

CO2 : Explain in detail about causes and effects of natural and manmade disasters.

CO3 : Apply geospatial techniques (including GIS) that can enhance vulnerability assessments

CO4 : Identify and analyse the factors that give rise to differential vulnerabilities and levels of community resilience and suggest necessary mitigation plans

CO5 : Assess and manage these vulnerabilities through disaster planning and policy-making.

NATURAL DISASTERS

Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche. **(9)**

MAN MADE DISASTERS

Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster- Forest Fire- Oil fire -accident in Mines. **(9)**

GEOSPATIAL TECHNOLOGY

Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping. **(9)**

RISK ASSESSMENT AND MITIGATION

Hazards, Risks and Vulnerabilities - Disasters in India, Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans. **(9)**

DISASTER MANAGEMENT

Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism - Role of Engineers in Disaster Management. **(9)**

TOTAL : 45

TEXT BOOKS

1. *R. Subramanian, “Disaster Management” Vikas Publishing House Pvt. Ltd, New Delhi, 2018.*
2. *Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2017.*

REFERENCES

1. *Disaster Management in India-A Status Report- Published by the National Disaster Management Institute, Ministry of Home Affairs, Govt. of India, 2004.*
2. *Murthy D. B. N., "Disaster Management : Text and Case Studies", Deep and Deep Publications (P) Ltd., New Delhi, 2007.*
3. *Sundar I. and Sezhiyan T., "Disaster Management", Sarup and Sons, New Delhi, 2007.*
4. *Singhal J.P. "Disaster Management”, Laxmi Publications, 2010.*

5. *Khanna BK, "All You Wanted To Know About Disasters", New India Publishing Agency, New Delhi, 2005.*
6. *Ramana Murthy, "Disaster Management", Dominant, New Delhi, 2004.*
7. *Rajdeep Dasgupta, "Disaster Management and Rehabilitation", Mittal Publishers, New Delhi, 2007.*

19MEOE01 - DESIGN OF EXPERIMENTS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Demonstrate the fundamental concepts applied with mathematical knowledge, methodologies to bring knowledge of characterize, analyse and solve a wide range of problems between the purpose of a model and the appropriate level of complexity and accuracy.

CO2 : Plan, design and conduct experimental investigations efficiently and effectively; choose an appropriate experiment to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results.

CO3 : Analyse the nature of variables, statistical inference, influence parameter selection, factorial concepts, Conduct Design of experiments; interpret the direct and interaction effects using RSM.

INTRODUCTION

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. **(7)**

BASIC STATISTICAL CONCEPTS

Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples. **(9)**

EXPERIMENTAL DESIGN

Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples. **(11)**

ANALYSIS AND INTERPRETATION METHODS

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples. **(9)**

EXPERIMENT DESIGN USING TAGUCHI'S ORTHOGONAL ARRAYS

Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples. **(9)**

TOTAL :45

TEXT BOOKS

1. *C.F. Jeff Wu & Michael Hamada, "Experiments-Panning, Analysis, and Optimization", 3rd Edition, John Wiley & Sons. Inc., 2021.*
2. *D.C. Montgomery, "Design and Analysis of Experiments", 10th Edition, John Wiley & Sons. Inc. 2019.*

REFERENCES

1. *T.B. Barker, Andrew Milivojevich, "Quality by Experimental Design", 4th Edition, CRC Press, 2021*
2. *https://nptel.ac.in/courses/110/105/110105087/*
3. *https://nptel.ac.in/courses/111/104/111104075/*

19MEOE02 - ENGINEERING OPTIMIZATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Formulate single or multi-variable engineering optimization problems and comply with the appropriate objective functions.

CO2 : Select the appropriate optimization technique for the specified engineering problems based on number of variables and constraints.

CO3 : Derive, develop and utilize the possible randomness or any other associated factors that would possibly occur during constrained and unconstrained optimization situations.

INTRODUCTION

Problem formulation - design variables, constraints, constraint surfaces, objective functions, objective function surfaces. Classification of optimization - based on existence of constraints, nature of design variables, structure of the problem, nature of equation involved, permissible value of the design variables, deterministic nature of the variables, separability of the functions and the number of objective functions. Example of engineering optimization problems. **(11)**

SINGLE VARIABLE OPTIMIZATION

Optimal criteria - bracketing method - exhaustive search method, region elimination method - interval halving, Fibonacci, golden search method, point estimation method - successive quadratic approximation, gradient search method - Newton Raphson's method. **(10)**

MULTIVARIABLE OPTIMIZATION WITH CONSTRAINTS

Multivariable optimization - semi definite case - saddle point. Multivariable optimization with equality constraints - solution by direct substitution - solution by the method of constrained variation - solution by the method of Lagrange multipliers. Multivariable optimization with inequality constraints - Kuhn-Tucker conditions, constraint qualification. **(12)**

UNCONSTRAINED OPTIMIZATION

Introduction - classification of unconstrained minimization methods - general approach - rate of convergence - scaling of design variables. Direct Search Methods - random search methods - random walk method with direction exploitation - advantages of random search methods. Indirect Search Methods - gradient of a function - evaluation of the gradient - rate of change of function along a direction - steepest descent (Cauchy) method. **(12)**

TOTAL : 45

TEXT BOOKS

1. *S. S. Rao, "Engineering Optimization: Theory and Practice", 5th Edition, John Wiley & Sons, 2019.*
2. *K. Deb, "Optimization for Engineering Design - Algorithms and Examples", 2nd Edition, Prentice Hall India, 2013.*

REFERENCES

1. *J. S. Arora, "Introduction to Optimum Design", 4th Edition, Academic Press, 2016.*
2. *Ashok D. Belegundu &Tirupathi R. Chandrupatla, "Optimization Concepts and Applications in Engineering", 3rd Edition, Kindle Edition, Cambridge University Press, 2019.*

3. *A. Ravindran, K. M. Ragsdell, Reklaitis G.V., "Engineering Optimization: Methods and Applications", John Wiley & Sons, Inc., 2006.*
4. *https://nptel.ac.in/courses/112/105/112105235/*
5. *https://nptel.ac.in/courses/105/108/105108127/*
6. *https://nptel.ac.in/courses/112/101/112101298/*

19MEOE03 - ENGINEERING POLYMERS, COMPOSITES AND ALLIED MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Choose manufacturing processes for polymers and PMC materials to obtain required shapes by applying product design considerations

CO2 : Find the processes to develop new ceramic and cermet materials for manufacturing of high temperature cutting tools by applying design considerations

CO3 : Develop and characterize the Nano-composites, MMCs, CMCs and PMCs for the engineering applications using secondary processing methods

CO4 : Synthesize, characterize, compaction and sintering of metal powders for application of P/M parts using powder metallurgy techniques

CO5 : Synthesize and characterize the nanostructured materials for fabricating electronic devices, MEMS, magnetic, electronic and optical sensors and fabricating carbon nano structured materials for fuel cell and energy storage applications

SHAPING PROCESSES FOR PLASTICS

Properties of polymer melts - extrusion - production of sheet and film - fibre and filament production (spinning) - coating processes - injection moulding - compression and transfer moulding - blow moulding and rotational moulding - thermoforming. Casting - polymer foam processing and forming - product design considerations. **(8)**

RUBBER-PROCESSING TECHNOLOGY

Rubber processing and shaping - manufacture of tyres and other rubber products - product design considerations. **(5)**

SHAPING PROCESSES FOR POLYMER MATRIX COMPOSITES

Materials for PMC - open mold processes - closed mold processes - filament winding -pultrusion process - other PMC shaping processes. **(4)**

PROCESSING OF CERAMICS AND CERMETS

Processing of traditional ceramics - processing of new ceramics - processing of cermets - product design considerations. **(4)**

APPLICATION OF COMPOSITES

Composites including Nano-composites for electrical, superconducting and device applications, fabrication of Nano-composites, secondary processing and joining of various composite materials for structural applications and their fracture behavior and safety. **(9)**

POWDERS

Production and characterization of powders, compaction of metal powders - die compaction, isostatic pressing, powder forging, powder rolling and extrusion, pressure less compaction techniques, hot pressing and hot isostatic pressing, sintering of powder compacts, liquid phase sintering, sintering furnaces, post sintering operations, applications of P/M parts. **(7)**

INTRODUCTION TO NANOMATERIALS

Nano structured materials, low-dimensional structures: quantum wells, quantum wires, and quantum dots, Nano clusters & Nanocrystals, electronic and optical properties of Nano crystallites, metallic and semiconducting superlattices, synthesis of nanostructured materials, fabrication and characterization of Nano electronic devices and MEMS, basics of synthesis and

characterization of Nano-multi-component systems for sensors (magnetic, electronic and optical) and electrodes, synthesis and fabrication of carbon Nano structures for fuel cell and energy storage applications. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Mikell P. Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", 4th Edition, John Wiley & sons, Inc. 2015.*
2. *Ajayan P. M., Schadler L. S., & Braun P. V, "Nano composite Science and Technology", John Wiley & Sons, Inc., 2014.*

REFERENCES

1. *Charles A. Harper, "Modern Plastics Handbook", McGraw-Hill, 2010.*
2. *Sperling L.H., "Introduction to Physical Polymer Science", 3rd Edition, John Wiley & Sons, 2011.*
3. *Chawla K.K., "Ceramic matrix composites", 1st Edition, Chapman & Hall, 2013.*
4. *Randall M German, "A-Z of Powder Metallurgy (Metal Powders Technology)", Elsevier Science, 2007.*
5. *Upadhyaya G. S., "Powder Metallurgy Technology", Cambridge International Science Publishing, 2002.*

19MEOE04 - INDUSTRIAL ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Examine the configuration of a robot and suggest a robot for a particular operation (pick and place, welding, vision, climbing etc.).

CO2 : Calculate the position, velocity and acceleration for a robot manipulator and solve the forward and inverse kinematics.

CO3 : Calculate mass and inertia for the links of a robot manipulator and also find its forward and inverse dynamics.

CO4 : Choose an appropriate vision system for the robot and then extract these images to get the desired output.

CO5 : Write a program to determine path for obstacle avoidance for a specific task and can solve using matrix laboratory software.

INTRODUCTION

Brief history of robots, robot definitions, today's practical importance of robot applications, challenges faced by robots in industrial situations, future scope of robotics. **(3)**

GENERAL CONSIDERATION OF ROBOTIC MANIPULATORS

Introduction - Brief history of robotics- Robot geometrical configurations - wrist and gripper subassemblies - robot drive systems - robot software. **(5)**

KINEMATICS OF ROBOT MANIPULATORS

Homogeneous representation of objects, robot manipulator joint coordinate system, Euler angles and Euler transformations, Denavit- Hartenburg (D-H) representations, direct kinematics in robotics, inverse kinematic solutions, geometrical approach in inverse Kinematics, Jacobian of transformation in robotic manipulation. **(12)**

ROBOT WORKSPACE AND MOTION TRAJECTORY DESIGN

General Structure of robotic workspaces, robotic workspace performance index, extreme reach of robotic hands, robotic task description, robotic motion, trajectory design, general design considerations on trajectories, 4-3-4 trajectory, 3-5-3 trajectory, simulation of robotic workspaces. **(8)**

MOTION CONTROL OF ROBOTIC MANIPULATORS

General arm control system - open and closed loop control systems error controlled robotic dynamics - control structure of amplifier- control of a single axis robotic arm, common control systems for industrial robots, force control of robotic manipulators. **(9)**

ROBOT SENSING AND ROBOT VISION SYSTEM

Desirable features of sensor- range sensors - proximity sensors - tactile sensors-force sensors, torque sensing detectors - TV cameras - illumination techniques - fundamentals of image processing visual data acquisition - image enhancement - image segmentation - image extraction and recognition- object and model matching - image extraction. Typical vision systems, robot programming languages - characteristics of robot- level languages - characteristics of task level languages, simulation languages. **(8)**

TOTAL : 45

TEXT BOOK

1. *Fu.K S, Gonzales .R.C., & Lee.C.S.G., "Robotic Control, Sensing, Vision and Intelligence", McGraw Hill International, 2006.*
2. *Ashitava Ghushal "Robotics : Fundamental Concepts and Analysis", Oxford, 2006.*

REFERENCES

1. *Mikell.P.Groover, Mitchell Weiss, Tooger. N. Nager, & Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill International, 2004.*
2. *Richard. D. Klafter, Thomas. A. Chmielewski, & Michaelnegin, "Robotic Engineering - An Integral Approach", Prentice Hall of India, 2002.*
3. *https://nptel.ac.in/courses/112/105/112105249/*

19MEOE05 - BUSINESS PROCESS REENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Gain knowledge about BPR, Factors affecting BPR operations and design BPR techniques.

CO2 : Use BPR tools, utilize concepts of BPR, analyse cost / Benefit and appreciate the need of IT in BPR.

CO3 : Incorporate changes in the business operation based on market demand and implement the same in the manufacturing system.

CO4 : Select an appropriate practice of the business re-engineering project by taking the practical situations into consideration.

CO5 : Provide the most feasible practical solution to the problem keeping in mind the considerations of business automation, value, processes and risks in launching the business reengineering project.

INTRODUCTION TO BPR

Definition; the paradigm shifts in production; the need for BPR, advantages and benefits of BPR, constraining factors, challenges, the positioning concept; the re-engineering visions; The BPR Life Cycle Methodology, Guidelines for BPR steps, Role of Information Technology in BPR; process Improvement and Process Redesign; BPR Experience in Indian Industry. **(9)**

METHODOLOGIES AND TOOLS FOR BPR

Process management; dynamic business re-engineering change framework; steps to reengineer the process. Tools used in Modelling the Business: flow-charting, business activity maps, relational diagrams, benefit/cost analysis. The enabling role of information technology in business re-engineering. Conceptual Foundation of Business Process Re-engineering; Process Identification and Mapping; Role/Activity Diagrams. **(9)**

CHANGE MANAGEMENT

Planned changes in business re-engineering projects; challenges of business change; business change development. Success factors in re-engineering. The assessment of business re-engineering. Process Visioning and Benchmarking. Business process Improvement, Business Process Redesign; Man Management for BPR implementation; Re-organizing People and Managing Change. **(9)**

GOVERNANCE & BPR

Total Quality Management, Risk Management, Organizational Structures, BPR Project Management, The Power of Habit in organizations. The role of eLearning environments. Applications, gaming, BPR facilitation, BPR in Software Development, Basic principles, Relation to BPR. **(9)**

BEST PRACTICES IN BPR

Research & Practice, Perspectives in BPR, Discussion on research challenges, and practice challenges for industry and governments Case studies: Nissan, Chrysler, Hewlett Packard etc. Workflow systems, Imaging technology, Floware, Business design facility tools, Risk and impact measurement. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Davenport, "Process Innovation: Reengineering work through information technology". Harvard Business School Press, 1993.*
2. *Hammer & Champy, "Reengineering the Corporation: A Manifesto for Business Revolution" Harper Business Books, 1993.*

3. *Hammer & Stanton, "The Reengineering Revolution" Harper Collins. London, 1995.*
4. *Henry J Johansson, Patrick McHugh, John Pendlebury & William A. Wheeler, "Business Process Reengineering: Break Point Strategies for Market Dominance", Wiley, New Delhi, 1993.*

REFERENCES

1. *Harmon, P, "Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals", Elsevier/ Morgan Kaufmann Publishers, 2007.*
2. *R. Anupindi et al., "Managing Business Process Flows: Principles of Operations Management", Pearson Education Inc, 2006.*
3. *Kock, N.F., "Process Improvement and Organizational Learning: The Role of Collaboration Technologies", Idea Group, 1999.*
5. *Walford, R.B., "Business Process Implementation for IT Professionals and Managers" Artech Business Process Reengineering" Prentice Hall, New Delhi, 1993.*

19MEOE06 - ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1 : Analyze the demand and supply and sketch a demand and supply curve.

CO2 : Determine the Breakeven point and find out the strength and weakness of the Market Structure.

CO3 : Sketch the curve for cost behavior for the short run concept.

CO4 : Analyze and specify the causes and provide the solution to each cause.

CO5 : Formulate the steps involved in a recruitment process as a chart and interpret it.

INTRODUCTION

Definition -Nature and Scope-Significance of Economics for Engineers. **(5)**

BASICS OF MICRO ECONOMICS

Demand Analysis and Supply Analysis - Elasticity of Demand and Supply - Case Study in Demand Forecasting - Cost concepts - Classifications - Short run and Long run cost curves - Break-even Analysis. **(8)**

MARKET STRUCTURE

Classification of Market - Perfect Competition-Characteristics -Monopoly - Monopolistic Competition - Oligopoly and Duopoly - Price Discrimination under different markets - Price and output determination in short run and long run. **(8)**

MONEY AND BANKING

Money - Quantity theory of Money -Supply of Money - RBI Measures of Money Supply - Banking - Functions of Commercial Banks and Central Banks- Balance of Payments - Meaning and methods of Exchange control Methods of Foreign Payments - IMF, IBRD, WTO- Agreements of WTO and its Impact on Indian Economy. **(9)**

NATIONAL INCOME

Meaning - National Income - Concepts -Methods of Calculating and Problems in calculating National Income - Inflation - Causes - Measures -Deflation - Stagflation - Phillips Curve - Unemployment New Environment Policy- Liberalisation -Privatisation - Globalisation. **(8)**

HUMAN RESOURCE MANAGEMENT

Principles of Management, Evolution of Management, Development of Managerial Skills- Human Resource Management- Importance- Objectives- Job Analysis- Recruitment- Selection and Placement and Training Development. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Dewett. K. K., & Navalur M.H., "Modern Economic Theory", S. Chand and Company Ltd, New Delhi, 2014*
2. *Lipsey & Chrystal, "Economics", Oxford University Press, 2010*
3. *V. S. Bagad, "Principles of Management", Technical Publication, Pune*

REFERENCES

1. *Paul A Samuelson & William, "Economics", Tata McGraw Hill, New Delhi, 2012.*
2. *Francis Cheriunullem, "International Economics", McGraw Hill Education, 2011.*
3. *William A McEachern & Smrit Kaur, "Micro Economics", Cengage Learning, 2013.*
4. *William A McEachern & Indira A., "Macro Economics", Cengage Learning, 2014.*
5. *Lipsey & Chrystal, "Economics", Oxford University Press, 2010.*
6. *https://nptel.ac.in/courses/112/107/112107209/*

19EEOE01 - ENERGY AUDITING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Exhibit Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing

CO2 : Compute the thermal efficiency of various thermal utilities and use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.

CO3 : Analyse the cost- benefit of various investment alternatives for meeting the energy needs of productive processes through energy conservation study.

CO4 : Illustrate the energy saving techniques to reduce power consumption of the non- productive loads

CO5 : Advocacy of strategic and policy recommendations on energy conservation and energy auditing.

ENERGY AUDIT

Global energy scenario - Heat and Electrical energy - Role of energy managers in industries - Energy auditing -Types of energy audit- Data to be collected in auditing - Needs, methodology and types of energy audits - Simple payback period - Net present value of saving- Energy audit report **(9)**

ELECTRICAL ENERGY CONSERVATION

Basic Industrial electrical distribution- energy saving and energy efficiency with Transformers, reactive power correction and cable loss reduction- Energy saving in lighting systems -Specific Energy Consumption (SEC) - Load management - Demand Side Management (DSM). **(9)**

HEAT ENERGY CONSERVATION

Energy Audit - Losses in Boiler - Waste heat recovery - Sources of waste heat - High temperature heat recovery - Medium temperature heat recovery - Waste heat recovery applications- Cogeneration- Heating, ventilation and air conditioning systems (HVAC) :Types - energy conservation in cooling towers and Spray ponds. **(9)**

BUILDING, TRANSPORT AND UTILITY ENERGY CONSERVATION

Real buildings systems: Consumption - Cost versus lifecycle cost - Building design - Water supply systems Real Transportation Systems: Energy conservation in transportation - New technologies - Progress in clean diesel technology. Energy conservation inpumps, and fan and blowers - Energy efficient motors. **(9)**

ENERGY AUDIT PLANNING AND MONITORING

Energy Action Planning: Energy management system - Management commitment and Energy conservation policy - Energy performance assessment - Data collection and management - Analysis of data, baseline and benchmarking - Estimation of energy savings potential - Action planning and Training planning.

Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & targeting - Data and information, various techniques - Energy consumption, Production and Cumulative sum of differences (CUSUM). **(9)**

TOTAL : 45

TEXT BOOKS

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

2. *AmlanChakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2012.*
3. *YP.Abbi and Shashank Jain, "Handbook on Energy Audit and Environment Management", TERI, 2006.*
4. *Frank Krieth and D Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, 2007.*
5. *C.B. Smith, "Energy Management Principles", Pergamon Press, New York, 1981.*

REFERENCES

1. *"General Aspects of Energy Management and Energy Audit-Unit- 1,2,3,4", BEE Guide book, 2010.*
2. *Hamies, "Energy Auditing and Conservation: Methods, Measurements, Management & case study", Hemisphere, Washington, 1980.*
3. *Diamant R.M, "Total Energy", Pergamon Press, Oxford Press, 1970.*
4. *Albert Thumann, "Fundamentals of Energy Engineering", Prentice Hall, May 1984*
5. *Larry C Whit et.al, "Industrial Energy Management & Utilization", 1st Edition, Springer, 1988.*

19EEOE02 - SOLAR AND WIND ENERGY SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Summarize the solar radiation, measurements and characteristics of solar PV cell.

CO2 : Develop the model of a PV system and its applications.

CO3 : Illustrate the basic types, mechanical characteristics and model of wind turbine.

CO4 : Analyse the electrical characteristics and operation of various wind-driven electrical generators.

CO5 : Utilize various power electronic converters used for hybrid system.

SOLAR RADIATION AND SOLAR CELL FUNDAMENTALS

Basic characteristics of sunlight - solar spectrum - insolation specifics- irradiance and irradiation pyranometer - solar energy statistics- Solar PV cell - I-V characteristics -P-V characteristics- fill factor. Modeling of solar cell- maximum power point tracking. **(9)**

SPV SYSTEM PERFORMANCE AND APPLICATIONS

PV module - blocking diode and by -pass diodes- composite characteristics of PV module - PV array - solar cell array design concepts - Peak power operation-System components. PV- powered fan-PV fan with battery backup - PV-powered pumping system - PV powered lighting systems - grid - connected PV systems. **(9)**

WIND ENERGY FUNDAMENTALS AND COMPONENTS

Wind source-wind statistics-energy in the wind- Basic principle of wind energy conversion - nature of wind - power in the wind -turbine power characteristics- parts of wind turbines- braking systems-tower-Maximum power operation. **(9)**

WIND TURBINE TYPES AND CONTROL

Classification of WECS - Generating Systems - DC generator, Synchronous generator, Induction -generator, Doubly fed Induction generator, Direct -driven generator- generator control - load control. **(9)**

SYSETM INTEGRATION

Energy storage-Power electronic converters for interfacing wind electric generators - power quality issues- Hybrid system: wind - diesel systems, wind-solar systems. **(9)**

TOTAL : 45

TEXT BOOKS

1. *S N Bhadra, S Banerjee and D Kastha, "Wind Electrical Systems", Oxford University Press, 1st Edition, 2005.*
2. *Chetan Singh Solanki, "Solar Photovoltaic's: Fundamentals,Technologies and Applications" PHI Learning Publications, 3rd Edition, 2015.*

REFERENCES

1. *Roger A. Messenger and Jerry Ventre, "Photovoltaic systems engineering", Taylor and Francis Group Publications, 2020.*

2. *M.Godoy Simoes and Felix A. Farret, "Alternative Energy Systems: Design and Analysis with Induction Generators", CRC press, 2nd Edition, 2008.*
3. *Ion Boldea, "The electric generators hand book - Variable speed generators", CRC press, 2015.*

19EEOE03 - ELECTRICAL SAFETY PROCEDURES AND MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Identify and analyze the precautions and protection of electrical hazards

CO2 : Select and use the suitable personal protective equipment according to the working environment

CO3 : Interpret the safety procedures for the specific work place

CO4 : Analyze and apply the various grounding techniques

CO5 : Infer the electrical safety against low voltage and high voltage and to manage the medical equipments

INTRODUCTION AND HAZARDS OF ELECTRICITY

Electrical Safety introduction : Hazard Analysis: Primary and secondary hazards - Arc, blast, shocks - Causes and effects - Summary of causes- Protection and precaution - Injury and death protective strategies - IE Rules 1956 - Basic rules for new installations: power system, Domestic and Industry (Qualitative treatment only) **(9)**

ELECTRICAL SAFETY EQUIPMENT

General inspection and testing procedure for electrical safety equipment - Electrical safety equipment for external protection: Flash and thermal protection - Head and eye protection - Insulation protection. Electrical safety equipment for internal protection: Over voltage, Short circuit, Earth Fault, Leakage current, High/ Low frequency - Single Line diagram of industrial power system with safety control - Electrician's Safety kit and materials. **(9)**

SAFETY PROCEDURES

Introduction - Six step safety method - Job briefings - Energized or De - energized - Safe switching of power systems - General energy control programs - Lockout - Tagout - Voltage measurement techniques - Placement of safety grounds - Flash hazard calculations and approach distances - Calculating the required level of arc protection (flash hazard calculations) - Barriers and warning signs - Tools and test equipment - Field marking of potential hazards - Shock avoidance techniques - One minute safety audit. **(9)**

GROUNDING AND ELECTRICAL MAINTENANCE

Need for electrical equipment grounding - System grounding - Equipment grounding - Types of Earthing - Earth testing for electrical equipment in Power house and Industry - Eight step maintenance program - Maintenance requirements for specific equipment and location - IEC and UL standard. **(9)**

VOLTAGE SAFETY SYNOPSIS AND MEDICAL SAFETY MANAGEMENT

Safety equipment and safety procedures for low voltage and high voltage system - Electrical safety around electronic circuits- Electrical safety for medical equipment like over current safety, Isolation, EMI and harmonics - Battery maintenance procedure- Stationary battery safety - Accident prevention - Accident investigation - First aid - Rescue techniques - Electrical safety program structure and development - Safety meetings - Safety audits. **(9)**

TOTAL : 45

TEXT BOOK

1. *John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel and Al Winfield, "Electrical Safety Handbook", 4th edition, Mc Grew Hill, 2012*

REFERENCE S

1 *Mohamed A El - Sharkawi, "Electric safety: Practice and Standards", CRC press, New York, 2013*

2. *Martha J. Boss and Gayle Nicoll, "Electrical Safety: systems, sustainability and stewardship", CRC press, New York, 2014*

3. *Ray A. Jones and Jane g. Jones, "The Electrical Safety Program Guide", National fire protection association, Quincy, 2011*

4. *Electrical Safety booklets issued by Government bodies*

19EEOE04 - ENERGY EFFICIENT ILLUMINATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

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

CO2 : Perform the calculation of luminance parameters in various applications.

CO3 : Identify the criteria for selection of lighting equipment's and control systems in various applications.

CO4 : Impart design and technology for Interior lighting and Exterior lighting applications

CO5 : Review the various technologies used in Smart lighting systems.

INTRODUCTION : BASICS OF LIGHTING

Lighting Physics - Optical Radiation - Concept of Color - Biological Factors : Human eye and brain response - Different entities of illuminating systems. Properties of Lighting - Natural and Artificial lighting - Good and Bad Lighting - Challenges in Lighting - Good Practices in Lighting - Types of Lighting. **(7)**

LIGHTING CALCULATIONS AND LIGHT SOURCES

Basic Terms in Lighting System - Luminance measurement - Laws of Illumination - Polar Curves - Rousseau's construction - Concept of Photometry - Introduction of lighting software.

Lamps: Incandescent Lamps: Halogen lamps - Discharge Lamps: MV and SV Lamps, Fluorescent Lamps: FTL, CFL - Arc lamps - Special Lamps: LED: Surface Mounted Devices (SMD-LEDs), Chip on Board (COB-LEDs) - Neon lamps - Lasers - Comparison of Lamps - Life Cycle Cost (LCC) Analysis - Efficacy. **(12)**

LIGHTING EQUIPMENTS AND STANDARDS

Luminaries, Wiring, Control gears, Switching boards, Reflectors and Control circuits - Heating, Harmonics and EMI Suppression techniques from lighting equipment - Switching and Dimming control algorithm - Recommendation of Illumination Levels for Various Tasks / Activities / Locations - Role of 3D printing technology for designing luminaries - International Standards and codes of lighting system. **(9)**

LIGHTING APPLICATIONS

Interior lighting: Industrial, Residential, Indoor stadium and Hospitals. Exterior lighting: Flood, Street, Aviation and Transport lighting - Sign and display Board Lighting - Lighting in Agriculture - Lighting in Automobiles. **(8)**

SMART LIGHTING SYSTEMS

Intelligent lighting system - Smart LED lighting systems - LED Smart Projector system - Solar Street Lighting Systems - Role of IoT in lighting system - Concept of Light Fidelity (Li-Fi) - Significance of UV-C lighting in medical - Concept of Artificial Moon for street lighting. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to the Laser", Visions Communications, Washington DC, USA, 2nd Edition, 1994.*
2. *Jack L. Lindsey, "Applied Illumination Engineering", Prentice Hall of India, New Delhi, 3rd Edition, 2008*

3. *Leon Gaster, John Stewart Dow, "Modern Illuminants and Illuminating Engineering", Nabu Press, Washington DC, 1st Edition, 2010.*
4. *Philip Gordon., "Principles and Practices of Lighting Design: The Art of Lighting Composition", Blue Matrix Productions, 2011.*

REFERENCES

1. *Lighting Engineering: Practical Hand Book, INDALUX 2002*
2. *IES Lighting Handbook, 10th Edition, 2011.*
3. *NPTEL Course: Illumination Engineering*
4. *Lighting - Research paper reference from Philips - Lighting Academy and Signify Lighting University.*

19EEOE05 - ELECTRIC VEHICLE TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Apprehend the fundamentals and importance of electric vehicles and its components

CO2 : Select the suitable drive scheme based on the motor and topology for the given specification and applications

CO3 : Design and categorize the battery system for electric vehicles and hybrid electric vehicles

CO4 : Recognize the suitable battery charging scheme for different environments and applications.

CO5 : Describe the significance of E-mobility and its various business opportunities

ELECTRIC VEHICLES

An Overview of Conventional, Battery, Hybrid and Fuel Cell Electric Systems - Conventional IC Engine Vehicle - BEVs - HEVs - Series HEV - Parallel HEV - Series-Parallel HEV - FCEV - EV subsystems - Vehicle Dynamics: Vehicle Load Forces - Basic Power, Energy, and Speed Relationships - Aerodynamic Drag - Aerodynamic Drag and Fuel Consumption - Rolling Resistance - Gradability **(9)**

ELECTRIC PROPULSION

Electric Motors in EVs - Configuration and control of DC motor drives - Induction motor drives- Permanent Magnet motor drives - Switched reluctance motor drives - Transmission configuration, Components - gears, differential, clutch, brakes - regenerative braking - types - Motor sizing.- Matching the electric machine and the internal - combustion engine (ICE), Sizing the propulsion motor, sizing the power - electronics, selecting the energy storage technology, Communications- supporting subsystems **(9)**

BATTERIES

Introduction to Batteries - Energy Storage Requirements in Electric Vehicles: Batteries Types: Lead-Acid Battery - Nickel-Metal Hydride - Lithium-Ion - Battery Operation - Battery Parameters and Comparisons - Battery Packs - Battery Sizing - Battery based energy storage and its analysis - Fuel Cells - Fuel Cell based energy storage and its analysis - Super capacitors- Hybridization of different energy storage devices **(9)**

BATTERY CHARGING

Charging methods for battery- Fast charging - Battery Charging, Protection, and Management System - Termination methods - Charging from grid - Isolated and Non-isolated DC - DC Converters - Bidirectional DC-DC converter - High-frequency transformer based isolatedcharger topology - Transformer less topologies. **(9)**

E-MOBILITY

Energy Management Strategies - Automotive networking and communication, EV and EV charging standards, V2G, G2V, V2B, V2H - E-mobility business - Electrification challenges - Connected Mobility and Autonomous Mobility- Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). **(9)**

TOTAL : 45

TEXT BOOKS

1. *Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 2nd Edition CRC Press, 2018.*
2. *Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021*

REFERENCES

1. *James Larminie, John Lowry, Electric Vehicle Technology Explained, 2nd edition, Wiley, 2012*
2. *Soylu "Electric Vehicles - The Benefits and Barriers", InTech Publishers, Croatia, 2011.*
3. *J.M. Miller, "Propulsion Systems for Hybrid Vehicles", Institution of Electrical Engineers (IEE), 2nd edition, London, UK, 2010.*
4. *R. Stone and J.K. Bell, "Automotive Engineering Fundamentals", SAE International, Warrendale, PA, 2004.*
5. *Viswanathan B. and Scibioh Aulice M, "Fuel cells: Principles and Applications", University Press, 2008.*

19EEOE06 - ENERGY EFFICIENCY IN THERMAL AND ELECTRICAL UTILITIES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Preaudit the energy

CO2 : Analyse the possibility of energy savings

CO3 : Analyze the methods of energy savings

CO4 : Design the solutions

CO5 : Identify and perform appropriate energy management

ENERGY EFFICIENCY IN THERMAL UTILITIES - I

- Fuels and Combustion: Introduction to fuels, properties of fuel oil, coal and gas, storage, handling and preparation of fuels, principles of combustion, combustion of oil, coal, and gas.
- Boilers: Types, combustion in boilers, performance evaluation, analysis of losses, feedwater treatment, blowdown, energy conservation opportunities..
- Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.
- Insulation and Refractories: Insulation-types and application, the economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss.
- FBC boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, Retrofitting FBC system to conventional boilers, saving potential. **(9)**

ENERGY EFFICIENCY IN THERMAL UTILITIES - II

- Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate, and flash steam recovery system, identifying opportunities for energy savings
- Cogeneration: Definition, need, application, advantages, classification and saving potentials.
- Waste Heat Recovery: Classification, advantages, and applications, commercially viable waste heat recovery devices, saving potential.
- Energy Management & Audit: Definition, need and types of an energy audit. Energy management (audit) approach-understanding energy costs, benchmarking, energy performance, matching energy use to the requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.
- Material and Energy balance: Facility as an energy system, methods for preparing process flow, material, and energy balance diagrams. **(9)**

ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

- Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.
- Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy-saving opportunities with energy- efficient motors.

- Energy-Efficient Technologies in Electrical Systems: Maximum demand controllers, automatic power factor controllers, energy-efficient motors, soft starters with energy savers, variable speed drives, energy-efficient transformers, electronic ballasts, occupancy sensors, energy-efficient lighting controls. **(9)**

ENERGY EFFICIENCY IN THERMO ELECTRIC UTILITIES - I

- Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities
- HVAC and Refrigeration System: Vapor compression refrigeration cycle, refrigerants, the coefficient of performance, capacity, and factors affecting Refrigeration and Air conditioning system performance and savings opportunities.
- Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system, saving potentially
- Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.
- Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. **(9)**

ENERGY EFFICIENCY IN THERMO ELECTRIC UTILITIES - II

- Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy-saving opportunities assessment of cooling towers.
- Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues.
- Diesel Generating system: Factors affecting the selection, energy performance assessment of diesel conservation avenues **(9)**

TOTAL : 45

ENERGY PERFORMANCE ASSESSMENT FOR EQUIPMENT AND UTILITY SYSTEMS

Open Book examination on the following energy performance assessments for equipment and utility systems:

- Boilers, Furnaces
- Cogeneration, Turbines (gas, steam)
- Heat Exchangers
- Electric Motors, Variable Speed Drives
- Fans and Blowers, Water Pumps, Compressors
- HVAC systems
- Lighting Systems
- Performing Financial Analysis.
- Applications of Non-conventional & Renewable Energy Sources (NRES)
- Waste minimization and resource conservation

TEXT BOOKS

1. *Mehmet Kanolu, Yunus A. Çengel, "Energy efficiency and management for engineers", McGraw- Hill Education, 2020*
2. *Stephen A. Roosa, Steve Doty, Wayne C. Turner, "Energy Management Handbook", 9th edition, River Publishers, Taylore and Francis Group, 2020*
3. *Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency (BEE), Guide books*
4. *Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency (BEE), Guide books*

REFERENCES

1. *Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2017*
2. *Wayne C. Turner," Energy Management Handbook", Eighth Edition, 2012*
3. *Stephen A. Roosa, Steve Doty, "Energy Management Handbook", 2018*
4. *General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency (BEE), Guide books*
5. *Energy Performance Assistance for Equipment and Utility Systems, Bureau of Energy Efficiency (BEE), Guide books*

19ECEOE01 - SIGNAL PROCESSING AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Compute the Discrete Fourier Transform (DFT) of a given discrete time sequence using Radix-2 Fast Fourier Transform algorithms and design FIR/IIR Filters

CO2 : Apply source coding procedure to calculate coding efficiency based on entropy & mutual information and outline different pulse analog modulation techniques

CO3 : Analyze various equalization techniques and compare its performance

CO4 : Calculate channel capacity using Shannon's channel capacity theorem and develop channel error control codes

CO5 : Analyze speech processing methods in time and frequency domain and design codec methods for speech compression techniques

ORTHOGONAL TRANSFORMS AND DIGITAL FILTER STRUCTURES

DFT-DCT-Properties of DFT- Computation of DFT, FFT and structures-Decimation in time-Decimation in frequency - Linear convolution using DFT

Basic FIR/IIR filter structures-FIR/IIR Cascaded lattice structures-Parallel allpass realization of IIR transfer functions- Sine cosine generator - Computational complexity of filter structures **(10)**

DATA COMPRESSION

Information entropy-Source coding-Huffman algorithm-Delta Modulation-Adaptive Delta Modulation- Continuously Variable Slope Delta Modulation-Differential Pulse Code Modulation - Adaptive Differential Pulse Code Modulation. **(8)**

SIGNAL PROCESSING IN COMMUNICATION RECEIVER

Temporal Equalization-Space Time Equalization-Frequency Domain Equalization-Symbol Timing Recovery- Channel Quality Estimation- Automatic Frequency Control-Overall Receiver Block. **(9)**

ERROR CORRECTING CODES & CHANNEL CODING

Error Correcting codes-Error Correction-Linear Blocks Codes-Cyclic Codes- Bose, Chaudhari and Hocquenghem Codes-Convolution Codes-Viterbi Decoding-Interleaving Codes-Concatenated Codes- Turbo Codes. **(9)**

SPEECH CODING

Speech Coding-Adaptive Predictive Coding-Sub Band Coding,-Vocoders-Liner Predictive Coding- Image Coding-Joint Photo Graphic Expert Group (JPEG)-Moving Pictures Expert Group (MPEG), the layer-3 of MPEG-1 Algorithms(MP3),Lempel- ZIV Algorithms - Recognition techniques:Speech Recognition and Image recognition. **(9)**

TOTAL : 45

TEXT BOOKS

1. *V. Oppenheim, R. W. Shafer and J.R.Buck, "Discrete-Time Signal Processing", Pearson Education, 3rd Edition, 2011.*
2. *Simon Haykin, "Digital Communications Systems", 1st Edition, Wiley, 2013.*

REFERENCES

1. *Sanjit. K. Mitra and Sanjit Kumar Mitra, "Digital Signal Processing - A computer based approach", Tata McGraw Hill, 4th Edition, 2011.*
2. *Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 2005.*
3. *Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003*
4. *L.R.Rabiner and R.W.Schaffer "Digital Processing of Speech signals" Prentice Hall 1978*
5. *Nirmal K. Bose, Calyampudi Radhakrishna Rao, "Signal Processing and Its Applications" North-Holland, 1993*

19ECEOE02 - SMART SENSORS AND IoT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the classification ,types,packaging and testing of smart sensors

CO2 : Interpret the construction and working principles of Electronic sensors

CO3 : Exemplify the working of different types of light radiation sensors .

CO4 : Illustrate the key concepts of temperature ,gas and airquality sensors used to measure the parameters.

CO5 : Interpret the characteristics, functional blocks and architecture of IoT to develop an IoT based applications.

SMART SENSORS BASICS

Sensor Classification, Performance and Types, Error Analysis characteristics- Semiconductor Packaging- Hybrid Packaging- Packaging for Monolithic Sensors- Reliability Implications-Testing Smart Sensors- HVAC Sensor Chip- Amplification and Signal Conditioning- Integrated Signal Conditioning- Digital conversion- MCU Control-MCUs for Sensor Interface- Techniques and System Considerations- Sensor Integration. **(9)**

ELECTRONIC SENSORS

Resistance strain gauge - piezoelectric pressure gauge - characteristics- load cells-torque sensor- Piezo-resistive and capacitive pressure sensor- optoelectronic pressure sensors- vacuum sensors- Capacitor plate sensor, Inductive sensors, LVDT- Hall effect- Doppler detectors- liquid level detectors, flow sensors - ultrasonic sensor- flow sensors. **(9)**

GHT RADIATION SENSORS

Electronic and Optical properties of semiconductor as sensors - LED - Semiconductor lasers- Fiber optic sensors- Thermal detectors - Photo multipliers- photoconductive detectors- Photo diodes- Avalanche photodiodes - CCDs - Intensity sensor - Interferometers-Phase sensor: Phase detection, Polarization maintaining fibers. **(9)**

TEMPERATURE, GAS AND AIR QUALITY SENSORS

Bimetallic strip- Bourdon temperature gauge- thermocouples- Resistance thermometers- thermistors- bolometer- Pyroelectric detector-Engine combustion process- Catalytic exhaust after treatment, Emission limits- Exhaust sensors and Engine control - Exhaust sensors for OBD- Hydro-Carbon Sensors- NOx-Sensors-Oxygen Sensors- Measurement of oxides of sulphur,oxides of nitrogen unburnt hydrocarbons, carbonmonoxide, dust mist and fog- smoke sensors. **(9)**

IoT AND ITS APPLICATIONS

IoT Definition - Characteristics - IoT Functional Blocks -IoT Architecture -Physical design of IoT - Logical design of IoT- Sensing & Actuation -Basics of Networking - Communication Protocols- Machine-to-Machine - Communication models & APIs.

Domain specific applications of IoT: Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture, Smart Traffic Control and Smart water management. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Jacob Fraden," Handbook of modern sensors: physics, designs, and applications", 5th Edition, Springer, 2016.*
2. *Randy Frank, "Understanding Smart Sensors", Artech House, 2nd Edition, Boston, 2011.*

REFERENCES

1. *Arshdeep Bahga, Vijay Madisetti, "Internet of Things - A hands-on approach", Universities Press, 2015.*
2. *Jon. S. Wilson, "Sensor Technology Hand Book", Elsevier, 1st Edition, Netherland, 2011.*
3. *John G Webster, "Measurement, Instrumentation and sensor Handbook", CRC Press, 2nd Edition, Florida, 2017.*
4. *John P. Bentley," Principles of Measurement systems", 3rd Edition, Pearson Education Asia Pvt. Ltd, 2009.*
5. *D. Patranabis," Sensors and Transducers", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2006.*
6. *Ernest O Doebelin, Dhanesh N Manik, "Measurement Systems, Application and Design", McGraw Hill, 6th Edition, 2007.*

19ECEOE03 - CONSUMER ELECTRONICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Understand the various types of microphones and loudspeaker.

CO2 : Explain the principle and working of Monochrome TV.

CO3 : Describe the Colour TV scanning process and camera tube.

CO4 : Illustrate LCD, LED TV, working of cable TV and DTH.

CO5 : Interpret the significant technical considerations using a broad systems perspective.

AUDIO SYSTEMS

Microphones Carbon, moving coil, wireless microphone; Loudspeakers - Direct radiating Electrostatic and horn loudspeaker; Multi-speaker system; Sound Recording - Magnetic Recording, Digital Recording, Optical Recording (CD system and DVD). **(9)**

MONOCHROME TV

Elements of TV communication system, Scanning process, Scanning methods and Aspect Ratio, Need of synchronizing and blanking pulses, Composite Video Signal, Camera Tube: Vidicon. **(9)**

COLOUR TELEVISION

Primary, secondary colours, Concept of Mixing, Colour Triangle, Camera tube, PAL TV Receiver, Concept of Compatibility with Monochrome Receiver, NTSC, PAL, SECAM. **(9)**

LCD AND LED TELEVISION

Basic principle and working of LCD & LED TV, Cable Television: Working of Cable TV, DTH **(9)**

DOMESTIC & CONSUMER APPLIANCES

Operation of Microwave Oven, Automatic Washing Machine, Photostat Machine, Digital Camera, Vacuum cleaner, Food Processors, Scanner. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Bali S.P., "Consumer Electronics" Pearson Education, 2017.*
2. *Bali R and Bali S.P. "Audio video systems: principle practices & troubleshooting", Khanna Book Publishing Co. (P) Ltd., 2010.*

REFERENCES

1. *Gulati R.R., "Modern Television practices" New Age International Publication (P) Ltd.2011.*
2. *Gupta R.G, "Audio video systems" Tata Mc graw Hill, 2nd Edition, 2010.*
3. *Whitaker Jerry & Benson Blair, "Standard Handbook of Audio engineering" McGraw-Hill Professional, 3rd Edition, 2010.*
4. *Amit Dhir, "The Digital Consumer Technology Handbook", Elsevier Science, 2004.*

19ECEOE04 - ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

Upon completion of this course, students will be able to demonstrate an ability to

CO1 : Describe the concepts of robotics, safety measures and homogeneous transformation.

CO2 : Formulate the concepts of mechanical drives and sensors in robotics.

CO3 : Describe the types of sensors and Robotic Vision

CO4 : Develop robotics programming, classifications and its applications.

CO5 : Exemplify the concepts of artificial intelligence.

ROBOT KINEMATICS

Introduction - Robotics and programmable automation - Historical background - Laws of Robotics - Robot definitions - Robotics system and Robot anatomy - Specifications of Robots - Safety measures in Robotics. **(10)**

ROBOTIC DRIVERS AND CONTROLS

Robot drives, actuators and control - Functions of drive systems - General types of fluids - Pump classification - Pneumatic systems - Electrical drives - DC motors - Stepper motors - Drive mechanism. **(9)**

SENSORS AND MACHINE VISION

Need for sensing systems- Principles and Applications of the following types of sensors- Position and displacement sensors - Potentiometers, Encoders, Linear Variable Differential Transformer, Force and Torque sensors- Wrist sensor, Joint sensor, Tactile array sensor, Slip sensors- Proximity sensors- Range finders- Imaging sensors- Inductive Proximity switch- Acoustic sensors- Opto-electronic sensors- Lighting Techniques, Robot Vision- Sensing and Digitizing, Image Processing and analysis- Preprocessing, Segmentation, Description, Recognition, Interpretation and Applications of robot vision system **(9)**

ROBOTIC LANGUAGE AND PROGRAMMING

Robot language and programming. Robot language - Classification of Robot languages - Computer control and robot software - VAL system and language. Applications of Robots: Capabilities of Robots - Robotics applications - Obstacle avoidance. **(8)**

ARTIFICIAL INTELLIGENCE IN ROBOTICS

The history of Artificial Intelligence- Artificial and Natural Intelligence- Artificial Intelligence and Automated manufacturing- The application domains of Artificial Algorithms- Risks and Benefits of AI- Agents and Environments- Knowledge representation. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Satya Ranjan Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 2nd Edition, 2012.*
2. *Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2014.*

REFERENCES

1. *Robin.R.Murphy, "Introduction to AI Robotics", The MIT Press, Canbridge, Massachusetts, London, England, Second Edition, 2019.*
2. *Jadran Lenarcic, Jean-Pierre Merlet, "Advances in Robot Kinematics 2016", Springer International Publishing AG, 2018.*

3. *Peter McKinnon, "Robotics", CreateSpace Independent Publishing Platform, 2016.*
4. *Ritu Tiwari, Anupam Shukla, Rahul Kala, "Intelligent Planning for Mobile Robotics: Algorithmic Approaches", Information science reference, United states of America, 2013.*
5. *David. L. Pool and Alan. K. Mackworth, "Artificial Intelligence: Foundations of Computational agents", Cambridge University, 2011.*

19ECEOE05 - INFORMATION THEORY AND CODING TECHNIQUES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Explain the information content in a discrete memoryless source through parameters such as entropy and mutual information.

CO2 : Estimate a channel's capacity based on Shannon's channel capacity theorem

CO3 : Analyze various channel encoding and decoding methods

CO4 : Design and develop an error control coding methods for random error and burst error detection and correction techniques

CO5 : Understand different applications in coding techniques

INFORMATION THEORY AND SCHEMES FOR SOURCE CODING

Uncertainty Information and Entropy - Basic Properties of entropy - Information rate - Conditional entropy - Joint Entropy - Mutual Information - Channel capacity of a Gaussian channel

SOURCE CODING : Prefix codes - Necessary conditions for source coding - Kraft Mcmillan Inequality- Huffman Coding- Shannon Fano Coding Efficiency calculations. **(9)**

MEMORYLESS FINITE SCHEMES FOR CHANNEL CODING

Discrete Memoryless Channel - Channel models - BSC and BEC channels - Cascaded channels - Channel capacity of discrete and analog channels - Channel capacity of a Gaussian channel-Bandwidth-S/N trade-off-Channel coding theorem - Information capacity theorem - Code rate and redundancy-Parity check codes - Rate Distortion Theory. **(9)**

LINEAR BLOCK CODES AND CYCLIC CODES

Rationale for coding - Types of codes - Matrix description of linear block codes - Syndrome decoding - Minimum distance considerations -Repetition codes - Dual codes- Cyclic codes :Generator polynomial - Parity check polynomial - Encoder of cyclic codes - Calculation of syndrome - Cyclic codes for error correction. **(10)**

CONVOLUTIONAL CODES

Convolutional codes : Tree codes- Trellis codes- Viterbi decoding of convolutional codes - Catastrophic Error Propagation in Convolutional Codes -Performance Bounds for Convolutional Codes - Coding Gain - Convolutional Code Trade off - Soft Decision Viterbi Decoding -Feedback Decoding - Sequential Decoding **(9)**

CODING TECHNIQUES IN DATA COMPRESSION

Static and Dynamic Huffman coding - Arithmetic coding - Run length encoding- Lempel-Ziv coding -Image compression techniques -JPEG standard for Lossy and Lossless compression- Video compression standards. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Roberto Togneri, Christopher J.S DeSilva, "Fundamentals of Information Theory and Coding Design", CRC press, 2003.*
2. *Ranjan Bose, "Information Theory Coding and Cryptography", Tata McGraw Hill, 3rd Edition 2016.*

REFERENCES

1. *Richard B.Wells, "Applied Coding and Information Theory for Engineers", Pearson Education, 1st Edition Indian reprint, 2009.*
2. *Khalid Sayood, "Introduction to Data Compression", 4th Edition, Elsevier, 2012.*
3. *Bernard Sklar, "Digital Communications: Fundamentals and Applications", Pearson Education, 2nd Edition, 2009.*
4. *Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons, 2nd Edition, 2006.*
5. *Reza F M, "An Introduction to Information theory", McGraw Hill, 2000.*
6. *Todd K Moon, "Error Correction Coding - Mathematical methods and Algorithms", John Wiley & Sons, 1st Edition, 2021.*

19ECEOE06 - WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Outline the challenges & issues in the wireless sensor network and its subsystems and interpret network architecture and its components

CO2 : Describe the essential principles of the MAC protocols for Wireless Sensor Networks

CO3 : Elucidate the Routing & localization tracking inWireless Sensor Networks

CO4 : Discuss the features of WSN Operating systems

CO5 : Illustrate the methodologies to provide WSN based solution for various critical issues.

SENSOR NETWORKS - INTRODUCTION & ARCHITECTURES

Challenges for Wireless Sensor Networks-Enabling Technologies for Wireless Sensor Networks- Characteristic requirements for WSN - WSN architecture - Commercially available sensor nodes -Imote, IRIS, Sunspot -Physical layer and transceiver design considerations in WSNs-Single Node Architecture -Energy Consumption of Sensor Nodes- Sensor Network Scenarios- Optimization Goals and Figures of Merit. **(9)**

DATA LINK LAYER

Fundamentals of MAC protocols- Issues in designing a MAC Protocol for WSN - Low duty cycle protocols and wakeup concepts - Contention based protocols:PAMAS - Schedule-based protocols:LEACH - Sensor MAC - Berkeley MAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4- Link Layer protocols - fundamentals task and requirements, error control, framing, link management, Address and Name Management, Assignment of MAC Addresses, Unique,Content-based and geographical addressing. **(10)**

ROUTING AND TRACKING

Routing Challenges and Design Issues in Wireless Sensor Networks- Taxonomy :Data-centric routing SPIN - Energy aware routing, Gradient-based routing -Hierarchical Routing LEACH -Location Based Routing GAF, Data aggregation - Various aggregation techniques

A Tracking Scenario - Problem formulation - Distributed representation and inference of states- Tracking multiple objects - Sensor models - Topology control - Clustering - Time synchronization - Localization and Localization Services **(10)**

EMBEDDED OPERATING SYSTEMS FOR WSNs

Embedded Operating Systems: Operating Systems for WSNs - Introduction - Operating System Design Issues- Introduction to Tiny OS - NesC - Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM. **(7)**

APPLICATIONS OF WSN

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications - Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling **(9)**

TOTAL : 45

TEXT BOOKS

1. *Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, First Edition, 2007.*
2. *Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.*

REFERENCES

1. *Anna Hac, "Wireless Sensor Network Design", John Wiley & Sons, First Edition, 2003.*
2. *C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "Wireless Sensor Networks", Springer Publication, 2004.*
3. *Paolo Santi, "Topology Control in Wireless Adhoc and Sensor Networks", John Wiley & Sons, 2005.*
4. *Philip Levis, David Gay,"TinyOS Programming", Cambridge University Press, 2009 Contiki - Open Source Operating System for IoT - http://www.contiki-os.org/*

19ECEOE07 - AUTOMOTIVE EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Design modules for hybrid vehicle using automotive system components.

CO2 : Design control system in automotives by appropriate choice of Microcontrollers, Sensors and actuators.

CO3 : Examine the communication protocols for real time applications

CO4 : Understand the safety and comfort in Automobiles as per the government test procedures.

CO5 : Understand the communication and diagnostic protocols

AUTOMOTIVE SYSTEMS

Overview of Automotive industry - Tools and Processes - Introduction to modern automotive systems -Spark and Compression Ignition Engines - Automotive Transmissions - Vehicle braking fundamentals -Steering Control - Overview of Hybrid Vehicles - Analog and Digital Systems - Basic measurements systems. **(9)**

SENSORS AND ACTUATORS

Sensors: Characteristics, response and modeling - Actuators - Microcontroller and Digital Signal Processors used for automotive applications. **(9)**

EMBEDDED COMMUNICATION

Embedded Automotive Protocols: CAN, LIN, FLEXRAY, MOST **(9)**

SAFETY SYSTEMS

Active Safety Systems: ABS, TCS, ESP, brake assist - Passive Safety Systems: Airbag systems, Advance Driver Assistance system (ADAS) -Computer vision techniques - Connected cars technology - Trends towards Autonomous vehicles. **(9)**

FUNDAMENTALS OF DIAGNOSTICS

Basic wiring system and Multiplex wiring system, Self-Diagnostic system - various On board and off board diagnostics in Automobiles - Diagnostics tools - Diagnostics Protocols: KWP20000 and UDS. **(9)**

TOTAL : 45

TEXT BOOK

Ronald K Jurgen, "Automotive Electronics Hand Book", McGraw- Hill, 2nd Edition 1999.

REFERENCES

1. *William B. Ribbens, Ph.D, "Understanding Automotive Electronics", Elsevier Publications, 7th Edition, 2012.*
2. *Tom Denton, "Advance Automotive Diagnosis", 2nd Edition, Elsevier 2006.*
3. *BOSCH Automotive Handbook, 8th Edition.*
4. *Denton. T, "Automobile Electrical and Electronics Systems", SAE (Society for Automobile Engineers) International, 3rd Edition, 2004.*
5. *Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009.*

19ECEOE08 - 5G TECHNOLOGIES AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : describe the evolution of cellular systems from 2G to 4G

CO2 : explain the motivation, targets of 5G technology and its standardization

CO3 : elaborate the 3GPP releases and 5G radio access network architecture

CO4 : discuss the services offered by 5G deployment and its design approaches

CO5 : understand the role between 5G and emerging next generation wireless technologies

EVOLUTION OF CELLULAR SYSTEMS

Evolution from 2G to 3G and 3G to 4G - Circuit Switch to Packet Switch - ITU Standardization Process- - Evolution of LTE and releases. **(9)**

INTRODUCTION TO 5G

Motivation for 5G - 5G targets - Technology components - Spectrum - capabilities - The role of 3GPP in standardization - use cases - 5GPPP (Public-Private Partnership) **(9)**

5G RADIO ACCESS NETWORK

Radio access - 3GPP Releases - 5G New Radio (NR) - Requirements - 3GPP phases for IMT-2020 - NR air interface - 5G RAN architecture **(9)**

5G SERVICES

Enhanced Mobile Broadband (eMBB) systems - Massive Machine Type Communication (MMTC) system - Ultra Reliable and Low Latency Communication (URLLC) systems - Design approaches **(9)**

EMERGING TECHNOLOGIES IN 5G

Massive MIMO - Network Function Virtualization - Software Defined Networking - Cognitive radio -Millimetre Wave - Heterogeneous network - Internet of Things **(9)**

TOTAL : 45

TEXT BOOKS

1. *Saad Asif, "5G mobile Communications Concepts and Technologies", CRC Press,2018*
2. *Biljana Badic, Christian Drewes, Ingolf karls, Markus Mueck, "Rolling out 5G Use cases, Applications and Technology Solutions", Apress, 2016*

REFERENCES

1. *Antti Toskala, Harri Holma, Takehiro Nakamura, "5G Technology 3GPP New Radio", Wiley & Sons Ltd. 2020.*
2. *Devaki Chandramouli, Juho Pirskanen, Rainer Liebhart, "5G for the Connected World", Wiley,2019*
3. *Haesik Kim, "Design and Optimization for 5G Wireless Communications", Wiley, 2020*
4. *Ramjee Prasad, "5G Outlook Innovations and Applications", River Publications, 2016*
5. *Anwer Al-Dulaimi, "5G Networks Fundamental Requirements, Enabling Technologies, and Operations Management", Wiley, 2018*
6. *Mauro Boldi, Olav Queseth, Patrick Marsch, Ömer Bulakci, "5G System Design Architectural and Functional Considerations and Long Term Research", Wiley,2018*

19ECEOE09 - VEHICULAR COMMUNICATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Understand basic principles, technologies, and system architecture of vehicular ad-hoc networks (VANET)

CO2 : Analyze Physical Layer and MAC Layer for signal propagation for vehicular communication

CO3 : Describe the various routing mechanisms and protocols to fulfill vehicular networking requirements.

CO4 : Explain the challenges and issues in establishing cellular V2X connection and mobility management.

CO5 : outline vehicular communication platforms for various emerging applications

INTRODUCTION TO VEHICULAR RADIO NETWORKS

Basic principles and challenges-Mobile Wireless Communications and Networks-Need for Vehicular Communications-VANET activities- Network Architecture for Vehicular Communications. **(9)**

PHYSICAL LAYER AND MAC LAYER

Signal Propagation-Doppler spread and its impact on OFDM Systems-Proposed MAC approaches and standards, Intelligent Transportation Systems: IEEE 802.11p-ITS-IVC **(10)**

VANET ROUTING PROTOCOLS

Opportunistic packet forwarding-topology based routing- geographic routing **(8)**

VEHICULAR MOBILITY MANAGEMENT

Connected Vehicles& Connected Autonomous Vehicles- Dedicated Short Range Communication-flow and traffic models-Standards and Regulations- DSRC Protocol Stack, Cellular V2X **(9)**

EMERGING VANET APPLICATIONS

Vehicle to Infrastructure Safety Applications-communication paradigms-message coding and composition-data aggregation-Security and Privacy **(9)**

TOTAL : 45

TEXT BOOKS

1. *H. Hartenstein and K. P. Laberteaux, VANET: Vehicular Applications and Inter-Networking Technologies, John Wiley & Sons Ltd., 1st Edition 2010.*
2. *Luca Delgrossi, Tao Zhang, "Vehicle Safety Communications: Protocols, Security, and Privacy", John Wiley & Sons Ltd 1st Edition 2012.*

REFERENCES

1. *P. H.-J. Chong, I. W.-H. Ho, Vehicular Networks: Applications, Performance Analysis and Challenges, Nova Science Publishers, 2019.*
2. *C. Sommer, F. Dressler, Vehicular Networking, Cambridge University Press, 2015.*
3. *Popescu-Zeletin R, Radusch I and Rigani M.A, "Vehicular-2-X Communication",Springer,2010.*
4. *M. Watfa, Advances in Vehicular Ad-Hoc Networks: Development and Challenges, Information Science Reference, 2010.*
5. *H. Moustafa, Y. Zhang, Vehicular Networks: Techniques, Standards, and Applications, CRC Press, 2009.*
6. *Xiang W, "Wireless Access in Vehicular Environments Technology", Springer, 2015*

19ECEOE10 - SENSING FOR AUTOMOTIVE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

CO1 : Acquaint with the basic automotive system components and need for automotive sensors.

CO2 : Discuss the fundamentals of various Power train sensors in automotive systems.

CO3 : Comprehend various sensors for chassis management.

CO4 : Understand the sensors for vehicle management & security systems in Automobiles.

CO5 : Examine the vehicle communication protocols standards in automotive applications.

AUTOMOTIVE SYSTEMS

Introduction to Modern Automotive Systems- Electronics in Automobiles - Combustion Engines- Power-train- braking systems - Transmission- Applications and Challenges in the automotive. **(9)**

POWERTRAIN AUTOMOTIVE SENSORS

Exhaust temperature sensor - λ sensors - PM sensor - NOx sensor - fuel quality sensor- level sensor- torque sensor-speed sensor- manifold pressure sensor - mass flow sensor. **(9)**

CHASSSIS SENSORS

Wheel speed sensors/direction sensors- steering position sensor (multi turn)- acceleration sensor (inertia measurement)- brake pneumatic pressure sensor- ABS sensor- electronic stability sensor. **(9)**

SENSORS FOR VEHICLE MANAGEMENT & SECURITY SYSTEMS

Gas sensors (CO2)- Temperature/humidity sensor- air bag sensor- key less entering sensor- radar sensors. Tire pressure monitoring systems- Two wheeler and Four wheeler security systems. **(9)**

VEHICLE COMMUNICATION STANDARDS

Automotive Protocols : CAN, LIN, FLEXRAY, MOST **(9)**

TOTAL : 45

TEXT BOOK

John Turner, Automotive Sensors, 2010, Momentum Press, 1st Edition, New York.

REFERENCES

1. *Automotive Electrics, Automotive Electronics: Systems & Components, 2014, 5th Edition, BOSCH.*
2. *Ronald K Jurgen, "Automotive Electronics Hand Book", McGraw- Hill, 2nd Edition 1999.*
3. *Automotive Sensors Handbook, 8th Edition, 2011, BOSCH*
4. *Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, Iwao Yokomori, "Sensors for Automotive Technology", 4th Edition, Wiley, New York, 2010.*
5. *Jack Erjavec, "Automotive Technology: A Systems Approach", Delmar Cengage Learning, 5th Edition, 2009.*

19CSOE01 - CUSTOMER RELATIONSHIP MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : State the evolution of marketing and define CRM architecture explaining customer acquisition, retention and segmentation.

CO2 : Describe the business value, its costs and deploying data mining for CRM.

CO3 : Understand the type of collecting and connecting the customer data with proper guidelines for privacy.

CO4 : Demonstrate the scoring process and apply the various CRM optimization techniques to optimize the CRM process in order to improve customer profitability.

CO5 : Evaluate CRM tools using tool assessment and methodology to choose the appropriate tool for real time applications.

INTRODUCTION

Most profitable Customer - CRM: Custom centered database, Managing campaigns, Evolution of marketing, Closed loop marketing, CRM architecture - Customer profitability - Customer acquisition - Cross selling - Customer retention - Customer segmentation. **(9)**

BUILDING THE BUSINESS CASE

Introduction - Uncovering the needs for data mining - Defining the business value - The costs - Deploying Data mining for CRM: Introduction - Define the problem - Define the user - Define the data - Scope the project - Trial - Quality assurance - Education Launch - Continuation. **(10)**

COLLECTING CUSTOMER DATA

Introduction - Three types of customer data - Collecting customer data - Connecting customer - Customer data and privacy - Privacy and data mining - Guidelines for privacy - Legal issues associated with data mining. **(8)**

SCORING YOUR CUSTOMER

Introduction - Process - Scoring architectures and configurations - Preparing the data - Integrating scoring with other applications- Optimizing the CRM process: Introduction - Improved customer profitability through optimization - Optimized CRM - Complete loop - Optimal CRM process - Optimization techniques. **(8)**

OVERVIEW OF DATA MINING AND CRM TOOL MARKETS

Introduction - Data mining market place - Taxonomy of data mining tools - Tool assessment attributes and methodology - Tool evaluation -Data mining tool: WEKA -CRM tools - Next generation for CRM. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Alex Berson, Stephen Smith, Kurt Thearling, "Building Data mining Applications for CRM", Tata McGraw Hill, Fifteenth Reprint, 2008.*
2. *Ian H.Witten ,Eibe Frank, Mark A.Hall, "Data Mining Practical Machine Learning Tools and Techniques", Morgan Kaufmann, Fourth Edition, 2016*

REFERENCES

1. *Francis Buttle, Stan Maklan "Customer Relationship Management: Concepts and Technologies", Routledge, Fourth Edition, 2019.*
2. *Roger J. Baran, Robert J. Galka, "CRM: The Foundation of Contemporary Marketing Strategy", S.Chand (G/L) & Company Ltd, Second Edition, 2017.*

19CSOE02 - FUNDAMENTALS OF SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the various software life cycle models and choose an appropriate model for a given application.

CO2 : Identify the functional requirements, prepare data flow, ER diagrams and Software Requirement Specifications.

CO3 : Employ suitable architectural styles, software design methodologies, coding standards and practices in developing practical applications

CO4 : Discuss various testing techniques and their application in defect removal.

INTRODUCTION

The Software Engineering Discipline - Software Development Projects - Software Life Cycle Models: Use of Life Cycle Models - Classical Waterfall Model-Iterative Waterfall Model-Prototype model-Evolutionary Model-Spiral Model **(9)**

SOFTWARE REQUIREMENTS AND ANALYSIS

Requirements Analysis and Specification - Requirements Gathering and Analysis- Value of good SRS - Requirement process- Requirement Specification - desirable characteristics, components and Structure of requirements document - Functional Specification with use cases - basics - developing Use Cases -DFDs - Data Dictionary - ER Diagrams. **(8)**

SOFTWARE DESIGN

Design concepts - Cohesion and Coupling- The Open-Closed Principle - Function Oriented Software Design : Structured charts - Structured design methodology - Detailed Design: Logic / Algorithm design - State Modeling of Classes. **(10)**

CODING

Programming principles and guidelines - Structured programming - Information hiding - Some programming practices - Coding standards - Code inspection - Planning- Self review - Group review meeting. **(7)**

TESTING

Testing Fundamentals -Black Box Testing: Equivalence Class Partitioning - Boundary Value Analysis - White box Testing: Control Flow based criteria - Data Flow based Testing - Levels of Testing: Unit Testing - Integration Testing - System Testing - Acceptance Testing. **(11)**

TOTAL : 45

TEXT BOOKS

1. *Pankaj Jalote, "Software Engineering A Precise Approach", Wiley India, Third edition 2012.*
2. *Rajib Mall, "Fundamentals of Software Engineering", PHI Learning Private Limited, Third Edition 2013. (Introduction only)*

REFERENCES

1. *Roger.S.Pressman "Software Engineering A Practitioner's Approach", McGraw Hill International Edition, Seventh Edition, 2014.*
2. *Ian Sommerville, "Software Engineering", Dorling Kindersley (India) Private Ltd., Eighth Edition, 2008*

19CSOE03 - INTERNET PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Gain knowledge in overview of www and web based applications.

CO2 : Design and develop dynamic and Interactive web page using DHTML.

CO3 : Design and develop web applications using servlets.

CO4 : Gain knowledge on E-business models and E-marketing.

BASIC WEB CONCEPTS

Basic Web Concepts - Web based Client/Server model -Web Protocols- Working of web browser - Browser & Server Communication - Review of HTML: Markup Languages, Introduction to HTML- forms - frames - tables. **(9)**

CLIENT SIDE PROGRAMMING

Client-side Programming (Review of JavaScript): Introduction, Writing Comments, Variables, Operators, Statements, Alert, Confirm, and Prompt Boxes, Functions, Event and Error Handling, Introduction to Built-in Classes, Form Validation, Cookies. **(9)**

DYNAMIC HTML

Dynamic HTML :Introduction - cascading style sheets-object model and collections - event model - filters and transition - data binding - data control - ActiveX control - handling of multimedia data. **(9)**

SERVER SIDE PROGRAMMING

Servlets - Deployment of simple servlets - Web server (Java web server / Tomcat / Web logic) - HTTP GET and POST requests - Session tracking - Cookies - JDBC - Simple web applications - Multi-tier applications. **(9)**

WEB BASED APPLICATIONS AND ITS TECHNOLOGIES

Rails: Overview of Rails-Ajax: Overview of Ajax Rails with Ajax- e-Business Models-e-Marketing-online payments-Security. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Deital & Deital, "Internet and World Wide Web-How to Program", Pearson Education Fifth Edition, 2011.*
2. *Robert W.Sebesta, "Programming with World Wide Web", Pearson Education, Eighth Edition, 2015.*

REFERENCES

1. *Scot Johnson, Keith Ballinger, Davis Howard Chapman, "Special Edition Using Active Server Pages", Prentice Hall of India, paperback 1999.*
2. *Ravi Kalakota and Andrew B Whinston, "Frontiers of e-commerce", Addison Wesley, paperback 1999.*
3. *Jeffrey C. Jackson," Web Technologies: A Computer Science Perspective", Pearson Education, Reprint 2011.*
4. *Elliotte Rusty Harold, "Java Network Programming", O'Reilly Publishers, Fourth Edition 2013.*

19CSOE04 - INTRODUCTION TO DATA WAREHOUSING AND DATA MINING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the basic concepts, architecture, data models of database management systems and data warehouse.

CO2 : Demonstrate the multidisciplinary fields of data mining and illustrate the techniques for data preprocessing.

CO3 : Find frequent item set and generate association rules for the given transactions.

CO4 : Analyze different types of data using classification and clustering techniques.

BASIC CONCEPTS OF DATABASE SYSTEM

Purpose of DBMS - Applications - Views of data - Data Abstraction - Instances and Schemas - Data Models - Database Languages - Relational Databases - Database Architecture - Database users and administrators - History of Database systems. **(8)**

DATA MINING

Data Mining - On What Kind of Data-Data Mining Functionalities - Classification of Data Mining Systems - Data Mining Task Primitives - Integration of a Data Mining System with a Database or Data Warehouse System-Major Issues in Data Mining. **(9)**

DATA WAREHOUSING

Data Warehouse - Introduction-Multidimensional Data Model-Data Warehouse Architecture -Data Warehouse Implementation from Data Warehousing to Data Mining. **(8)**

DATA PREPROCESSING AND ASSOCIATION RULES

Data Preprocessing: Needs Preprocessing the Data - Data Cleaning- Data Integration and Transformation-Data Reduction-Discretization and Concept Hierarchy Generation. Association Rules: Basic concepts - Apriori Algorithm - Generation of association rules from frequent item sets - FP Tree Algorithm - Pattern evaluation methods **(10)**

CLUSTERING AND CLASSIFICATION

Cluster analysis - Partitioning Methods - K-Means and K-Medoid algorithm - CLARA - CLARANS - Hierarchical clustering - BIRCH - Density based clustering - DBSCAN - Decision tree induction. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Tata McGraw Hill, Sixth Edition, 2013. (Basic Concepts of Database System only)*
2. *Jiawei Han & Micheline kamber, "Data Mining-Concepts and Techniques" Morgan Kaufmann Publishers, Third Edition, 2012.*

REFERENCES

1. *Arun K Pujari, "Data Mining Techniques" Universities Press India Ltd., Third Edition, 2012.*
2. *Dunham, "Data Mining- Introductory and Advanced Topics", Pearson Education, New Delhi, First Edition, 2006.*
3. *Sam Anahory, Dennis Murray, "Data Warehousing in the Real World ", Pearson Education, Seventh Indian Reprint New Delhi,2003.*
4. *George M. Marakas, "Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, First Edition, 2003*
5. *Paulraj Ponnaiah, "Data Warehousing Fundamentals", Wiley Publishers, Singapore, First Edition, 2001.*

19CSOE05 - INTRODUCTION TO EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Examine the characteristics and challenges in embedded system development

CO2 : Identify the parameters affecting CPU performance and develop optimized code

CO3 : Demonstrate the scheduling of given set of real-time tasks using the appropriate scheduling algorithm

CO4 : Design embedded system for simple applications

INTRODUCTION

Characteristics of embedded computing applications- Challenges in embedded computing design - Performance in embedded computing. Embedded System Design Process - Computer Architecture Taxonomy - ARM Processor -Assembly Language Programming. **(10)**

CPU PERFORMANCE

I/O Primitives - Busy -Wait I/O - Interrupts - Memory System Mechanisms: Cache, Memory Management Unit and Address Translation - Pipelining - CPU Power Consumption **(8)**

DEVELOPMENT AND DEBUGGING

Development environments - Debugging Techniques - Debugging challenges - System Level Performance analysis - Program Level Performance analysis - Program Optimization **(9)**

SCHEDULING

Scheduling states of a Process-Running Periodic Processes - Preemption - Priorities- Rate Monotonic Scheduling - Earliest Deadline First Scheduling - Priority Inversion - Data dependency. **(10)**

NETWORKS

Bus Standards: I2C, CAN Bus, Field Bus. CASE STUDY: Alarm Clock, Elevator Controller. **(8)**

TOTAL : 45

TEXT BOOK

1. *Marilyn Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman, Third Edition, 2012*

REFERENCES

1. *Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education, First Edition, 2009. (For Scheduling)*
2. *David. E. Simon, "An Embedded Software Primer", Pearson Education, First Edition, 2012*
3. *Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill, Third Edition, 2014.*

19ITOE01 - DIGITAL COMPUTER BASICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Explain various schemes of number system representations, code conversions and perform arithmetic operations.

CO2 : Describe Boolean Algebra, formulate and simplify Boolean expressions using K-Maps and illustrate the logic gates realization.

CO3 : Describe the working of basic combinational circuits and sequential circuits.

CO4 : Describe the structure and functioning of various memory schemes.

NUMBER SYSTEMS

Binary Numbers, Number Base Conversions, Octal and Hexadecimal Numbers.

Complements of Numbers - Signed Binary Numbers. Binary Codes : Binary-Coded Decimal (BCD) Code, Gray Code, ASCII Character Code, Error Detecting Code. BCD Addition - Decimal Arithmetic. Binary Storage and Registers. **(9)**

BINARY LOGIC AND BOOLEAN ALGEBRA

Definition of Binary logic. Boolean Algebra - Basic Definitions - Theorems and Properties of Boolean Algebra - Canonical and Standard Forms. Digital Logic Gates : Integrated Circuits. Gate-Level Minimization: Map Method - Four Variable K-Map - Product of Sums Simplification. Realization of Boolean functions using Gates **(9)**

COMBINATIONAL CIRCUITS

Adder : Half Adder - Full Adder - Binary Parallel Adder - BCD Adder. Subtractor : Half Subtractor - Full Subtractor. Code Conversion. Decoders - De-Multiplexer - Encoders - Multiplexers. **(10)**

SEQUENTIAL CIRCUITS

Storage Elements - Latches, Flip Flops - RS, D, JK and T flip -flops- Triggering of flip -flops - Characteristic Tables - Characteristic Equations. Registers - Shift Registers. Counters: Binary ripple counter - Up down binary counter. **(9)**

MEMORY AND PROGRAMMABLE LOGIC

Random Access Memory - Memory Decoding - Read Only Memory - Types of ROMs, Programmable Logic Array, Programmable Array Logic **(8)**

TOTAL : 45

TEXT BOOK

1. *M. Morris Mano and Michael D. Cieti,"Digital Design with an Introduction to the Verilog HDL, Pearson Education, Fifth Edition, 2013.*

REFERENCES

1. *M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, First Edition, 2008.*
2. *Thomas L.Floyd, "Digital Fundamentals", Pearson Education, Tenth Edition, 2011.*

19ITOE02 - PROGRAMMING IN JAVA

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the fundamental aspects of object oriented programming paradigm.

CO2 : Develop java programs using features like methods, classes, constructors, overloading and string handling.

CO3 : Write exception handling routines for practical applications.

CO4 : Describe multithreading, synchronization and networking features of Java.

CO5 : Demonstrate use of applets and database connectivity in developing practical Applications.

OBJECT ORIENTED PROGRAMMING

Introduction to object oriented languages - Evolution of object oriented languages - Object oriented programming paradigm - Basic concepts of object oriented programming - Procedural Vs object oriented programming. **(6)**

INTRODUCTION TO JAVA

Java and Internet - Byte Code - Features of Java - Java Development Environment- Java Programming: Methods and Classes- Constructor - Garbage Collection - Overloading - Inheritance - Overriding - Packages and Interfaces - Java IO systems - String Handling : String and String Buffer. **(12)**

EXCEPTION HANDLING

Exception Handling: Fundamentals of Exception handling and types - Built in Exceptions - User defined Exceptions. **(5)**

MULTI THREADS

Multithreaded Programming: Thread Model -Thread properties -Thread priorities - Synchronization- Inter thread communication- Networking :Inet address- Datagrams - Sockets - URL connections. **(11)**

APPLET AND DATABASE CONNECTIVITY

Introduction to Abstract Window Tool kit - Applet class - HTML applet tags - Parameter passing - Audio clip interface - Event class: Keyboard and Mouse events handling. **(11)**

TOTAL : 45

TEXT BOOK

1. *Herbert Schilt :"Java 2 - Complete references ", Tata McGraw Hill, ftinth Edition, McGraw Hill Education, 2014.*

REFERENCE

1. *Deitel H.M and Deitel P.J, "Java - How to Program", Prentice Hall of India, Ninth Edition, 2012.*

19ITOE03 - FUNDAMENTALS OF DATABASE SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the database system concepts and explain the key features of Relational data models.

CO2 : Describe the features of Entity Relationship diagram and draw Entity Relationship diagram for the given real world application

CO3 : Design a normalized database system and carry out data retrieval using SQL.

CO4 : Demonstrate various transaction concepts and various concurrency control mechanisms

DATABASE SYSTEMS

Data Vs Information-Introducing the database and DBMS- Importance of Database Design- Files and File systems-Problems with File System Data Management, Database Systems. Relational Database Model: Logical view of Data- Keys- Integrity Rules- Relational Set Operators- Data Dictionary and the system catalog -Codd's relational database rules. **(10)**

RELATIONAL MODEL

Entity Relationship Model: Entities-Attributes-Relationship-Connectivity and cardinality- Existence Dependence-Relationship Strength-Weak Entities-Relationship participation- Relationship Degree-Recursive Relationship-Developing an ER Diagram. **(8)**

STRUCTURED QUERY LANGUAGE

Introduction to SQL- Data Definition Commands- Data Manipulation Commands-Advanced Data Definition and SELECT Commands - Virtual Tables -Creating Views- Joining Database Tables. **(8)**

DATABASE DESIGN

Database Tables and Normalization- Need for Normalization- Normalization Process- Improving the Design-Surrogate Key Considerations, High level Normal Forms, Normalization and Database Design-Denormalization. **(10)**

TRANSACTION MANAGEMENT

Transaction Concepts: Transaction Properties- Transaction Concurrent Executions. Concurrency control with Locking Methods: Lock Granularity-Lock Types-Two-Phase Locking to Ensure Serializablity-Deadlocks-Database Recovery Management-RAID. **(9)**

TOTAL : 45

TEXT BOOK

1. *Peter Rob, Coras M.Colonel, "Database Systems: Design, Implementation and Management", Thompson Learning Course Technology, Tenth Edition, 2012.*

REFERENCES

1. *Abraham Silberschatz, Henry F.Korth,S.Sudharshan,"Database System Concepts", McGraw-Hill, Sixth Edition, 2013.*
2. *Ramez Elmasri, Shamkant B. tJavathe, "Fundamentals ofDatabase Systems", Pearson Education, Sixth Edition, 2013.*
3. *Raghu Ramakrishnan, Johannes Gehrke, "Database ManagementSystems", McGraw Hill Education, Third Edition, 2014.*
4. *Thomas M.Connolly and Carolyn E.Begg, "A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2004.*

19ITOE04 - CLOUD COMPUTING FUNDAMENTALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Understanding the client- server, distributed collaborative and cloud computing architecture along with cloud storage and services.

CO2 : Classify the different virtualization environments and techniques.

CO3 : Illustrate various services deployed from a cloud architecture supported by different providers.

CO4 : Analyze the major security challenges and privacy problems in the cloud and virtual environment.

INTRODUCTION

Understanding Cloud Computing- history of cloud computing: Client/Server computing, Peer to peer computing, Distributed computing and Collaborative computing.- Understanding cloud architecture, cloud storage and services-Pros and cons of cloud computing. **(9)**

VIRTUALIZATION

Introduction-Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Technology Examples **(9)**

CLOUD COMPUTING ARCHITECTURE

Cloud reference model: Architecture, Infrastructure / Hardware as a service, Platform as a service-Software as a service, Types of cloud: Public clouds, Private clouds, Hybrid Cloud, Community Clouds. **(9)**

CLOUD SERVICES

Discovering Cloud services Development services and tools: Amazon, Google App Engine, IBM, Salesforce.com, Other Cloud Services development tool **(9)**

CLOUD SECURITY

Security Overview - Cloud SecurityChallenges - Software as a Service Security - Security Governance - Risk Management - Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Michael Miller "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online",1st Edition, Pearson Education, New Delhi, 2009.*
2. *Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013. (Virtualization, Cloud Computing Architecture)*
3. *John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010. (Cloud Security)*

REFERENCES

1. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.*
2. *Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2002.*
3. *Kai Hwang, Geoffrey C Fox,Jack GDongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2002.*

19ITOE05 - INFORMATION SECURITY FUNDAMENTALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Identify and analyze the security threats and attacks and applydevice suitable security policies and standards.

CO2 : Assess the risks and apply suitable risk control strategies.

CO3 : Employ appropriate intrusion detection and prevention systems to ensure information security.

CO4 : Discuss various national and international laws of information security and its framework.

INTRODUCTION, NEED FOR SECURITY

Introduction to Information Security - The History of Information Security- Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing Components - Balancing Information Security and Access - The Systems Development Life Cycle - The Security Systems Development Life Cycle. The Need for Security: Introduction Business Needs First -Threats -Attacks. **(9)**

RISK MANAGEMENT AND INFORMATION SECURITY

Introduction - An Overview of Risk Management - Risk Identification -Risk Assessment - Risk Control Strategies - Selecting a Risk Control Strategy - Risk Management Discussion Points - Recommended Practices in Controlling Risk. **(9)**

POLICIES, STANDARDS, PRACTICES AND BUSINESS CONTINUITY

Introduction - Information Security Policy, Standards and Practices -The Information Security Blueprint: ISO 17799/BS 7799, ISO 27001and itscontrols, NIST SecurityModels, Design of Security Architecture - Security Education, Training and Awareness Program - Continuity Strategies. **(6)**

SECURITY TECHNOLOGY

Introduction - Intrusion Detection and Prevention Systems: IDPS Terminology, Use of IDPS, Strengths and Limitations of IDPS - Honey Pots, Honey Nets, and Padded Cell Systems - Scanning and Analysis Tools, Access Control Devices **(6)**

BIOMETRIC CONTROLS

Biometrics - Nature of Biometrics Identification/Authentication Techniques - Biometric Techniques - Matching and Enrollment Process in Biometrics - Benefits Over Traditional Authentication Methods. **(6)**

SECURITY OF WIRELESS NETWORKS

Attacks on Wireless Networks: Other Security Risks in Wireless Networks, Management and Mitigations for Wireless Networks Attacks. **(7)**

LAWS AND LEGAL FRAMEWORK

Introduction - Information Security and the Law: The Rising Need -Understanding the Laws for Information Security:A Conceptual Framework - The Indian ITAct - Laws for Intellectual Property Rights (IPR) -Health Insurance Portability and Accountability Act (HIPAA) - Building Security into Software/System Development Life Cycle. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Course Technology, New Delhi, Fourth Edition, 2012 Reprint.*

2. *Nina Godbole, "Information Systems Security-Security Management, Metrics, Frameworks and Best Practices", Wiley India Pvt. Ltd., New Delhi, First Edition, 2009.(Biometric Controls, Security of Wireless Networks, Laws and Legal Framework)*

REFERENCES

1. *Thomas R.Pettier, "Information Security Fundamentals", Auerbach Publications, Second Edition, 2013.*
2. *Vicki Krause and Harold F.Tipton, "information Security Management Handbook", Auerbach Publications, Sixth Edition,2008.*
3. *Mark Merkow and Jim Breithaupt,"Information Security - Principles & Practices", Second Edition, Pearson Education, 2014.*

19ITOE06 - INTRODUCTION TO HUMAN COMPUTER INTERACTION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the importance and need for effective user friendly Graphical User Interfaces (GUI).

CO2 : Choose suitable interactions devices/tools to meet application specific requirements.

CO3 : Design Graphical User Interfaces(GUI) using apt components and apply the design guidelines for user-friendly navigation and presentation.

CO4 : Asses graphical user interfaces for compliance against the screen design guidelines.

INTRODUCTION

Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design **(9)**

THE GRAPHICAL USER INTERFACE & DESIGN PROCESS

GUI: Popularity of graphics - The concept of direct manipulation - Graphical system - Characteristics - Web user - Interface Popularity - Characteristics and Principles of User Interface.

Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration - Human Interaction Speeds and Understanding Business Junctions. **(9)**

SCREEN DESIGNING

Design Goals - Screen Planning and Purpose - Organizing Screen Elements - Ordering of Screen Data and Content - Screen Navigation and Flow - Visually Pleasing Composition - Amount of Information - Focus and Emphasis - Presenting Information Simply and Meaningfully - Information retrieval on web - Statistical Analysis - Technological considerations in Interface Design. **(9)**

WINDOWS & COMPONENTS

Windows: New Navigation Schemes - Selection of Window - Selection of DevicesBased on Screen Based Controls. Components: Text and Messages - Icons and Increases - Multimedia - Colors - Uses -Problems - Choosing colors. **(11)**

SOFTWARE TOOLS AND INTERACTION DEVICES

Specification Methods - Interface Building Tools - Keyboard and Function Keys - Pointing Devices Speech Recognition. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.*
2. *Ben Shneidermann, "Designing the User Interface", Fifth edition, Pearson Education Asia, 2013. (Software Tools and Interaction Devices)*

REFERENCE

1. *Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition*

19ITOE07 - ENTERPRISE RESOURCE PLANNING CONCEPTS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1 : Describe the operational aspects of ERP system and its related technologies.

CO2 : Demonstrate the steps required for ERP Project management and implementation process by choosing the right vendors/consultants, employee training and monitoring.

CO3 : Categorize the business modules of an ERP package in order to define the functionality of various departments in a company.

CO4 : Analyze the ERP market place and its vendors, and assess how Enterprise Application Integration (EAI), e-business help the company use ERP to its utmost benefit.

INTRODUCTION

Enterprise - An Overview - Introduction to ERP - Benefits Of ERP - ERP and Related Technologies - Business Process Reengineering (BPR) - Data Warehousing - Data Mining - OLAP--SCM. **(9)**

ERP IMPLEMENTATION

ERP Implementation Lifecycle - Implementation Methodologies - ERP deployment methods - Package Selection - Process Definition - Vendors and Consultants - Contract with Vendors, Consultants and Employees - Training and education- Project Management and Monitoring. **(10)**

THE ERP BUSINESS MODULES

Business modules of an ERP Package - Finance - Manufacturing - Human Resources - Plant Maintenance - Materials Management - Quality Management - Sales and Distribution. **(9)**

THE ERP MARKET & ERP - PRESENT AND FUTURE

ERP Marketplace and Marketplace Dynamics - ERP Vendors - SAP AG, Oracle Corporation, Microsoft Dynamics, EPICOR, QAD, RAMCO Systems - Enterprise Application Integration (EAI)- ERP and E-Business- Future Directions and Trends in ERP. **(9)**

SAP

Gateway to SAP: Architecture of SAP R/3 -SAP Integrated-Three Tier Architecture - SAP Easy Access - Understanding ABAP Workbench **(8)**

TOTAL : 45

TEXT BOOKS

1. *Alexis Leon, "ERP Demystified", Tata McGraw Hill, New Delhi, Third Edition, 2014.*
2. *Dreamtech Press, "SAP R/3, Black Book", Dreamtech Software Team, 2006. (SAP)*

REFERENCES

1. *Ellen F.Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Course Technology Ptr, Fourth Edition, 2011.*
2. *Vinod Kumar Garg and Venkitakrishnan N.K., "Enterprise Resource Planning - Concepts and Practice", Prentice Hall of India, New Delhi, Second Edition, 2012.*

19CHOE01 - INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Practice the safety norms and inspect turning machines, boring machines, milling machine, planning machine, grinding machines, CNC machines and wood working machinery to create risk free working environment.

CO2 : Assess the adequacy of machinery guarding to eliminate or reduce the hazards from the point operation, flying chips and sparks and moving parts.

CO3 : Apply the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes, etc.,

CO4 : Predict, identify and evaluate, hazardous conditions and practices safety rules in in cold forming and hot working of metals

CO5 : Employ the safety rules in inspection and testing process and take plan the preventive measures in health and welfare of workers' aspects in engineering industry.

SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards. **(9)**

PRINCIPLES OF MACHINE GUARDING

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS - guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe - drilling - boring - milling - grinding - shaping - sawing- shearing presses - forge hammer - flywheels - shafts - couplings -gears - sprockets wheels and chains pulleys and belts - authorized entry to hazardous installations-benefits of good guarding systems **(9)**

SAFETY IN WELDING AND GAS CUTTING

Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing - explosive welding, selection, care and maintenance of the associated equipment and instruments - safety in generation, distribution and handling of industrial gases-colour coding - flashback arrestor - leak detection-pipeline safety-storage and handling of gas cylinders. **(9)**

SAFETY IN COLD FORMING AND HOT WORKING OF METALS

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills - hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes. **(9)**

SAFETY IN FINISHING, INSPECTION AND TESTING

Heat treatment operations, electro plating, paint shops, sand and shotblasting, safety in inspection and testing, dynamic balancing, hydrotesting, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal

monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal **(9)**

TOTAL : 45

TEXT BOOKS

1. *Wells G.L.,R.M.C. Seagrave-Flow sheeting for safety, Indian Institute of Chemical Engineering, London U.K,1977.*
2. *TrevurKletz Butterworth, Learning from accidents, - London, 1988.*
3. *John Barton and Richard Rogers, Chemical reaction Hazards - A guide to safety, Institution of Chemical Engineering London, 1997.*
4. *Philip Hagan "Accident Prevention Manual for Business and Industry", N.S.C.Chicago, 13th edition 2009.*

REFERENCES

1. *Rohatgi A.K, Safety handling of Hazardous Chemicals Enterprises, Bombay, 1986.*
2. *Shukla S.K., Envirohazards and Techno Legal aspects, Shashi Publications, Jaipur India, 1993.*
3. *John V.Grimaldi and Rollin H.Simonds," Safety Management", Richard D Irwin, 1994.*
4. *Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.*
5. *"The Indian boilers act 1923 with amendments", Law Publishers (India) Pvt. Ltd., Allahabad.*
6. *"Health and Safety in welding and Allied processes", Welding Institute, UK, High Tech. Publishing Ltd., London, 1989.*
7. *"Safe use of wood working machinery", HSE,UK,2005.*

19CHOE02 - RISK ANALYSIS AND HAZOP

L	T	P	C
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ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Identify individual hazards in a process and deduce the associated risks.

CO2 : Identify radiation intensity and effects of explosion

CO3 : Perform risk analysis of various types of problems

CO4 : Evaluate effect about key hazard identification techniques

CO5 : Apply risk analysis techniques and Hazop study

INTRODUCTION AND DISPERSION MODELS

Risk analysis introduction, quantitative risk assessment, rapid risk analysis - Comprehensive risk analysis - Emission and dispersion - Leak rate calculation. Single and two-phase flow - Dispersion model for dense gas - Flash fire - Plume dispersion - Toxic dispersion model - Ealuation of risk. **(9)**

RADIATION INTENSITY

Radiation - Tank on fire - Flame length - Radiation intensity calculation and its effect on plant, people and property radiation VCVCE - Explosion due to over pressure - Effects of explosion, risk contour -Effects, explosion, BLEVE - Jet fire - Fire ball.**(9)**

RISK ANALYSIS

Overall risk analysis - Generation of meteorological data - Ignition data - Population data - Consequences analysis and total risk analysis - Overall risk contours for different failure scenarios - Disaster management plan - Emergency planning - On site and off site emergency planning, risk management ISO 14000, EMS models case studies - Marketing terminal, gas processing complex, refinery. **(9)**

HAZARD ANALYSIS

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough - Mexico - Madras - Vizag - Bopal analysis **(9)**

CASE STUDIES

Hazop - Guide words, parameters, derivation - Causes - Consequences - Recommendation - Coarse Hazop study - Case studies - Pumping system - Reactor - Mass transfer system. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Ragavan K.V., Khan A.A., Methodologies in Hazard identification and assessment -Manual, CLRI publication, 1990.*
2. *Marcel.V.C., Major Chemical Hazard, Ellis Hawood Ltd., Chi Chester, UK, 1987.*
3. *Skeleton B., Process Safety Analysis, Institution of chemical Engineers, U.K., 1997.*

REFERENCE

1. *Daniel A Crowl., Louvar J.F., Chemical Process Safety: Fundamentals with Applications, Prentice Hall, New Jersey, 2002.*

19CHOE03 - GREEN TECHNOLOGY

L	T	P	C
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ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Outline the green technology concepts and relevance in twenty first century requirements.

CO2 : Defend the environmental and sustainability issues, role of CSR and CER and Indian corporate structure and environment.

CO3 : Recall the indicators of sustainability and their use and can also find the alternate theories.

CO4 : Criticize the environmental reporting, ISO 14001, ISO 14064, financial initative by UNEP, etc.

CO5 : Analyse the green tax incentives and rebates, business redesign and its models.

INTRODUCTION

The concept of green technology; evolution; nature, scope, importance and types; developing a theory; green technology in India; relevance in twenty first century. **(9)**

SUSTAINABILITY & ENVIRONMENT

Organizational environment; internal and external environment; Indian corporate structure and environment; how to go green; spreading the concept in organization; environmental and sustainability issues for the production of high-tech components and materials, life cycle analysis of materials, sustainable production and its role in corporate social responsibility (CSR) and corporate environmental responsibility (CER). **(9)**

ECOSYSTEM APPROACHES

Approaches from ecological economics; indicators of sustainability; ecosystem services and their sustainable use; bio-diversity; Indian perspective; alternate theories **(9)**

ACTS OF GREEN TECHNOLOGY

Environmental reporting and ISO 14001; climate change business and ISO 14064; green financing; financial initiative by UNEP; green energy technology; green product technology. **(9)**

GREEN ECONOMICS

Definition; green techniques and methods; green tax incentives and rebates (to green projects and companies); green project technology in action; business redesign; eco-commerce models. **(9)**

TOTAL : 45

REFERENCES

1. *Green Technology and Green Technologies: Exploring the Causal Relationship by Jazmin Seijas Nogarida, 2008.*
2. *Green Marketing and Technology: A global Perspective by John F. Whaik, 2005.*
3. *The Green Energy Technology Book by Leo A. Meyer.*
4. *Green Project Technology by Richard Maltzman and David Shiden.*
5. *Green Marketing by JacquelinOttman.*
6. *Green and World by Andrew S. Winston.*

19CHOE04 - CORROSION SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Classify the types of corrosion and theories and also relate the various controlled corrosion process.

CO2 : Examine the factors involved in the corrosion and control methods of various corrosion.

CO3 : Analyse the mechanism of corrosion and evaluate the effects like pH, temperature, flow rate on corrosion.

CO4 : Design and develop the corrosion control methods like cathodic protection, sacrificial anode and impressed current anodes and anodic protection.

CO5 : Predict the different corrosion testing, monitoring and inspection tests by surface analytical studies.

INTRODUCTION

Introduction, classification, economics and cost of corrosion. emf series, galvanic series, corrosion theories derivation of potential Current relations of activities controlled and diffusion controlled corrosion process. Potential - pH diagram, Fe-H2O system, application and limitation. Passivation - Definition, anodic passivation theory of passivation, oxidation laws, effects of oxygen and alloying on oxidation rates. **(9)**

CORROSION CONTROL METHODS

Forms of corrosion - Definition, factors and control methods of various forms of corrosion such as pitting, inter granular, crevice, dezincification, stress corrosion, corrosion fatigue, fretting corrosion, hydrogen embitterment, corrosion processes and control methods in fertilizers, petrochemical, chemical building industries **(9)**

MECHANISM OF CORROSION

Environmental aspects, atmospheric corrosion - Classification, factors influencing atmospheric corrosion, temporary corrosion preventive methods, corrosion in immersed condition, effect of dissolved gases, salts, pH, temperature, and flows rates on corrosion, marine corrosion, underground corrosion. Biological corrosion, definition, mechanism of corrosion, control of bio-corrosion. **(9)**

CORROSION PREVENTION

Corrosion control aspects, electrochemical methods of protection-theory of cathodic protection design of cathodic protection, sacrificial anodes, impressed current anodes, anodic protection. Corrosion inhibitors for acidic, neutral and alkaline media, cooling water system - Boiler water system. Organic coating, surface preparation, natural, synthetic resin, paint, formulation and application. Design aspects in corrosion prevention, corrosion resistant materials. **(9)**

CORROSION TEST

Corrosion testing, monitoring and inspection, laboratory corrosion tests, accelerated chemical tests for studying different forms of corrosion. Electrochemical methods of corrosion rate measurements by DC and AC methods, corrosion monitoring methods, chemical and electrochemical removal of corrosion products, newer techniques to study corrosion processes, inspection methods by NDT. Surface analytical techniques such as AES, ESCA, SEM. Evaluation of paints by conventional and electrochemical methods. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Roberge P. R., Corrosion Engineering, McGraw Hill, New York, 2008.*
2. *Fontana M.G., Greene N.D., Corrosion Engineering, Third Edition, McGraw Hill, NewYork, 2005.*
3. *Uhling H. H., Revie R.W., Corrosion and Corrosion Control, John Wiley and Sons, Inc, 1985.*

REFERENCE

1. *Banarjee.S.N., An introduction to corrosion and corrosion inhibitors, Oxonian Press Ltd., New Delhi, 1985.*

19CHOE05 - INTRODUCTION TO CHEMICAL ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Express the fundamentals of chemical engineering and to solve problems.

CO2 : Ability to develop basic fluid concepts, transfer and separation operations.

CO3 : Design equipment for transport and separation processes.

CO4 : Apply material and Energy balance to precisely calculate material required for a process.

CO5 : Apply steady state balances to develop process flow sheets.

OVERVIEW OF CHEMICAL ENGINEERING

Concepts of unit operations and unit processes, and more recent developments, The Chemical Industry-scope, features & characteristics. Flow sheets, and symbols for various operations. **(9)**

MATERIAL AND ENERGY BALANCE CALCULATIONS

Material balances in simple systems involving physical changes and chemical reactions; systems involving recycle, purge, and bypass, combustion reactions, Forms of energy, optimum utilization of energy, Energy balance calculations in simple systems. Introduction to Computer aided calculations-steady state material and energy balances, combustion reactions. **(9)**

BASIC FLUID CONCEPTS

Dimensions and Units, Velocity and Stress Fields, Viscosity and surface tension, Non Newtonian viscosity, Dimensional Analysis (Buckingham PI theorem), Types of flows, Methods of Analysis, Fluid Statics. pipe flow, Pumps, Agitation and Mixing, Compressors. **(9)**

HEAT TRANSFER OPERATIONS

Review of conduction, resistance concept, extended surfaces, lumped capacitance; Introduction to Convection, natural and forced convection, correlations; Radiation; Heat exchangers- Fundamental principles and classification of heat exchangers, Evaporators. **(9)**

MASS TRANSFER OPERATIONS

Fundamental principles and classification of Distillations, Adsorption, Absorption, Drying, Extraction, Membrane Process. Energy and Mass Conservation in process systems and industries. Introduction to chemical reactors. **(9)**

TOTAL : 45

REFERENCES

1. *G.T. Austin, R.N. Shreve, Chemical Process Industries, 5th Ed., McGraw Hill, 1984.*
2. *W.L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 6th Edition, McGraw Hill, 2001.*
3. *R. M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd Ed., John Wiley, New York,2004.*
4. *L.B. Anderson and L.A. Wenzel, Introduction to Chemical Engineering, McGraw Hill, 1961.*
5. *H.S. Fogler, Elements of Chemical Reaction Engineering, 4th Ed., Prentice-Hall, 2006.*

19CHOE06 - NANOMATERIAL SYNTHESIS AND CHARACTERIZATION LABORATORY

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : To synthesize several nanomaterials in different methods in lab scale.

CO2 : To understand and operate the instruments for material characterization.

CO3 : To interpret the properties of synthesized nanomaterials by analyzing the results

EXPERIMENTS

1. Chemical synthesis of Ag nanoparticles; UV-Visible absorption of the colloidal sol.
2. Chemical synthesis of CdS nanoparticles; Optical absorption spectra; Band gap estimation from the band edge.
3. Synthesis of ceria nanofibres by Solvothermal method.
4. Synthesis of silica nanoparticles using Stober method.
5. Synthesis of Au nanoparticles by simple chemical method.
6. Synthesis of Fe_3O_4 nanoparticles by simple reduction method.
7. Effect of reducing agent on the synthesis of metal nanoparticles.
8. Aqueous to organic phase transfer of Ag and CdS nanoparticles; Confirmation by UV-Visible absorption.
9. Effect of concentration on the synthesis of silver nanoparticles.
10. Effect of reducing agent on gold nanoparticles.
11. Fabrication of silver nanofilms.
12. Synthesis of polyvinyl alcohol fibres by electrospinning method.
13. Synthesis of Au and Ag nanoparticles at aqueous-organic liquid interface; UV-visible spectroscopy of the colloidal film; comparison with the corresponding colloidal sol.
14. Sol gel synthesis of $ZnO/TiO_2/CdO$ nanoparticles.
15. A bioroute to Au nanoparticles.
16. Sol-gel spin coating route to SnO_2 nanothin films: surface roughness measurement by AFM.
17. Hydrothermal synthesis of ZnS Nanorods: Nanorods formation by SEM analysis.
18. Fabrication and wettability characterization of nanostructured soft polymer surfaces.
19. Preparation of nanofluids.
20. Determination of viscosity of nanofluids.
21. Evaporation studies of nanofluids.
22. Measurement of stability of nanofluids.
23. Optical properties of nanofluids.
24. Measurement of onset of natural convection in nanofluids.
25. Thermal conductivity measurement of nanofluids.

TOTAL : 60

REFERENCES

1. *Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, Nanofluids: Science and Technology, Wiley, 2007.*
2. *Vincenzo Bianco, Oronzio Manca, Sergio Nardini, Kambiz Vafai, Heat Transfer Enhancement with Nanofluids, CRC Press, 2017.*
3. *Amy S., Thermal Energy Storage Using Phase Change Materials: Fundamentals and Applications Fleischer, Springer, 2015.*
4. *Mohsen Sheikholeslami and Davood Domairry Ganji, Applications of Nanofluid for Heat Transfer Enhancement, Elsevier, 2017.*
5. *S.M. Sohel Murshed, Carlos Nieto de Castro, Nanofluids: Synthesis, Properties and Applications, Nova Science Publishers, 2014.*
6. *T. Pradeep, A Textbook of Nanoscience and Nanotechnology. Tata McGraw-Hill Education, 2003.*
7. *P.R. Chandran, M. Naseer, N. Udupa, N. Sandhyarani. Size controlled synthesis of biocompatible gold nanoparticles and their activity in the oxidation of NADH. Nanotechnology. 8, 23(1), 2011.*
8. *I.A. Ibrahim, A.A. Zikry, M.A. Sharaf. Preparation of spherical silica nanoparticles: Stober silica. J. Am. Sci. 6(11), 985-9, 2010.*
9. *X. Chen, S.S. Mao. Titanium dioxide nanomaterials: synthesis, properties, modifications, and applications. Chemical reviews. 11, 107(7), 2891-959, 2007.*
10. *Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, Nanofluids: Science and Technology, Wiley, 2007.*

19CHOE07 - MULTIVARIATE STATISTICS LABORATORY

L	T	P	C
0	0	6	3

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

After completion of the course, students are able to

CO1 : Design experiments to obtain statistical principles of Univariate examples.

CO2 : Apply the concepts of statistics to draw conclusions from data

CO3 : Assess practical knowledge to carry out meaningful interpretation of data from real life

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

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

LIST OF EXPERIMENTS

1. Point and Interval Estimation for Normal and Chi-Square Distribution using Excel and R.
2. Point and Interval Estimation for T-Distribution and F-Distribution using Excel and R.
3. K-means Clustering.
4. One-way ANOVA Model in Excel and R.
5. Linear Regression
6. Logistic Regression
7. Naive Bayesian Classifier
8. Decision Trees
9. Simulation of Principal component analysis using Excel and R.
10. Simulation of Fischer Discriminant Analysis using Excel and R.
11. Modeling the Change by Differential Equations using R and Excel.
12. Modeling the Change by Difference Equations using R and Excel.
13. Multivariate Normal & Hoteling's T2 Distribution.
14. Multivariate Analysis of Variance (MANOVA).
15. Correspondence Analysis using R.

TOTAL : 60

REFERENCES

1. *Apostol T.M. (1985) Mathematical Analysis, Narosa,Indian Ed.*
2. *Courant R. And John F. (1965) Introduction to Calculas and Analysis, Wiley.*
3. *Miller K.S. (1957) Advanced Real Calculas, Harper, New York.*
4. *Rudin, Walter (1976) Principles of Mathematical Analysis,McGraw Hill.*
5. *Malik S.C. (2005) Principles of Real Analysis, New Age International (p)Ltd.*
6. *Bartle R.G. (1976) Elements of Real Analysis*

19MOE01 - GRAPH THEORY AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the idea of graph theory and to solve the real time problem.

CO2 : To relate the Graph theory Algorithms' in their field of engineering and apply the same in the irrespective mainstream.

CO3 : To become familiar with Special graphs for modeling the networks.

CO4 : Able to design and solve Coloring concepts for defined problems.

CO5 : Model the networks using graph theory.

GRAPHS ANDSUB GRAPHS

Graph-Standard Concepts in Graphs - Sub graphs - Complete Graph - Bipartite Graph - Isomorphism - Adjacency Matrix and Incidence Matrix-Walk, Trail and Path - Bipartite Graph - Connectedness - The Shortest Path Problem - Dijkstra's Algorithm **(9)**

TREES

Trees- Characterization - Blocks - Block Graphs - Cayley's Formula - Spanning Trees - Spanning Tree Algorithms - Kruskal's and Prim's Algorithm **(9)**

EULERIAN AND HAMILTONIAN GRAPHS

Eulerian graphs - Euler's theorem - Hamiltonian graphs - Dirac's and Ore's theorems - Closure of a graph - Bondy -Chvatal theorem - Traveling salesman problem - The Chinese Postman Problem - Fleury's Algorithm. **(9)**

COVERING AND COLORING

Covering - Independent Sets - Matching - Perfect Matching- Applications - The Personal Assignment Problem - Coloring - Chromatic Number - Four Color Problem - Chromatic Polynomials - Application. **(9)**

DIRECTED GRAPHS

Digraph - orientation - strongly, weakly and unilaterally connected digraphs - directed acyclic graph - adjacency matrix and incidence matrix of graph - Network Flows - Transport Networks - Max - Flow Min-Cut Theorem - Activity Network **(9)**

TOTAL : 45

TEXT BOOKS

1. *Gary Chatrand and Ping Zhang, Introduction to Graph Theory, Mc Graw Hill Education (India), 2017.*
2. *Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India Private Limited, 2004.*

REFERENCES

1. *Douglas B.West, "Introduction to Graph Theory" Second Edition, Prentice Hall of India Private Limited, 2001.*
2. *Balakrishnan. R, Ranganathan. K , "A Text book of GraphTheory", Second Edition, Springer Newyork, 2012.*
3. *Clark. J. and Holton. D.A, "A First Look at GraphTheory", Allied Publishers,1995.*
4. *Frank Harary, Graph Theory, 10th Edition, Narosa Publishing House, 2001.*

19MOE02 - METHODS OF APPLIED MATHEMATICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the idea of integral equations and to solve the real time problems.

CO2 : To familiarize the students with basic concept of ordinary differential equations, special functions and solve problems associated with engineering applications.

CO3 : To achieve an understanding of the basic concepts of boundary value problems and characteristic function representations and method of solving them.

CO4 : Able to construct and solve a mathematical model for heat flow problems in real life situation

CO5 : Able to use the concepts of Calculus of variations and basic concepts for solving equations involving functional

INTEGRAL EQUATIONS

Relation between integral and differential equations - Green's function. Fredholum's equation with separable Kernals Hilbert Schmidt theory, interactive methods for solving equations of second kind. **(9)**

SECOND ORDER ORDINARY DIFFERENTITAL EQUATIONS AND SPECIAL FUNCTIONS

Singular points, Series solutions and the methods of Frobenius, Bessel Equation, Bessel Functions, modified Bessel functions and their properties, Ber and Bei functions. **(9)**

BOUNDARY PROBLEMS AND CHARACTERISTIC FUNCTION REPRESENTATIONS

Sturm - Liouviller problems. Orthogonal functions and expansions in series of Orthogonal functions. Stodola and Vianello method for Sturm - Liouviller problems, Fourier - Bessel and Legendre Series **(9)**

PARTIAL DIFFERENTITAL EQUATIONS

Linear and quasi - linear equations of the first and second order. Characteristics of first and second order linear equations. Heat flow equations. Problems in one, two and three dimensions - Fourier method. **(9)**

INTEGRAL TRANSFORM METHODS

Calculus of variations - Variational notation, Constraints and Lagarangian multipliers, variable and points, Rayleigh - Ritz method. **(9)**

TOTAL : 45

TEXT BOOKS

1. *M.K. Venkatraman, Higher Mathematics for Engineering and Science, Third Edition, The National Publishing Company, 2014.*
2. *F.B. Hildebrand: Advanced Calculus for applications second Edition (EEE).Prentice Hall of India P.Ltd., 2014.*

REFERENCES

1. *F.B. Hildebrand - Methods of Applied Mathematics, Second Edition. Prentice Hall of India P.Ltd., 2012.*
2. *David Borthwick : An introduction to partial differential equation Springer International Publishing 2017.*
3. *Mattias Blennow: Mathematical methods in Physics and Engineering, CRC Press, 2018.*

19MOE03 - LINEAR AND NON - LINEAR PROGRAMMING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the idea of linear Programming problems and to solve the real time problems.

CO2 : To familiarize the students with basic concept of Transportation models and solve problems associated with engineering applications.

CO3 : To achieve an understanding of the basic concepts of Assignment problems and method of solving them.

CO4 : Able to construct and solve a Game theory models in real life situation

CO5 : Able to use the concepts of Non-linear Programming problems for solving Constrained and unconstrained equations.

LINEAR PROGRAMMING

Formulation of LPP - Graphical methods for two variables - The Simplex method - Artificial Variables Techniques - Big M - method - The Two Phase method - Dual Simplex Method **(9)**

TRANSPORTATION MODEL

Mathematical formulation of a Transportation problem - Methods for finding initial basic feasible solution - North West corner rule - Least cost method - Vogel's Approximation method - Modified distribution method - Degeneracy in Transportation problems. **(9)**

ASSIGNMENT PROBLEM

Mathematical formulation of an Assignment problem - Hungarian Method - Unbalanced Assignment Models -Maximization case in Assignment Problems - Restrictions in Assignments - Travelling Sales man Problem. **(9)**

GAME THEORY

Two person zero - sum Games - The Maxmini - Minimax Principle - Saddle Point and value of the game -Games without saddle points, Mixed Strategies - Matrix Oddment method for n×n games - Dominance Property - Graphical Method of 2×n or m×2 games. **(9)**

NON - LINEAR PROGRAMMING

Non - linear Programming Algorithm - Unconstrained Non - linear Algorithms - Constrained Non -linear Lagrange multipliers, Kuhn - Tucker optimality conditions. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Operations Research An Introduction, Eight Edition, Hamdy A .TAHA, Pearson Prentice Hall 2016, New Delhi.*
2. *Resource management techniques by V.Sundaresan, Tenth Edition, 2016, A.R Publications, Chennai.*

REFERENCES

1. *Kanti Swarup, P.K. Gupta and Man Mohan, " Operations Research", Sultan Chand & Sons, Educational publishers, New Delhi. 20th Edition, 2019.*
2. *Frederick S. Hillier, Gerald J. Lieberman, "Introduction to Operations Research", Mc Graw Hill, (India) Private Limited, India, 11th Edition, 2021.*

19MOE04 - PROBABILITY AND RANDOM PROCESSES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to understand the basic probability problems and to solve the real time problems.

CO2 : To familiarize the students with basic concept of probability distributions and solve problems associated with engineering applications.

CO3 : To achieve an understanding of the basic concepts of Correlation and regression and method of solving them.

CO4 : Able to solve a signal processing problems by using random process concepts.

CO5 : Able to use the concepts of Correlation functions and Power spectral densities for solving Electrical and electronics problem.

THEORY OF PROBABILITY

Sample Space, Events, Axioms of probability, Conditional probability, Independent events, Theorem of total probability, Baye's Theorem. **(9)**

PROBABILITY DISTRIBUTIONS

Definition of Discrete and Continuous random Variables

Discrete distributions : Binomial, Poisson and Geometric - Properties and Simple problems

Continuous distributions : Normal, Uniform Exponential - Properties and Simple problems. **(9)**

CORRELATION AND REGRESSION

Correlation -Meaning and scope of Correlation - Scatter diagram, Karl Pearson's co-efficient of Correlation, Spearman's Rank Correlation, Multiple Correlation and partial correlation - simple problems.

Regression Analysis - Meaning and Scope of regression - Regression in two variables - Uses of Regression. **(9)**

RANDOM PROCESSES

Classification - Stationary process - Markov process - Poisson process - Random telegraph process. **(9)**

CORRELATION FUNCTIONS AND POWER SPECTRAL DENSITIES

Auto Correlation functions - Cross Correlation functions - Properties - Power spectral density - Cross spectral density - Properties. **(9)**

TOTAL : 45

TEXT BOOKS

1. *S.C. Gupta and V.K. Kapoor, Fundamental of Mathematical Statistics, Tenth Revised Edition, 2020.*
2. *T. Veerarajan, Probability, Statistics and Random Processes, Second Edition, Tata Mc Graw - Hill 2017.*

REFERENCS

1. *Robert Hogg & Joseph McKean: Introduction to Mathematical Statistics, Pearson 8th Edition 2018.*
2. *Bhat, B. R.: Modern Probability Theory - An Introductory Text Book, Third Edition, New Age International 2015.*

3. *Cochran,W.G: Sampling Techniques, Wiley Eastern Private Limited, 2007.*
4. *Sukhatme, P.V. and Sukhatme, B.V.(1977) : Sampling Theory of Survey with Applications, Asia publishing House.*
5. *Rakesh Dube, "Higher mathematics for Engineering and Science" Manakin Press, 2018.*
6. *Ibe,O.C.,"Fundamentals of Applied Probability and Random processes", 2nd Edition, Elsevier, 2019.*
7. *Peyton Peebles, "Probability Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, NewDelhi, 2017.*

19POE01 - INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology.

CO2 : Understand the different classes of nanomaterials.

CO3 : Identify the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

CO4 : Outline the applications of nanotechnology and develop an ability to critically evaluate the promise of a nanotechnology device.

BASICS OF NANOTECHNOLOGY

Introduction - Time and length scale in structures - Definition of a nanosystem - Dimensionality and size dependent phenomena - Surface to volume ratio - Fraction of surface atoms - Surface energy and surface stress- surface defects - Effect of nanoscale on various properties - Structual, thermal, mechanical, magnetic, optical and electronic properties. **(9)**

DIFFERENT CLASSES OF NANOMATERIALS

Classification based on dimensionality - Quantum Dots, Wells and Wires - Carbon based nano materials (buckyballs, nanotubes, graphene) - Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites - Nanopolymers - Nano ceramics - Biological nanomaterials. **(9)**

SYNTHESIS OF NANOMATERIALS

Chemical Methods: Metal Nanocrystals by Reduction - Sol - gel processing - Solvothermal Synthesis - Photochemical Synthesis - Chemical Vapor Deposition (CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE). **(9)**

CHARACTERIZATION OF NANOSTRUCTURES

Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX) - Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM) - Atomic force microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman spectroscopy - X-ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy(AES). **(9)**

APPLICATIONS

Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics - Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices - Nanomaterials for data storage - Photonics, Plasmonics - Chemical and biosensors - Nanomedicine and Nanobiotechnology. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Nano technology: Basic Science and Emerging technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)*
2. *A Text book of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw Hill Education Pvt. Ltd., 2012.*
3. *Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, 2002.*
4. *Introduction to Nanotechnology, Charles P.Poole,Frank J.Owens, Wiley Interscience (2003)*

5. *Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, Springer Science & Business Media, 2013.*

REFERENCES

1. *Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)*
2. *Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994*
3. *Dupas C., Houdy P., Lahmani M.,Nanoscience: Nanotechnologies and Nanophysics, Springer-Verlag Berlin Heidelberg, 2007*

19POE02 - PHYSICS AND TECHNOLOGY OF THIN FILMS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Recognize the fundamental growth and material parameters of thin films.

CO2 : Evaluate and use models for nucleation and growth of thin films.

CO3 : Asses the relation between deposition technique, film structure and film properties.

CO4 : Identify modern techniques for the characterization of thin films

CO5 : Demonstrate the applications of thin films

Preparation of thin films : Preparation methods: electrolytic deposition, cathodic and anodic films, thermal evaporation, cathodic sputtering, chemical vapour deposition. Molecular beam epitaxy and laser abalation methods. Thickness measurement and monitoring: electrical, mechanical, optical interference, microbalance, quartz crystal methods. **(9)**

Growth Kinetics of Thin Films : General features.- nucleation theories - energy formation of a nucleus - critical nucleation parameters; spherical and non spherical (cap, disc and cubic shaped) Effect of electron bombardment on film structure. Post-nucleation growth, epitaxial films and growth. **(9)**

Analytical techniques of characterization : X-ray diffraction - Photoluminescence - UV-Vis-IR spectrophotometer - Atomic Force Microscope - Scanning Electron Microscope - Hall effect - Vibrational Sample Magnetometer - Secondary Ion Mass Spectrometry - X-ray Photoemission Spectroscopy - Auger emission spectroscopy. **(9)**

Properties of Thin films : Dielectric properties - experimental technique for the determination of dielectric properties - optical properties - experimental technique for the determination of optical constants - mechanical properties - experimental technique for the determination of mechanical properties of thin films - magnetic and superconducting properties. **(9)**

Applications : Optoelectronic devices : LED, LASER and Solar cell - Micro Electromechanical Systems (MEMS) - Fabrication of thin film capacitor - application of ferromagnetic thin films; data storage, Giant Magnetoresistance (GMR) - sensors - fabrication and characterization of thin film transistor and FET. **(9)**

TOTAL : 45

TEXT BOOKS

1. *A. Goswami, Thin Film Fundamentals, New Age international (P) Ltd. Publishers, New Delhi, 2006.*
2. *L.I. Maissel and Glang (Eds.), Handbook of Thin film Technology, McGraw-Hill, 1970.*
3. *K.L. Chopra, Thin Film Phenomena, McGraw-Hill (1983)*

REFERENCES

1. *Thin-Film Deposition : Principles and Practice, Smith Donald Donald L Smith Smith, McGraw-Hill Professional Pub, 1995*
2. *J.C. Anderson, The Use of Thin Films in Physical Investigation, Academic Press 1966.*
3. *J.J. Coutts, Active and Passive Thin Film Devices, Academic Press 1978.*
4. *George Hass, Physics of Thin Films: Volumes 1.:12, Academic Press 1963.*
5. *Kiyotaka Wasa, Makoto Kitabatake, Hideaki Adachi, Thin Films Material Technology, Springer-Verlag Berlin Heidelberg, 2004.*

19POE03 - SOLAR CELL FUNDAMENTALS AND MATERIALS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Demonstrate the knowledge about photovoltaics.

CO2 : Gain knowledge about principle of operation of solar cells

CO3 : Realization about semiconducting materials used in the manufacture of PV cells

CO4 : Outline the various advanced solar cell technologies, their current status and future technological challenges

EVOLUTION OF SOLAR CELLS

Historical development; present and future global issues- commercialization/economic factors- basic components of PV systems - The solar spectrum - terrestrial and space spectra; air mass (AM0, AM1.5) - Introduction to 1st, 2nd and 3rd generation photovoltaics. **(9)**

SOLAR CELL FUNDAMENTALS

Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell - light absorption- creating charge carriers forming the electric field - driving the charge carriers - solar cell parameters- electrical characteristics - the ideal solar cell, solar cell in practice, the quantum efficiency and spectral response, optical properties - basics of solar cell device design. **(9)**

SEMICONDUCTOR PROPERTIES

Overview of semiconductor properties relevant to solar cell operations- semiconductor band structure, carrier statistics in semiconductors, the transport equations, carrier mobility, carrier generation by optical absorption - band to band transitions, free-carrier absorption, recombination- bulk recombination processes, surface recombination, minority carrier life time. **(9)**

SILICON AND THIN FILM SOLAR CELLS

Si photovoltaics - single crystal silicon cells - semicrystalline and polycrystalline silicon cells - overview of various thin film solar cells: gallium arsenide solar cells - fabrication techniques, InP & cadmium telluride based solar cells - copper indium diselenide solar cells - multijunction cells - environmental and health aspects. **(9)**

ADVANCED SOLAR CELLS

Advanced solar cell concepts - organic (polymer) photovoltaics - new concepts - quantum dots, wires, intermediate band, multiple exciton generation - Dye sensitized solar cells - perovskite solar cells - challenges in materials and device design - current and future research trends in PV. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Fonash S. J., "Solar Cell Device Physics", Academic, 2010.*
2. *Goetzberger, J. Knobloch, and B. Voss "Crystalline Silicon Solar Cells" Wiley, 1998.*
3. *Green M. A. "Third Generation Photovoltaics: Advanced Solar Energy Conversion" Springer, 2006 .*

REFERENCES

1. *Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", PHI Learning Pvt. Ltd., 2009.*
2. *Jha A.R., "Solar Cell Technology and Applications", CRC Press, 2010.*

19POE04 - ADVANCED MATERIAL PROCESSING TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

After completing the course successfully, the students will be able to,

CO1 : Recognize the criteria for material selection based on properties of materials and to choose the required material for a specified application.

CO2 : Understand various metallurgical forming processes such as casting, rolling extrusion, drawing, development of grain structure and processing of different composite types.

CO3 : Demonstrate knowledge about powder metallurgy, ceramic and polymer processing methods.

CO4 : Identify and choose the required surface treatment technique for coating formation on account of enhancing the surface properties of the mechanical components for engineering applications.

CO5 : Understand the applicable joining and machining techniques and their limitations

INTRODUCTION AND SELECTION OF MATERIALS

Motivation for selection - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability, corrosion and wear resistance - Relationship between materials selection and processing - Case studies - aero, auto, marine, machinery and nuclear applications. High and low temperature materials, superconductors, supramagnetic materials, high entropy alloys, nanomaterials and biomaterials. **(9)**

METALLURGICAL FORMING AND PROCESSING OF COMPOSITES

Metallurgical forming: Casting, rolling extrusion, drawing, development of grain structure for specific properties. Processing of composites: lay up methods, press/ autoclave / resin transfer moulding, Reinforced Reaction Injection Molding (RRIM), obtrusion and filament winding. **(9)**

POWDER METALLURGY, CERAMIC AND POLYMER PROCESSING

Powder metallurgy and ceramic processing: green fabrication methods, sintering, hot pressing, Hot Isostatic Pressing (HIP), spark plasma sintering, development of microstructure in powder processed materials. Polymer processing: extrusion, injection moulding, blow moulding, rotational moulding, vacuum forming and related processes processing of cellular polymers. **(9)**

COATING METHODS

Introduction to surface Engineering, Differences between surface and bulk properties, Properties of surfaces-wear, wettability. Chemical vapour deposition, physical vapour deposition, electro deposition, electroless deposition, thermal spray processes. Principle of various coating processes, process parameters, controlling the yield of coating and various surface properties of the coating. Criteria for selection of a surface coating technology. Product oriented surface coating technology. **(10)**

JOINING AND MACHINING

Joining: fusion welding, solid state welding, adhesive bonding, mechanical joining and recent advancements in welding. machining: Electromachining (electrochemical and electro-discharge), mechanical machining and recent advancements. **(8)**

TOTAL : 45

TEXT BOOKS

1. *Charles J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials", 3rd Edition, Butterworth-Heinemann, 1977.*
2. *Betzalel Avitzu, "Metal Forming- Processes and Analysis", Tata McGraw Hill, 1977.*

3. *William F Hasford, Robert M Caddell "Metal Forming: Mechanics and Metallurgy" Cambridge University Press P. ltd, 2007.*
4. *Angelo P C and Subramanian R" Powder Metallurgy Science, Technology and Applications", Prentice Hall of India, New Delhi, 2012.*

REFERENCES

1. *Michael Barsoum, "Fundamentals of Ceramics", Mc Graw Hill Publishing Co., INC, 1997*
2. *Gowariker V R, Viswanathan N V, Jayadev Sreedhar, "Polymer Science", New Age International P Ltd., 2005.*
3. *David S. Rickerby, Allan Matthews "Advanced surface coatings: a handbook of surface engineering", Blackie, 1991.*
4. *Parmar, R.S, "Welding Engineering and Technology", Khanna Publishers, 2003.*

19COE01 - MEDICAL NANO TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

The students will be able to

CO1 : Understand the essential features of nanomedicine

CO2 : Identify the medical based nanotools

CO3 : Assess health effects due to nanoparticle exposure

ASSESSING NANOTECHNOLOGY HEALTH

Nanomaterials : The Current State of Nanotechnology Application - Nanotechnology Risks - Risk Analysis - Hazard Identification - Exposure Assessment for Nanomaterials - Risk Characterization - Risk Management - Best Practices for Nanomaterials in the Workplace - Safety Research - Needs for Engineered Nanoscale Materials **(9)**

RISK ASSESSMENT AND ENVIRONMENTAL PROTECTION

Context for Technological Risk - Need for Risk Assessment for Nanotechnology - Adaptive Risk Assessment for Nanomaterials - Origins and Development of Risk Assessment - Risk Assessment Used in Environmental Decision Making - Issues in Applying the Four Steps of Risk Assessment to Nanotechnology - Hazard Assessment - Exposure Assessment - Dose - Response Evaluation **(9)**

SUSTAINABLE NANOTECHNOLOGY DEVELOPMENT

Necessity of Risk Assessment in Nanotechnology - The Pace of Nanotechnology Development and the Paucity of Information - Potential for Wide Dispersion in the Environment Amid Uncertainty - Few Standards or Guidelines - Environmental Risk Issues - Carbon Nanotubes - Defining the Toxic Dose - Environmentally Friendly Nanotechnology - Life Cycle Analysis for Sustainable Nanotechnology **(9)**

HUMAN HEALTH, TOXICOLOGY, AND NANOTECHNOLOGY RISK

Mechanisms of Toxicity - Types of Toxicological Studies - Pulmonary Toxicity Studies - Gastro intestinal Toxicity - In Vitro Studies - Dermal - In Vitro Toxicity Studies **(4)**

ENVIRONMENTAL RISKS

Antimicrobial Properties of Nanoscale Silver - Buckyballs, Titanium Dioxide - Short-term Toxicity Tests - Daphnia LC50 Assays - Studies of Nanomaterial Toxicity to Fish - Buckyballs and Bass-TiO_2 in Arsenic - Field Studies - Environmental Exposures - Nanoscale Zerovalent Iron **(9)**

NANOELECTRONIC DEVICES

Resonant tunneling diodes - Field effect transistors - Single electron transfer devices - Potential effect transistors - Light emitting diodes and lasers - Nanoelectromechanical system devices - Quantum dot cellular automata **(5)**

TOTAL : 45

TEXT BOOKS

1. *George W. Hanson, "Fundamentals of Nanoelectronics", Prentice Hall, 2007*
2. *Vladimir V. Mithin et.al, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications" Cambridge University Press, 2012*

REFERENCES

1. *Mithin.V, Kochelap.V and Stroscio.M, "Introduction to Nanoelectronics", Cambridge University Press, 2008*
2. *Karl Gosar et.al, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices", Springer, 2005.*

19COE02 - ADVANCED DRUG DELIVERY SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will be able to know the fundamentals of Nanoscience and their applications in pharamacological industries

CO2 : The students will able to describe polymeric drug delivery systems and their encapsulation methodology to study targeted drug delivery with different polymeric systems

CO3 : The students will able to identify lipids-nanocarriers and their application in biological system

CO4 : The students will able to study site specific drug delivery for gene therapy

THEORY OF ADVANCED DRUG DELIVERY

Fundamentals of Nanocarriers - Size, Surface, Magnetic and Optical Properties, Pharmacokinetics and Pharmacodynamics of Nano drug carriers. Critical Factors in drug delivery. Transport of Nanoparticles - In Vitro and Ex Vivo Models. **(10)**

POLYMERS Dendrimers- Synthesis -Nanoscale containers- Dendritic Nanoscafold systems Biocompatibility of Dendrimers, Gene transfection. pH based targeted delivery- chitosan and alginate. Copolymers in targeted drug delivery- PCL,PLA, PLGA. **(8)**

LIPID BASED NANOCARRIERS

Liposomes, niosomes and solid lipid nanoparticles. Ligand based delivery by liposomes. Cubosomes. **(9)**

MICROBES AND ANTIBODY BASED NANOCARRIERS

Bacterial dependent delivery of vaccines. Drug delivery and subcellular targeting by virus, Drug packaging and drug loading. Delivery of therapeutics by antibodies and antibodybioconjugates. **(9)**

SITE SPECIFIC DRUG DELIVERY

Concepts and mechanism of Site specific drug delivery- Microneedles, Micropumps, microvalves. Implantable microchips. **(9)**

TOTAL : 45

REFERENCES

1. *Drug Delivery: Engineering Principles for Drug Therapy, M. Salzman, Oxford University Press, 2001.*
2. *Drug Delivery and Targeting, A.M. Hillery, CRC Press, 2002.*
3. *Drug Delivery: Principles and Applications, B. Wang, Wiley Intersceince, 2005.*
4. *Nanoparticle Technology for Drug Delivery, Ram B. Gupta, Uday B. Kompella Taylor & Francis, 2006.*

19COE03 - BIOSENSORS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

CO1 : The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing

CO2 : The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products

CO3 : The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors

CO4 : The students will able to study about the fabrication of biosensors and its application as nanochip analyzer

PROTEIN BASED BIOSENSORS

Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporous silica - Protein based nano crystalline Diamond thin film for processing **(9)**

DNA BASED BIOSENSOR

Heavy metal complexing with DNA and its determination, water and food samples - DNA zymo biosensors **(9)**

ELECTRO CHEMICAL APPLICATION

Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors **(9)**

FABRICATION OF BIOSENSORS

Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis **(9)**

BIOSENSORS IN RESEARCH

Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design - Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors **(9)**

TOTAL : 45

REFERENCES

1. *Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004*
2. *Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007*
3. *Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.*

19COE04 - NANOCOMPOSITES

L	T	P	C
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

REFERENCES

1. *Nanocomposites Science and Technology - P. M. Ajayan, L.S. Schadler, P. V. Braun 2006.*
2. *Physical Properties of Carbon Nanotubes- R. Saito 1998.*
3. *Carbon Nanotubes (Carbon, Vol 33) - M. Endo, S. Iijima, M.S. Dresselhaus 1997.*
4. *The search for novel, superhard materials- Stan Veprek (Review Article) JVST A, 1999*
5. *Electromagnetic and magnetic properties of multi component metal oxides, hetero*
6. *Nanometer versus micrometer-sized particles-Christian Brosseau,Jamal Ben, Youssef, Philippe Talbot, Anne-Marie Konn, (Review Article) J. Appl. Phys, Vol 93, 2003*
7. *Diblock Copolymer, - Aviram (Review Article), Nature, 2002*

19COE05 - BIOREFINERY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

The students will be able to

CO1 : Understand various renewable feedstocks for biofuels production

CO2 : Understand the broad concept of second and third generation biofuel products from biomass and other low-cost agri-residues and biowastes.

CO3 : Analyze the design processes for biofuel production

CHEMISTRY & BIOCHEMISTRY OF BIOMASS

Types of biomass (e.g. wood waste, forestry residues, agricultural residues, perennial annual crops, organic municipal solid waste). Composition of lignocellulose (lignin, hemicellulose, cellulose); energy crops; chemical pretreatment; enzymatic pretreatment; degradation of cellulose; trichoderma cellulases; bacterial cellulases; and comparison with degradation of high starch. **(9)**

BIODIESEL

Sources and processing of biodiesel, nature of lipids, fatty acids and triglycerides.Sources and characteristics of lipids for use as biodiesel feedstock; and conversion of feedstock into biodiesel, (transesterification). Use of vegetable oil (SVO) and waste vegetable oil (WVO). Environmental issues of biodiesel; major policies and regulations pertaining to the production, distribution, and use of biodiesel. **(9)**

BIOMETHANE OR BIOGAS

Hydrolysis; anaerobic digestion; methanogenesis (acetoclastic, hydrogenotrophic), rates of methane formation; and one and two stage fermentation.Thermal depolymerization.Use of exhaust gases (e.g. CO_2, H_2S and H_2) from geothermal power plants and industrial operations (e.g. coal and oil refineries) as an energy sources (methane and hydrogen) **(9)**

GASIFICATION & PYROLYSIS TECHNOLOGIES

Gasification processes and the main types of gasifier designs; production of electricity by combining a gasifier with a gas turbine or fuel cell.Combined- cycle electricity generation with gas and steam turbines, and generation of heat and steam for district heating systems or CHP, including kalina Cycle. Production of synthesis gas (i.e. CO, H_2, H_2O, CO_2) tar vapor and ash particles) for subsequent conversion to hydrogen and transport fuels; advanced gas cleaning technologies for biomass. Biological conversion of syngas into liquid biofuels. Fast pyrolysis technology to produce a range of fuels, chemicals, and fertilizers; biorefineries, and new uses for glycerine in biorefineries. **(9)**

POLICIES AND FUTURE R&D OF BIOFUELS & BIOENERGY

Analysis of both current and future EU regulations and directives on biofuels and bioenergy.Tax regulations. Evaluation of different production alternatives to produce bioenergy; competitiveness of bioenergy alternatives in agriculture compared to other energy sources. Evaluation of current and future R&D needs; legal framework to support sustainable development and increased use of biofuels; government policies and programs with regard to biofuels and investment opportunities worldwide. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Robert C.Brown, "Biorenewable Resourses: Engineering", New Products from Agriculture, Wiley- Blackwell Publishing, 2003.*
2. *Samir K.Khanal, "Anaerobic Biotechnology for Bioenergy Production: Principles and Application", Wiley- Blackwell Publishing 2008.*

REFERENCES

1. *Martin Kaltschmitt; Hermann Hofbauer. "Biomass Conversion and Biorefinery", Springer Publishing, 2008.*

19HOE01 - PRINCIPLES OF MANAGEMENT

COURSE OUTCOMES

CO1 : Design the Management function for a given organization

CO2 : Design and develop a strategic approach for the completion of the project

CO3 : Analyze the behavior of individuals and groups in organizations in terms of the key factors

CO4 : Formulate the procedure for recruitment, selection, training of staff to establish an organization

Unit I - Introduction to Management: Meaning, Definition and Significance of Management-Basic functions of Management-Development of Management Thought **(9)**

Unit II - Management Concepts: Planning, Organizing, Staffing, Directing and Controlling- MBO-Six sigma **(9)**

Unit III - Organizational Behavior: Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and Perceptions at work **(9)**

Unit IV - Business Process Reengineering: Need for BPR, Various phases of BPR, Production and Productivity-Factors influencing Productivity **(8)**

Unit V - Human Resource Management: Evolution of Management- Development of Managerial skills-Human Resource Management - Objectives -Job analysis -Recruitment -Selection and Placement and Training Development **(10)**

TOTAL : 45

TEXT BOOKS

1. *Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management" Tata Mcgraw Hill, New Delhi, 2013.*
2. *Mamoria, CB, "Personnel Management", Sultan Chand and Sons, New Delhi, 2013.*

REFERENCES

1. *Robbin Finchanm and Peter Rhodes, "Principles of Organizational Behavior" Oxford University Press, 2010.*
2. *CB Gupta "Management Theory and Practice" Sultan Chand and Sons, New Delhi, 2009.*
3. *VSP Rao "Management Text and Cases" Excel Books, New Delhi, 2009.*
4. *Fred Luthans "Organizational Behavior" Mc-Graw hill, New York, 2005.*
5. *Knanna OP "Industrial Engineering and Management", Dhanpat Rai publications, New Delhi, 2003.*

19HOE02 : CURRENT TRENDS IN INDIAN ECONOMY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Outline the structure of our Indian Economic System

CO2 : Access the role of industrial sector in Indian economy

CO3 : Interpret the demographic trends for the current scenario

CO4 : Analyze the role of two tier for the achievement of common national goals

Unit - 1 National Income and Agriculture Sector: Economics Development-Meaning-National Income and Per capita Income in India- Indian Planning-Agricultural Development of India: Major crops- Production-Productivity-Contribution to GDP and Exports **(8)**

Unit - II Industrial Sector: India's industrial development-Industrial policies of 1948, 1956 and 1991-Liberalisation-Public sector-Privatization-Disinvestment policy-Role and importance of large scale industries and small scale industries-Special economic zones-Contribution to GDP-Growth rate **(8)**

Unit - III Population: Growth and policy issues-Demographic trends-Vital statistics-India's population: size and growth rate-Demographic dividend-HDI-Population policy-Issues of Unemployment, Poverty and inequality in India **(10)**

Unit - IV Service sector: Service sector in India-Banking-Insurance-Telecommunication-IT sector-Software exports-BPO-Contribution to GDP **(9)**

Unit - V Federal System and Foreign Trade: Federal setup in India-Taxes: Direct and Indirect Tax-Value added Tax-Foreign direct investment-Merits and Demerits-India's imports and exports: Composition and direction-Foreign exchange reserve position-MNC's in India **(10)**

TOTAL : 45

TEXT BOOKS

1. *Ruddar Datt and Sundaram, KPM, Indian Economy, S.Chand and company, New Delhi-2015*
2. *Ramesh Singh Indian Economy, McGraw hill Education 7th edition, 2015*

References: www.jagranjosh.com

19H0E03 - MONETARY ECONOMICS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Evaluate the monetary measures formulated through static and dynamic role of money

CO2 : Design the driving force of circular flow of money

CO3 : Analyse how quantity theory of money fluctuate the price level

CO4 : Estimate the demand and supply of money based on the Interest rate

Unit I Nature and significance of Money: Definition of Money-Functions of Money-Static and Dynamic role of Money-Circular flow of Money-Monetary standards-Gold standard-Paper currency standard-Principles of Note issue-Measures of Money supply **(9)**

Unit II Quantity Theory of Money: Fisher's quantity theory of Money-Assumptions-Cash Balance Approach (Cambridge Equations)- Equation of Marshall, Pigou and Keynes-Similarities and dissimilarities of cash balance and cash transaction approaches-Income and expenditure theory-Superiority of Income and expenditure theory-Demand for Money: Classical and Keynesian liquidity preference theory approach **(9)**

Unit III Inflation and Deflation: Meaning-Types-Causes of Inflation-Demand Pull and Cost push inflation -Inflationary Gap-Phillips Curve-Effects of Inflation-Deflation-Causes-Measures to control Inflation and Deflation-Stagflation **(9)**

Unit IV Commercial Banking and Financial Markets: Functions of Commercial Banks-Credit Creation-Meaning and constitute of Money Markets-Capital Market-Institutional structure of Capital Market-Primary Market-Secondary Market-Indian capital Market-Non-Banking financial intermediaries **(9)**

Unit V Central Banking and Monetary Policy: Central Banking-Functions-Organization-Instruments of Credit control-Monetary Policy: Meaning, Objectives, and Recent policy changes in RBI-Monetary Policy in a developing economy **(9)**

TOTAL : 45

TEXT BOOK

1. *Jhinghan ML "Monetary Economics:" Vrinda Publications, New Delhi, 2013.*

REFERENCES

1. *Sethi TT, "Monetary Economic Theory", S Chand & Co, New Delhi, 1996.*
2. *Mithani DN, "Money Banking and International Trade", Himalaya, Mumbai, 2013.*

19HOE04 - ENGLISH FOR ACADEMIC PURPOSE

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Write a description and apply grammatical rules.

CO2 : Analyse a passage and enhance vocabulary.

CO3 : Formulate a research paper

CO4 : Listen to a lecture and prepare a summary.

CO5 : Construct dialogues using appropriate expressions.

FOCUS ON LANGUAGE

Sentence construction- types of clauses- sequence- co ordination- subordination- paragraphing information - describing a system & procedure **(9)**

READING

Understand a writer's purpose - Use strategies to ascertain meaning from unfamiliar vocabulary encountered in context - Recall and use vocabulary regarding urbanization and megacities - To identify and outline main ideas in a passage - Skim a reading passage for main ideas - Summarize texts and images - Using a dictionary to obtain lexical, phonological and orthographical information - Identify and use target vocabulary words - Highlight important parts and texts. **(13)**

WRITING

Achieving appropriate tone and style in academic writing - writing a Research article - Types of Research Designs - Choosing a Research Problem- The Abstract - The Introduction - The Literature Review - 6. The Methodology - The Results - The Discussion - The Conclusion - Citing Sources - Proofreading.

LISTENING

Listening to conversation - lectures - topics - discussions - listening comprehension on specific topics - listening to recognize formal and informal spoken English **(11)**

SPEAKING

Seminar skills - Engage in verbal role playing in Formal and Informal situation. - Express advice and personal opinions with supporting information - Paraphrase stories and information - Expressing requests - Suggestions - Complaints - Apology - Giving and Accepting compliments - Making invitations - Refusing invitations **(12)**

TOTAL : 45

REFERENCES

1. *Wisniewska, I., Riggenbach, H.,& Samuda, V. (2007). Grammar dimensions*
2. *Form, meaning, and use (4th Ed.). Boston, MA: Heinele Cengage Learning Longman Introductory Course for the TOFEL Test*
3. *Original publications and web- based resources will be reviewed as necessary.*

19HOE05 - ENGLISH FOR COMPETITIVE EXAMS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Listen to TOEFL exercises and formulate appropriate answers.

CO2 : Speak using right grammar and appropriate pronunciation on general and academic topics.

CO3 : Analyze the passage and answer the question.

CO4 : Generate and organize ideas on a given topic

LISTENING

Listening to conversation - Narration - Suggestion - Assumptions - Predictions - Implications - Problems - Academic conversations - Discussions - Lectures **(11)**

SPEAKING

Independent speaking - Integrated speaking - Speaking about a personal experience - Preferences - Report the speakers opinion - Explain a problem and solution - Give a summary of a academic lecture. **(13)**

READING

Read and understand short passages - Integrated reading tasks - Read the passage and choose the right summary of the passage - Reading for main ideas - Scanning the passage for synonyms - Making inferences - Identifying exceptions - Locating references. **(12)**

WRITING

Independent writing - Integrated writing - Writing short essays - Writing dialogues - Articles - Sentence construction **(9)**

TOTAL : 45

REFERENCES

1. *Sharpe J.Pamela. Barron's How to prepare for the TOEFL Test of English as a foreign Language. 11th Edition, Galgotia Publications Pvt. Ltd: New Delhi, 2004.*
2. *Sharpe J.Pamela. Barron's TOEFL iBT Internet- Based Test. 12th Edition, Galgotia publications Pvt.Ltd: New Delhi, 2009.*

19HOE06 - LIFE AND LITERATURE

L	T	P	C
3	0	0	3

COURSE OUTCOMES

CO1 : Compose an essay on the prose piece

CO2 : Analyse the poem and write a critical appreciation of it

CO3 : Read the story and find the moral values implied in the stories

CO4 : Write a review the fiction

Unit - 1 : Prose

The Postmaster by Rabindranath Tagore

Snapshot of a Dog by J G Thurber

On the Rule of the Road by A.G. Gardiner

The Village Schoolmaster by Oliver Goldsmith

Incident of the French Camp by Robert Browning **(13)**

Unit - 2 : Poems

Stopping By Woods on a Snowy Evening by Robert Frost

The Ballad of Father Gilligan by W.B. Yeats **(9)**

Unit - 3 : Short stories

The Model Millionaire by Oscar Wilde

The Ant and the Grasshopper by W. Somerset Maugham

The Doll's House by Katherine Mansfield, Biography

Albert Einstein and Steve Jobs **(11)**

Unit - 4 : Fiction

The Old Man and the Sea by Ernest Hemmingway

The Scarlet Pimpernel by Baroness Emma Orczy

Practice in creative writing, review writing **(13)**

TOTAL : 45

REFERENCES

1. *Xavier. ed. An Anthology of Popular Essays and Poems. Macmillan: New Delhi, 2009.*
2. *Kumara Pillai. ed. A Book of Modern Short Stories. Macmillan: New Delhi, 2009.*
3. *Colleen and Darius Krishnaraj. ed. Convergence , A Book of Short Stories. Macmillan: New Delhi, 2009.*
4. *Ernest Hemmingway. The Old Man and the Sea. Arrow: Warwickshire, 2000.*
5. *Baroness Emma Orczy, The Scarlet Pimpernel. Hutchinson : 1995.*

COIMBATORE INSTITUTE OF TECHNOLOGY

(Autonomous Institution affiliated to Anna University Chennai)

COIMBATORE - 641 014

DIAMOND JUBILEE

(1956 - 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF MECHANICAL ENGINEERING

CURRICULUM & SYLLABI

THIRD TO EIGHTH SEMESTER

Under Choice Based Credit System

(For the students admitted during the academic year 2019 - 2020 and onwards)

INDEX

S.No	Contents	Page No.
1.	Vision and Mission of the Institute	1
2.	Vision and Mission of the Department	2
3.	Programme Educational Objectives (PEOs)	3
4.	Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)	4
5.	Curriculum	6
6.	List of Open Electives	10
7.	List of One Credit Courses	11
8.	Syllabus for Semester - III	12
9.	Syllabus for Semester - IV	25
10.	Syllabus for Semester - V	38
11.	Syllabus for Semester - VI	53
12.	Syllabus for Semester - VII	64
13.	Syllabus for Semester - VIII	71
14.	Syllabus for Professional Electives	
15.	Syllabus for Open Electives	
16	Syllabus for One Credit Courses	151

CURRICULUM

(R2019)

MASTER OF ENGINEERING

ADVANCED MANUFACTURING TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY, COIMBATORE – 641 014
(A Govt. Aided Autonomous Institution Affiliated to Anna University and Accredited by NBA and NAAC with 'A' Grade)
COIMBATORE – 641 014

CURRICULUM

M.E- ADVANCED MANUFACTURING TECHNOLOGY

SEMESTER – I						
S.No	**COURSE CODE**	**COURSE NAME**	**TEACHING SCHEME**			**CREDITS**
			L	**T**	**P**	
1.	19MMA11	Applied Numerical Analysis	3	0	0	3
2.	19MMA12	Mechatronics in Manufacturing Systems	3	0	0	3
3.	19MMA13	Computer Integrated Manufacturing	3	0	0	3
4.	19MMA14	Optimization for Engineering Applications	3	0	0	3
5.	19MMA15	Advanced Material Engineering	3	0	0	3
6.		Professional Elective – I	3	0	0	3
7.	19MMA17	CIM Laboratory & Mechatronics Laboratory	0	0	4	2
		Total Credits:	**18**		**4**	**20**

SEMESTER – II						
S.No	**COURSE CODE**	**COURSE NAME**	**TEACHING SCHEME**			**CREDITS**
			L	**T**	**P**	
1	19MMA21	Design for Manufacture and Assembly	3	0	0	3
2	19MMA22	Advanced Metal Joining Technology	3	0	0	3
	19MMA23	Finite Element Analysis in Manufacturing Engineering	3	0	0	3
3		Professional Elective – II	3	0	0	3
4		Professional Elective – III	3	0	0	3
		Professional Elective – IV	3	0	0	3
5	19MMA27	Simulation Laboratory & Welding Laboratory	0	0	4	2
8		Mini project / Industrial Training / Employability Enhancement Courses	0	0	4	2
		Total Credits:	**18**		**8**	**22**

M.E- ADVANCED MANUFACTURING TECHNOLOGY

SEMESTER – III						
S.No	**COURSE CODE**	**COURSE NAME**	**TEACHING SCHEME**			**CREDITS**
			L	**T**	**P**	
1		Professional Elective - IV	3	0	0	3
2		Professional Elective -V	3	0	0	3
		Open Elective / Professional Elective	3	0	0	3
3	19MMA41	Project Work and Viva Voce	0	0	0	0
		Total Credits:	**9**			**9**

SEMESTER – IV						
S.No	**COURSE CODE**	**COURSE NAME**	**TEACHING SCHEME**			**CREDITS**
			L	**T**	**P**	
1	19MMA41	Project Work and Viva Voce	0	0	0	18
		Total Credits:				**18**

TOTAL CREDITS FOR THE PROGRAMME = 20 + 22 + 9 + 18 = 69

M.E- ADVANCED MANUFACTURING TECHNOLOGY

LIST OF PROFESSIONAL ELECTIVES						
Sl.no	**COURSE CODE**	**COURSE TITLE**	**TEACHING SCHEME**			**CREDITS**
			L	**T**	**P**	**C**
1.	19MMAE 01	Design of Hydraulic and Pneumatic system	3	0	0	3
2.	19MMAE 02	Optimization Techniques in Manufacturing	3	0	0	3
3.	19MMAE 03	Advanced Operations Research	3	0	0	3
4.	19MMAE 04	Industrial Robotics and Machine Vision	3	0	0	3
5.	19MMAE 05	Manufacturing Information systems	3	0	0	3
6.	19MMAE 06	Supply Chain Management	3	0	0	3
7.	19MMAE 07	Advanced Metrology and Non - Destructive testing	3	0	0	3
8.	19MMAE 08	Productivity Management and Re-Engineering	3	0	0	3
9.	19MMAE 09	Supply chain Information systems	3	0	0	3
10.	19MMAE 10	Additive Manufacturing	3	0	0	3
11.	19MMAE 11	Advances in Casting and Welding	3	0	0	3
12.	19MMAE 12	Product Design and Development	3	0	0	3
13.	19MMAE 13	Computer Aided Process Planning	3	0	0	3
14.	19MMAE 14	Advanced Manufacturing Planning and Control	3	0	0	3
15.	19MMAE 15	Flexible competitive manufacturing system	3	0	0	3
16.	19MMAE 16	Corrosion and Surface engineering	3	0	0	3
17.	19MMAE 17	Advanced Tool Engineering and Design	3	0	0	3
18.	19MMAE 18	Total Quality Systems and Engineering	3	0	0	3
19.	19MMAE 19	Plastics and Composite Materials	3	0	0	3
20.	19MMAE 20	Advances in Foundry Technology	3	0	0	3
21.	19MMAE 21	Advanced Agile and Lean Manufacturing Systems	3	0	0	3
22.	19MMAE 22	Advanced Biomaterials	3	0	0	3
23.	19MMAE 23	Concepts and Analysis of Robot Manipulators	4	0	0	4
24.	19MMAE 24	Smart Materials and Systems	3	0	0	3
25.	19MMAE 25	Ultrasonic and Applications	3	0	0	3
26.	19MMAE 26	Vibration Analysis and Control	3	0	0	3
27.	19MMAE 27	Design of Experiments and Taguchi Methods	3	0	0	3
28.	19MMAE 28	Metal Cutting Theory and Practice	3	0	0	3
29.	19MMAE 29	Automotive Suspension and System Dynamics	3	0	0	3
30.	19MMAE 30	Design and Analysis of Experiments	3	0	0	3

M.E- ADVANCED MANUFACTURING TECHNOLOGY

LIST OF OPEN ELECTIVES TO OTHER DEPARTMENTS						
S. No	COURSE CODE	COURSE NAME	TEACHING SCHEME			CREDITS
			L	T	P	
1.	OE01	Automation and Robotics	3	0	0	3
2.	OE02	Work Study and Ergonomics	3	0	0	3
3.	OE03	Product Life Cycle Management	3	0	0	3
4.	OE04	IoT in Manufacturing	3	0	0	3
5.	OE05	Artificial Intelligence and Machine Learning in Design and Manufacturing	3	0	0	3
6.	OE06	Research Methodology and IPR	3	0	0	3

LIST OF EMPLOYABILITY ENHANCEMENT COURSE						
S.No	COURSE CODE	COURSE NAME	TEACHING SCHEME			CREDITS
			L	T	P	
1.	19MMA 41	Project Work and Viva Voce	-	-	-	18
2.	EEC01	English for Research Paper Writing	0	0	4	2
3.	EEC02	Constitution of India	0	0	4	2
4.	EEC03	Pedagogy Studies	0	0	4	2
5.	EEC04	Personality and skill Development	0	0	4	2
6.	EEC05	Python Programming	0	0	4	2
7.	EEC06	Intellectual Property Rights and Patents	0	0	4	2
8.	EEC07	Study of Indian Economy	0	0	4	2
9.	EEC08	Seminar and term paper writing	0	0	4	2

Professional Core Subjects – I Semester

19MMA11 – APPLIED NUMERICAL ANALYSIS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- Provide the students with strong background on numerical strategies and knowledge on theory that supports numerical algorithms.

COURSE OUTCOMES

1: Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems**.**

2: Apply numerical methods to obtain approximate solutions to mathematical problems.

3: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

4:Analyse and evaluate the accuracy of common numerical methods.

SYSTEM OF EQUATIONS AND EIGENVALUE PROBLEMS

Solving set of equations - Gauss elimination method, LU - Choleski method, successive over relaxation method, system of non-linear equations - Newton Raphson method, power method and inverse power method**.** (9)

CURVE FITTING AND APPROXIMATION OF FUNCTIONS

Concept of least square approximations, linear regression, non-linear regression, error and standard deviation, multiple linear regression, applications of cubic splines - Bezier curves and B-splines (8)

BOUNDARY VALUE PROBLEMS

Shooting method, solution through a set of equations, derivative boundary conditions, Rayleigh-Ritz method. (8)

ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS

Laplace's equation, Poisson equation – difference equation, Liebmann method – derivative boundary conditions, alternating direct implicit method, irregular and non – rectangular grids, matrix patterns, application to steady heat flow problems. (10)

PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS

Explicit method, Crank-Nicholson method, derivative boundary condition, stability and convergence criteria, parabolic equations in two or more dimensions, applications to heat flow problems. Hyperbolic partial differential equations - Solving wave equation by finite differences, stability of the solution, wave equation in two dimensions. (10)

TOTAL:45 HOURS

REFERENCES

1. *Curtis F Gerald and Patrick O Wheatley, "Applied Numerical Analysis", Pearson Education, New Delhi, 2011.*
2. *Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata Mcgraw Hill, New Delhi, 2007.*
3. *John H Mathews and Kurtis D Fink, "Numerical Methods using MATLAB", Prentice Hall, New Delhi, 2005.*
4. *Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning, New Delhi, 2013.*
5. *Richard T Burden and Douglas Faires J, "Numerical Analysis", Cengage Learning, New Delhi, 2012.*

19MMA12 – MECHATRONICS IN MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To provide basic knowledge about different types of sensors, controllers and actuators used in Mechatronics system
- Gain knowledge in signal conditioning principles
- Gain programming knowledge using microcontroller and PLC in manufacturing systems.

COURSE OUTCOME:

At the end of the course, the students will be able to

1: Develop the mathematical model of a system in the form of differential equation, state space andtransfer function

2: Understand the concept of sensors and its characteristics.

3: Condition the signals using operational Amplifier.

4:Design a PID controller for second order system.

5: Design the PLC programs for simple industrial applications.

INTRODUCTION TO MECHATRONICS AND SYSTEM MODELLING

Mechatronics – Basic elements, Design process, Examples. System – Types of system – Mathematical models: Differential equation, state space and Transfer function of mechanical, electrical and hydraulic (9**)**

SENSORS AND TRANSDUCERS

Sensor and Transducers – Definition, performance, static and dynamic characteristic. Potentiometer, Strain gauge, Capacitive proximity sensor, Differential transformer, LVDT, Optical encoders, Pneumatic sensors, Proximity switches, Hall effect sensor – Flow sensor – Level sensor – Temperature sensor (9)

SIGNAL CONDITIONING

Signal conditioning processes – Operational amplifier - Inverting, Non inverting, Summing, Integrating, Difference amplifiers. Filtering – Characteristics of low, high and band pass filter – Wheat stone bridge – Thermocouple compensation – Pulse modulation (8)

CONTROL SYSTEM

Control system – Block diagram – Root locus – Bode plot – Routh stability criterian – Controllers – P.PI,PD, PID. Design of PID controllers for second order plant. **(10)**

PROGRAMMABLE LOGIC CONTROLLERS

Programmable Logic Controllers - Basic PLC structure, I/O processing, Ladder programming, Instruction list, Latching and internal relays, Timers and controls, Shift register. Example PLC ladder diagram for simple industrial applications. **(9)**

TOTAL:45 HOURS

REFERENCE

1. *Bolton.W Mechatronics - Electronic Control system in Mechanical and Electrical Engineering [Book]. - New Delhi : Pearson, 2012.*
2. *Control systems (State Variable Approach). Anoop k.Jairath. Ane books pvt ltd, 2008.*
3. *Control systems by A. Nagoor Kani RBA Publications Second edition, 2006.*
4. *Histand Micheal B. and Alciatore David G. Introduction to Mechatronics and Measurement systems [Book]. - Singapore : Mc Graw Hill International Ed, 1999.*

19MMA13 – COMPUTER INTEGRATED MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- Gain knowledge on total manufacturing system at various levels of planning and manufacturing
- Understand the automated flow line process, FMS, grouping of products.
- Ability to handle the product data, different protocols related to implementation of CIM systems

COURSE OUTCOME

On Completion of the course, the students should be able to:

1: Sequence the flow of production line in industrial process.

2: Classify the various material handling, transportation and storage systems for better efficient shop floor design.

3: Optimize the shop floor structure based on product classifications and by automated process planning.

4: Principles behind the computerizing the manufacturing system.

INTRODUCTION

Origin of CIM- manufacturing automation – computerized manufacturing support systems, Automation strategies - Ten Strategies for Automation and Process Improvement. (5)

AUTOMATED FLOW LINES

System Configurations, Workpart Transfer Mechanisms, Storage Buffers, Control of Production Line, Analysis of Transfer Lines-Transfer Lines with No Internal Parts Storage, Transfer Lines with Internal Storage Buffers. Manual Assembly Lines: Assembly Workstations, Work Transport Systems, Analysis of Single Model Assembly Lines- Line Balancing Problem, Line Balancing Algorithms-Largest Candidate Rule, Kilbridge and Wester Method, Ranked Positional Weights Method. (9)

AUTOMATIC MATERIAL HANDLING AND STORAGE SYSTEMS:

Design Considerations in Material Handling, Material Transport Equipment-Industrial Trucks, Automated Guided Vehicles, Monorails and Other Rail-Guided Vehicles, Conveyors, Cranes and Hoists. Automated Storage/Retrieval Systems, Carousel Storage Systems, Engineering Analysis of

AS/RS and Carousel Systems. Automated Inspection systems: Overview of Automated Identification Methods, Bar Code Technology, Radio Frequency Identification and Machine Vision. (7)

CELLULAR MANUFACTURING SYSTEMS

Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Machine Cell Design, Applications of Group Technology, Quantitative analysis of Cellular Manufacturing, grouping of parts and Machines by Rank Order Clustering, Arranging Machines in a GT Cell.CAPP - Retrieval CAPP Systems, Generative CAPP Systems, Feature Identification- Algorithms, Graph Based Approach, Attribute Adjacency Graph, Benefits of CAPP. (9)

FMS AND SHOP FLOOR CONTROL

FMS- components of FMS - types FMS-A Dedicated FMS, A Random Order FMS -Workstations, FMS material handling, FMS Applications and Benefits. Computer Control System, Shop floor control-phases -factory data collection system. (7)

CIM IMPLEMENTATION AND DATA COMMUNICATION

The Scope of CAD/CAM and CIM, Computerized elements of a CIM System, Components of CIM, Database for CIM, Manufacturing automations protocol (MAP) and technical office protocol (TOP).CIM open system architecture (CIMOSA) - manufacturing enterprise wheel-CIM architecture. Communication fundamentals- local area networks -topology -LAN implementations – network. (8)

TOTAL:45 HOURS

REFERENCES

1. *Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Prentice Hall, 2016.*
2. *Alavudeen,A and Venkateshwaran N, " Computer Integrated Manufacturing", PHI Learning Pvt. Ltd, 2017.*
3. *Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., 2016.*

19MMA14 – OPTIMIZATION FOR ENGINEERING APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To understand the major capabilities and limitations of deterministic operations research modeling as applied to problems in engineering applications.
- To recognize, formulate and to use prepared computer programs to solve linear and non- linear constrained/unconstrained problems.
- To summarize the reasons why the applicable algorithms, work and the effects on the computed solutions of variations in the data or in the assumptions underlying the models.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Mastery of the knowledge, techniques, skills and modern tools used in optimization.
2. Apply current knowledge of optimization and adapt to emerging applications in engineeringandtechnology.
3. Conduct, analyze and interpret experiments and apply experimental results to improveprocesses.
4. Apply creativity in the design of systems, components or processes appropriate to programobjectives.

INTRODUCTION

Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization - Optimization Techniques - based on nature of contraints. (6)

CLASSICAL OPTIMIZATION TECHNIQUES

Single-Variable Optimization - Multivariable Optimization without constraints - Multivariable Optimization with Equality constraints - Method of Lagrange multipliers - Multivariable Optimization with Inequality constraints - Kuhn-Tucker conditions (8)

LINEAR PROGRAMMING

Introduction - Standard form of a linear programming problem - Geometry of linear programming problems - Solution of a system of linear simultaneous equations - Simplex algorithm - Big M method - Two phase methods - Duality in linear programming - Applications of linear programming (11)

NONLINEAR PROGRAMMING

Introduction - Unimodal function - Region elimination methods - Exhaustive search method - Fibonacci method - Golden search method - Gradient search method - Direct root method - Hooke-Jeeves' method Powell's method - Cauchy's steepest search method. (9)

NON TRADITIONAL OPTIMIZATION ALGORITHMS

Non Traditional Optimization - Multi objective optimization - Genetic algorithms and Simulated Annealing - Meta heuristics search techniques - Tabu search and Ant colony optimization - Computer programming for these algorithms. (11)

TOTAL:45 HOURS

REFERENCES

1. *Singeresu S. Rao, "Engineering Optimization - Theory and Practice", Whiley Publishers, 5th Edition, 2019.*
2. *Kalyanamoy Deb, "Optimization for Engineering Algorithms and Examples", Prentice Hall of India, 2nd Edition, 2012.*
3. *Goldberg D.E., "Genetic Algorithms in Search, Optimization and Machine Learning", Baren, Addison-Wesley, New York, 2004.*

19MMA15 – ADVANCED MATERIALS ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide details about the behavior of engineering materials and various strengthening procedures.
- To gain knowledge about different modes of material fracture and procedure of failure analysis.
- To know about properties, processing and applications of both latest metallic and non-metallic materials.
- To acquire the essential knowledge about the selection of different latest materials for various applications.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Apply the principles of material selection in engineering manufacture and design and also oneffective materials usage.
2. Identify service requirements and describe how to relate materials to those requirements.
3. Select modern metallic and non-metallic materials for suitable applications.

INTRODUCTION

Elastic and plastic behavior -Elasticity in metals and polymers -Mechanism of plastic deformation, role of dislocation, yield stress, shear strength of perfect and real crystals -Strengthening mechanism, work hardening, solid solution, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior -super plasticity - Deformation of non-crystalline material. **(9)**

FRACTURE MECHANISM

Fracture behavior -Griffth's theory, stress intensity factor and fracture toughness-Toughening mechanisms -Ductile brittle transition in steel. High temperature fracture, creep-Larsen Miller parameter- Deformation and fracture mechanism maps, Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law-Effect of surface and metallurgical parameters on fatigue- Fracture of non- metallic materials -Failure analysis, source of failure, procedure of failure analysis. **(9)**

MATERIAL SELECTION AND CASE STUDIES

Selection of materials -Motivation for selection, cost basis and service requirement, Selection of material properties, strength, toughness, fatigue and creep. Selection of surface durability corrosion and wear resistance -Relationship between material selection and processing - case studies in material selection, with relevance to aero, auto, marine machinery and nuclear application **(8)**

NEW MATERIALS

Modern metallic materials-Dual phase steels, Microalloyed steel, High strength low alloy (HLSA) steel, Transformation induced in plasticity (TRIP) steel, Maraging steel-Inter metallic Ni and Ti aluminides. Shape memory alloys - Metallic glass-Quasi crystal and Nano crystalline materials. – smart materials. **(9)**

COMPOSITES

Non metallic materials -polymeric materials -Formation of polymer structure -production techniques of fibre, foams, adhesives and coatings -structure, properties and application of engineering polymers - advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond -properties, processing and applications. Introduction to composites – MMC – CMC – PMC – Applications of Composites. (10)

TOTAL:45 HOURS

REFERENCES

1. *Physical Metallurgy and Advanced Materials, R. E. Smallman, A.H.W. Ngan, Seventh Edition, Elsevier, 2011*
2. *George E.Dieter, "Mechanical Metallurgy", McGraw Hill, 1988.*
3. *Michael F Ashby, "Materials Selection in Mechanical Design", Butterworth Heinemann, 2005.*
4. *Flinn R.A. and Trojan P.K., "Engineering Materials and their application", 6th Edition, Jaico, 2000*
5. *Kenneth G.Budinski., "Engineering materials: properties and selection", 7th Edition, Prentice Hall of India Limited, New Delhi, 2005.*

Program Core Laboratory – I Semester

19MMA17 – CIM LABORATORY

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

- Study about the usage of CAD packages, to gain hands on training on various commands used to familiarize with different analysis modules.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Effectively develop various geometrical modeling and assembling.
2. Develop the optimum coding for simple manufacturing operations.
3. Perform FEA, using ABAQUS software.

CIM LAB

Geometric modeling techniques - Wire Frame, Surface and Solid Modeling - Geomagic freeform modeling. Assembly of mechanical components using CAD software's, Coordinate Measuring Machine.

Finite Element Analysis (FEA) using Pre-processing (solid modeling, meshing, analysis and post processing with software (ABAQUS) (Exercises include simple beam, plane stress, strain, axi-symmetric, 3D solids).

Advanced manufacturing – Abrasive water jet machining, 3D Printing, Field Electron Scanning Emission Microscope (FESEM), Fatigue Testing.

19MMA17 – MECHATRONICS LABORATORY

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OBJECTIVE

- Study the definition and element of mechatronics system
- Learn how to acquire and process real time signals by using sensors.
- Simulate various mathematical functions and also electronic devices.

COURSE OUTCOME:

At the end of the course, the students will be able to

1. Write LabView and MATlab coding for mathematical and logical operations
2. Interface sensors and actuators with LabView program
3. Write LabView and MATlab code for System simulation

MECHATRONICS LAB

1. Introduction to LabView elements
2. Arithmetic and logical problem solving using LabView
3. Hardware integrated data acquisition and logging
4. System simulation using LabView
5. Introduction to MATlab
6. Basic MATlab coding for arithmetic and logical problem solving.
7. System simulations using MATlab

Professional Core Subjects – II Semester

19MMA21 – DESIGN FOR MANUFACTURE AND ASSEMBLY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide the essential concepts of DFM so that the products to be designed can be manufactured easily.
- Enable students to consider all the inherent cost benefits available in the manufacturing process in designing engineering products.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Describe the role of manufacture & assembly within manufacturing industry.
2. Evaluate and select manufacturing & assembly processes.
3. Apply the cost reduction techniques for forming design, casting design, machining and welding design andsolve technical problems.

DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY

DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka- Yoke principle; Six sigma concept; design creativity. **(9)**

TOLERANCEANALYSIS

Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law. ISO standards - surface finish, review of relationship between attainable tolerance grades and different machining and sheet metal processes. (11)

SELECTIVE ASSEMBLY

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples. (11)

FORM DESIGN OF CASTINGS

Design for Manufacturability considerations, influence of fabrication properties. Redesign of castings based on parting line considerations, preparation of process drawings for different operations, minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, Computer Applications of DFMA, examples. **(7)**

FORM DESIGN OF FORGING, WELDMENTS AND MACHININING

Forging considerations – Requirement and rules – Redesign of components for forging and Case studies. Design consideration for welding, minimizing distortion, weld strength, minimizing weld cost. Design considerations for turning, drilling, tapping, milling and grinding operations, reduction in machining area, simplification by separation and amalgamation. (7)

TOTAL:45 HOURS

REFERENCES

1. *Harry Peck, `Designing for Manufacture", Pitman Publications, London, 1993.*
2. *George E. Dieter and Linda C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA.*
3. *Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Second Edition, CRC press, Taylor & Francis, Florida, USA*
4. *Benhabib, B. and Marcel Dekker. Manufacturing: Design, Production, Automation and Integration. New York, NY: Gordon and Breach Science Publishers, 2003. ISBN: 9780824742737.*

19MMA22 – ADVANCED METAL JOINING TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide knowledge about the principle and applications of latest welding processes
- To acquire essential significance of thermal effects of welding and subsequent remedial measures to reduce residual stresses and distortion in weldments.
- To gain knowledge about the Weldability of different commercially available materials, their corresponding weld joints design and automation of welding processes.

COURSE OUTCOME

On Completion of the course, the students will be able to:

1. Select suitable welding process and technique to join a given material.
2. Identify and minimize the distortion and residual stresses induced in weldments.
3. Evolve better weld joint design for both static and fatigue loading conditions.

SPECIAL WELDING PROCESSES

Electron beam welding, laser beam welding, ultrasonic welding, explosion welding, electro slag and electro gas welding, cold pressure welding, friction stir welding, cold metal transfer, Magnetically Impelled Arc Butt (MIAB) welding, under water welding - wet & dry, procedure, Electrical welding, Resistance welding processes: spot welding, seam welding, projection welding, high-frequency resistance welding, resistance butt welding, flash butt welding, Brazing, Adhesive bonding. (9)

HEAT EFFECTS OF WELDING

Metallurgical effects of heat flow in welding-TTT curve- continuous cooling transformation diagrams-development of residual stress, methods of relieving or controlling welding residual stresses, types and control of distortion, pre-heat and post welding heat treatment. **(9)**

WELDABILITY OF FERROUS AND NON-FERROUS ALLOYS

Weldability of carbon and alloy steels, stainless steels, cast irons, copper and its alloys, aluminum and its alloys, titanium and its alloys, Ni and its alloys, weldability tests. **(8)**

WELDING DESIGN

Typical joints for different welding processes, principles of welding joint design and location of joint within the member, evolving good weld design, welding symbol- Blue print reading, welding design for static and fatigue loading and problems, fracture toughness. **(10)**

AUTOMATION IN WELDING

Welding sequence and classification of processes, manual and semi-automatic, automatic, automated welding- adaptive controls- remote welding, robotic welding- selecting welding system, gravity welding and fire cracker welding. **(9)**

TOTAL:45 HOURS

REFERENCES

1. *Parmar.R.S, "Welding Processes and Technology", 3rd Edition, Khanna Publishers,2013.*
2. *Parmar.R.S, "Welding Engineering and Technology", 2nd Edition, Khanna Publishers, 2013.*
3. *Roa P.N. "Manufacturing Technology", Tata McGraw -Hill, 2005.*
4. *Dieter, "Mechanical Metallurgy", Tata McGraw - Hill, 2005.*
5. *Harris, J.N., "Mechanical working of Metals - Theory and Practice", Pergamon Press ,1995*
6. *Altan T., "Metal forming - Fundamentals and applications" , American Society of Metals, Metals Park, 2003.*
7. *ASM Hand book, Forming and Forging, Ninth Edition, Vol - 14, 2003.*

19MMA23 – FINITE ELEMENT ANALYSIS IN MANUFACTURINGENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To gain fundamental knowledge and techniques of FEM for solving boundary value problems and manufacturing process.
- To gain exposure to commercial FE analysis packages.

COURSE OUTCOME

On Completion of the course, the students should be able to:

1. Solve boundary value problems using classical as well as finite element methods.
2. Demonstrate his/her ability in selection of appropriate elements.
3. Solve simple practical problems using commercial FE analysis packages.

INTRODUCTION:

Historical background, Concept of finite element method, boundary, initial and Eigen value problems, Finite element formulation starting from governing differential equations – Weighted residual method, Finite element formulation based on stationary of a functional. Review of static analysis using 1D elements. (8)

STATIC ANALYSIS USING 2D ELEMENTS: (9**)**

Triangular and quadrilateral elements, Isoparametric formulation, problems using 2D elements, shape functions for axisymmetric, shape functions for higher order elements. Introduction to plates and shell

FINITE ELEMENT FORMULATION OF HEAT TRANSFER PROBLEMS:

Basic differential equations of heat transfer, one dimensional and two dimensional finite element formulation using variational and Galerkin's method, one dimensional steady state heat transfer problems involving conduction and convection. Analysis of tapered fin, Formulation of thermal stress problems and examples, transient thermal analysis, solidification of casting. **(9)**

THERMOMECHANICAL MODELING:

Formulation of thermal stress problem and examples, thermo mechanical modeling of welding using FEA software, concept of moving heat source, use of gaussian distribution, determination of residual stress. **(5)**

NON-LINEAR ANALYSIS:

Introduction, Non-linear differential equation, Solution procedures for non-linear problems, Linearization and directional derivative, Material non-linearity-analysis of axially loaded bars, Geometric non-linearity-Basic continuum mechanics concepts, Governing differential equations and weak forms, Introduction to contact problems. **(7)**

FINITE ELEMENT METHOD FOR BULK METAL FORMING: (7)

Solid formulation and flow formulation, concept of plasticity and visco plasticity, extremum principles, strain heat effect, implementation of finite element procedure for non-steady state process.

TOTAL:45 HOURS

REFERENCES:

1. *Chandrupatla T R and Belegundu A D, "Introduction to Finite Elements in Engineering", Pearson Education, New Delhi, 2007.*
2. *Logan D L, "A First Course in the Finite Element Method", Thomson Learning, 2007.*
3. *Rao S S, "The Finite Element Method in Engineering", Elsevier, 2005.*
4. *Rajasekaran S, "Finite Element Analysis in Engineering Design", S Chand, 2008.*
5. *Seshu P, "A Text book on Finite Element Analysis", Prentice Hall of India, New Delhi, 2003.*

Laboratory – II Semester

19MMA27 – SIMULATION LABORATORIES

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

- Provide software simulation knowledge on various types of manufacturing systems

COURSE OUTCOME

1. *Simulate and validate any type of manufacturing systems and flexibly use suitable software.*
2. *Model and optimize manufacturing system.*

SIMULATION LAB

Introduction to simulation languages- Simulation procedure-simulation of manufacturing systems-use of simulation software's - PROMODEL, ARENA, LEKIN.

CNC part programming with FANUC – CNC simulator – Simulation [Turning, Facing, Drilling and Contouring – Milling – Linear and Circular Interpolation] – Manufacturing Simulation.

Simulation of single line multi stage manufacturing system, Simulation of Multi-line multi stage manufacturing and assembly system. LEKIN Scheduling – Scheduling exercises

19MMA27 – WELDING LABORATORIES

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OBJECTIVE

- Provide exposure to the students on various welding processes and modeling welding processes.

COURSE OUTCOME

1. Select suitable welding technique for the contemporary issues in manufacturing industries
2. Model and optimize welding processes.

WELDING LABORATORY

1. MIG Welding process parameters and Microstructural Characterization of Mild Steel Joint.
2. TIG Welding process parameters and Microstructural Characterization of Mild Steel Joint.
3. Friction stir welding of Al sheets
4. Pre & Post Weld Heat treatments
5. GMAW, SAW and FCAW processes
6. Studies on Friction stir welding and surfacing.
7. Studies on Robotic welding technology
8. Studies on Pulsed MIG/TIG welding process.

Professional Electives.

19MMA E01 – DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To gain knowledge on various hydraulics and pneumatics systems.
- To understand hydraulic and pneumatic circuits used in industries.
- To study the various actuators, control systems and its selection methods.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Develop simple and complex hydraulic and pneumatic systems for required applications.
2. Select appropriate control systems for particular applications.
3. Demonstrate the robotic applications with the help of microprocessors and PLCs.

INTRODUCTION

Fluid Power - Hydraulic fluids - properties and selection. Pneumatic fluid - properties and selection. Advantages and application of Fluid power (5)

HYDRAULIC MOTORS AND PUMPS

Oil hydraulic systems-Hydraulic Power Generators-Selection and specification of pumps, pump characteristics. (5)

ACTUATORS AND CONTROL UNITS

Hydraulic actuators-Linear and Rotary Actuators- selection, specification and characteristics. Control and regulation elements-Pressure, direction and flow control valves-relief valves, non return and safety valves. (9)

HYDRAULIC CIRCUITS

Hydraulic circuits-Reciprocation, quick return, sequencing, synchronizing circuits- accumulator circuits-industrial circuits- press circuits- hydraulic milling machine- grinding, planning, copying, forklift, earth mover circuits – design and selection of components. (8)

PNEUMATICS - BASICS AND CIRCUITS

Pneumatic systems and circuits - Pneumatic fundamentals - control elements position and pressure sensing - logic circuits - switching circuits- fringe condition modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method- compound circuit design. (8)

COMBINED CIRCUITS

Installation, maintenance and special circuits - Pneumatic equipments - selection of components - design calculations- application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing PLC, Low cost automation – Robotic Circuits (10)

TOTAL:45 HOURS

REFERENCES

1. *Antony Espossito, "Fluid power with Applications", Prentice Hall, 7th Edition, 2012.*
2. *Majumdar S R, "Oil Hydraulic Systems: Principles and Maintenance", Tata McGraw Hill Publishing Company Limited, 2003.*
3. *Majumdar S R, "Pneumatic Systems : Principles and Maintenance", Tata McGraw Hill Publishing Company Limited, 2003.*
4. *Dudleyt, A.Pease and John J.Pippenger, "Basic Fluid Power ",Prentice Hall, 1987.*
5. *Andrew Parr, "Hydraulic and pneumatics" ,(HB), Jaico Publishing House, 1999.*
6. *Bolton.W. "Pneumatic and Hydraulic Systems", Butterworth - Heinemann, 1997.*

WEB REFERENCES

1. *www.pneumatics.com*
2. *www.fluidpower.com.tw.*

19MMA E02 OPTIMIZATION TECHNIQUES IN MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To understand the major capabilities and limitations of deterministic operations research modeling as applied to problems in engineering applications.
- To recognize, formulate and to use prepared computer programs to solve linear and non-linear constrained/unconstrained problems.

COURSE OUTCOME

On Completion of the course, the students should be able to :

- Apply current knowledge and adapt to emerging applications in manufacturing.
- Conduct, analyze and interpret experiments and apply experimental results to improve processes
- Apply creativity in the design of systems, components or processes appropriate to programobjectives.

INTRODUCTION

Optimization – Historical Development – Engineering applications of optimization – Statement of an optimization problem – classification of optimization problems. (9)

CLASSIC OPTIMIZATION TECHNIQUES

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming - Goal programming (9)

NON-LINEAR PROGRAMMING

Introduction – Lagrangian Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming (9)

INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic programming – Formulation, Various applications using Dynamic Programming. Network techniques - Shortest Path model - minimum spanning tree problem - maximal flow problem. (9)

ADVANCES IN SIMULATION

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems. (9)

TOTAL:45 HOURS

REFERENCES

1. *Rao S.S., "Engineering Optimization - Theory and Practice", New Age International Private Limited, 2010.*
2. *Kalyanamoy Deb, "Optimization for Engineering Algorithms and Examples, Prentice Hall of India, 2011.*
3. *M. C. Joshi, Kannan M. Moudgalya, "Optimization: Theory and Practice", Narosa Publishing House, 2013.*
4. *Johnson Ray. C., "Optimization Design of Mechanical Elements", John Wiley & Sons, 1981.*
5. *David E Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education India, 2004.*

19MMA E03 – ADVANCED OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To provide an in-depth knowledge on different kinds of problems and its optimization procedures.
- To provide understanding of capabilities and limitations of deterministic modeling as applied to problems in engineering applications and able to formulate.
- To develop computer programs to solve linear and nonlinear constrained / unconstrained problems

COURSE OUTCOME

On Completion of the course, the students should be able to:

1. Demonstrate the knowledge, techniques, skills and use of modern tools in optimization.
2. Apply this knowledge to emerging applications in engineering and technology.
3. Apply creativity in the design of systems, components or processes appropriate to programobjectives.

DYNAMIC PROGRAMMING

Introduction - Multistage Decision Processes - Concept of Sub Optimization and Principle of Optimality - Computational Procedure in Dynamic Programming - Example Illustrating the Calculus Method of Solution - Example Illustrating the Tabular Method of Solution - Conversion of a Final Value Problem into an Initial Value Problem - Linear Programming as a Case of Dynamic Programming - Continuous Dynamic Programming – Additional Applications of Dynamic Programming. (11)

INTEGER PROGRAMMING

Introduction - Graphical Representation - Gomory's Cutting Plane Method - Bala's Algorithm for Zero-One Programming Problems - Integer Polynomial Programming - Brach-and-Bound Method – Sequential Linear Discrete Programming – Generalized Penalty Function Method. (11)

NON-TRADITIONAL OPTIMIZATION

Introduction to non-traditional optimization, computational complexity – NP-hard, NP complete, no free lunch theorem – working principles of simulated annealing, Tabu search, and neural networks, simple application. **(11)**

SELECTED ALGORITHMS

Quadratic Programming - Separable Programming - Multi Objective Optimization - Game Theory – Optimal Control Theory – CPM and PERT. (11)

TOTAL:45 HOURS

REFERENCES

1. *Hamdy Taha, "Operations Research - An Introduction" 9th Edition, Prentice Hall of India, (P) Ltd., 2012.*

2. *Singeresu S. Rao, "Engineering Optimization - Theory and Practice", 4th Edition, Whiley Publishers, 2010.*

3. *Rao S.S. "Optimization Theory and Applications" Wiley Estem Ltd., New Delhi, 2004.*

4. *Phillips T, Ravindran A, "Operations Research Principles and Practices", 2nd Edition, Whiley Publishers, 2007.*

19MMA E04 – INDUSTRIAL ROBOTICS AND MACHINE VISION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide the advanced features of robots, its components and industrial applications of robotics.
- To give details about automation and machine vision.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Demonstrate knowledge on automation in robotics application, utilization of robotics in industryand design of robotics system.
2. Apply the principles of sensors & their application in robots.
3. Demonstrate programming methods & languages of robots.

ROBOTICS AND ITS COMPONENTS

Robotics - Introduction-Basic Structure- Classification of robot and Robotic systems -laws of robotics - robot motions - work space, precision of movement. Drives and control systems: Hydraulic systems, power supply - servo valve - sump - hydraulic motor - DC servo motors - stepper motors - operation. Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link - Road Systems, Rotary to linear motion conversion, Ract and pinion drives, ball bearing screws, speed reducers, Harmonic drives. **(9)**

KINEMATICS OF ROBOT

Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning **(9)**

ROBOT END EFFECTORS

Types of end effectors - Mechanical grippers - Types of Gripper mechanisms - Grippers force analysis - Other types of Grippers - Vacuum cups - Magnetic Grippers - Adhesive Grippers-Robot end effector interface.Sensors: Position sensors - Potentiometers, encoders - LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers. **(9)**

MACHINE VISION

Introduction - Image processing Vs image analysis, image Acquisition, digital Images - Sampling and Quantization -Image definition, levels of Computation. Image processing Techniques: Data reduction - Windowing, digital conversion. Segmentation - Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations. **(9)**

FEATURE EXTRACTION

Geometry of curves - Curve approximation, Texture and texture analysis, Image resolution - Depth and volume, Color processing, Object recognition by features, Depth measurement, specialized lighting techniques. Segmentation using motion - Tracking. Image Data Compression, Real time Image processing, Application of Vision systems. **(9)**

TOTAL:45 HOURS

REFERENCES

1. *Davies E R, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Academic Press, 2012.*
2. *John Craig, "Introduction to Robotics, Mechanics and Control", Pearson Education, 2008.*
3. *James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.*
4. *Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall of India, New Delhi, 2001.*
5. *Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI, 2003*
6. *Rafael C. Gonzalez, Richard E. Woods 'Digital Image Processing' Addition- Wesley Publishing Company, 2001.*
7. *M.P. Groover, Industrial Robotics - Technology, Programming and Applications, McGraw-Hill, USA, 2010.*
8. *Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 2010.*
9. *Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1997.*
10. *P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 2001.*

19MMA E05 – MANUFACTURING INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide knowledge on production planning and control system, the databases required to handle records and their maintenance, various methods of collecting data from the shop floor in order to analyze and improve the performance of the manufacturing system.
- To realize the importance of information system along with scheduling techniques for customer requirement.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Design the database using various models and approaches.
2. Maintain and analyze the database in manufacturing industries.
3. Solve the problems of sequencing and scheduling in the real time production shop floor.

INTODUCTION

Introduction - Information Needs of Manufacturing, Information Technology and Information Systems, Manufacturing Information (8)

Manufacturing Databases

Database Systems- Database Models, Database Design, Database Normalization, General Database Management Issues, Applications of Relational Databases and Future Trends (9)

Manufacturing Resource Planning Systems

Introduction; Materials Requirements Planning- Manufacturing Resources Planning System (MRP II) (7)

MANUFACTURING SHOP FLOOR CONTROL SYSTEM

Manufacturing Consideration-Product and its structure, Inventory and Process Flow-Shop Floor Control-Data Structure and Procedure-Various Model- Order Scheduling Module, Input/Output Analysis Module, Stock Database- IOM Database. **(10)**

MANUFACTURING INFORMATION SYSTEM

Introduction; Concept of Strategic Information Systems, Objectives and function of MIS, classification of Information system, The Evolution of IS/IT, Use of Information Systems for Competitive Advantage, The Applications Portfolio, Critical Success Factors, Strategic Planning **(11)**

TOTAL:45 HOURS

REFERENCES

1. *Franjo Cecelja, "Manufacturing Information and Data Systems Analysis, Design and Practice", Penton Press, 2002*
2. *DAVENDRANATH G. JHA, "Computer Concepts and Management Information Systems", PHI Learning Pvt. Ltd, 2013*
3. *Luca G. Sartori,"Manufacturing Information Systems", Addision-Wesley Publishing Company, 2003.*
4. *Date.C.J, "An Introduction to Database Systems", Narosa Publishing House, 2004.*
5. *Orlicky.G, "Material Requirements Planning", McGraw-Hill Publishing & Co., 2002.*

19MMA E06 – SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To provide a basic and a deeper understanding about supply chain management and the role of supply chain in an industry for meeting end user needs.
- To provide a detailed knowledge on product and process management.
- To provide an insight of supply chain management from both industrial and end - user perspective.

COURSE OUTCOME

On Completion of the course, the students will be able to :

1. Recognize the entire process that is undergone by manufacturers in meeting end-user needs.
2. Demonstrate from the manufacturer's perspective, students will have innovative ideas toeffectively meet the end user needs.
3. Solve industrial problems in supply chain management.

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 - Product life cycle, Fishers classification of products - Effective and responsive supply chains **(7)**

SUPPLY CHAIN PROCESS

Forecasting in supply chain, characteristics, components, methods and approaches, collaborative forecasting - time series methods of forecasting- forecast error distribution order quantity and reorder point - Demand Management in MPC - MTS - ATO - MTO, customer order lead time - Postponement. Lean - elements of lean, lean techniques, agility, leagility. Mapping business processes using lean. Supply chain process optimization. **(8)**

PRODUCT PROCUREMENT & INVENTORY MANAGEMENT

Procurement process - Sourcing in a supply chain - deciding factors for in-house or outsourcing - 3PL - 4 PL - Supplier selection and assessment - Inventory, economies of scale to exploit fixed costs, Economies of scale to exploit quantity discounts, Managing multi-echelon cycle inventory - Bullwhip effect Safety inventory, Managing safety inventory practice - Product substitution. EOQ - Order Timing Decisions, safety stock, continuous distributions, probability of stocking out criterion,

customer service criterion, time period correction factor. General inventory models, dynamic order quantity, deterministic and stochastic inventory models. **(10)**

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. **(10)**

IT IN SUPPLY CHAIN

Dynamic supply chain design, Impact of technology on SCM, Key trends in SCM, IT in supply chain coordination, IT in supply chain design - MRP, record processing, technical issues, using MRP and system dynamics - ERP - Performance metrics - Functional Silo approach - Integrated supply chain metrics - cash to cash time - CRM - ISCM - Discussion on supply chain adopted by primary industrial sectors and case studies. **(10)**

TOTAL: 45 HOURS

REFERENCE BOOKS

1. *Ayers, J., Hand Book of Supply Chain Management, CRC Press, 2006.*
2. *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.*
3. *Chopra, S., Meindl, P. and Kalra, D.V., Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc., 2015.*
4. *Fredendall, D.L. and Hill, E., Basics of Supply Chain Management, The St Lucie Press / APICS Series on Resource Management, 2001.*
5. *Monczka, R., Trent, R. and Handfield, R., Purchasing and Supply Chain Management, 3 rd Edition, Thompson Learning Inc., 2007.*
6. *Taha, H.A., Operations research : An Introduction, Prentice Hall, 2017.*
7. *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, 2014.*
8. *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 (2006), Inventory and Supply Chain Management with Forecast Updates, Springer International Series.*
5. *Mohantry, P.R and Deshmukh, G.S., (2005), Supply Chain Management, Theories and Practices, Published by Biztantra Innovations in Management.*
6. *Kulkarani, S and Sharma, A., (2008), Supply Chain Management, Tata McGraw Hill Publishing Company Limited.*

19MMA E07 – ADVANCED METROLOGY AND NONDESTRUCTIVE TESTING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To provide an insight for the need of quantifying the physical parameters and their techniques in evaluating them.
- To provide an insight to principles of latest metrological systems used in industries.
- To provide fundamental knowledge on non-destructive testing methods.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Demonstrate techniques used to quantify and comparison of products to required standards.
2. Conversant with the newer technologies used in metrology.
3. Demonstrate his or her knowledge in developing control mechanism to check variation inattributes and variables.

INTRODUCTION

Measuring Machines - Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Images shearing microscope- Use of computers- Machine vision technology - Microprocessors in metrology. **(9)**

STATISTICAL QUALITY CONTROL

Statistical Quality Control - Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - reliability and life testing. **(9)**

BASIC NDT TESTS

Liquid penetrants and magnetic particle tests - characteristics of liquid penetrants - different washable systems - Developers - applications - method of production of magnetic fields - Principles of operation of magnetic particle test - applications -Advantages and limitations. **(9)**

RADIOGRAPHY

Radiography - Sources of ray - x- ray production - properties of □ and x rays - film characteristics - exposure charts-contrasts-operational characteristics of x ray equipment - applications. **(9)**

ULTRASONIC TESTING METHODS

Ultrasonic and acoustic emission techniques - Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method -A, B, C scans -Principles of acoustics emission technique - Advantage and limitations - Instrumentation – applications. **(9)**

TOTAL: 45 HOURS

REFERENCES

1. *Connie Dotson and Roger Harlow, "Fundamentals of Dimensional Metrology", Cambridge University Press, 2016.*
2. *Galyer J F W and Shotbolt C R, " Metrology for Engineers", Thompson Learning Publishers, New York, 2003.*
3. *Barry Hull and Vernon John ," Non Destructive Testing ", Mac Millan, 2015.*
4. *Progress in Acoustics Emission, " Proceedings of 10th International Acoustics Emission Symposium", Japanese Society for NDI,1990.*

WEB REFERENCES

1. *www.metrologytooling.com*
2. *www.sisndt.com*
3. *www.iuk'tu-harburg.de*

19MMA E08 – PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide an understanding of production management and re-engineering concepts, their applications to manufacturing system.
- To deal with managerial, strategic and technological dimensions of productivity management and re-engineering.
- To understand the improvement tools and techniques, so as to deal with business challenges from a leadership and management perspective globally.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Apply the need for quality assurance, in the industry with engineering standards like ISO 9000-2000
2. Use variety of analysis and design techniques to document process improvement and modelsrequired for productivity.
3. Use various models and tools are implemented towards effective Re-engineering concept.

PRODUCTIVITY:

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organization level - Productivity measurement models. (9)

SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT:

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector. (9)

ORGANISATIONAL TRANSFORMATION:

Elements of Organizational Transformation and Reengineering Principles of organizational transformation and re-engineering, fundamentals of process reengineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model. (9)

RE-ENGINEERING PROCESS IMPROVEMENT MODELS:

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model. (9)

RE-ENGINEERING TOOLS AND IMPLEMENTATION:

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases studies. (9)

TOTAL:45 HOURS

REFERENCES

1. *Edosomwan, J.A., "Organisational transformation and process re-engineering", British Library Cataloging in Pub. Data, 2012.*
2. *Sumanth, D.J., "Productivity engineering and management", Tata McGraw Hill, New Delhi, 2010.*
3. *Rastogi, P.N. "Re-engineering and Re-inventing the enterprise", Wheeler Pub. New Delhi, 2006.*
4. *Premvrat, Sardana, G.D. and Shahay, B.S., "Productivity Management - A systems approach", Narosa Pub. New Delhi, 2010.*
5. *Lawrence Leemis., "Reliability : Probabilistic models and Statistical methods", Prentice Hall, 2000.*

19MMA E09 – SUPPLY CHAIN INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide the role played by information system in supply chain enhancement.
- To provide a detailed knowledge about e-business and e-commerce application in real World supply chains.
- To develop knowledge & role of databases in SCM, along with the knowledge on future projected SC information system.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Demonstrate knowledge in integrated relationship between supply chain and information system
2. Identify &analyze the role played by information in initiating the material flow, and the role

INTRODUCTION

World Wide Web - Web search elements - Web fundamentals - new technologies and innovations - Security protocols - Networks and numbers - Zones and domain names - Packets and protocols - OSI reference model - Intranet and its applications - Types of client server architecture - Extranet Role of IT in network design - forecasting – planning – transportation – sourcing – coordination. **(7)**

E -BUSINESS

e - Business - Evolution of e-business - Types of e-business- Benefits of e-business - Dimensions of e-business and e-com - e-business infrastructure - ERP system - Enterprise structure modeling (Oracle application)- CRM - Selling chain management - infrastructure of selling chain - e-business servers - client connectivity - e-business case studies - e-business relationships with the stake holders - Internal & internet based requisition development (Access / SQL) **(9)**

E -COMMERCE

The concept of e-commerce - e-commerce activities - Advantages and issues of e-com - Building blocks of electronic commerce - e-commerce business models - Value chain in e-commerce - Electronic auctions - Forward, reverse & Internet Auction - Intermediary Oriented B2B - EDI - Business to Business (B2B) – Kaplan – Sawhney B2B matrix. **(8)**

APPLICATION OF E-COMMERCE

Features and challenges of B2B exchanges - Buyer oriented B2B - Supplier oriented B2B - Business to Consumer (B2C) -Online retailing vs traditional retailing - Product suitability for online retailing - Alternative models of e-retailing: Amazon vs Webvan - elements of successful B2C strategy - Marketing on the internet - Consumer to Business (C2B) - Consumer to Consumer (C2C) - Case studies on e-commerce – m – commerce. **(10)**

ADVANCED SUPPLY CHAIN INFORMATION SYSTEMS

SC information flows - A map of SCM Systems - Drivers of new SC systems & applications - ERP systems - E-sourcing/supply & web based systems- Types of systems - Reverse auctions - Evolving E-sourcing vendors - E-sourcing and fully integrated systems - Information visibility - Benefits of information visibility – e supply chain fusion – The continuing evolution of E – Supply chains. **(11)**

TOTAL: 45 HOURS

REFERENCES

1. *Agarwala, N. K., Lal, A. and Agarwala, D., Business on the Net - An Introduction to the 'Whats' and 'Hows' of e-commerce, Macmillan India Ltd., 2000.*
2. *Awad, E.M., Electronic Commerce from Vision to Fulfillment, Prentice Hall India, 3rd Edition, 2015.*
3. *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.*
4. *Chakrabarti, R. and Kardile, V., The Asian Managers Handbook of e -commerce, McGraw Hill Publishing Company Limited, 2002.*
5. *Chopra, S., Meindl, P. and Kalra, D.V., Supply Chain Management, Strategy, Planning and Operation, Pearson Education, Inc., 2015.*
6. *Elsenpeter, C.R and Velte, J.T., E Business: A Beginner's Guide, Tata McGraw Hill Publishing Company Limited., 2001.*
7. *Gerald, B., King, N. and Natchek, D., ORACLE E -Business Suite Manufacturing & Supply Chain Management, Oracle Press, Tata McGraw Hill Publishing Company Limited., 2006.*
8. *Kalakota, R and Robinson M., e-business 2.0, Roadmap for Success, Pearson Education Inc., 2009.*
9. *Monczka, R., Trent, R. and Handfield, R., Purchasing and Supply Chain Management, 3rd Edition, Thompson Learning Inc., 2007*

19MMA E10 – ADDITIVE MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To provide a detailed knowledge on advanced manufacturing techniques, the Additive manufacturing processes.
- To aid in understanding the need, types, application, method of operation and the future of AM system in industrial applications.
- To enhance innovative thinking and solve business case studies in AM technique.

COURSE OUTCOME

On Completion of the course, the students will be able to :

1. Demonstrate in-depth knowledge about RP/AM technologies along with recent trends in advanced manufacturing.
2. Illustrate quick response manufacturing and develop end to end solutions in product manufacture.
3. Develop innovative component and product designs using RP/AM technogies.

INTRODUCTION

Process requirements for Rapid Prototyping - Product Prototyping and Product Development - Prototyping - Need for Prototyping - Issues in Prototyping - Conducting Prototyping - Design Procedure - Prototype Planning and Management - Product and Prototype Cost Estimation - Fundamentals of Cost Concepts - Prototype Cost Estimation - Cost Complexities - Prototype Design Methods - Prototype Design tools - Morphological Analysis - Functional Efficiency Technique - Paper Prototyping - Selecting a Prototype - Learning from Nature. (9)

VIRTUAL PROTOTYPING, MATERIALS SELECTION & PROCEDURE FOR PROTOTYPING

Using Commercial Software for Virtual Prototyping - Prototyping Materials - Material Selection Methods - Rapid Prototyping Overview - Rapid Prototyping Cycle - Rapid Prototyping Procedure - STL files - Converting STL File from Various CAD Files - Controlling Part Accuracy in STL Format - Slicing the STL File – Case Studies in Design for Assembly, product optimization for actual and support materials. Design thinking. Inputs for AM – Understanding the various inputs types. (9)

TYPES OF ADDITIVE MANUFACTURING PROCESS

Types of AM Process - Stereolithography -- Fused Deposition Modelling - Selective Laser Sintering - 3D Printing Process, Polyjet printing -- Laminated Object Manufacturing - Electron Beam Melting Process -- History - Operation - Advantages and Disadvantages - Applications - Relation to Other AM Technologies - (applies to all the process) - Direct Laser Deposition. (9)

APPLICATIONS OF ADDITIVE MANUFACTURING

Investment casting – Sand casting – Permanent Mould casting – Direct RP tooling – Silicone Rubber Tooling – Investment Cast Tooling – Powder Metallurgy Tooling – Desktop Machining – Case studies on current application of AM – Novel Application of AM systems – Future trends of AM system (9)

RAPID MANUFACTURING

Rapid Manufacturing - Potential of RM on Design - Geometrical Freedom - Material Combinations - Customer Input - RM of Prototypes - Reverse Engineering - Interactive CAD Models - Role of Materials in RM - Materials for RM Process - Product Customisation and Case Studies - Future Developments Serving RM - Production Economics of RM - Cost of Manufacture - Application of AM in Medical, Automotive, Aeronautical, Space and Construction Industries. (10)

TOTAL: 45 HOURS

TEXT BOOK

1. *Hopkinson, N., Hague, R.J.M, and Dickens, P.M., Rapid Manufacturing, An Industrial Revolution for the Digital Age, John Wiley & Sons, Ltd, UK, 2006.*
2. *C.K. Chua, K.F. Leong, C.S. Lim, "Rapid prototyping Principles & Application (3rd Edt), World Scientific Publication, 2018*

REFERENCE

1. *Cooper, G.K., Rapid Prototyping Technology Selection and Application, Marcel Dekker Inc, USA, 2001.*
2. *Liou, W.F., Rapid Prototyping and Engineering Applications, A toolbox for prototype development, CRC Press, Taylor & Francis Group LLC, USA, 2008.*
3. *Kai., C.C, Lim, C.S. and Leong, F.K., Rapid Prototyping: Principles and Applications in Manufacturing, Wiley Publication, 2008*
4. *Additive Manufacturing Design, Methods & Processes, Steinar killi, Taylor & Francis, 2017*

JOURNALS

Rapid prototyping
Additive manufacturing

19MMA E11 – ADVANCES IN CASTING AND WELDING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide knowledge about solidification of metals and corresponding design principles of casting.
- To import principles and applications of latest casting processes
- To gain knowledge about thermal effects of welding, Weldability of ferrous and non-ferrousmetals, residual stresses in weldments, good weld joint design principles and latest weldingprocesses.
- To acquire latest knowledge about automation in casting and welding.

COURSE OUTCOME

On Completion of the course, the students will be able to:

1. Demonstrate the ability to analysis & design economical procedure of product development,incorporating environmental and social issue.
2. Acquire skills required to work in a multi-disciplinary environment.
3. Recognize knowledge on emerging science of manufacturing principles& engage in lifelonglearning process.

CASTING METALLURGY AND DESIGN

Casting metallurgy and design-Heat transfer between metal and mould-Solidification of pure metals and alloys-Shrinkage in cast metals-Progressive and directional solidification-Principles of gating and riser-Degasification of the melt-Design considerations in casting- Casting defects, Designing for directional solidification and minimum defects. **(9)**

SPECIAL CASTING PROCESS

Special casting process-Shell Moulding, precision investment casting, CO2, Stir casting, Combo casting, squeeze casting, moulding, centrifugal casting, die casting and continuous casting. **(9)**

WELDING METALLURGY AND DESIGN

Welding metallurgy and design-Heat affected zone and its characteristics-Weldability of steels, Stainless steel, aluminium and Titanium alloys-Hydrogen embitterment-Lamellar tearing-Residual stress-Heat transfer and solidification-Analysis of stresses in welded structures-pre and post welding heat treatments- weld joint design – welding defects – testing of weldment. **(9)**

UNCONVENTIONAL AND SPECIAL WELDING PROCESSES

Unconventional and special welding processes-Friction welding- Friction stir welding - Explosive welding-Diffusion bonding-High frequency Induction welding-Ultrasonic welding-Electron beam welding-Laser beam welding. **(9)**

RECENT ADVANCES IN CASTING AND WELDING

Recent advances in casting and welding-Layout of mechanized foundry-sand reclamation-Material handling in foundry-Pollution control in Foundry-Recent trends in casting-Computer Aided design of Castings, Low pressure die casting, Squeeze casting, full mould casting process. Automation in welding-Welding Robots – Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding. **(9)**

TOTAL: 45 HOURS

REFERENCES

1. *Lal.M. and Khanna.O.P."A Text Books of Foundry Technology", Dhanpat Rai & Sons, 2012.*
2. *R S Parmer, "Welding Engineering Technology", Khanna Publishers, 2nd Edition, 2008.*
3. *Jain p L, "Principles of Foundry Technology", Tata McGraw Hill, 2012.*
4. *Titoun.D. & Stepanov.Yu.A.,"Foundry Practice", MIR Publishers,Moscow, 2010.*
5. *Heine Loper& Rosenthal, "Principles of Metal Casting", Tata McGraw Hill, 2010..*
6. *Cornu.J.,"Advanced Welding Systems"-Volumes I,II, and III, JAICO Publishers,1994.*
7. *Lancaster.J.F., "Metallurgy of welding"-George Allen & Unwind Publishers, 1980.*
8. *"Welding Handbook".(Section I) American Welding Society, 1991.*
9. *Kazakov. N.F.,"Diffusion bonding of materials", MIR Publishers, Moscow,1985.*

19MMA E12 – PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To create the abilities to create a new product.
- Competence with a set of tools and methods for product design and development.

COURSE OUTCOME

On Completion of the course, the students will be able to:

1. Identify and analyze the product design and development processes in manufacturing industry.
2. Apply product specification through a methodical approach to the management of product development to satisfy customer needs.
3. Build product architecture and conceptualize industrial design for the product.
4. Be familiar with the design protection and Intellectual property.

INTRODUCTION:

Significance of product design, product design and development process, sequential engineering design method, the challenges of product development.Identifying opportunities, evaluate and prioritize projects, allocation of resources. (9)

IDENTIFYING CUSTOMER NEEDS&PRODUCT SPECIFICATIONS AND CONCEPT SELECTION

Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs.Establish target specifications, setting final specifications. Activities of concept generation, clarifying problem, search both internally and externally, explore the output. Overview, concept screening and concept scoring, methods of selection. (9)

INDUSTRIAL DESIGN& CONCEPT TESTING:

Assessing need for industrial design, industrial design process, management, assessing quality of industrial design. Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response. (9)

THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ):

Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model based technology for generating innovative ideas. (9)

INTELLECTUAL PROPERTY AND DESIGN FOR ENVIRONMENT:

Elements and outline, patenting procedures, claim procedure. Design for Environment: Impact, regulations from government, ISO system. (9)

TOTAL: 45 HOURS

REFERENCES:

1. *Ulrich K.T., Eppinger, S D, "Product design and development; McGraw Hill; 2004.*
2. *Otto, K.N., Wood, K L, "Product Design – Techniques in Reverse Engineering and New Product development, Prentice Hall, 2001*
3. *Pahl G., Beitz W., Feldhusen J, Grote K.H, Engineering Design - A systematic Approach, Springer 2007.*

19MMA E13 – COMPUTER AIDED PROCESS PLANNING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To study the Process Planning concepts, Part Design Representation, Process engineering and planning and Computer Aided Process Planning Systems, Integrated Process Planning Systems and part family generation.
- To make them apply these in the industries, process planning sheet preparations.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Develop process planning techniques for an Industry.
2. Discuss part design representation and Process planning.
3. Apply Decision making process for appropriate planning idea about various process planning software

INTRODUCTION

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology. (8)

PART DESIGN REPRESENTATION

Design Drafting - Dimensioning - Conventional tolerancing - Geometric tolerancing - CAD - input/output devices - topology - Geometric transformation - Perspective transformation - Data Structure - Geometric modeling for process planning – GT coding – Optiz – MICLASS system (9)

PROCESS ENGINEERING AND PROCESS PLANNING

Experience based planning – decision table and decision tree - Process capability analysis - Process Planning - Forward and Backward planning & scheduling, software for studying, Input format, Artificial Intelligence (9)

COMPUTER AIDED PROCESS PLANNING

Computer Aided Process Planning Systems - Logical Design of a Process Planning - Implementation considerations - manufacturing system components, production volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP. - Process planning Softwares (9)

AN INTEGRATED PROCESS PLAN SYSTEMS

Totally integrated process plans systems - An overview - Modulus structure - Data Structure, operation - Report generation, Expert Process Planning. (10)

TOTAL : 45 HOURS

REFERENCES

1. *Gideon Halevi and Roland D.Weill,"Principles of Process planning, A logical approach", Chapman Hall, 1995.*
2. *Tien - Chien Chang, Richard A.Wysk,"An introduction to automated process planning systems", Prentice Hall,1985.*
3. *Chang, T.C.,"An Expert process planning system", Prentice Hall, 1985.*
4. *Nanua singh, "Systems approach to Computer Integrated Design and Manufacturing", John Wiley & Sons,1996.*
5. *P.N. Rao, "Computer Aided Manufacturing",Tata McGraw Hill Publising CO., 2000.*

WEB REFERENCE

1. *http://claymore.engineer.gusu.edu/jackh/eod/automate/capp/capp.htm*
2. *http://Estraj.ute.sk/journal/engl/027/027.htm*

19MMA E14 – ADVANCED MANUFACTURING PLANNING AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To understand the various components and functions of production product planning, process planning, production scheduling and plant control.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Describe (identify/write) the various components that make up the manufacturing planning and control system for effective plant configurations.
2. Show how (i) the material requirement plans, manufacturing resource plans, and capacity requirement plans can be developed, and (ii) lot sizing decisions can be made for a manufacturing system.
3. Describe the issues concerning Just-in-Time (JIT) manufacturing and its benefits.
4. Develop the algorithm that are appropriate for solving single machine, two machine and flow shop scheduling problems.

INTRODUCTION TO MANUFACTURING SYSTEMS ENGINEERING:

Process Planning, Logical design of process planning, Computer Aided Process Planning (CAPP), Computerization of file management; Variant (Retrieval), Generative and semi generative approaches, General remarks on CAPP developments and trends. (9)

RESOURCE PLANNING & PRODUCTION CONTROL:

Overview of production control, Forecasting, Master production schedule, Materials requirements planning, Evolution from MRP to MRP II, Evaluation of MRP approach, Order release, Shop floor control. (9)

JUST IN TIME (JST) PRODUCTION:

Introduction- The spread of JIT movement, Some definitions of JIT, Core Japanese practices of JIT, Profit through cost reduction, Elimination of over production, Quality control, Quality assurance, Respect for humanity, Flexible work force, JIT production adapting to changing production quantities, Process layout for shortened lead times, Standardization of operation, automation. (9)

JOB SEQUENCING AND OPERATIONS SCHEDULING:

Introduction- Job sequencing-n jobs, One machine-n jobs, Two machine-n jobs, Three machines-n jobs- two jobs, M machines –n jobs, M machines-sequencing jobs on parallel machines, Minimization of setup costs. (9)

PLANT CONFIGURATIONS:

Introduction-Ultimate plant configuration, Job shop fabrication, Dedicated production lines, overlapped production, Daily schedule, Forward linkage by means of Kanban, Physical merger of processes, Adjacency, Mixed models, Automated production lines, Pseudo robots, Robots, CAD and manufacturing, Conveyers and stacker cranes, Automatic Quality monitoring. (9)

TOTAL: 45 HOURS

REFERENCES:

1. *S. K. Mukhopadhyay, "Production Planning and Control: Text and Cases", PHI, 2007.*
2. *G. Halevi & R. D. Weill, "Principles of Process Planning", Chapman & Hall, Madras, 1995.*
3. *M. P. Groover, "Automatic Production System and Computer Integrated Manufacturing", Prentice Hall, 1990.*
4. *Bary Hawkes, "CAD/CAM Processes", 1990.*
5. *Evert E. Adams Jr., & Donold J. Ebert, "Production and Operation Management", Prentice Hall of India, 1994.*
6. *S. N. Chary, "Production and Operations Management", 3rd Edition, Tata McGraw Hill, New Delhi,1991.*
7. *Patrik Jonsson & Stig-Arne Mattsson, "Manufacturing Planning and Control", Tata McGraw Hill, 2011.*

19MMA E15 – FLEXIBLE COMPETITIVE MANUFACTURING SYSTEM

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To gather information about Flexible manufacturing system concept in detail and also understand the importance of sequencing

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Implement the concepts of group technology, the techniques of part family generation and improve the performance of manufacturing system.
2. Apply newer techniques in real time manufacturing environment methodologies in order to reduce total manufacturing lead time and down time in the production shop floor.

INTRODUCTION

Manufacturing in a competitive environment - Automation of manufacturing process - types of automation - material handling and movement - industrial robots - Sensor technology - flexible, fixturing - Design for assembly, disassembly and services. (9)

GROUP TECHNOLOGY AND CELL DESIGN

Group technology - Part families generation - classification and coding - Production flow analysis – Machine cell design – Benefits (9)

FLEXIBLE MANUFACTURING SYSTEM AND APPLICATIONS

Flexible Manufacturing System - Introduction - Components of FMS - Application work stations - Computer control and functions - Planning, scheduling and control of FMS - Scheduling - Knowledge based scheduling - Agile manufacturing. (9)

SOFTWARE INTEGRATION WITH FMS

Computer software, simulation and database of FMS - System issues - Types of software - specification and selection Trends - Application of simulation software - Manufacturing data system - data flow - CAD/ CAM considerations - Planning FMS database. ` (9)

LEAN MANUFACTURING

Just in time - Characteristics of JIT - batch size concepts - work station loads - close supplier ties - flexible work force - line flow strategy. Total productive maintenance - Kanban system - strategic implications - implementation issues - MRD JIT - Lean manufacturing. (9)

TOTAL : 45 HOURS

REFERENCES

1. *H.K. Shivanand, M.M. Benal, V. Koti, Flexible manufacturing system, New Age international, First edition, 2010.*
2. *Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt Ltd., New Delhi, 2014.*
3. *Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New*
4. *Delhi 2010*
5. *Kalpakjain, "Manufacturing Engineering and Technology", Addision-Wesley Publishing Co. 2010.*
6. *Talichi Ohno, Toyoto, "Production System Beyond Large-Scale production", Productivity Press (India) Pvt. Ltd.,1992.*

19MMA E16 – CORROSION AND SURFACE ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide detailed knowledge about different types of corrosion mechanism, corrosion behavior of ferrous and non-ferrous materials and the factors that influence it.
- To gain knowledge about the standard corrosion testing procedure and corrosion prevention methods.
- To acquire properties and applications of various surface coating techniques

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Identify the possible type of corrosion that the selected material could be subjected to and thecorresponding corrosion prevention measures to be adopted.
2. Knowing the corrosion and wear behavior of materials one could select suitable surface coatingmethods and effectively control the properties of coatings.

INTRODUCTION

Mechanisms and types of corrosion - Principles of direct and Electro chemical corrosion, Hydrogen evolution and oxygen absorption mechanisms - Galvanic corrosion, Galvanic series - specific types of corrosion such as, Uniform, Pitting, Inter granular, - Factors influencing Corrosion. **(9)**

CORROSION OF MATERIALS

Corrosion Behavior of Materials - Corrosion of Steels, Stainless steels, Aluminium alloys, Copper alloys, Nickel alloys and Titanium alloys - Corrosion of polymers, Ceramics and composite materials **(9)**

TESTING METHODS

Testing and prevention of corrosion - Corrosion testing techniques and procedures - Prevention of corrosion - Design against corrosion - Modification of corrosive environment - Inhibitors - Cathodic protection - Protective surface coatings **(9)**

SURFACE ENGINEERING

Surface engineering for wear and corrosion resistance - Surface engineering by material removal and material addition; Surface modification of ferrous and nonferrous metals- carburizing, nitriding, cyaniding, hot dipping, galvanizing, chromating, anodizing, phosphating of aluminium; Surface engineering by energy beams, Plasma enhanced surface engineering, Laser assisted surface modification **(9)**

THIN LAYER ENGINEERING PROCESSES

Thin Layer Engineering Processes - Laser and Electron Beam hardening - Effect of process variables such as power and scan speed - plasma enhanced chemical vapour deposition, plasma chemical vapour deposition, Arc vapourisation, Sputtering, ion plating - Coating of tools, TiC, TiN, and Al_2O_3 - Coating on diamond and polymers - Applications of thin coatings. **(9)**

TOTAL : 45 HOURS

REFERENCES

1. *Fontana, G., "Corrosion Engineering", McGraw-Hill, 2010.*
2. *Schweitzer P.A., "Corrosion Engineering Hand Book", 3rd Edition. Marcel Decker, 1996.*
3. *Winston Revie, R,Uhlig's "Corrosion, Hand Book", 2nd Edition, JohnWiley, 2000.*
4. *Kammeth G.Budinski, "Surface Engineering for Wear resistance", Prentice Hall, 2000.*
5. *"Metals Handbook, Vol.5- Surface Engineering", ASM International, 1996.*
6. *K. L. Chopra, Thin Film Phenomena, McGraw Hill, 1979.*
7. *R.F. Bunshah, Deposition Technologies for Films and Coatings, Noyes Publications, New Jersey, 1982.*

19MMA E17 – ADVANCED TOOL ENGINEERING AND DESIGN

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To enable the students to understand the analysis, planning, design, construction and application of tools, methods and procedures necessary to increase manufacturing productivity.
- To provide an exposure to the recent trends in the field of tool engineering.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Work on tool design related software's and its applications.
2. Design of the metal cutting tools.
3. Select proper tools for appropriate applications considering type of process.

MECHANISM OF CHIP FORMATION AND TYPES OF CHIPS

Mechanism of chip formation, Types of chip, techniques for the study of chip form formation, chip tool interface, built – up edge, chip breakers etc – problems. **(4)**

FORCES IN METAL CUTTING

Stress on the shear plane, Shear angle relationship in thin plane analysis. Minimum energy theory - stresses on the tool. Measurement of tool Forces - virtual tool dynamometers - evaluation of cutting forces, tool failures, work piece failure etc. with various real time problems. **(6)**

THERMAL ASPECTS OF METAL CUTTING

Heat in metal cutting, Flow of heat, Methods of tool temperature measurement, significance of cutting tool temperature. Cutting fluids - Types and selection - evaluation of heat flow in both the tool and work piece. **(6)**

CUTTING TOOL MATERIAL AND TOOL WEAR

Cutting tool materials - classification, application, heat treatment. Mechanisms of tool wear, Tool failure, Methods of tool wear Measurement. Tool life, Machinability index, Tool life equations, Universal machinability index, Economics of turning. **(8)**

THERMAL ANALYSIS WITH CFD SOFTWARE

Introduction to CFD - various tools and techniques in CFD - various features of CFD - Applications of CFD – Comparison of CFD with ANYSY and NISA – CFD in thermal analysis of metal cutting. **(6)**

JIGS & FIXTURES

Fundamental ideas and principles of Jigs and Fixtures. Design of drill jigs and fixtures for turning, drilling, milling, broaching and grinding operations. Locating and clamping devices of jigs and fixtures. Indexing devices and types. Different types of jigs & fixtures. Design of a jig and fixtures for the given component by using Computer Aided Design (CAD) **(8)**

PRESS TOOLS & ECONOMIC ASPECTS OF TOOLING

Dies, punches, types of presses, clearances, types of dies, strip layout, calculation of press capacity, center of pressure. Design consideration for die elements. Economics of tooling - Tool selection and tool replacement with respect to small tools. **(7)**

TOTAL : 45 HOURS

REFERENCES

1. *Ranganath B J, "Metal Cutting and Tool Design", Vikas Publishing House, 2001.*
2. *Ranganath.B J, "Tool Engineering Design:, Vikas Publishing House Pvt. Ltd, New Delhi, 2nd Edition, 2012.*
3. *ASTME "Fundamentals of Tool design:.Prentice Hall of India Pvt. Ltd., New Delhi. 5th Edition, 2000.*
4. *Sharma. P.C.,"A Text Book of Production Engineerig" S.Chand & Co. Ltd., New Delhi, 2005*
5. *"P.S.G Design Data Book", PSG college of Technology, DPV printers, Coimbatore, 2005.*

19MMA E18 – PLASTICS AND COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To import knowledge about different types of plastics and composites and their fabrication methods.
- To acquire details about the effects of machining and joining parameters on its quality
- To gain knowledge about the different types of reinforcements and its corresponding fabrication methods of composites.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Select suitable plastics and composite materials for the required applications and itscorresponding fabrication method.
2. Identify service requirements and how to relate materials to those requirements.
3. Identify the various properties of composites and plastics.

INTRODUCTION

Introduction - Chemistry and classification of Polymers - Properties of Thermo plastics and Thermosetting plastics - Applications - Merits and Demerits. **(6)**

PLASTICS PROCESS

Processing of plastics - Extrusion - Injection Moulding -Blow Moulding - Compression and transfer Moulding - casting - Thermo forming. Machining and joining of plastics – General machining properties of Plastics - Press Fitting. **(15)**

COMPOSITE MATERIALS

Introduction to Composite Materials - Fibers - Glass, Boron , Carbon , Organic , Ceramic and Metallic Fibers - Matrix Materials - Polymers, Metals and Ceramics **(6)**

POLYMER MATRIX COMPOSITES

Processing of Polymer Matrix Composites - Open Mould Processes, Bag Moulding, Compression Moulding with BMS and SMS - Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding – Application of PMC’s. **(10)**

METAL MATRIX COMPOSITES

Processing of metal matrix composites - Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques - Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fiber - Liquid State Fabrication Method - Infiltration - Squeeze Casting - Rheo Casting - Compocasting – Application of MMC's. **(10)**

TOTAL : 48 HOURS

REFERENCES

1. *Harold Belofsky, "Plastics: Product Design and Process Engineering", Hanser Publishers, 1995.*

2. *Bera, E and Moet, A, "High Performance Polymers", Hanser Publisners ,1991*

3. *Hensen.F, "Plastics Extrusion Technology", Hanser Publishers, 1988.*

4. *Johnnaber F, "Injection Moulding Machines", Hanser Publishesr, 1983.*

5. *Rauwendaal, C, "Polymer Extrusion", Hanser Publishers, 1990.*

6. *.A.K.B hargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice-Hall of India Limited, New Delhi, 2005.*

19MMA E19 – TOTAL QUALITY SYSTEMS AND ENGINEERING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Design a better system in manufacturing and implement the appropriate processes.
2. Apply the basic concepts of sampling problems in real world applications.
3. Demonstrate his ability in solving industrial problems using SQC methods.

PRINCIPLES OF TQM

Introduction - Principles of Quality Management - Pioneers of TQM - Quality costs - Quality system Customer Orientation - Benchmarking - Re-engineering - concurrent engineering. **(9)**

LEADERSHIP AND QUALITY AUDITING

Practices of TQM - leadership - organizational structure - Team building - Information systems and documentation - Quality Auditing - ISO 9000 - QS 9000. **(9)**

TQM TECHNIQUES

Techniques of TQM - Single vendor concept - JIT- Quality Function Deployment - Quality circles – KAIZEN - SGA - POKA - YOKE - Taguchi Methods. **(9)**

STATISTICAL QUALITY CONTROL

Statistical Quality control - Methods and Philosophy of Statistical process control - Control Charts for variables and Attributes - Cumulative sum and exponentially weighted moving average control charts. Other SPC Techniques - Process Capability Analysis - Six Sigma accuracy. **(9)**

SAMPLING

Acceptance sampling - Acceptance sampling problem - Single sampling Plans for attributes - double, multiple and sequential sampling, Military standards - The Dodge & Romig sampling plans. **(9)**

TOTAL : 45 HOURS

REFERENCES

1. *Suresh Dalela and Saurabh, "ISO 9000 - A Manual for total Quality Management", S.Chand and Company Ltd., 1997*

2. *John Bank, "The Essence of Total Quality Management", Prentice Hall of India Pvt. Ltd., 2nd Edition, 2001.*
3. *Dale H. Besterfield, Carol Besterfield-Michna and Glen H. Besterfield, "Total Quality Management", Pearson Education Private Ltd., 2007.*

4. *Oakland J S , "Total Quality Management - Text with cases", Butterworth - Heinemann - An Imprint of Elseiver, First Indian Print, 2003.*

5. *Suganthi. L and Anand A Samuel, "Total Quality Management", Prentice - Hall of India, New Delhi, 2005.*

6. *Howard Gitlow, Alan Oppenheim and Proa Oppenheim, "Quality Management", McGraw-Hill Inc, 2005.*

7. *Mohamed Zairi, "Total Quality Management for Engineers", Woodhead Publising Limited 1991.*

8. *Harvid Noori and Russel, "Production and operations management - Total Quality and Responsiveness", McGraw-Hill Inc, 1995.*

9. *Douglus C Montgomery, "Introduction to Statistical Quality Control", McGraw Hill, 2009.*

10. *Grant E.L and Leavensworth, "Statistical Quality control", McGraw Hill, 2000.*

WEB REFERENCES

1. *www.ahepr.gov/research/feboo/0200ra15.htm.*

2. *www.mcb.co.uk/tam.htm*

19MMA E20 – ADVANCES IN FOUNDRY TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To know about the casting metallurgy and design aspects of molding, gating and riser.
- To learn about the special casting processes and foundry mechanization.
- To understand about the computer applications in foundry technology.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Perform casting design with the acquired knowledge on runner, riser, gates materials andcomponents for the desired product.
2. Apply computer aided design for the casting and select suitable foundry technique for the desiredproduct.
3. Design a better foundry layout in order to increase the productivity by implementing mechanizationtechniques and computers.

INTRODUCTION

Basics of casting techniques - Various aspects of advances inn foundry technology - Scope of the study **(1)**

CASTING METALLURGY AND DESIGN

Casting metallurgy & design - Solidification of pure metals and alloys - Fluidity- Shrinkage in cast metals - Absorption of gases - Degassing methods - Progressive solidification - Directional solidification – Hot spot & Junction – Design for moulding - Design for core support. **(9)**

PRINCIPLE OF GATING AND RISER

Principle of gating and riser - Improvement of yield efficiency - Simple problems in gating and risening for steels and cast irons. **(9)**

SPECIAL CASTING PROCESSES

Special casting processes - Shell moulding, investment casting, Carbon - Dioxide moulding, Centrifugal casting, Die casting, Continous casting, Squeeze casting, Vaccum casting, Full mould processes, Semi-solid metal casting, Thixocasting and Rheocasting process, Compocasting **(11)**

FOUNDRY MECHANIZATION

Foundry mechanization - Layout of mechanized foundry - Sand reclamation - Material handling in foundry – Pollution control in foundry – casting defects – Identification, Analysis and Remedies. **(10)**

COMPUTER AIDED DESIGN AND CASTINGS

Computer aided design and castings - Computer aided pattern making and use of rapid prototyping technology in foundry, Feeder design and solidification analysis, Gating design and mould filling analysis, Rapid tooling fabrication, Implementing rapid casting development technologies, Case study from industry. **(6)**

TOTAL : 48 HOURS

REFERENCES

1. *Heine R W., Loper, C.R.Rosenthal, P.C.,"Principles of Metal Casting",Tata-McGraw Hill Publishing Co Ltd, 2010*
2. *Jain P.L,"Principles of Foundry Technology", Tata McGraw Hill Publishing Co Ltd, New Delhi, 2010*
3. *R.K. Jain "Principles of Foundry Technology", 3rd Edition, Tata Mc Graw Hill, 2005.*
4. *"ASM Metals Hand book on Casting", Revised Edition 1995.*
5. *Heine.R.W.Loper and Rosenthal "Principles of Metal Casting" Tata Mc Graw Hill, 1997.*
6. *Peter Beelay "Foundry Technology", Second Edition, Butterworth, 2001.*
7. *Ravi.B "Metal Casting Computer aided Design and Analysis" Prentice Hall, 2005.*
8. *Srinivasan. N.K. "Foundry Engineering" Khanna Tech Pub Co, New Delhi, 2000.*

19MMA E21 – ADVANCED AGILE AND LEAN MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Utilize the fundamental principle in transforming conventional manufacturing organization intoE-manufacturing systems.
2. Apply the knowledge of various e-manufacturing technologies and their possible implementation.
3. Identify the considerations and paradigms needed when selecting, evaluating, and adoptingthe E-manufacturing concept in the manufacturing industries.

INTRODUCTION

Introduction - Manufacturing operations - Manufacturing Industries and products - Manufacturing Support systems - E- manufacturing concept. **(7)**

MANUFACTURING STRATEGY

Manufacturing strategy and supply chain - Forecasting systems - Dimensions of manufacturing strategy Supply chain management concepts - Aggregate planning - Single stage inventory control(**10)**

LEAN MANUFACTURING

Lean Manufacturing - Principles of lean manufacturing - Lean flow- Two paths of implementing lean manufacturing - methodologies for change- environment for change - Pitfalls in implementing lean manufacturing **(8)**

AGILE MANUFACTURING

Agile manufacturing - Meaning and definition of Agility - Force pulling towards Agility - Three consequences converging physical products, information and services - Empowerment -Enterprise Integration – Concurrent operations - Planning internal alignment of company - Role of strategic planning departments **(10)**

E-MANUFACTURING

E-Manufacturing - Concepts of E-Manufacturing - Use of internet in manufacturing industries - E-business technology in manufacturing industry - Scope of applications - Implementation Methodology - Benefits of E- Manufacturing. **(10)**

TOTAL : 48 HOURS

REFERENCES

1. *William M Feld, "Lean Manufacturing Tools, Techniques and How to Use Them", The St. Lucie Press/APICS Series on Resource Management , 2001.*

2. *Mikell P. Groover., "Automation, Production Systems and Computer - Integrated Manufacturing ", Pearson - Prentice Hall, 2016.*

3. *Ronald G.Askin, " Design and Analysis of Lean Production System ", John Wiley and Sons, 2007 .*

4. *Bedwprth D D, " Integrated Production control systems Management,Analysis, Design ", John Wiley and Sons, Newyork, 2002.*

5. *Vollman T E ," Manufacturing Planning and Control Systems", Galgotia publication, New Delhi,1998.*

6. *Paul Kenneth wright , " 21st Century Manufacturing", Prentice Hall, 2001*

7. *Montgomery J C and Levine L O, "The Transition to Agile Manufacturing - Staying Flexible for Competitive Advantage", ASQC Quality Press, Wisconsin, 1995.*

19MMA E22 – ADVANCED BIOMATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To develop knowledge, understanding and practical experience of synthetic used in different biomedical applications, together with a qualitative understanding of the mechanical behavior of a variety of tissues.

COURSE OUTCOME

On Completion of the course, the students should be able to:

1. Demonstrate the relationship between the structure of materials and their behavior as a basisfor material selection in biomedical applications
2. Examine biocompatibility on the relationship between natural tissue structure, function andmechanical behavior.
3. Perform mechanical testing for the determination of the mechanical behavior of differentbiomedical materials.

FUNDAMENTALS OF BIOMATERIALS AND BIOCOMPATIBILITY

Overview - Introduction - definition and their Implications – Types of Biomaterials and their applicationsfor the human body - Biocompatibility - Host response - Cell - Material interactions - Experimental Evaluation of Biocompatibility - In vitro and In vivo tests - steps for characterizations of biomaterials - Broad view of fundamentals. (9)

MATERIALS FOR ORTHOPEDIC APPLICATIONS

Overview - 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 - Bio inert ceramics - Polymeric biomaterials - Polymer composites - HDPE - Hap - Al_2O_3 Hybrid Composites - Metal 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. (9)

TITANIUM DENTAL IMPLANTS SYSTEMS

Overview - introduction - requirements for successful implants systems - Biological compatibility - Mechanical compatibility - Morphological compatibility - Osseo integration and Bone / Implant interface -Integrated Implant system (9)

PROCESSING OF BIOMATERIALS

Overview - Introduction - Processing of Biomaterials - metals - ceramics - polymers - Bio composites - Sterlization - Processing for scale - micro / nano surface modification - micro / nano fabrication - tensiletesting, microscopy (SEM,AFM) evaluation (9)

BIOMATERIAL APPLICATIONS

Overview - Introduction - Applications of biomaterialsin Medicine , Biology , Artificial Organs - Cardiovascular medical devices - Extracorporeal Artificial organs - Orthopedic Implants - Dental Implantation - Bioadhesive - Opthamologic Applications - Cochlear Prosthesis - Drug delivery - Tissue Engineering - 2D and 3D tissue engineering applications and their mechanical characterization - Array technologies and Specific medical applications. (9)

TOTAL: 48 HOURS

REFERENCES

1. *Joon B Park, Joseph D Bronzino , "Bio Materials - Principles and Applications" , CRC Press, 2010.*
2. *Joon B Park and Lakes.R.S, "Bio Materials - An Introduction", Springer, Newyork, 2009.*
3. *Bikramjit Basu, Ashok kumar and Dhirendra S.Katti, "Advanced Biomaterials - Fundamentals, Processing and Applications", Wiley & Sons Publication, 2009.*
4. *Kay C Dee, Puleo, David A, Puleo and Rena Bizios, " An Introduction to Tissue Biomaterial Interactions: Tissue - Biomaterials", Wiley & Sons Publications, 2007*

19MMA E23 – CONCEPTS AND ANALYSIS OF ROBOT MANIPULATORS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To get adequate exposure on Kinematics of serial robots.
- To learn statics, dynamics & motion control.
- To gather knowledge on advanced programming of robots.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Demonstrate statics & dynamics of serial and parallel robots.
2. Develop advanced program using robot language

INTRODUCTION

Introduction - brief history, basic of robot structure, types, classification and usage, science and technology of robots, degrees of freedom, Grubler's criterion, loop mobility criterion.

KINEMATICS OF SERIAL ROBOTS

Position and orientation of a rigid body, types of transformations, transformation matrix, homogeneous transformations, and representation of joints, links representation- D-H parameters - Examples.

Direct and inverse kinematics problems - serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R – serial manipulator. **(6)**

KINEMATICS OF PARALLEL ROBOTS

Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-form and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough – Stewart platform, screw theory. **(8)**

VELOCITY AND STATICS OF ROBOT MANIPULATORS

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough Stewart platform, Singularity analysis and statics. **(7)**

DYNAMICS OF SERIAL AND PARALLEL ROBOTS

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Simulations using Matlab or ADAMS. **(8)**

MOTION PLANNING AND CONTROL

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/ force control, Advanced topics in non-linear control of manipulators. **(8)**

ADVANCED TOPICS IN ROBOTICS

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's). **(8)**

TOTAL : 45 HOURS

REFERENCES

1. *Ashitava Ghosal ,Robotics: Fundamental Concepts and Analysis, Oxford University Press Second reprint, May 2012.*
2. *T. Yoshikawa, Foundations of Robotics, PHI, 1990.*
3. *J. P. Merlet, Parallel Robots, Springer, 2nd Edition 2006.*
4. *S. K. Saha, Introduction to Robotics, 2nd Edition, Tata McGraw Hill, 2008.*
5. *Lung-Wen -Tsai, Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Wiley, John Wiley & Sons, 1999.*

19MMA E24 – SMART MATERIALS AND SYSTEMS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To gain fundamental knowledge on different types of smart materials and systems and to understand the applications of smart materials in various domains.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Demonstrate and analyze the various types of smart materials and systems.
2. Evaluate the characteristics of smart material with different domains.
3. Analyze and select a piezoelectric composite material according to the requirement.

INTRODUCTION AND HISTORICAL PERSPECTIVE

Classes of materials and their usage - Intelligent /Smart materials - Evaluation of materials Science - Structural material - Functional materials - Polyfunctional materials - Generation of smart materials - Diverse areas of intelligent materials - Primitive functions of intelligent materials - Intelligent inherent in materials - Examples of intelligent materials, structural materials, Electrical materials, biocompatible materials etc. - Intelligent biological materials - Biomimetics - Wolff's law - Technological applications of intelligent materials. **(11)**

SMART MATERIALS AND STRUCTURAL SYSTEMS

The principal ingredients of smart materials - Thermal materials - Sensing technologies - Micro sensors - Intelligent systems - Hybrid smart materials - An algorithm for synthesizing a smart material - Passive sensory smart structures- Reactive actuator based smart structures - Active sensing and reactive smart structures - Smart skins - Aero elastic tailoring of airfoils - Synthesis of future smart systems. (**9)**

ELECTRO-RHEOLOGICAL (FLUIDS) SMART MATERIALS

Suspensions and electro-rheological fluids - Bingham-body model - Newtonian viscosity and non-Newtonian viscosity - Principal characteristics of electro rheological fluids - The electrorheological phenomenon - Charge migration mechanism for the dispersed phase - Electrorheological fluid domain - Electrorheological fluid actuators - Electro-rheological fluid design parameter - Applications of Electrorheolgoical fluids. **(8)**

PIEZOELECTRIC SMART MATERIALS

Background - Electrostriction - Pyroelectricity - Piezoelectricity - Industrial piezoelectric materials - PZT - PVDF - PVDF film - Properties of commercial piezoelectric materials - Properties of piezoelectric film (explanation) - Smart materials featuring piezoelectric elements - smart composite laminate with embedded piezoelectric actuators – SAW filters. **(10)**

SHAPE - MEMORY (ALLOYS) SMART MATERIALS

Background on shape - memory alloys (SMA) Nickel - Titanium alloy (Nitinol) - Materials characteristics of Nitinol - Martensitic transformations - Austenitic transformations - Thermoelastic martensitic transformations - Cu based SMA, chiral materials - Applications of SMA - Continuum applications of SMA fastners - SMA fibers - reaction vessels, nuclear reactors, chemical plants, etc. - Micro robot actuated by SMA - SMA memorisation process (Satellite antenna applications) SMA blood clot filter - Impediments to applications of SMA - SMA plastics - primary molding - secondary molding - Potential applications of SMA plastics. **(8)**

TOTAL : 45 HOURS

REFERENCES

1. *M.V.Gandhi and B.S. Thompson, Smart Materials and Structures, Chapman and Hall, London, First Edition, 1992.*

2. *T.W. Deurig, K.N.Melton, D.Stockel and C.M.Wayman, Engineering Aspects of Shape Memory Alloys, Butterworth -Heinemann, 1990.*

3. *C.A.Rogers, Smart Materials, Structures and Mathematical Issues, Technomic Publising Co., USA, 1989.*

19MMA E25 – ULTRASONIC AND APPLICATIONS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To gain fundamental knowledge on ultrasonic transducers and determine the velocity of propagation and absorption in different mediums and to use this principle to solve various real life problems.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Compute the propagation of ultrasonic waves in different medium.
2. Determine the velocity of propagation of ultrasound.
3. Apply ultrasonic principle to various real-world problems.

ULTRASONIC TRANSDUCERS

Piezoelectric and Magneto strictive transducers - equivalent circuits - Efficiency - Transducer mounting mechanical and Electronics, Linear and sector transducers – variable frequency systems. (**9)**

ABSORPTION OF ULTRASONIC RADIATION

Classical absorption due to viscosity - Absorption due to thermal conductivity - Relaxation process - Evaluation of dispersion and absorption curves - structural relaxation - relation between collision frequency and relaxation time – Ultrasonic attenuation in solids. **(9)**

ULTRASONIC PROPAGATION IN SOLIDS AND LIQUIDS

Propagation of Ultrasonic waves in solids - Plane wave propagation - Relation between velocity of sound and elastic properties - Adiabatic and Isothermal elastic constants - Ultrasonic propagation in liquids – internal pressure and free volume calculations. **(9)**

DETERMINATION OF VELOCITY OF PROPAGATION OF ULTRASOUND

Transit time method - Pulse Echo methods - Acoustic Interferometry - Measurements at high pressure and high temperature – Transducer coupling materials. **(9)**

APPLICATION OF ULTRASONICS

Industrial applications - Medical Applications - Acoustic microscope - Acoustic hologram – ultrasonic tranaxial tomography. **(9)**

TOTAL: 45 HOURS

REFERENCES

1. *G.L.Gooberman, Ultrasonics - Theory and Applications, - The English Universities Press Ltd., London, 1968.*
2. *Schreiber, Anderson and Soga, Elastic Constants and Their Measurement, Mc Graw Hill Book Co., New Delhi, 2007.*
3. *R.A.Lerski (Editor), Practical Ultrasound, IRL Press, Oxford,1988.*
4. *Robert T.Beyer and Stephen V. Letcher, Physical Ultrasonics, Academic Press, London, 1969.*

19MMA E26 – VIBRATION ANALYSIS AND CONTROL

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- *To gain fundamental knowledge on vibration analysis for both single and multi-degree of-freedom systems and to understand various vibration control methods.*

COURSE OUTCOME

On Completion of the course, the students should be able to:

1. Analyze a given physical problem and develop a simple mathematical model.
2. Compute multi-degree freedom system and continuous system with different methods.
3. Determine overall response of a vibratory system based on initial conditions.

FUNDAMENTALS OF VIBRATION

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration-Review of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers - .Response To Arbitrary and non- harmonic Excitations - Transient Vibration - Impulse loads-Critical Speed of Shaft- Rotor systems. **(9)**

TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration of Undamped and Damped- Forced Vibration with Harmonic Excitation System – Coordinate Couplings and Principal Coordinates (9)

MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

Multi Degree Freedom System -Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix - Eigen Values and Eigen Vectors-Matrix Iteration Method -Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method - Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams **(9)**

VIBRATION CONTROL

Specification of Vibration Limits -Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing - Vibration Control by Design Modification- - Active Vibration Control **(9)**

EXPERIMENTAL METHODS IN VIBRATION ANALYSIS

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic and Electrodynamics -Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes **(9)**

TOTAL : 45 HOURS

REFERENCES

1. *Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.*
2. *Thomson, W.T. - "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.*
3. *Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.*
4. *S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw -Hill Publishing Com. Ltd., New Delhi, 2007.*
5. *G.K.Grover.," Mechanical Vibrations " Nem Chand Publishers, 2009*

19MMA E27 – DESIGN OF EXPERIMENTS AND TAGUCHI METHODS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- *To provide details about the various techniques involved in Design of Experiments.*
- *To gain knowledge to solve complex engineering problems*
- *To acquire the essential knowledge on Multi-level experiments and Multi-response optimization.*

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Select the appropriate experimental techniques for solving the complex problems.
2. Demonstrate the acquired knowledge to solve real time problems, involving several parameters.
3. Apply the Taguchi Quality philosophy, Taguchi's Loss Function, and to assess the loss impact of process centering and variation reduction efforts.

EXPERIMENTAL DESIGN FUNDAMENTALS

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model (9)

SINGLE FACTOR EXPERIMENTS

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests. **(9)**

MULTIFACTOR EXPERIMENTS

Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2K factorial Experiments. **(9)**

SPECIAL EXPERIMENTAL DESIGNS

Blocking and confounding in 2k designs. Two level Fractional factorial design, nested designs, Split plot design, Response surface methods. **(9)**

TAGUCHI METHODS

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization. (9)

TOTAL : 45 HOURS

REFERENCES

1. *Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI Learning Private Ltd., 2012.*
2. *Montgomery, D.C., Design and Analysis of Experiments, John Wiley and Sons, Eighth Edition, 2012.*
3. *Nicolo Belavendram, Quality by Design; Taguchi Techniques for Industrial Experimentation, Prentice Hall, 1995.*
4. *Phillip J.Rose, Taguchi Techniques for Quality Engineering, McGraw Hill, 1996.*
5. *Montgomery, D.C., Design and Analysis of Experiments, Minitab Manual, John Wiley and Sons, Seventh Edition, 2010.*

19MMA E28 – METAL CUTTING THEORY AND PRACTICE

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To make the students familiar with various principles of metal cutting, cutting tool materials and its wear mechanisms during machining operations
- To determine physical and design interpretations of metal cutting parameters in design of machine tools.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Perform cutting force analysis of metal cutting machines.
2. Perform economics of machining and tool life estimation.

INTRODUCTION

Need for rational approach to the problems of cutting materials - observations made in the cutting of metals - basic mechanism of chip formation - thin and thick zone modes - types of chips - orthogonal Vs oblique cutting - force relationship for shear plane angle in orthogonal cutting - energy consideration in machining - Merchant, Lee and Shafter theories - critical comparison. **(9)**

SYSTEM OF TOOL NOMENCLATURE

Single point cutting tool - System of tool nomenclature and conversion of rake angles - nomenclature of multi point tools like drills, milling - conventional Vs climb milling, mean cross sectional areas of chip in milling – specific cutting pressures. **(9)**

THERMAL ASPECTS OF MACHINING

Heat distribution in machining - effects of various parameters on temperature - method of temperature measurement in machining - hot machining - cutting fluids. **(9)**

TOOL MATERIALS, TOOL LIFE AND TOOL WEAR

Essential requirements of tool materials - development in tool materials - ISO specification for inserts and tool holders - tool life - conventional and accelerated tool life tests - concepts of mach inability index – economics of machining. **(9)**

WEAR MECHANISMS AND CHATTER IN MACHINING

Processing and machining - measurement techniques - Reasons for failure in cutting tools and forms of wear - mechanisms of wear - chatter in machining - factors effecting chatter in machining - types of chatter – mechanism of chatter. **(9)**

TOTAL : 45 HOURS

REFERENCES

1. *Boothroid D.G & Knight W A., Fundamentals of Machining and Machine Tools, Marcel Dekker, New York 1989.*
2. *Shaw.M.C., Metal Cutting Principles,Oxford Clare Don Press, 1984.*
3. *Bhattacharya.A., Metal Cutting Theory and Practice, Central Book Publishers, India, 1984.*

19MMA E29 – AUTOMOTIVE SUSPENSION AND SYSTEM DYNAMICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To introduce the fundamental theory of vehicle dynamics, vehicle performance as well as related tests and regulations
- To demonstrate the knowledge of dynamic modeling and analysis in vehicle design

COURSE OUTCOME

On Completion of the course, the students should be able to:

1. Analyze the influence of vehicle configuration and design parameters on vehicle Performance
2. Conduct dynamic modeling and analysis of vehicle design

INTRODUCTION TO VEHICLE DYNAMICS

Classification of vibration, Definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies - Model of an automobile, one degree of freedom, two degree of freedom system, Free, forced and damped vibrations. Magnification factor and transmissibility, Vibration absorber. **(9)**

SUSPENSION SYSTEM

Types of suspension, Factors influencing ride comfort, Types of suspension springs Independent suspension - front and rear, Rubber, pneumatic, hydro elastic suspension, shock absorber. Types of wheels - construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres. **(9)**

DYNAMICS OF SUSPENSION SYSTEM

Requirements of spring mass Frequency, wheel hop, wheel wobble, wheel shimmy, choice of suspension, spring rate. Calculation of effective spring rate. Vehicle Suspension in force aft. Hydraulic damper and choice of damping characteristics. Compensated suspension systems. **(9)**

BRAKING SYSTEM

Types of brakes, principle of shoe brakes, constructional Details - materials, braking torque developed by leading and trailing shoes. Disc brake theory, constructional details, advantages, brake actuating systems, Factors affecting brake performance, Exhaust brakes, power assisted brakes, testing of brakes. **(9)**

SENSORS AND MICROPROCESSORS IN AUTOMOBILES

Basic sensor Arrangement. Types of sensors - oxygen sensors, fuel metering/vehicle speed sensor, pressure sensor. Microprocessor and microcomputer-controlled devices in automobiles such as Instrument cluster, Voice warning system, keyless entry system, and Automatic transmission. Environmental requirements (vibration, temperature and EMI) **(9)**

TOTAL : 45 HOURS

REFERENCES

1. *P.M. Heldt, 'Automotive Chassis' Chilton Co., Newyork, 1992.*
2. *W.Steeds, 'Mechanics of Road Vehicle', IIIiffe Books Ltd, London, 1990.*
3. *J.Y.Wong, 'Theory of Ground Vehicle', John Wiley Sons, New York.*
4. *Robert N.Brady, Automotive Computers & Digital Instrumentation, Prentice Hall, New Jersy, 1988.*
5. *N.K.Giri,'Automobile Mechanics' Khanna Publishers, New Delhi, 1999.*

19MMA E30 – DESIGN AND ANALYSIS OF EXPERIMENTS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- To provide a thorough background into basic of design and analysis.

COURSE OUTCOME

On completion of this course the student will be able to,

1. Demonstrate different types of experimental designs and analysis of data.
2. Design experiments, carry them out and analyze the data obtained from the experiment.
3. Identify the problem, design and conduct experiments and optimize the solutions obtained

INTRODUCTION

Basic principles, guidelines for designing experiments, Basic statistical concepts, inferences about the differences in mean, randomized, paired comparison designs, Analysis of variance. **(9)**

RANDOMIZED BLOCKS, LATIN SQUARES AND RELATED DESIGNS

Completely randomized, randomized, Latin square, Graceo-Latin square and crossover designs. (**9)**

FACTORIAL DESIGN

Advantage of factorials, description, calculation of direct and interaction effects. 2k factorial designs. Blocking and confounding - principles and use of confounded designs. **(9)**

FRACTIONAL FACTORIAL DESIGN

Two- three- and mixed-level fractional factorial designs-applications. **(9)**

RESPONSE SURFACE DESIGN

Fitting regression model. Response Surfaces - first and second order designs. **(9)**

TOTAL : 45 HOURS

REFERENCES

1. *Douglas C.Montgomery, "Design and Analysis of Experiments",John Wiley & Sons, Inc., Fifth Edition, 8th edition, 2013.*

2. *Cochran W.G. and Cox G.M., "Experimental Designs", Second Edition, John Wiley & Sons, 2006.*

3. *JohnLawson and John Erjavee, "Modern Statistics for Engineering and Quality Imrovement" Duxbury, 2001.*

4. *Stephen R Schmidt and Robert G launsby, "understanding Industrial Designed Experiments", Air Academy Press, 199.*

5. *Davies O.L., "The Design and Anlaysis of Experiments", Longman Group Ltd., 1978.*

6. *Andre I Khuri and John A Cornel, "Response surfaces - Design and Analysis", 1987.*

Open Electives

OE 01 – AUTOMATION AND ROBOTICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- To expose the students to levels of automation and about emphasis on basics of manipulators, control techniques, sensor and devices, robot applications.

COURSE OUTCOME

After successfully completing the course students will be able to:

1. Select and identify suitable automation hardware for given applications.
2. Design / Simulate a robot which meets kinematic requirement.
3. Ability to obtain the Jacobian matrix and use it to identify singularities.

AUTOMATED MANUFACTURING SYSTEMS

History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS. (6)

AUTOMATION COMPONENTS

Sensors for temperature, pressure, force,displacement, speed, flow, level, humidity and pH measurement.Actuators, process control valves, power electronics devices DIAC,TRIAC, power MOSFET. Introduction of DC and ACservo drives for motion control (9)

CONTROL SYSTEM

Industrial control Systems- Process, Discrete manufacturing industries-Continuous andDiscrete Control systems-An overview of Computer process control- Fundamentals ofautomated assembly system.Actuators& Sensors, Fluid Power and Electrical ActuatorsPiezoelectric Actuator; Sensors for position,motion, force, Strain and temperature. (9)

ROBOTICS

Introduction to Robotics-Robotics System-Classification of Robots-Robot Characteristics, Kinematics formanipulator-Frames and Transformations-Forward and inverse Kinematics-DHrepresentation-Derivationof forward and Inverse kinematic equations for various types ofRobots- Applications of Robots. (9)

ROBOTIC MANIPULATORS

Introduction to manipulator Jacobian- Tool Jacobian- Velocity Propagation from link to link Static forces in manipulators-Jacobian in Force Domain-Introduction to dynamic analysisLagrangian formulation-Trajectory Planning-Joint space and Cartesian space. (6)

MACHINE VISION SYSTEM AND ROBOT INTELLEGENCE

Introduction to Machine vision - sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.

Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking. (7)

TOTAL: 45 HOURS

REFERENCES

1. *R.K.Mittal and I.J.Nagarath: Robotics and Control, TMH-2003*
2. *John J Craig: Introduction to Robotics, Mechanics and control, 3rd Edition, Prentice-Hall, 2005.*
3. *Saeed B Niku: Introduction to Robotics, Analysis, Systems and applications. Prentice Hall India-2002.*
4. *Mark W Spong & M Vidyasagar: Robot Dynamics and Control, John Wiley & Sons, 1989*
5. *K S Fu R C Gonzales, C S G Lee: Robotics Control, Sensing, Vision and Intelligence, McGraw Hill 1987*
6. *R P Paul: Robot Manipulators Mathematics Programming, Control, The computer control of robotic manipulators, The MIT Press 1979*
7. *Robert J Schilling: Fundamentals of Robotics, Analysis and Control. Printice Hall of India 1996*

OE 02 – WORK STUDY AND ERGONOMICS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OBJECTIVE

- Introduces the role of work study in the industry and how productivity issues can be addressed by the application of work study.
- Introduces the concept of conducting time study and production studies to assess time standards and production standards for achieving high efficiency of production.
- Scope of ergonomics and principles of work design for evaluating the impact of various human factors for designing safe work environment.

COURSE OUTCOME

After successfully completing the course students will be able to:

1. Conduct a method study in organization for improving the process, material, movement systems or design of a work place.
2. Develop time standards for operations, identify production bottle necks and improvise operations.
3. Evaluate the impact of various personnel attributes on proper safe working practices.

WORK STUDY

Study of operations – work content – work procedure – breakdown – human factors – safety and methodstudy – methods and movements at the workplace – substitution with latest devices – robotic concepts – applications in hazardous workplaces – productivity, quality and safety (PQS). (11)

ERGONOMICS

Definition – applications of ergonomic principles in the shop floor – work benches – seating arrangements – layout of electrical panels- switch gears – principles of motion economy – location of controls – display locations – machine foundations – work platforms, fatigue, physical and mental strain – incidents of accident – physiology of workers. (11)

PROCESS AND EQUIPMENT DESIGN

Process design – equipment – instrument – selection – concept modules – various machine tools - in-built safety – machine layout-machine guarding-safety devices and methods – selection, inspection, maintenance and safe usage – statutory provisions, operator training and supervision – hazards and prevention. (11)

MAN MACHINE SYSTEMS

Job and personal risk factors – standards-selection and training-body size and posture-body dimension (static/dynamic) – adjustment range – penalties – guide lines for safe design and postures – evaluation and methods of reducing posture strain.

Man-machine interface-controls -types of control-identification and selection-types of displays-compatibility and stereotypes of important operations-fatigue and vigilancemeasurement characteristics and strategies for enhanced performance (12)

TOTAL:45 HOURS

REFERENCES

1. *Introduction to Work Study", ILO, Oxford and IBH Publishing company, Bombay, 1991".*
2. *"Work Study", National Productivity Council, New Delhi, 1995.*
3. *E.J.McCormick and M.S.Sanders "Human Factors in Engineering and Design", TMH, New Delhi, 1982.*
4. *W.BenjaminNeibal, "Motion and Time Study", 7th Edition.*
5. *Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.*
4. *Hunter, Gomas, "Engineering Design for Safety", McGraw Hill Inc., 1992*

OE 03 – PRODUCT LIFE CYCLE MANAGEMENT

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVES

- Familiarize the current principles, practices, and applications of Product life cycle management (PLM).
- Learn integrated, information driven approach to all aspects of a products life from its design inception, through its manufacture, service and final disposal.
- Learn about effective integration of PLM technologies into the delivering innovative products.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Understand product data, information, structures and PLM concepts.
2. Apply PLM systems in production, after sales, sales and marketing and subcontracting.
3. Measure benefits of PLM implementation in material costs, productivity of labour and quality costs.
4. Apply for service-based industry and in E – business

FUNDAMENTALS OF PLM

Product data or Product information, Product lifecycle management concept, Information models and product structures-Information model, The product information (data) model, The product model, Reasons for the deployment of PLM systems. (10)

ENTERPRISE SOLUTION WITH PLM

Use of product lifecycle management systems in different organization verticals, Product development and engineering, Impact of Manufacturing with PLM Challenges of product management in the engineering and manufacturing industry, Life cycle thinking, value added services and after sales, Case 1: Electronics manufacturer, Case 2: An engineering product. (10)

PLM FOR E-MANUFACTURING

Electronic business and PLM, Preconditions for electric business from the viewpoint of the individual company, Significance of product management, collaboration and electronic business for the manufacturing industry. (9)

INTEGRATION OF THE PLM SYSTEM WITH OTHER APPLICATIONS

Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. (7)

PLM APPLICATIONS IN PROCESS AND PRODUCT INDUSTRIES EXAMPLES

Case 1: Electronics manufacturer, Case 2: An engineering product, Case 3: Capital goods manufacturer and customer-specifically variable product, Case 4: An IT-service provider and a customer specifically variable product (9)

TOTAL:45 HOURS

REFERENCES

1. *Jaya Krishna S, Product Lifecycle Management: Concepts and cases, ICFAI Publications 2011.*
2. *SOA approach to Enterprise Integration for Product Lifecycle, IBM Red books, 2011*
3. *Saaksvouri, A. and Immonen, A., Product Lifecycle Management, 3rd Ed., Springer, 2008,*
4. *Grieves, M., Product Lifecycle Management, McGraw-Hill, 2006.*
5. *Crnkovic, I., Asklund, U., and Dahlqvist, A. P., Implementing and Integrating Product Data Management and Software Configuration Management, Artech House Publisher, 2003,*

OE 04 – IOT IN MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OBJECTIVE

- Introduce the smart connected system design using Internet of Things, Cloud storage and industrial Automation.

COURSE OUTCOME

On Completion of the course, the students should be able to :

1. Design the smart connected systems
2. Apply appropriate technologies and protocols in design and automation.
3. Apply cloud storage management for smart connected system

INTRODUCTION

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs.Design Principles for Connected Devices;Internet Principles.Thinking about Prototyping – Costs versus ease of prototyping, prototyping andProduction, open source versus Closed Source. (9)

PROTOTYPING

Prototyping Embedded devices – Electronics, Embedded Computing Basics, Arduino/ Raspberry Pi/ BeagleBone Black/ etc., Electric Imp and other notable platforms. Prototyping of Physical Design. Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions, Other Protocols. (9)

MEMORY AND STORAGE MANAGEMENT

Techniques for Writing Embedded Code – Memory Management, Performance andBattary Life, Libraries and debugging.Automatic Storage Management in a Cloud World – Introduction to Cloud, RelationalDatabases in the Cloud, Automatic Storage Management in the Cloud.Smart Connected System Design Case Study. (9)

DEVELOPMENT AND CHALLENGES IN IoT

Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python Design challenges, Development challenges, Security challenges, Other challenges (9)

IoT IN MANUFACTURING PLANTS

Facility management, Production flow monitoring, inventory management, plant safety and security, quality control, packaging optimization. Digital twins – Supply chain management – Self dependent systems – Workshop mirroring – smart pumping. (9)

TOTAL:45 HOURS

REFERENCES

1. *M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992.*
2. *F. Lamb, Industrial Automation: Hands on, 1st edition, McGraw-Hill Education, 2013, ISBN 10:0071816453*
3. *A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X.*
4. *N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.*
5. *Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"*
6. *Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice*

OE 05 – ARTIFICIAL INTELLIGENCE/EXPERT SYSTEMS IN DESIGN AND MANUFACTURING

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOME

On Completion of the course, the students should be able to :

4. Analyze and design a neural network system using neural network toolbox, fuzzy logic system and rule-based expert system.
5. Identify problems that are amenable to solution by AI methods
6. Design a machine vision system application.
7. Ability to design and develop Hybrid expert system for real world problems.

INTRODUCTION

Foundation of AI - Agents and Environments- Concept of Rationality - Nature of Environments - programming in AI environment, developing artificial intelligence system, natural language processing, neural networks. (9)

MACHINE LEARNING

Machine Learning – Concept, Artificial Neural Networks, Biological and Artificial Neuron, Types of Neural Networks, Applications in manufacturing Use of probability and fuzzy logic for machine thinking, Machine learning, adaptive Learning. (9)

KNOWLEDGE BASED GROUP TECHNOLOGY

Group Technology: Models and Algorithms – Visual method, Coding method, Cluster analysis methodKnowledge based group technology – Group technology in automated manufacturing system, Structure of knowledge based system for group technology (KBSGT) – Database, Knowledge base, Clustering algorithm. (10)

EXPERT SYSTEM DEVELOPMENT AND TOOLS:

Definition, choice of domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing. Expert systems, controlling reasoning, rule based system, canonical systems, rules and meta rules, associative nets and frame systems, graphs trees and networks, representing uncertainty, probability in expert systems-learning. (9)

INDUSTRIAL APPLICATION OF AI AND EXPERT SYSTEMS:

Intelligent system for design, equipment selection, scheduling, material selection, maintenance, facility planning and process control, Robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition (9)

TOTAL : 45 HOURS

REFERENCES

7. *Dan W.Patterson "Introduction to AI and ES", Pearson Education, First Edition, 2007*
8. *Deepak Khemani, "A First Course in Artificial Intelligence", Mc Graw Hill Education, First Edition,2013.*
9. *Peter Jackson, "Introduction to Expert Systems", Addison Wesley, 2000.*
10. *Stuart J Russell and Peter Norvig, "Artificial Intelligence- A Modern Approach", Pearson Education Series, Third Edition, 2010.*
11. *Elaine Rich, Kevin Knight and Shivashankar, "Artificial Intelligence", McGraw Hill, Third Edition, 2009*

OE 06 – RESEARCH METHODOLOGY AND IPR

L	T	P	C
3	0	0	3

COURSE OUTCOME

On Completion of the course, the students will be able to *:*

1. Understand and formulation of research problem.
2. Select the appropriate methodologies for carrying out the research.
3. Write effective research proposals following research ethics.
4. Understand the importance of IPR in creating, investing in R&D leading to new and better products.

DEFINING THE RESEARCH PROBLEM

Introduction, Meaning of Research, Objectives of Research, Types of Research,Research Approaches, Significance of Research, Research Methods versus Methodology, Research and ScientificMethod, Research Process, Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem,Technique Involved in Defining a Problem, (9)

RESEARCH DESIGN

Review of the literature, searching the existing literature, reviewing the selected literature, Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs (6)

METHODS OF DATA COLLECTION

Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method (6)

MEASUREMENT AND SCALING TECHNIQUES

Design of Sample Surveys:Design of Sampling: Introduction, Sample Design, Sampling and Non-samplingErrors, Sample Survey versus Census Survey, Types of Sampling Designs. Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodnessof Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools,Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale (10)

TESTING OF HYPOTHESIS

Characteristics and application of multivariate analysis, classification of multivariate analysis, classificationof multivariate analysis- important multivariate techniques, Factor analysis, path analysis

Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests (11)

INTERPRETATION AND REPORT WRITING

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report,Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. (5)

INTELLECTUAL PROPERTY RIGHTS

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies. (7)

TOTAL : 45 HOURS

REFERENCES

1. *Kothari C.R., "Research Methods: Methods and Techniques", 2nd Edition, New Age International 2004.*
2. *Fink A., "Conducting Research Literature Reviews: From Internet to Paper", Sage Publications, 2009.*
3. *John W. Creswell, Cheryl N. Poth., "Qualitative Inquiry and Research Design: Choosing among five approaches", 4th Edition, SAGE Publishing, 2017*
4. *Robert P. Merges, Peter S. Menell, Mark A. Lemley., "Intellectual Property in New Technological Age", 2016*
5. *Radhakrishnan R, Balasubramanian S, "Intellectual Property Rights: Text and Cases, Excel Books, 2008.*
6. *Mathew B. Miles, Huberman A, "Qualitative Data Analysis", 3rd Edition, SAGE Publication, 2014.*
7. *Robert K. Yin, "Case Study Research: Design & Methods, 4th Edition, SAGE Publication, 2013.*
8. *Kanakala K.C, Narasan A.K, Radhakrishnan V, "Indian Patent Law & Practise", Oxford University Press, 2019.*

Employability Enhancement Courses

EEC01 – ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
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COURSE OUTCOMES

On Completion of the course, the students will be able to *:*

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

SENTENCE FRAMING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness (5)

SENTENCE PRESENTATION
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction (5)

LITERATURE
Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. (5)

ABSTRACT KEY SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature. (5)

WRITTING
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions (5)

PHRASES
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission (5)

TOTAL: 30 HOURS

REFERENCES

1. *Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)*
2. *Model Curriculum of Engineering & Technology PG Courses [Volume-I][80]*
3. *Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press*
4. *Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .*
5. *Adrian Wall work , English for Writing Research Papers, Springer New York Dordrecht*
6. *Heidelberg London, 2011*

EEC02 – CONSTITUTION OF INDIA

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

COURSE OUTCOMES:

On Completion of the course, the students will be able to *:*

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History -Drafting Committee, (Composition & Working) (5)

CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties. (5)

ORGANS OF GOVERNANCE

Parliament - Composition - Qualifications and Disqualifications - Powers and Functions - Executive - President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications- Powers and Functions (5)

LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila, Pachayat. - Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy (5)

ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women. (5)

TOTAL: 30 HOURS

REFERENCES

1. *The Constitution of India, 1950 (Bare Act), Government Publication.*
2. *Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.*
3. *M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.*
4. *D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.*

EEC03 – PEDAGOGY STUDIES

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

COURSE OUTCOMES:

On Completion of the course, the students will be able to *:*

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching. (5)

THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies. (10)

PROFESSIONAL DEVELOPMENT

Alignment with classroom practices and follow-up support -Peer support- Support from the head teacher and the community. Curriculum and assessment- Barriers to learning: limited resources and large class sizes (10)

RESEARCH GAPS AND FUTURE DIRECTIONS -Research design - Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. (5)

TOTAL: 30 HOURS

REFERENCES

1. *Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.*
2. *Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.*
3. *Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.*
4. *Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.*
5. *Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.*
6. *Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.*

EEC04 – PERSONALITY AND SKILL DEVELOPMENT

L	T	P	C
0	0	4	2

COURSE OUTCOMES:

On Completion of the course, the students will be able to *:*

1. Use of self-awareness and self-development
2. Develop teamwork skills, time management, stress management skills for better life.
3. Apply the conceptual understanding of communication into everyday practice.
4. Develop written communication and apply business etiquette skills effectively

INTRODUCTION TO PERSONALITY DEVELOPMENT

Meaning and definition of personality; Theoretical perspectives on personality- Behavioral trait and humanistic personality pattern; molding the personality patterns.

The concept personality- Dimensions of theories of Freud & Erickson- personality – significant of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analyses. (6)

SELF ESTEEM

Term self-esteem - Symptoms - Advantages - Do's and Don’ts to develop positive self-esteem – Low selfesteem - Symptoms - Personality having low self-esteem - Positive and negative self-esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviours - Lateral thinking. (6)

OTHER ASPECTS OF PERSONALITY DEVELOPMENT

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills -Leadership and qualities of a successful leader - Character-building -Team-work - Time management -Work ethics – Good manners and etiquette. (6)

COMMUNICATION SKILLS

Process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. (6)

ROLE OF ICT IN COMMUNICATION.

Recent advances in communication- Print and electronic, internet, e-mail, fax, mobile, interactive video and teleconferencing, computer, egovernance. (6)

TOTAL: 30 HOURS

REFERENCES

1. *Barun K. Mitra, Personality Development and Soft sklills, Oxford University Press, 2012*
2. *Raman, Meenakshi and Sangeetha Sharma. 2011. Technical Communication: Principles and Practice, Oxford University Press, New Delhi.*
3. *Rizvi and Ashraf M. 2005. Effective Technical Communication, Tata McGraw-Hill, New Delhi.*

EEC05 – PYTHON PROGRAMMING

L	T	P	C
0	0	4	2

COURSE OBJECTIVE:

- Understand the fundamentals of the Python programming language.
- To acquire programming skills in Python.
- Apply data types, operators, and arrays

COURSE OUTCOMES:

On Completion of the course, the students will be able to*:*

1. Problem solve and programming capability in Engineering applications.
2. Express different Decision-Making statements and Functions

INTRODUCTION

High level Programming, Modular Programming, Features, Python – Variables –Executing Python from Command Line - Basic syntax, Strings and data types, condition statements, looping Simple input and Output. (6)

DATA TYPES

Introduction, data types – logical – numerical – strings. Operators – arithmetic operators – assignment operators. (6)

CONTROL STATEMENTS

Types of control statements, Control Flow and Syntax – Indenting – IF statement – Relational operators – Logical Operators – Bit wise operators – while loop – break and continue – For loop. (6)

STRINGS AND FUNCTIONS

Basic operations, Assessing strings, String slices. Functions – Types of functions – calling a function. (6)

MODULES

Importing Module, Math module, Random module Packages Composition. (6)

TOTAL: 30 HOURS

REFERENCES

1. *Wesley J Chun, "Core Python Applications Programming", Prentice Hall, 2012.*
2. *Mark Summerfield, "Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009.*
3. *Martin C. Brown, "PYTHON: The Complete Reference", McGraw-Hill, 2001.*

EEC06 – INTELLECTUAL PROPERTY RIGHTS AND PATENTS

L	T	P	C
0	0	4	2

COURSE OUTCOMES:

On Completion of the course, the students will be able to*:*

3. Apply intellectual property law principles (including copyright, patents, design and trademarks) to real problems.
4. Identify, apply and assess principles of law relating to areas of intellectual property.
5. Analyze ethical and professional issues which arise in the intellectual property law context

INTELLECTUAL PROPERTY

Introduction and need for Intellectual property – IPR in India: Genesis and Development – IPR in abroad – Important examples of IPR (6)

PATENTS

Macro-economic impact of the patent system - Patent and kind of inventions protected by a patent - Patent document – Protecting inventions- Granting of patent Rights of a patent - Searching a patent Drafting and Filing of a patent - Different layers of the international patent system (national, regional and international options). Utility models – Differences between a utility model and a patent – trade secrets and know-how agreements. (6)

COPYRIGHT AND TRADEMARKS

Definition – Coverage – how long does copyright last? – need for copyright – related rights – differences between copyright and related rights – rights covered by copyright.Trademarks – rights of trademark – trademark types – registration and protection of trademarks – Validity and coverage – Domain name and its relation to trademarks. (6)

GEOGRAPHICAL INDICATIONS, INDUSTRIAL DESIGNS AND UNFAIR COMPETITION

Geographical Indications – Need for protecting geographical indications – protection of geographical indicationsIndustrial designs – Protection – coverage and validity – why protect industrial design?Unfair competition – Relationship between unfair competition and intellectual property rights (6)

ENFORCEMENT OF INTELLECTUAL PROPERTY RIGHTS

Infringement of IPR – Enforcement measures – emerging issues – licensing and enforcing IPR – commercializing invention – case studies of patents. (6)

TOTAL:30 HOURS

REFERENCES

4. *AjitParulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006.*
5. *B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000.*
6. *P . Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010.*

EEC07 – STUDY OF INDIAN ECONOMY

L	T	P	C
0	0	4	2

COURSE OUTCOMES:

On Completion of the course, the students will be able to*:*

1. Develop ideas on the basic characteristics of Indian economy.
2. Understand agriculture as the foundation of economic growth and development.
3. Analyze the progress and changing nature of agricultural sector and its contribution to the economy.
4. Grasp the importance of planning undertaken by GOI.
5. Have the knowledge on various objectives, failures and achievements in terms of ongoing planning and economic reforms taken by the government.

BASIC FEATURES AND PROBLEMS OF INDIAN ECONOMY

Nature of Indian Economy, demographic features and Human Resource Development (HDI), Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India. (7)

SECTORAL COMPOSITION OF INDIAN ECONOMY

Issues in Agriculture sector in India,land reforms Green Revolution and agriculture policies of India, Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India. (7)

ECONOMIC POLICIES

Economic Planning in India, Planning commission v/s NITI Aayog, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India. (8)

EXTERNAL SECTOR IN INDIA

India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India. (8)

REFERENCES

1. *Dutt Rudder and K.P.M Sunderam, "Indian Economy", S Chand & Co. Ltd. New Delhi., 2001*
2. *Mishra S.K & V.K Puri, "Indian Economy and –Its development experience", Himalaya Publishing House (2001)*
3. *Bardhan, P.K. (1999), "The Political Economy of Development in India", Oxford University Press, (9th Edition)New Delhi. 1999*
4. *Jalan, B., "India's Economic Policy- Preparing for the Twenty First Century", Viking, New Delhi 1996.*

EEC08 – SEMINAR & TERM PAPER WRITING

L	T	P	C
0	0	4	2

COURSE OUTCOMES:

On Completion of the course, the students will be able to*:*

1. Participate actively in writing activities for both scientific and technical communication
2. Collect, analyze, document, and report clearly, concisely, logically and ethical interpretations of research data within scientific and technical communities.

TOPIC SELECTION

Select an area of interest, topic and state an objective

LITERATURE REVIEWS AND CITATIONS

Reading papers-writing review on selected topic- citations- Paraphrasing- Avoiding plagiarism- editing- Background Review - formulation of Research Question- Prepare a draft Outline (10)

METHODOLOGY AND INTERPRETATION

Defining Hypotheses -Predictions of each hypothesis – Types Research Methodology - Results/Data - Conclusions (10)

WRITING RESEARCH/REVIEW PAPER

Structure of a paper and details of all its parts – Abstract – Introduction – Methodology – Discussionof data – Peerediting – Selfediting tips – Grammarand vocabulary advice – Plagiarismcheck – Presentingthe written work (10)

Evaluation Pattern for all Units

s.no	Details	Marks %
1.	Presentation	10
2.	Participation	10
3.	Peered journals	10
4.	Formative writing	20

Semester	**II**
Subject Code	**21FYM21**
Subject Title	**Linear Algebra and Gradient Calculus**
Duration	One Semester
Total Contact Hours	60 Hours per semester
Pre-Requisite	N/A
Credit Points	4 CP
Learning and Teaching Structure	L T P C 3 1 0 4
Assessment Type	Theory
Course Objective	The goal of this course is for students to • Acquire sound knowledge of techniques in the fundamental concepts of linear algebra and their role in modern mathematics and applied in various machine learning contexts. • Deal with eigenvalues and eigenvectors that are essential in various branches of engineering. • Inculcate the concepts of Gradient calculus in data analysis. • Know the basics of differentiation and linearization for the study of computer science and engineering problems. • Analyze continues optimization equations that is imperative for the effective understanding of applications in real life problems.

Course Outcome

CO1: Incorporate suitable methods of linear mappings and orthogonal projections and implement the same for applications in machine learning algorithms.

CO2: understand the concepts matrix decompositions and implement in programming problems.

CO3: Gain the ideas of differentiation of univariate functions and gradients of vector valued functions and matrices.

CO4: Provide the strong background of gradient calculus for the study of science and technological problems.

CO5: Assimilate the efficient use of optimization in software problems.

VECTOR SPACES

Vector Spaces - Linear Independence - Basis and Rank- Linear Mappings- Matrix Representation of Linear Mappings- Basis Change. Norms- Inner Products- Lengths and Distances- Angles and Orthogonality - Orthonormal Basis- Orthogonal Complement- Orthogonal Projections (Gram-Schmidt Orthogonalization only) **(10)**

MATRIX DECOMPOSITION

Matrix Decompositions- Determinant and Trace- Eigenvalues and Eigenvectors- Cholesky Decomposition- Singular value Decomposition **(8)**	
GRADIENT CALCULUS - I	
Differentiation of univariate functions - partial derivatives and gradients - Gradients of vector valued functions and matrices **(9)**	
GRADIENT CALCULUS - II	
Backpropagation and automatic differentiation - Linearization and Multivariate Taylor Series **(8)**	
OPTIMIZATION	
Notion of maxima and minima - Optimization using gradient descent - Step-size- Gradient Descent With Momentum- Constrained Optimization and Lagrange Multipliers **(10)**	
Theory : 45; Tutorial : 15; **TOTAL: 60**	
Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Text Book

1. M. P. Deisenroth, A. A. Faisal, C. S. Ong, "Mathematics for Machine Learning", Cambridge University Press (1st Edition) , 2020.
2. S. Axler, "Linear Algebra Done Right", Springer International Publishing (3rd Edition), 2015.

Reference Book

1. Howard Anton and Chris Rorres,"Elementary Linear Algebra Applications", Wiley India, New Delhi, 2011.
2. David C Lay, "Linear Algebra and its Applications", Addison-Wesley, Boston, 2014
3. Milan Hladík, "Discrete and Continuous Optimization textbook" , Charles University Press, 2020

Semester	**II**
Subject Code	**21AD21**
Subject Title	**Fundamentals of IR 4.0**
Duration	One Semester
Total Contact Hours	30 hours per semester
Pre-Requisite	NIL
Credit Points	2 CP
Learning and Teaching Structure	L T P C 3 0 0 3
Assessment Type	Theory
Course Objective	The unit aims to cover the basics of IR4.0, building blocks, significance of data, smart systems, technologies, applications and case studies.

Course Outcome

CO1: Be able to understand the drivers and enablers of IR 4.0.

CO2: Be able to learn the concepts of intelligence in smart factories, smart production, smart cities and smart products.

CO3: Be able understand the role of AI and Data science in IR 4.0

CO4: Be able to understand the opportunities and challenges in IR4.0

Overview of IR 4.0
Different Industrial Revolutions - Drivers enablers, competitive forces in IR 4.0 - IR 4.0 development in different countries - IR 4.0 factory and conventional factory - Key trends changing IR 4.0 **(9)**
Principles and technologies in IR 4.0
Internet of Things and Industrial Internet of Things - Big data - Cloud Computing - Augmented Reality - Smart factories - Smart devices - Cybersecurity **(9)**
Cyber Physical Systems-CPS
Introduction to CPS - Elements of CPS - Functional requirements in CPS - Applications of CPS **(9)**
AI and DS in IR 4.0
Impact of AI in IR4.0 - Machine Learning Process - Categorization of Machine Learning - ML in industries - DS in industry **(9)**
Case studies and Applications
Industry 4.0 case studies - Smart manufacturing - Precision agriculture - Precision healthcare - Opportunities and challenges in IR 4.0 **(9)**
TOTAL : 45

Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Text Book

1. Sudip Misra, Chandana roy, Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0" , CRC Press, 2021

Reference Book

1. Alasdair Gilchris, "Industry 4.0: The Industrial Internet of Things", APress, 2017
2. Klaus Schwab, "The Fourth Industrial Revolution", Portfolio Penguin Press, 2017
3. Alec Ross, "The Industries of the Future", Simon & Schuster Press, 2016

Semester	**II**
Subject Code	**21FYC21**
Subject Title	**Environmental Science and Engineering**
Duration	One Semester
Total Contact Hours	45 Hours per semester
Pre-Requisite	N/A
Credit Points	1 CP
Learning and Teaching Structure	L T P C 3 0 0 1
Assessment Type	Theory
Course Objective	• To study the nature and facts about environment • To find and implement scientific, technological, economic and political solutions to environmental problems • To study the interrelationship between living organisms and the environment • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

Course Outcome

CO1: An insight into the chemical reactions in water, air and soil environment

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

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

CO4: An insight into the environmental protection act and the associated rules, knowledge on the institutional setup for environmental management and pollution control

NATURAL RESOURCES

Forest resources : use and over-exploitation, deforestation, Water resources : use and utilization of surface and ground water, floods, droughts and conflicts over water, dam benefits and problems – Mineral resources : use and exploitation, environmental effects of extracting and using mineral resources, Food resources : world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizers-pesticide problems, water logging, salinity **(9)**

RENEWABLE ENERGY RESOURCE AND ENVIRONMENTAL POLLUTION

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

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

ECOSYSTEM AND BIODIVERSITY

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

ENVIRONMENTAL BIOTECHNOLOGY AND GREEN CHEMISTRY

Biotechnology and its applications in environment protection, Bioinformatics-Bioremediation, Bio deodorization, Green chemistry for clean technology. Significance of green chemistry-basic components of green chemistry. Industrial application of green chemistry-green fuels-e-green propellants and biocatalysts. **(9)**

GLOBAL ENVIRONMENTAL ISSUES AND MANAGEMENT

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

TOTAL: 45

Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Text Book

1. Surinder Deswal and Anupama Deswal, “A Basic course in Environmental Studies”,2017, Dhanpat Rai & Co.
2. Anubha Kaushik and CP Kaushik, "Perspectives in Environmental Studies", 6" Edition (2015), New Age International (P) Ltd.

Reference Book

1. Benny Joseph, "Environmental Studies", (2017) 3rd Edition, McGraw Hill India.
2. Dr.S.S.Dara and Dr.D.D. Mishra, "A Text Book of Environmental Chemistry and Pollution Control", (2010), S Chand & Company.

Semester	**II**
Subject Code	**21CS21**
Subject Title	**Digital Design**
Duration	One Semester
Total Contact Hours	45 Hours per semester
Pre-Requisite	N/A
Credit Points	3 CP
Learning and Teaching Structure	L T P C 3 0 0 3
Assessment Type	Theory
Course Objective	The objective of this course is to introduce the concept of digital and binary systems and familiarize the concepts and design principles of combinational and sequential logic circuits.

Course Outcome

CO1: Understand the basics of number systems, arithmetic operations, data representation Schemes

CO2: Understand the concepts of logic gates, boolean algebra and simplify the Boolean expressions

CO3: Acquire knowledge in combinational logic and to design combinational circuits.

CO4: Ability to understand sequential logic and to design digital systems using sequential logic

CO5: Understand the various types of Memory, Memory organizations and their operations

DATA REPRESENTATION

Digital Computers and digital systems. Number system - Binary, Octal, Hexadecimal, Base Conversions. Complements-Subtraction of (unsigned) numbers using Complements. Binary Codes - BCD, Excess-3, Gray, ASCII, Error Detecting Codes- Reflected code. Fixed point Binary Data - Sign and Radix Point Representation-Signed Binary Numbers - Arithmetic Addition and Subtraction - Overflow. Decimal Data - Floating Point Data. **(9)**

BOOLEAN ALGEBRA & LOGIC GATES

Boolean Algebra - Basic Definitions – Theorems & Properties -Canonical and Standard Forms. Digital Logic gates. Simplification of Boolean Functions – Karnaugh Maps- Don't Care Conditions. NAND and NOR Implementation. Quine-McCluskey (Tabulation)Method **(8)**

COMBINATIONAL LOGIC

Design Procedure-Adders -Half Adder - Full Adder-Binary Parallel Adder-Carry Look-ahead Adder - BCD Adder. Subtractor- Half Subtractor - Full Subtractor-Magnitude Comparator-Binary Multiplier- Code Converters-Analysis Procedure- Decoders-Demultiplexers-Encoders-Priority Encoder- Multiplexers. Programmable Logic Arrays (PLA)-Programmable Array Logic(PAL) **(11)**

SEQUENTIAL LOGIC

Introduction - Flip Flops - Types -Triggering of Flip Flops. Analysis of Clocked Sequential Circuits - State Table - State Diagram - State Equation- State Reduction and Assignment. Flip Flop Excitation Tables.

Design Procedure - Design of Counters- Ripple Counters- Binary and BCD ripple counters. Synchronous counters - Binary and Binary updown counters- BCD Counters-Ring Counter-Johnson Counter. Registers – Shift Register. **(11)**

MEMORY

Memory Basics- Random Access Memory - RAM Family –Static RAMs-Memory Cell - Basic SRAM Cell Array –Cache Memory - DRAM Memory Cells – Types of DRAMs. Read-Only Memory-ROM Family Mask ROM-Simple ROM –Internal ROM Organization– Programmable ROMs.Flash Memory- Flash Memory Cell-Flash Memory Operation-Basic Flash Memory Array-Comparison of Flash Memories with other Memories. **(6)**

TOTAL: 45

Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Text Book

1. M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 1st edition, 2016.
2. Thomas L.Floyd, “Digital Fundamentals", Pearson Education; Eleventh edition, 2017. (For “MEMORY” Only).

Reference Book

1. Charles H. Roth Larry L. Kinney, Raghunandan G. H. “Fundamentals of Logic Design”, Cengage Learning, 1st edition, 2019.
2. Tocci R.J., Neal S. Widemer, Gregory L. Moss “Digital Systems: Principles and Applications”, Prentice Hall of India, 12th edition, 2016.
3. V.Rajaraman, T.Radhakrishnan, “Digital Logic and Computer Organization”, PHI Learning Pvt. Ltd, 2009. (For “Programmable Logic Arrays”).

Semester	**II**
Subject Code	**21CSL22**
Subject Title	**Python Programming**
Duration	One Semester
Total Contact Hours	75 Hours per semester
Pre-Requisite	N/A
Credit Points	3 CP
Learning and Teaching Structure	L T P C 1 0 4 3
Assessment Type	Theory
Course Objective	The subject objective is to cover the concepts of python programming to solve computational problems

Course Outcome

CO1: Understand the fundamental concepts of computers and basic blocks of programming.
CO2: Apply control statements, decision making statements to solve the given problems.
CO3: Usage of complex data types in python to develop on application.
CO4: Practice problem solving using functions and string operations.
CO5: Solve the real - world problems using file handling operations, modules, packages and error handling methods.

INTRODUCTION TO PROGRAMMING

Introduction to Computers - Fundamentals of Programming: Algorithm, Flowchart, Structured Programming, Object Oriented Programming. Python Introduction: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc. **(3)**

PYTHON STATEMENTS

Assignment statements, I/O statements. Control statements: if, else and else if, for loops, for each, While loops, Loop manipulation using pass, continue, break and else. **(3)**

PYTHON COMPLEX DATA TYPES

Lists: List operations, List slices, List methods, List loop, mutability, aliasing, cloning lists, list parameters. Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; Set: Creating Sets, Performing Set Operations: Union, Intersect and Difference. **(3)**

FUNCTIONS & STRING MANIPULATIONS

Functions: Parameters, Local and Global scope, Return values, Recursion. String operations: Subscript operator, Indexing, Slicing a string, Strings and Number system: Converting strings to numbers and vice versa. Using ASCII and Unicode Strings, Manipulating Strings with String Methods, format() Function, Escape Sequences. **(3)**

FILES, MODULES AND PACKAGES

Files: Text files, reading and writing files, Format operator; Command line arguments, Errors and Exceptions, Handling Exceptions, Modules: import Statement, from...import Statement, **Packages:** Numpy, Scipy. **(3)**	
Theory : 15; Practical : 60 **TOTAL: 60 + 15 = 75**	
Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Text Book

1. John V. Guttag, "Introduction to Computation & Programming using Python", 2nd Edition, The MIT Press. 2016
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist". 2nd edition, Updated for Python 3. Shroff O'Reilly Publishers, 2016.
3. Guido van Rossum and Fred L. Drake Jr., “An Introduction to Python — Revised and updated for Python 3.2". Network Theory Ltd., 2011.

Reference Book

1. Mark Lutz. "Learning Python", 5th edition. Orelly Publication, 2013.
2. John Zelle, "Python Programming: An Introduction to Computer Science", 2nd edition. Course Technology Cengage Learning Publications. 2013.
3. Michel Dawson, "Python Programming for Absolute Beginners", 3rd Edition. Course Technology Cengage Learning Publications, 2013.
4. David Beazley Brian Jones.. "Python Cookbook". 3rd Edition. Oreilly Publication. 2013.

Semester	**II**
Subject Code	**21MEL11**
Subject Title	**ENGINEERING GRAPHICS**
Duration	One Semester
Total Contact Hours	75 Hours per semester
Pre-Requisite	N/A
Credit Points	3 CP
Learning and Teaching Structure	L T P C 1 0 4 3
Assessment Type	Theory
Course Objective	• To introduce the students to the "universal language of Engineers" for effective communication through drafting exercises of different geometrical shapes. • To develop the ability to communicate with others through the language of technical drawing and sketching. • To enable the students with various concepts like dimensioning. Conventions and standards related to working drawings in order to become professionally efficient.

Course Outcome

CO1: Understand the importance of BIS and ISO Standards in Engineering Drafting.
CO2: Imagine and visualize the geometric details of engineering objects.
CO3: Communicate ideas through technical drawings.
CO4: Use computer aided drafting in their respective engineering field.
CO5: Interpret Orthographic and Isometric views of objects.

INTRODUCTION TO ENGINEERING DRAWING

Principles of Engineering Graphics and their significance, usage of drawing instruments and Lettering, dimensioning and scales. **(7)**

ORTHOGRAPHIC PROJECTIONS

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes. **(15)**

PROJECTIONS OF REGULAR SOLIDS

Projections of solids Inclined to both the Planes - Draw simple annotation. **(15)**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Sections - Prism, Cylinder, Pyramid, Cone; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone. **(15)**

ISOMETRIC PROJECTIONS	
Principles of Isometric projection — Isometric Scale, Isometric Views, Conventions; Isometric Views of simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa. **(15)**	
OVERVIEW OF COMPUTER GRAPHICS	
Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]. **(8)**	
	TOTAL: 60 + 15 = 75
Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Text Book

1. K. Venugopal and V. Prabhu Raja, Engineering Graphics, NewAge International Publishers, 2017.

Reference Book

1. Bhatt N.D., Panchal V.M. & Ingle PR.,"Engineering Drawing", Charotar Publishing House. 2014.
2. Shah. M.B. &Rana B.C., "Engineering Drawing and Computer Graphics", Pearson Education, 2008.
3. Agrawal B. &Agrawal C. M., "Engineering Graphics", TMH Publication. 2012.
4. Narayana. K.L. & P Kannaiah,"Text book on Engineering Drawing", SciTech Publishers. 2008.

<table>
<tr><td>Semester</td><td>II</td></tr>
<tr><td>Subject Code</td><td>21PL21</td></tr>
<tr><td>Subject Title</td><td>PHYSICS LABORATORY II</td></tr>
<tr><td>Duration</td><td>One Semester</td></tr>
<tr><td>Total Contact Hours</td><td>30 Hours per semester</td></tr>
<tr><td>Pre-Requisite</td><td>N/A</td></tr>
<tr><td>Credit Points</td><td>0.5 CP</td></tr>
<tr><td>Learning and Teaching Structure</td><td>
<table>
<tr><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0.5</td></tr>
</table>
</td></tr>
<tr><td>Assessment Type</td><td>Practicals</td></tr>
<tr><td>Course Objective</td><td>To make students to understand the basic concepts of matter, light, electricity and semiconductors and acquire experimental skills by carrying out experiments.</td></tr>
<tr><td colspan="2">Course Outcome
CO1: Will be able to gain a fundamental understanding of the apparatus used in the experiments and recognize how observations, experiment and theory work together</td></tr>
<tr><td colspan="2">EXPERIMENTS BASD ON THE FOLLOWING TOPICS</td></tr>
<tr><td colspan="2">1. Implementation of Basic Logic Gates using Universal Gates.
2. Study of I-V characteristics of Solar Cell and Determination of its efficiency.
3. LASER - Determination of wavelength.
4. Young's Modulus- cantilever
5. Study of charging and discharging of a capacitor.
6. Determination of Specific Resistance.
7. Determination of Numerical aperture of an Optical fibre (Demonstration Experiment).</td></tr>
<tr><td colspan="2">TOTAL: 30</td></tr>
<tr><td>Minimum Requirement to pass the subject</td><td>To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.</td></tr>
</table>

Semester	**II**
Subject Code	**21CL21**
Subject Title	**CHEMISTRY LABORATORY II**
Duration	One Semester
Total Contact Hours	30 Hours per semester
Pre-Requisite	N/A
Credit Points	0.5 CP
Learning and Teaching Structure	L T P C 0 0 2 0.5
Assessment Type	Practicals
Course Objective	• To help the students to understand the principles involved in complexometric titration. • To learn the principles such as flame photometry, spectrophotometry and potentiometry. • To understand and appreciate the working of spectrophotometer, flame photometer and potentiometer.

Course Outcome

CO1: By performing EDTA titrations, the students could understand how hardness producing salts create boiler troubles and how to quantify hardness producing ions present in raw water.

CO2: By the determination of weight loss method, the student will be able calculate rate of corrosion

CO3: Students are able to handle analytical tools such as spectrophotometer, flame photometer, conductometer and potentiometer.

EXPERIMENTS BASD ON THE FOLLOWING TOPICS

1. Determination of sodium in water sample by flame photometry.
2. Estimation of iron in water sample by spectrophotometry.
3. Estimation of Calcium using Eriochrome Black -T indicator Substitution method
4. Determination of corrosion rate of steel in acid media by weight loss method
5. Estimation of acid in a mixture by conductometry.
6. Estimation of ferrous ion by potentiometric titration

TOTAL: 30

Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Semester	**II**
Subject Code	**21CSL21**
Subject Title	**DIGITAL DESIGN LABORATORY**
Duration	One Semester
Total Contact Hours	30 Hours per semester
Pre-Requisite	N/A
Credit Points	1 CP
Learning and Teaching Structure	L T P C 0 0 2 1
Assessment Type	Practicals
Course Objective	To analyze the working philosophies of Sequential and Combinatorial circuits.

Course Outcome

CO1: Understand the operations of logic gates and verify Boolean algebra theorems

CO2: Ability to design combinational digital circuits like adder, subtractor, decoders, encoders, multiplexers, and de-multiplexers.

CO3: Construct and analyze sequential digital circuits like flip-flops, registers, and counters.

EXPERIMENTS BASD ON THE FOLLOWING TOPICS

1. Realization of AND, OR and NOT gates using Universal gates.
2. Verification of Boolean algebra theorems and postulates.
3. Design of Half adder, Full adder, Half subtractor and Full subtractor.
4. Design of combinational circuits using NAND and NOR gates.
5. Design of code converter.
6. Design of Encoders, Decoders, Multiplexer and De-Multiplexer circuits.
7. Design and implementation of Priority Encoder.
8. Implementation of Boolean functions using 4x1 Multiplexer.
9. Realization of R-S, J-K, D and T Flip flops.
10. Design of Counters.
11. Design of Shift registers.
12. Simple VHDL programming.

TOTAL: 30

Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

Semester	**II**
Subject Code	**21FYEL21**
Subject Title	**English for Employability**
Duration	One Semester
Total Contact Hours	30 Hours per semester
Pre-Requisite	N/A
Credit Points	1 CP
Learning and Teaching Structure	L T P C 0 0 2 1
Assessment Type	Theory
Course Objective	The objective of this course is to prepare students for gaining English proficiency in both written as well as oral form of language to scale greater heights in their chosen career.

Course Outcome

CO1: Solve timed objective questions on logical reasoning and verbal ability.

CO2: Generate ideas and speak confidently, for a given speaking task on topics JAM, Describing an Object, Book Review, and Extempore.

CO3: Use appropriate functional language, for a given social situation viz., travel and transport, complaining, giving instructions, advising and sympathizing, requesting and warning people.

CO4: Generate valid points for and against the topic and present them with appropriate group behaviour, for a given HR topic.

CO5: Plan and prepare a 20 min HR mock interview, for any job requirement.

UNIT – 1

Ice Breakers - Just a Minute - Book Reviews - Describing an object – Extempore – Paraphrasing **(6)**

UNIT – II

Spoken English - Travel and Transport, Complaining - Giving Instructions, Advising and Sympathizing – Requesting and warning people **(5)**

UNIT – III

Logical Sequence of Words- Exercises - Sequential Order of Things - Comparison Type Questions – Introduction and Exercises - Idioms and Phrases - Types and Exercises - Vocabulary through Mythology - One word Substitutes, Word Power Exercises - Common Errors in English - Sentence Correction **(7)**

UNIT – IV

Activity based on newspaper articles - Vocabulary – Homophones and Homonyms - Reading Prose – Reading Comprehension Activity **(4)**

UNIT – V

Professional Communication - Mock Group Discussion – Mock Interview – Telephoning Skills – Personality Development Activities **(8)**	
TOTAL: 30	
Minimum Requirement to pass the subject	To pass a subject and meet all COs to a minimum standard, student must have achieved an aggregate mark for the unit of 50% or more.

COIMBATORE INSTITUTE OF TECHNOLOGY

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

VISION AND MISSION OF THE INSTITUTE

VISION

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

MISSION

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

COIMBATORE INSTITUTE OF TECHNOLOGY
(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

VISION AND MISSION OF THE DEPARTMENT

VISION

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

MISSION

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

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

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

COIMBATORE INSTITUTE OF TECHNOLOGY
(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MSc. Artificial Intelligence and Machine Learning

(Five-Year Integrated Programme)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will:

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

PEO 2: Promote research in intelligent technology and concepts

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

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COIMBATORE INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MSc. Artificial Intelligence and Machine Learning

(Five-Year Integrated Programme)

PROGRAMME OUTCOMES (POs)

Graduates of the programme will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF COMPUTING-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MSc. Artificial Intelligence and Machine Learning

(Five-Year Integrated Programme)

Curriculum from the Academic Year 2019 - 2020 onwards

Semester I

Course Code	Course Name	L	T	P	C	CAT
19MAM11	Technical English	2	0	0	2	HS
19MAM12	Applied Algebra	3	0	0	3	BS
19MAM13	Fundamental Statistical Methods	3	0	0	3	BS
19MAM14	Data Structures	3	0	0	3	PC
19MAM15	Theory of Programming Languages	3	0	0	3	PC
	PRACTICALS					
19MAM16	Algebra and Statistics Lab	0	0	4	2	PC
19MAM17	Data Structures Lab	0	0	4	2	PC
19MAM18	Python Programming Lab	1	0	4	3	PC
19FYEL11	Employability Skills	0	0	2	1	EEC
	Total Credits				**22**	

Semester II

Course Code	Course Name	L	T	P	C	CAT
19MAMLE01	Professional English	2	0	0	2	HS
19MAM21	Applied Calculus	3	0	0	3	BS
19MAM22	Probability Distributions and Applications	3	0	0	3	BS
19MAM23	Computer System Architecture	3	0	0	3	PC
19MAM24	Advanced Data Structures	3	0	0	3	PC
	PRACTICALS					
19MAM25	Calculus and Probability Lab	0	0	4	2	PC
19MAM26	Programming Paradigm Lab	0	0	4	2	PC
19MAM27	Advanced Data Structures Lab	0	0	4	2	PC
19FYEL21	English for Employability	0	0	2	1	EEC
	Total Credits				**21**	

Semester III

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM31	Artificial Intelligence	3	0	0	3	PC
19MAM32	Theory of Computing	3	0	0	3	PC
19MAM33	Database Management Systems	3	0	0	3	PC
19MAM34	Predictive Analytics	3	0	0	3	BS
19MAM35	Human Computer Interaction	3	1	0	4	PC
	PRACTICALS					
19MAM36	Artificial Intelligence Lab	0	0	4	2	PC
19MAM37	Database Management Systems Lab	0	0	4	2	PC
19MAM38	Predictive Analytics Lab	0	0	4	2	PC
	Total Credits				**22**	

Semester IV

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM41	Operations Research	3	0	0	3	BS
19MAM42	Machine Learning	3	0	0	3	PC
19MAM43	Design and Analysis of Algorithms	3	0	0	3	PC
19MAM44	Data Communications and Networking	3	0	0	3	PC
19MAM45	Operating Systems	3	0	0	3	PC
	PRACTICALS					
19MAM46	Machine Learning Lab	0	0	4	2	PC
19MAM47	Design and Analysis of Algorithms Lab	0	0	4	2	PC
19MAM48	Network Programming Lab	0	0	4	2	PC
	Total Credits				**21**	

Semester V

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM51	Advanced Machine Learning	3	0	0	3	PC
19MAM52	Artificial Neural Networks	3	0	0	3	PC
19MAM53	Knowledge Based Systems	3	0	0	3	PC
19MAM54	AI Systems Engineering	3	0	0	3	PC
19MAM55	Distributed and Cloud Computing	3	0	0	3	PC
	PRACTICALS					
19MAM56	Advanced Machine Learning Lab	0	0	4	2	PC
19MAM57	Full Stack Web Development Lab	0	0	4	2	PC
19MAM58	Cloud Computing Lab	0	0	4	2	PC
19MAM59	Personality Development	0	0	2	1	EEC
	Total Credits				**22**	

Semester VI

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM61	Intelligent Agents	3	0	0	3	PC
19MAM62	Deep Learning	3	0	0	3	PC
19MAM63	Information Retrieval and Web Search	3	0	0	3	PC
19MAM64	Big Data Analytics	3	0	0	3	PC
	Elective – I	3	0	0	3	PE
	PRACTICALS					
19MAM65	Deep Learning Lab	0	0	4	2	PC
19MAM66	Mobile Application Development Lab	0	0	4	2	PC
19MAM67	Big Data Analytics Lab	0	0	4	2	PC
19MAM68	Communication Skills	0	0	2	1	EEC
19MAM69	Hackathon	0	0	2	1	EEC
	Total Credits				**23**	

Semester VII

Course Code	Course Name	L	T	P	C	CAT
19MAM71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM81	Graph Representation Learning	3	0	0	3	PC
19MAM82	Reinforcement Learning	3	0	2	4	PC
19MAM83	Meta-Heuristic Optimization Techniques	3	0	0	3	PC
	Elective II	3	0	0	3	PE
	Elective III	3	0	0	3	PE
	PRACTICALS					
19MAM84	Meta-Heuristic Optimization Lab	0	0	4	2	PC
	Elective Lab I	0	0	4	2	PE
	Elective Lab II	0	0	4	2	PE
	Total Credits				**22**	

Semester IX

Course Code	Course Name	L	T	P	C	CAT
	THEORY					
19MAM91	Computer Vision	3	0	0	3	PC
19MAM92	Cyber Threat Intelligence	3	0	0	3	PC
	Elective – IV	3	0	0	3	PE
	Elective -V	3	0	0	3	PE
	Elective -VI	3	0	0	3	PE
	PRACTICALS					
19MAM93	Computer Vision Lab	0	0	4	2	PC
19MAM94	Intelligent Cyber Security Lab	0	0	4	2	PC
19MAM95	Elective Lab-III	0	0	4	2	PE
	Total Credits				**21**	

Semester X

Course Code	Course Name	L	T	P	C	CAT
19MAM101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
	Grand Total of Credits				**210**	

Professional Electives- AI & ML

Course Code	Course Name	L	T	P	C	CAT
19MAME01	Ethics in AI	3	0	0	3	PE
19MAME02	Healthcare Analytics	2	0	2	3	PE
19MAME03	Smart Applications	3	0	0	3	PE
19MAME04	Spatial Data Modelling and Analysis	3	0	0	3	PE
19MAME05	Augmented and Virtual Reality	3	0	0	3	PE
19MAME06	Medical Image Processing	3	0	0	3	PE
19MAME07	Natural Language Processing	3	0	0	3	PE
19MAME08	Probabilistic Graphical Models	2	0	2	3	PE
19MAME09	Cognitive Computing	3	0	0	3	PE
19MAME10	Recommender Systems	2	0	2	3	PE
19MAME11	Robotics and its Applications	3	0	0	3	PE
19MAME12	Conversational AI	3	0	0	3	PE
19MAME13	Game Theory	3	0	0	3	PE

Professional Electives-Information Technology

Course Code	Course Name	L	T	P	C	CAT
19MAME14	Agile Software Development	3	0	0	3	PE
19MAME15	SOA and Web Services	2	0	2	3	PE
19MAME16	Internet of Things	3	0	0	3	PE
19MAME17	Digital Signal and Image Processing	2	0	2	3	PE
19MAME18	Cyber Security	3	0	0	3	PE

Professional Electives -Economics, Finance and Management

Course Code	Course Name	L	T	P	C	CAT
19MAME19	Business Intelligence	3	0	0	3	PE

Professional Electives-Laboratory

Course Code	Course Name	L	T	P	C	CAT
19MAMEL01	Spatial Data Modelling and Analysis Laboratory	0	0	4	2	PE
19MAMEL02	Augmented and Virtual Reality Lab	0	0	4	2	PE
19MAMEL03	Natural Language Processing Lab	0	0	4	2	PE
19MAMEL04	Graph Analytics Lab	0	0	4	2	PE
19MAMEL05	Internet of Things Lab	0	0	4	2	PE
19MAMEL06	Cyber Security Lab	0	0	4	2	PE

One Credit Courses**

Course Code	Course Name	L	T	P	C	CAT
19MAMOC01	Econometrics and Machine Learning in Finance	1	0	0	1	EEC
19MAMOC02	Java Programming	0	0	2	1	EEC

****Over and above the CGPA**

19MAM11 - TECHNICAL ENGLISH

Contact Hours

L	T	P	C
2	0	0	2

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Given a social context compose appropriate dialogues using functional words, Construct Descriptive paragraphs using sequencing words and unity of thought

CO2: Given a communication context, categorize the barriers to communication and formulate solutions. Plan and present a 15-minute presentation on technical topic.

CO3: Given short conversations and monologues for listening, specify appropriate responses and construct a summary.

CO4: Interpret the given technical graphical representation and compose passages. Summarize and paraphrase technical text sin about 250 to 300 words.

CO5: Apply the rules of the grammar viz, word formation, nouns, adjectives, adverbs, tenses, concord, phrasal verbs and idioms and use appropriate patterns in the given sentence.

FOCUS ON LANGUAGE: GRAMMAR & VOCABULARY

Changing Words from one form to another - Word Formation: Prefixes & Suffixes - Synonyms and Antonyms – Idioms - Phrasal Verbs – Nouns-Compound Nouns & Noun Phrases - Gerunds & Infinitives – Subject-verb Agreement- Tenses – Adjectives - Expressions of Quantity - Degrees of Comparison – Relative Clause – Modal Verbs – Wh Questions – Sequence Words.

(6)

TECHNICAL COMMUNICATION

Importance of Technical Communication- General and Technical Communication –Objective & Characteristics of Technical Communication – Process of Communication - Levels of Communication – Flow of Communication –Visual Aids in Technical Communication - Barriers to Communication: Noise – Classification of Barriers –Non-verbal Communication: Kinesics – Proxemics- Chronemics- Correlating Verbal and Non-verbal Communication- Cultural Variations.

(4)

READING

Reading & Interpreting Ideas - Interpreting Graphics in Technical Writing – Intensive & Extensive Reading- Reading Comprehension – Techniques for Good Comprehension – Skimming & Scanning – Sequencing of Sentences- Reading text on different topics.

(4)

WRITING

Techniques for Good Writing - Right Words and Phrases – Sentences: Sentence Patterns- Salient Point of Sentence Construction - Paragraph Construction – Paragraph Patterns – Kinds of Paragraph – Writing a First Draft, Revising & Finalizing - Steps to Effective Précis Writing – Process Description – Dialogue Writing – Essays.

(6)

LISTENING

Meaning and Art of Listening-Importance of Listening & Empathy in Communication – Reasons for Poor Listening – Traits of a good listener – Listening modes – Short Dialogues and Conversation- Listening to monologues.

(4)

SPEAKING

Introducing oneself – Exchanging personal information – Asking for and giving information – Expressing likes and dislikes – Making requests – Agreeing and Refusing Requests – Complaining, apologizing – Giving excuses, instructions and suggestions- Describing positive and negative features, favourite snacks, vacation plans, technology, holidays, festivals, customs and special events - – Making comparisons – Talking about food – giving step by step instructions, travel advice - Achieving Confidence, Clarity & Fluency – Vocal Cues - Barriers to Speaking – Types of Speaking – Persuasive Speaking – Public Speaking - Effective Presentation Strategies – Planning - Outlining & Structuring – Nuances of Delivery – Controlling Nervousness & Stage Fright – Visual Aids in Presentation – Applications of MS Power Point.

(6)

Practical sessions based on the above syllabus

TOTAL HOURS: 30

TEXTBOOKS

1. Jack C Richerds, 'Interchange – 2', CUP, Fourth Edition, Chennai, 2015.
2. Meenakshi Raman, Sangeeta Sharma, 'Technical Communication – Principles and Practice', Oxford University Press, New Delhi, 2015.

EXTENSIVE READING

1. Abhijit Acharjee & Rakesh Ramamoorthy, 'Frontiers of Communication – An Anthology of Short Stories and Prose', CUP, 2018. (Only Essay Questions)

REFERENCES

1. Sudharshana N. P. and Savitha C, 'English for Technical Communication', CUP, 2016.
2. Sudharshana N. P. and Savitha C, 'English for Engineers', CUP, 2018
3. Ronald Carter, Michael Mc Carthy, 'Cambridge Grammar of English', Cambridge University Press, 2011.
4. Michael Mc Carthy and Felicity O'Dell, 'English Vocabulary in Use', Cambridge University Press, 2012.
5. Mark Ibbotson, 'Cambridge English for Engineering', Cambridge University Press, 2012.

19MAM12 - APPLIED ALGEBRA

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Gain knowledge in sequences and series to analyse and study their area of applications
CO2: Become familiar in linear algebra concepts for data analysis in economics
CO3: Identify and understand linear algebra techniques which are applied in AI and ML
CO4: To incorporate the concepts of numerical solutions of linear systems which are widely used in Computer Applications.
CO5: Apply difference equation concepts in data modelling.

SEQUENCES AND SERIES
Arithmetic, geometric, and harmonic sequences-Finite and infinite series. Convergence and divergence of infinite series-Simple examples-n^{th} term test for divergence and p-series convergence. Applications of series in financial mathematics**:** Simple and Compound Interest-Nominal and Effective Interest Rates-Continuous Compounding –Future Value and Present Value-Annuities- **Ordinary Annuity**: Future and Present Value, Annuity Payment, Principal Sum, Period and Interest Rate, Annuity Due, Deferred Annuity and Perpetuity.

(11)

VECTOR SPACES
Definition of vector spaces-linearly dependent and independent-subspaces-basis and dimension-of vector space-rank and nullity of linear transformation. Inner product, properties- Cauchy Schwarz-inequality, norm and its properties, introduction of orthogonal basis and Gram-Schmidt orthogonalization process.

(11)

MATRIX ALGEBRA
Eigen Values and Eigen Vectors: Eigenvalues and eigenvectors-Cayley-Hamilton theorem (without proof)-Diagonalization– Quadratic form reduction in three variables-applications.
Matrix factorization techniques-special matrices-permutation matrix (non-negative elements)-Hessenberg matrix-sparse matrix-sparse matrix-band width-Linear system of equations-Gauss elimination-Gauss Jordan-Inverse of a matrix-Gauss-seidal-iteration method. Application of Linear systems: A homogeneous system in economics- non homogenous system by inversion-Applications of Matrices in Input-Output Analysis in Economics.

(12)

DIFFERENCE EQUATIONS
Finite differences-operators and their interrelations-Solutions of finite difference equations with constant coefficients-Solution of first order equation (Iterative Method)-General method of solving first order difference equation-simple applications in economics.

(11)
TOTAL HOURS: 45

TEXTBOOKS

1. Srimanta pal and Subodh C. Bhunia, “Engineering Mathematics”, Oxford University Press India, 1stEdition, 2015. (Para I, Para IV).
2. Biswa Nath Datta, “Numerical Methods for Linear Control Systems Design and Analysis”, Elsevier Academic press, 2004. (Para III).
3. David. C. Lay, “Linear Algebra and its Applications”, Addision Wesley, 2003. (Para II).
4. Curtis F Gerald and Patrick O Wheatly, “Applied Numerical Analysis”, Pearson Education, 2002. (Para V).
5. Mehta B.C, and G.M.K. Madani, “Mathematics for Economists", Sultan Chand & Sons, New Delhi, 2006. (Para III)

REFERENCES

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, Eight Edition, John Wiley & Sons Asia Private Limited, 2008.
2. Grewal, B.S., “Higher Engineering Mathematics”, Fourth Edition, Khanna Publishers, 2007.
3. Piskunov, ‘Differential and Integral Calculus”, MIR Publisher Moscow, 1974.
4. Wylie C. R. & Barret L. C “Advanced Engineering Mathematics” Sixth Edition, McGraw Hill, New York, 1995.

19MAM13 - FUNDAMENTAL STATISTICAL METHODS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: To describe and discuss the key terminologies, concepts, statistical tools and techniques used in statistical analysis.
CO2: To calculate and apply measures of central tendency and measures of dispersion for grouped and ungrouped data.
CO3: To analyze probability and probability distributions and moments of random variables.
CO4: To understand basic concepts in sampling.
CO5: To analyze bivariate data using correlation and simple regression.

INTRODUCTION TO STATISTICS
Definition -Data –Qualitative and Quantitative – Measurement of Data –Nominal and Ordinal - Raw data and grouped data – Primary and Secondary Data – Methods of Collection –Classification of Data – Tabulation –Frequency Distribution and Various Diagrammatic and Graphical Representations of Data.

(8)

SUMMARY STATISTICS
Measures of Central Tendency: Arithmetic Mean, median, mode, geometric mean and harmonic mean Merits and demerits- Relationship between mean, median and mode-Relationship AM, GM and HM, computation of the measures for grouped and ungrouped data-Weighted arithmetic mean
Measures of Dispersion: Range, Mean Deviation and Standard Deviation – Coefficient of Variation and its Use- Quartiles and inter quartile range-Quintiles deciles and percentiles- Moving averages -Skewness and Kurtosis and their uses.

(10)

PROBABILITY
Deterministic and Random Experiments –Definition of Sample Space and Events- Classical and Axiomatic Definitions- Properties of Probability- Addition Theorem- Conditional Probability and Multiplication Theorem of Probability- Definition of Independent Events – Random Variables and their Probability Distributions-Discrete and Continuous Random Variables Probability Mass Function and Cumulative Distribution Functions -Definition – Mathematical Expectation-Mean and Variance – Mean and Variances of Linear Combination of Random Variables – Chebyshev's Theorem- -Important Discrete Distributions-Discrete Uniform Distribution, Binomial, Poisson, -Continuous Distributions: Probability Density Functions and Cumulative Probability Distributions-Normal Distribution and its Properties and Applications.

(12)

SAMPLING
Population and Sample- Sampling and its need –Sampling vs. Complete Enumeration –Parameter and Statistics-Probability Sampling and - Random **S**ampling**-** Simple Random Sampling, Lottery Method and

Random Number Table Method- Stratified Random Sampling- Sampling distribution and standard error of a statistic.

(8)

CORRELATION AND REGRESSION

Definition of correlation - Scatter plot –Karl Pearson's correlation coefficient its properties– Definition of Regression – Simple Regression-Regression of x on y and y on x.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. S.C. Gupta, 'Fundamentals of Statistics', 7th and Enlarged Edition, Himalaya Publishing House, 2014.

REFERENCES

1. Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye , 'Probability and Statistics for Engineers and Scientists', Seventh Edition, Pearson Education, Inc. ,2002.
2. D M Levine T C Krehbiel and M L Berensen, 'Business Statistics: A First Course', Pearson Education, 2003.

19MAM14 - DATA STRUCTURES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the basics programming constructs of C language and write C programs to solve problems.
CO2: Recognize the representation of arrays, stacks, queues and linked list in memory and demonstrate its use in algorithms.
CO3: Solve computational problems using data structures such as arrays, stacks, queues and singly linked list.
CO4: Compare and use appropriate data structures in programming real world applications.
CO5: Learn and apply basic searching and sorting techniques in applications.

INTRODUCTION TO C
Overview of C - Basic data types - Identifier Names - Variables and Initialization – Constants - Operators – Expressions – Input/Output. **Control Statements:** Selection statements - Iteration statements - Branch statements - Expression statements. **Functions:** General form of a function - Accessing a function - Scope of a function – Passing Arguments to function - function prototype - Call by value - Call by reference - Recursion. **Arrays:** Single Dimensional arrays - Multi Dimensional arrays - Passing arrays to a function - Arrays and Strings. **Pointers:** Definition - Pointer type declaration - Pointer assignment - Pointer initialization - Pointer variables - Pointer operators –**Structures**: Defining and Accessing Structures.

(12)

BASIC CONCEPTS
Algorithm Specification - Data Abstraction - Primitive Data Structures - Iterative and Recursive algorithms - Performance Analysis: Space Complexity, Time Complexity, Asymptotic Notation.

(6)

ARRAYS
Array as an Abstract Data Type (ADT) – Implementation of One-Dimensional Array, Two Dimensional Arrays - Sparse Matrices-Applications- Representation of Multidimensional Arrays -String ADT.

(8)

STACKS AND QUEUES
Stack Primitive Operations- Array Representation and Implementation-Applications: Subroutine Handling, Recursion and Expression Processing. Queue Operations-Sequential Implementation - Circular Queues – Dequeues-Applications.

(8)

LINKED LISTS
Singly linked lists- Operations- Applications

(4)

SEARCHING AND SORTING

Linear Search and Binary Search-Selection Sort-Insertion Sort and Bubble Sort.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. Ellis Horowitz, Sartaj Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', University Press, Second Edition, 2008.
2. Yashavanth Kanetkar, 'Let Us C', BPB Publications, Fifteenth Edition, 2002. (Para I)

REFERENCES

1. Byron Gottfried, 'Schaum's Outline of Programming with C', McGraw-Hill Fourth edition 2018
2. Mark Allen Weiss, 'Data Structures and Algorithm Analysis in C', Pearson Edition, 2014.
3. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J.Augenstein, , 'Data structures using C & C++', Prentice Hall, 2012.
4. Krishnamoorthy R, 'Data Structures using C', Mc Graw-Hill Education Pvt. Ltd, 2010.

19MAM15 - THEORY OF PROGRAMMING LANGUAGES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Identify the paradigms of programming languages.
CO2: Apply the concepts of imperative programming in program development
CO3: Analyze various components of object-oriented programming and apply them to real-world applications.
CO4: Understand the concepts of functional, logical and assembly language programming and relate them to apply in various programming languages.
CO5: Identify the suitable programming language and apply the concepts to solve the given real-world problems.

PROGRAM CONSTRUCTS AND THEIR TYPES
Introduction to program constructs: Program units and Program types.

(4)

IMPERATIVE PROGRAMMING
Programming Paradigms- Statements: Structured Programming- Syntax-Directed Control Flow. Design Considerations: Syntax. Special Cases in Loops. Invariants. Partial Correctness. Control flow. Types: Data Representation-Role of Types- Basic Types Arrays-Records-Sets-Pointers- String Tables-Types and Error Checking-Procedure Activations-Activation Records- Parameter-Passing Methods-Scope Rules for Names-Nested Scopes in Source Text-Lexical Scope.

(8)

OBJECT-ORIENTED PROGRAMMING
Groupings of Data and Operations-Constructs for Program Structuring-Information Hiding- Design with Modules-Modules and Defined Types-Class Declarations-Dynamic Allocation. Templates: Parameterized Types-Object-Oriented Programming-Object-Oriented Thinking- Inheritance-Derived Classes and Information Hiding-Objects in Smalltalk.

(8)

FUNCTIONAL PROGRAMMING
Elements of Functional Programming. Types: Values-Operations-Function Declarations. Approaches to Expression Evaluation-Lexical Scope-Type Checking- Functional Programming in a Typed Language-Exploring a List-Functions as First-Class Values- Functional Programming with Lists- Structure of Lists-List Manipulation.

(10)

LOGICAL PROGRAMMING
Connectives - Conditional and Bi-conditional statements -Statement formulae and Truth tables - Tautologies and Tautological Implications -Normal forms -Disjunctive and Conjunctive Normal Forms - The Theory of Inference for the Statement Calculus -Consistency of Premises - The Predicate Calculus -

Variables and Quantifiers - Special variable formulae involving Quantifiers- Theory of Inference for the Predicate Calculus.

(6)

Computing with Relations. Prolog: Data Structures-Programming Techniques-Control.

(3)

ASSEMBLY LANGUAGE PROGRAMMING

Introduction to 8085 Instructions: Data Transfer Operations-Arithmetic Operations-Logic Operations-Branch Operations-Writing Assembly Language Programs.

(6)

TOTAL HOURS: 45

TEXTBOOKS

1. Ravi Sethi, 'Programming languages: Concepts and Constructs', Second Edition, Addison Wesley 1995. (Para II-VI: Chapters 1, 3 to 11).
2. E.V. Krishnamoorthy, 'Introduction to Theory of Computation', East West Press, 1983. (Para I).
3. Ramesh Gaonkar, 'Microprocessor Architecture, Programming and Applications with the 8085', Sixth Edition, PENRAM International Publishing Pvt. Ltd. (Para VII)

REFERENCES

1. Ellis Horowitz, 'Fundamentals of Programming Languages', Springer-Verlag, 1983.
2. Terrence W Pratt, Marvin Zelkowitz, 'Programming Languages Design and Implementation', Pearson Education, Fourth edition, 2003.

19MAM16 - ALGEBRA AND STATISTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM12, 19MAM13

ASSESSMENT: PRACTICALS

COURSE OUTCOMES
CO1: Solve problems in linear algebra using Scilab scripts and commands
CO2: Compute measures of central tendency and dispersion using Spreadsheets in built functions
CO3: Graphically represent statistical data using Spreadsheet tools
CO4: Analyze Bi-variate data using Spreadsheet's Data Analysis Tools
CO5: Develop skills in writing script files and analyze data using R and Spreadsheet's Data Analysis Pack

CONCEPTS TO BE COVERED

1. Scilab/R Fundamentals
2. Algebraic operations on matrices, Transpose of a matrix, Determinants, inverse of a matrix,
3. Solving System of linear equations and consistency,
4. Row reduced echelon form and normal form.
5. Eigen values, Eigen vectors, Rank of a matrix.
6. Solving algebraic and system of equations.
7. Estimating numerical values for given data by means of interpolation.
8. Perform data manipulation using spreadsheet.
9. Perform graphical and diagrammatic representation of statistical data, like bar diagram, pie, histogram and line diagram
10. Construct the pivotal tables and apply statistical functions to calculate the descriptive statistics
11. Practice the theory behind the descriptive statistics, like measures of central tendency, dispersion, skewness and kurtosis
12. Apply and implement the theory of probability in various applications
13. Simple probability and random sampling
14. Practicing the simple correlation and regression techniques.

Software/Tools: Scilab or R & Spreadsheet

REFERENCES

1. K.N.Berk and P.Carey, Data Analysis with Microsoft Excel, Brooks/Cole, USA,2010
2. Gilberto E.Urroz, Matrices and Linear Algebra with SCILAB, http://www.tf.uns.ac.rs/~omorr/radovan_omorjan_003_prII/s_examples/Scilab/Gilberto/scilab5a.pdf
3. Graeme Chandler and Stephen Roberts, Scilab Tutorials for Computational Science, http://paginapessoal.utfpr.edu.br/previero/calculo-numerico-ma64a-em41-e-em42/informacoes-da-disciplina/Scilab_Tutorials.pdf

19MAM17 - DATA STRUCTURES LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: PRACTICALS

COURSE OUTCOMES

CO1: Solve the given problem by devising an algorithm and implementing it into a program.
CO2: Develop reusable and efficient solutions using functions, pointers and structures.
CO3: Write programs to perform operations on strings using library functions.
CO4: Implement stacks, queues and singly linked list using Arrays
CO5: Write programs to implement linear search, binary search and sorting algorithms like selection, insertion and bubble sort.

CONCEPTS TO BE COVERED

Basic Programming

1. Simple programs to understand the concepts of data types.
2. Writing algorithms and converting them to programs to get familiarity on using conditional, control and Iterative statements.
3. Programs on recursion
4. Programs on string manipulations
5. Programs on one- and two-dimensional arrays
6. Declaring and defining functions, passing arguments, calling functions
7. Simple programs using pointers-variables and expressions
8. Creating and accessing structures

Data Structures

1. Sparse and dense matrix operations using arrays.
2. Stack implementation and operations using arrays.
3. Queue implementation and operations using arrays.
4. Singly linked list implementation and operations using arrays
5. Programs on linear search and binary search
6. Programs on selection sort, insertion sort and bubble sort

REFERENCES

1. Yashavanth Kanetkar, ‘Let Us C’, BPB Publications, Fifteenth Edition, 2002.
2. Richard F. Gilberg and Behrouz A. Forouzan, ‘Data Structures- A Pseudocode Approach with C’, Cengage Learning, Second Edition, 2005.
3. Deitel H. M. and Deitel P. J., ‘C - How to Program’, Prentice-Hall, Fifth Edition, 2006.

19MAM18 - PYTHON PROGRAMMING LAB

Contact Hours

L	T	P	C
1	0	4	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICALS

COURSE OUTCOMES
CO1: To write, test, and debug simple Python programs.
CO2: To implement Python programs using conditional, control and repetition statements.
CO3: Use functions and recursive functions for structuring Python programs.
CO4: Represent compound data using lists, tuples, dictionaries.
CO5: Read and write data from or to files in Python.

CONCEPTS TO BE COVERED

1. Naming conventions, basic operators, data types
2. Use of conditional, control and repetition statements
3. String operations and using string functions
4. Demonstrate use of Lists and Tuples
5. Demonstrate use of Dictionaries
6. Implement simple search and sort techniques
7. Demonstrate usage of basic regular expression
8. Demonstrate use of advanced regular expressions for data validation.
9. Implement linear data structures – arrays, stack and queue
10. Read and write into a file.
11. Create Comma Separate Files (CSV), Load CSV files into internal Data Structure
12. Demonstrate Exceptions in Python
13. Use of Python Libraries such as numpy, pandas, matplotlib, etc.

19FYEL11 - EMPLOYABILITY SKILLS

Contact Hours

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1: Given strictly timed objective questions on logical reasoning and verbal ability solve within the given time.

CO2: For a given specific speaking task on topics like describing a picture, movie reviews, storytelling, and extempore generate ideas and speak confidently.

CO3: For a given social situation viz., greeting, thanking, congratulating, apologizing and giving directions, demonstrate command over conversations using appropriate functional expressions.

CO4: For a given 2 to5 minutes speaking activity like Extempore and Debate, produce language structures accurately and fluently. For a given technical topic, prepare a power point presentation for 15 minutes.

CO5: Given short conversations and monologues for listening, specify appropriate responses and construct a summary. Construct dialogues for a given social scenario and interpret the given graphic information and write creative paragraphs.

INTRODUCTION TO SPOKEN ENGLISH

Self-Introduction - Barriers to Speaking and Listening - Introduction to Spoken English, Greetings, Thanking - Apologizing, Congratulating - Giving Directions, Shopping – Role Play.

(6)

VOCABULARY

Activity based on newspaper articles - Word Building - A picture and a few words activity - Current Events.

(4)

VERBAL APTITUDE

Alphabet test – Alphabet Order, Alphabet Series - Letter Word Problem, Word Formation and Scramble - Series Completion –Para Jumbles- Synonyms and Antonyms- Types and Exercises- Sentence Completion –Types and Exercises.

(8)

READING AND PRESENTATION SKILLS

Reading Comprehension- Skimming and Scanning - Reading Prose – Bacon's Essays (Speaking Activity based on the essays) - Story Building- Extempore - Movie Reviews.

(4)

LSRW SKILLS

Speech Sounds - Word Vocabulary - Reading Comprehension - Listening Practice- I -Dialogue Writing - Conversational Exercise – I - Focus on Language - Creative Writing - Conversational Exercise – II - Listening Practice – II.

(8)

TOTAL HOURS: 30

19MAMLE01- PROFESSIONAL ENGLISH

Contact Hours

L	T	P	C
2	0	0	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

CO1: Apply the rules of grammar namely Active and Passive voice, Direct and Indirect speech, Purpose and Function, Articles and Prepositions, Conjunction, Conditional sentences and use suitable patterns in a given sentence or passage.

CO2: Construct appropriate responses to greet, transfer, place the caller on hold, enquires, call backs, unintentional disconnects, interruptions, using suitable language and telephoning etiquettes. Given a business communication scenario construct a suitable strategy and action plan using specific negotiation tactics consistent with the objectives of the negotiator.

CO3: Given a communication context, specify the type and barriers to listening provide solutions and justify. For a given passage note the important points and summarize it.

CO4: Given a business communication scenario, compose a Business Letters, Memo, Emails, Reports, Technical Proposals, Instructions and Recommendation and checklist using appropriate language and format. For a given job requirement, prepare a job application letter with resume.

CO5: Generate valid points for and against the topic and present them with appropriate group behavior for a given HR topic and for any job requirement, plan and prepare for a 20 min HR mock interview.

FOCUS ON LANGUAGE: ENGLISH GRAMMAR & VOCABULARY

One Word Substitutes – Homophones – Homonyms – Eponyms – Direct Indirect Speech – Active Passive Voice – Conditional Sentences – Adverbs – Conjunctions – Prepositions – Articles – Relative Clause – Pronouns – Cause and Effect Expressions – Purpose and Function – Modals.

(6)

BUSINESS ENGLISH

Telephoning Skills: Understanding Telephone communication – Telephonic Conversations and Etiquettes - Handling Calls – Leaving a Message – Making Requests –Asking for and Giving Information – Giving Instructions - Negotiations: Types of Negotiation –Six Basic Steps of Negotiations – Informal and formal Negotiations.

(4)

READING

Summarizing – SQ3R Reading Technique – Note Making: Outline/Linear Method- Sentence Method – Schematic/Mapping Method – Understanding Discourse Coherence – Cloze Comprehension – Critical Reading: Creative and Critical Thinking- Reading proverbs, online advice forum.

(4)

WRITING

Letter Writing – Business Letters – Cover Letters – Resumes – Memos – Emails – Reports – Technical Proposals – Instructions & Recommendations – Technical Description – Checklist - Writing a paragraph – Writing a description of a person's past present and future, recent experiences, movie review, list of roles

– Writing a job application letter, Advice column list - Writing a guide book introduction – Writing about people response to a survey.

(6)

LISTENING

Stress and Intonation -Types of Listening – Barriers of Effective Listening – Listening for Generic Content and Specific Information - Listening & Note Taking – Intensive Listening - Listening to Descriptions - Listening to predicaments, call in radio show and excuses.

(4)

SPEAKING

Group Communication: Forms of Group Communication – Using Body Language in Group – Discussions – Group Discussions - Organizational GD – GD as a Part of Selection Process – Meetings – Conferences – Symposia & Seminars **–** Interviews: Objectives of Interviews – Types of Interviews – Job Interviews – Media Interviews – Press Conference - Describing abilities and Skills, acceptable and prohibited behaviour in different situations, Personality Traits, Countries, a predicament, Recent past events and experiences, movies and books – Giving Advice and suggestions- Making polite requests – Making invitations and excuses- Speculating about past and future events.

(6)

Practical sessions based on theory

TOTAL HOURS: 30

TEXTBOOKS

1. Jack C Richerds, ‘Interchange – 2’, Fourth Edition, Cambridge University Press, 2015.
2. Meenakshi Raman, Sangeeta Sharma, ‘Technical Communication – Principles and Practice’, Oxford University Press, 2015.

REFERENCES

1. Sudharshana N. P and Savitha C, ‘English for Technical Communication’, CUP, 2016.
2. Sudharshana N. P and Savitha C, ‘English for Engineers’, CUP, 2018.
3. Ronald Carter and Michael Mc Carthy, ‘Cambridge Grammar of English’, Cambridge University Press, 2011.
4. Michael Mc Carthy and Felicity O’Dell, ‘English Vocabulary in Use, Cambridge University Press, 2012.
5. Mark Ibbotson, ‘Cambridge English for Engineering’, Cambridge University Press, 2012.

19FY22F - BASIC FRENCH

Contact Hours

L	T	P	C
2	0	1	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the basics of the Language
CO2: Write simple narration and description and speak to communicate idea.
CO3: Demonstrate confidence in Social Interactions.

INTRODUCTION

(2)

UNITÉ-1

Faire connaissance - inviter et répondre à une invitation - décrire les personnes- articles définis et indéfinis - genre etnombre des noms et des adjectifs- interrogation et négation - conjugaison du présent. Paris monuments et lieux publics - la vie de quatre parisiens de professions différentes.

(7)

UNITÉ-2
Exprimer l' ordre et l'obligation demander et commander - evaluer et apprécier- féliciter et remercier - articles partitifs -adjectifs démonstratifs et possessifs prépositions et adverbes de quantité et de l'imperatif verbes pronominaux - une région deFrance la Bourgogne - vie quotidienne à la compagne.

(6)

UNITÉ-3
Raconter et rapporter - donner son avis - se plaindre et réprimander - expliquer et justifier - pronoms compléments -futur proche - passé composé et imparfait. Plusieurs régions de France - différents univers sociaux.

(7)

UNITÉ-4
Demander l'autorisation - interdire - formuler des projects - discuter et débattre. Pronoms < en > et < y > - pronoms relatifs et superlatifs - conjugaison du futur - présent continu et passé récent.La vie administrative et régionale - problems economiques et écologiques - traditions et modernit.

(8)

Practical sessions based on theory

(15)

TOTAL HOURS: 45

TEXTBOOK

1. Le Nouveau Sans Frontières - Philippe Dominique, Jacky Girardet Michèle Verdelhan, Michel Verdelhan

REFERENCES

1. Dondo Modern French Course ---Mathurin Dondo.
2. Modern French Grammar---Margaret Lang and Isabelle Perez.

19FY22G - BASIC GERMAN

Contact Hours

L	T	P	C
2	0	1	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the fundamental concepts of the Language
CO2: Write simple narration and description and speak to communicate idea.
CO3: Demonstrate confidence in Social Interactions.

EINFUHRUNG

BegrU ung - Name - Vorname - Familienname – Anrede **(5)**

THEMA

Hallo ! Wie geht's?

Begegnungen

Guten Tag, ich suche…,

Im Supermarkt

Arbeit und Freizeit

Familie und Haushalt **(7)**

GRAMMATIK-I

Position des Verbs : Aussage, W - Frage und

Ja/Nein - Frage; Artikel die der das.

W - Frage; Konjugation in Prasens;

Nominativ : bestimmter, unbestimmter und negative Artikel

Akkusativ : unbestimmterundnegativer Artikel

Adjektive : Akkusativ-Erganzung **(10)**

GRAMMATIK-II

Artikel als Pronomen Dative - Erganzung : Personalpronomen und Ortsangaben; Imperativ Modalverben; Ortsangaben; Richtungsangaben; Zeitangaben; Ordinalzahlen Possessiv - Artikel; trennbare und nicht trennbareVerben; Wechselprapositionen

(8)

Practical sessions based on theory

(15)

TOTAL HOURS: 45

TEXTBOOK

1. Studio d A1: Kurs - und Ubungsbuch (Deutsch alsFremdsprache) CornelsenVerlag.

REFERENCE

1. Tangarmaktuell1 : Kursbuch + Arbeitsbuch (Deutsch alsFremdsprache) Max HueberVerlag

19MAM21 - APPLIED CALCULUS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM12

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Become familiar in calculus tools to solve problems in optimization
CO2: Understand the concepts of integral calculus with a view towards applications.
CO3: Apply differential equations modeling.
CO4: Gain knowledge in Fourier series to analyze and study pattern recognition.
CO5: Get in-depth knowledge in numerical methods which are widely used in computer applications.

DIFFERENTIAL CALCULUS
Rate of change and limits-rules for finding limits-extensions of the limit concept-continuity-tangent lines-the derivative of function--related rates of change-extreme values of functions-the mean value theorem-first derivative test for local extreme values.

(7)

APPLICATIONS OF DIFFERENTIAL CALCULUS
Curvature–Evolutes–Envelopes–partial differentiation-Jacobians-Functions of several variables–-Hessian Matrix-Expansions and extreme values– Constrained extrema using Lagrange's multiplier method.

(8)

INTEGRAL CALCULUS
Integration–definition and geometrical meaning-double integrals as volumes-changing the order of integration, triple integrals in rectangular coordinates-applications to areas and volumes--compound interest. Special Functions: Beta and Gamma Functions- Double and triple integrals – Applications: Area – Volume.

(7)

FOURIER SERIES
Dirichlet's conditions-Full range series-Half range series-Complex form of series-Parseval's identity – Harmonic analysis.

(8)

ORDINARY DIFFERENTIAL EQUATIONS
Formation of differential equations-geometrical interpretation of ODE- Higher order differential equations with constant coefficients-Euler Cauchy Type-Applications in microeconomics.

(7)

NUMERICAL METHODS
Solution of Algebraic and transcendental Equations-Bisection Method and Newton Raphson Method--Real World Applications of Newton Raphson Method: Finding the Break Even Point of a Firm and finding the interest rates of Annuities -Interpolations-Newton's and Lagrange's method. Numerical solution of system of Equations. Numerical Integration-Numerical solution of ordinary differential equation of First order - RK method of order four-Milne Thomson method.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Thomas & Finney, 'Calculus', Pearson Education, Ninth Edition, 2006. (Para I,II, & III).
2. Srimanta Pal and Subodh C. Bhunia, 'Engineering Mathematics', Oxford University Press India, First Edition, 2015. (Para IV, Para V).
3. Mehta B.C, and G.M.K. Madani, 'Mathematics for Economists', Sultan Chand & Sons, 2006. (Para II, Para III, Para V)
4. Kandasamy P.et.al., 'Numerical Methods', First Revised Edition, Tata McGraw Hill Publishing Company Ltd., 2008. (Para VI)

REFERENCES

1. Erwin Kreyszig, 'Advanced Engineering Mathematics', Eighth Edition, John Wiley & Sons Asia Private Limited., 2008.
2. Grewal, B.S., 'Higher Engineering Mathematics', Fourth Edition, Khanna Publishers, 2007.
3. Piskunov, 'Differential and Integral Calculus, MIR Publishers, Moscow 1974.
4. Wylie C. R. & Barret L. C, 'Advanced Engineering Mathematics', Sixth Edition, Mc Graw Hill, New York, 1995.
5. Steven C. Chapra and Raymond P. Canale, 'Numerical Methods for Engineers', Sixth Edition, McGraw Hill, 2002.

19MAM22 - PROBABILITY DISTRIBUTIONS AND APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM13

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: To understand the properties and applications of advanced probability distribution.
CO2: To determine the moments and moment generating functions of important probability distributions and to impart knowledge on the functions of random variables.
CO3: To provide a good knowledge on the various methods of estimation of parameters.
CO4: To apply various tests of statistical hypothesis on a given statistical data.
CO5: Demonstrate the use and applications of Bayesian Analysis

PROBABILITY DISTRIBUTIONS
Discrete Random Variables: Geometric, negative binomial distributions and hyper geometric distributions. Continuous Probability Distributions: uniform, exponential, gamma, Beta, Chi-square log normal distributions and Weibull distributions and their properties.

(**8)**

FUNCTIONS OF RANDOM VARIABLES
Moments and Moment Generating functions of important distributions-Transformations of Variables and finding their distributions -method of direct transformation and method of moment generating functions- - Joint and Marginal Probability mass functions (for discrete) and density functions(for continuous). Conditional probability distributions-conditional mean and variance-Independence of random variables.

(10)

ESTIMATION
Estimation of parameters using method of moments- Maximum Likelihood Point Estimation(MLE) **–** Properties of estimators-Unbiasedness, minimum variance, efficience and sufficience-Mean Square Error-Asymptotic properties-consistency-Fisher Information and Cramer-Rao's Inequality – Interval Estimation.

(8)

SAMPLING AND TESTS OF HYPOTHESIS
Derivation of sampling distribution of mean and S^2- t-distribution and F-distribution-Central limit theorems- Test of significance – Basic concepts – null hypothesis – alternative hypothesis – level of significance – Standard error and its importance – steps in testing-One and two tailed tests-The use of p-values for Decision making – Large sample tests and Small sample tests for : Single sample: Testing on a single mean with variance known and variance unknown-Two samples-tests on means –One sample test on a single proportion-two sample tests of two proportions-Goodness of Fit tests, One and two sample tests concerning variances-Tests of independence for categorical data, tests for homogeneity.

(12)

BAYES THEOREM AND BAYESIAN STATISTICS
Partition of a sample space and Bayes Theorem (with proof)-Simple applications –Bayesian Concepts-Subjective Probability- Conditional Perspective-Bayesian Inferences-Prior and posterior distributions-Point Estimation Using the Posterior Distribution- Bayesian Interval Estimation-Bayes Estimates using

Decision Theory framework: Bayes estimate under squared error loss function and absolute error loss function.

(7)

Total: 45 Hours

TEXTBOOKS

1. S.C. Gupta, 'Fundamentals of Statistics', Seventh and Enlarged Edition, Himalaya Publishing House, 2014. (Para I-IV).
2. Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, 'Probability and Statistics for Engineers and Scientists', Seventh Edition, Pearson Education, Inc. , 2002. (Para V).

REFERENCES

1. S.C.Gupta and V.K.Kapoor, 'Fundamentals of Mathematical Statistics', Tenth Revised Edition, Sultan Chand & Sons, 2002.
2. Meyer, Paul L., 'Introductory Probability and Statistical Applications', Addison Wesley, Second Edition, 1970.
3. Anthony O'Hagan and Bryan R. Luce**, '**A Primer on Bayesian Statistics in Health Economics and Outcomes Research', MEDTAP International, Inc., 2003.
4. Michael Baron, 'Probability and Statistics for Computer Scientists', CRC Press, 2014.
5. Gianluca Bontempi, 'Handbook Statistical Foundations of Machine Learning', 2017

19MAM23 - COMPUTER SYSTEM ARCHITECTURE

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the basic structure and operation of digital computer
CO2: Perform arithmetic operation on the various number systems and conversions among them
CO3: Apply Boolean algebra to solve logic functions.
CO4: Understand the basics of pipelining and I/O interfaces.
CO5: Evaluate the performance of memory systems.
CO6: Understand parallel processing architectures and GPUs.

BASIC COMPUTER SYSTEM
Introduction-Technologies for Building Processors and Memory – Performance – Instructions: Language of the Computer-Operations, Operands – Instruction Representation.

(4)

NUMBER SYSTEMS AND CODES
Decimal, Binary, Octal and Hexadecimal Systems - Number base conversions-BCD (8421) code - Gray code and conversion- ASCII code - Error detecting and correcting codes: parity bit, block parity, Hamming code.

(7)

BINARY ADDITION AND SUBTRACTION
1's, 2's, 9's, 10's, 15's, 16's Complement representation - 1's and 2's Complement subtraction - unsigned and signed numbers - BCD addition - 9's and 10's BCD subtraction - Binary Multiplication and Division.

(8)

BOOLEAN ALGEBRA AND LOGIC GATES
Laws of Boolean algebra - Basic theorem and properties - Boolean expression and function - Canonical and Standard forms - Minimization of Boolean expression - Karnaugh Map and Quine Mc-Cluskey Method- Basic logic gates and truth tables - universal gates implementation.

(8)

PROCESSOR AND CONTROL UNIT
Building a Data path – Control Implementation Scheme – Pipelining – Handling Data Hazards & Control Hazards – Exceptions.

(6)

MEMORY & I/O SYSTEMS
Memory Hierarchy – Memory Technologies – Cache Memory – Measuring and Improving Cache Performance – Virtual Memory: Page Faults, Translation Lookaside Buffer.

(5)

PARALLELISIM

Parallel Processing Challenges – Flynn‘s classification: SISD, MIMD, SIMD, SPMD, and Vector Architectures – Multi-Core Processors and other Shared Memory Multiprocessors – CUDA Basics-GPU versus CPU-Overview of GPU Architecture-GPU as a Co-processor.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014. (Para I,V,VI).
2. A.P.Godse and Dr. D.A. Godse, ‘Digital Electronics’, Technical Publications, Pune, 2008. (Para II, III, IV).
3. William Stallings, Computer Organization and Architecture – Designing for Performance, Tenth Edition, Pearson India Education Services Pvt. Ltd., 2017. (Para VII)

REFERENCES

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, ‘Computer Organization and Embedded Systems’, Sixth Edition, Tata McGraw Hill, 2012.
2. John P. Hayes, ‘Computer Architecture and Organization’, Third Edition, Tata McGraw Hill, 2012.

19MAM24 - ADVANCED DATA STRUCTURES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM14

COURSE OUTCOMES
CO1: Implement the linked representation and traversal operations on singly and doubly linked list.
CO2: Gain knowledge on non-linear data structures such as trees and graphs and use them in programming applications.
CO3: Solve problems using data structures such as AVL search trees, heaps and m-way search trees.
CO4: Apply appropriate sorting techniques for solving real-time problems.
CO5: Understand the working principle of hashing and collision resolution techniques

LINKED LISTS
Doubly Linked List-Circular Linked List-Traversals-Applications: Addition of Polynomials, Sparse matrix Representation-Linked Stacks-Linked Queues.

(4)

TREES AND BINARY SEARCH TREES
Representation of Trees-Binary Trees: Representation, Operations, Traversals, -Threaded Binary Trees. Binary Search Trees: Searching, Insertion and Deletion of elements, Analysis-Forests.

(6)

GRAPHS
Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits- Euler Graphs -Hamiltonian Paths and Circuits. Elementary Graph Operations: Depth First Search, Breadth First Search, Connected Components, Spanning Trees. Minimum Cost Spanning Trees: Kruskal's Algorithm-Prim's Algorithm-Shortest Paths Algorithms: Single Source, Bellman Ford algorithm, All Pairs Shortest Paths.

(**8)**

HEAPS AND FORESTS
Priority Queues-Max Heap-Transforming a Forest into Binary Tree-Forest Traversals.

(5)

ADVANCED BINARY SEARCH TREES
AVL Trees: Balancing Trees- Searching, Insertion and Deletion of Elements-AVL Rotations, Analysis. Splay Trees: Notations, Analysis.

(7)

MULTIWAY TREES
m- Way Search Trees - B Trees - Red Black Trees - B+ Trees.

(5)

SORTING
Shell Sort-Quick Sort-Merge Sort-Heap Sort-Radix Sort-Time Complexity Analysis.

(6)

HASHING

Static Hashing: Hash Tables, Hash Functions-Dynamic Hashing-Collision Resolution: Open addressing - Linear Probing and Quadratic Probing.

(4)

TOTAL HOURS: 45

TEXTBOOK

1. Ellis Horowitz, Sartaj Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', University Press, Second Edition, 2008.

REFERENCES

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivert, Clifford Stein, 'Introduction to Algorithms', Second Edition, Prentice Hall of India, Publications, New Delhi, 2007.
2. Mark Allen Weiss, 'Data Structures and Algorithm Analysis in C++', Addison Wesley, 2014.
3. Anany Levitin, 'Introduction: The Design & Analysis of Algorithm', Pearson Education Inc., 2003.
4. S.K.Basu, 'Design Method & Analysis of Algorithm', PHI, 2005.

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19MAM25 - CALCULUS AND PROBABILITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

19MAM21,19MAM22

COURSE OUTCOMES

CO1: Solve Differential Equations of first and second order using R commands

CO2: Understand properties of probability distributions using R programming and MS-Excel Tools

CO3: Calculate definite integrals numerically using Trapezoidal and Simpson's methods

CO4: To perform statistical hypothesis testing using R programming.

CO5: To analyze the data using Bayesian data analysis technique with the aid of R programming.

CONCEPTS TO BE COVERED

1. Extreme Value of functions-finding local extrema
2. Numerical differentiation based on Newton's formula, Lagrange's formula.
3. Functions of several variables–-Hessian matrix-Expansions and extreme values– Constrained extrema using Lagrange's multiplier method-applications
4. Numerical integration-Trapezoidal and Simpson's 1/3 rules.
5. Solution of Ordinary Differential Equations,
6. Discrete and Continuous probability distributions
7. Joint Probability Distributions
8. Estimation of population parameters
9. Statistical Hypothesis testing- Large Sample tests
10. Statistical Hypothesis testing – Small Sample tests
11. Bayesian Data Analysis

19MAM26 - PROGRAMMING PARADIGM LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Understand the usage of different programming constructs of procedural programming
CO2: Apply the principles of object oriented programming to solve problems
CO3: Implement the concepts of logic programming and solve real world problems.
CO4: Develop solutions for problems using the concepts of functional programming paradigm.
CO5: Given a problem, develop solutions for it by applying all the four programming paradigms and compare it.

CONCEPTS TO BE COVERED

1. Illustrate concepts of :
   - Structured programming,
   - Data and control abstractions,
   - Programming with assertions (Programing with invariants)
2. Illustrate ideas of
   - Typing, expressions,
   - Pure functions,
   - Recursion,
   - Higher order functions,
   - Encapsulation,
   - Inheritance

   Using
     - Applicative programming and Python
     - Object oriented programming paradigm

REFERENCES

1. Harold Abelson, Gerald Jay Sussman and July Sussman, Structure and Interpretation of Computer Programs, 2nd edition, The MIT Press, 1996.
2. David A. Watt, Programming Language Concepts and Paradigms, Prentice-Hall, 1990.
3. Rajeev Sangal, Programming Paradigms in Lisp, McGraw Hill, 1991.
4. Ravi Sethi Concepts in Programming Languages

19MAM27 - ADVANCED DATA STRUCTURES LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM14

ASSESSMENT: PRACTICALS

COURSE OUTCOMES
CO1: Implement linked representation of linked list and its operations.
CO2: Implement and compare the complexities of various sorting algorithms including bubble sort, heap sort and quick sort.
CO3: Ability to define and apply tree data structures and binary search trees for real time applications.
CO4: Perform operations on graphs and heaps for real time problems.
CO5: Implement shortest path algorithms and hashing techniques for a given application.

CONCEPTS TO BE COVERED
1. Linked Lists Implementation -Singly linked lists, Doubly linked lists and Circular linked lists.
2. Programs on linked stacks.
3. Programs on linked queues.
4. Sorting algorithms-Bubble sort, Insertion sort, Selection sort, Quick sort, Heap sort and Radix sort.
5. Implementation of tree data structure and traversals
6. Applications of Binary search trees and its operations
7. Operations on AVL tree
8. B-Tree and its operations
9. Problems related to graphs and graph traversals
10. Construction of heap & its operation
11. Construction of minimum spanning tree algorithm.
12. Implementation of shortest path algorithms
13. Implementation of hashing techniques.

REFERENCES

1. Richard F. Gilbery, Behrouz A.Forouzan, ‘Data structures - A Pseudocode Approach with C’, Thomson Asia Pvt. Ltd. ,2002.
2. Yashwant Kanetkar, ‘Data Structures Through C’, Ninth Edition, BPB Publication, 2010.

19FYEL21 - ENGLISH FOR EMPLOYABILITY

Contact Hours

L	T	P	C
0	0	2	1

COURSE OUTCOMES

CO1: Given strictly timed objective questions on logical sequence of words, sequential order of things, comparison, and sentence correction, solve within the given time.

CO2: For a given specific speaking task on topics like Just a Minute Describing an object, book review and extempore generate ideas and speak confidently.

CO3: For a given social situation viz., Travel and Transport, complaining, giving instructions, advising and sympathizing, requesting and warning people, communicate effectively to peer using appropriate functional language.

CO4: For a given HR topic, generate valid points for and against the topic and present them with appropriate group behavior. For any job requirement, plan and prepare a 20 min HR mock interview.

CO5: For any job requirement, plan and prepare a 20 min HR mock interview.

SPEAKING SKILLS

Ice Breakers - Just a Minute - Book Reviews - Describing an object – Extempore – Paraphrasing.

(6)

FUNCTIONAL ENGLISH

Spoken English - Travel and Transport, Complaining - Giving Instructions, Advising and Sympathizing – Requesting and warning people.

(5)

VERBAL APTITUDE

Logical Sequence of Words- Exercises - Sequential Order of Things - Comparison Type Questions – Introduction and Exercises - Idioms and Phrases - Types and Exercises - Vocabulary through Mythology - One-word Substitutes, Word Power Exercises - Common Errors in English - Sentence Correction.

(7)

VOCABULARY IN CONTEXT

Activity based on newspaper articles - Vocabulary – Homophones and Homonyms - Reading Prose – Reading Comprehension Activity.

(4)

GROUP DISCUSSION AND INTERVIEW SKILLS

Professional Communication - Mock Group Discussion – Mock Interview – Telephoning Skills – Personality Development Activities.

(8)

Total: 30 Hours

19MAM31 - ARTIFICIAL INTELLIGENCE

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM24

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Apply various heuristic search strategies in optimal decision making
CO2: Understand uncertainty in real world situations.
CO3: Employ first order logic for building a knowledge base and demonstrate reasoning on this.
CO4: Express different planning strategies to deal with problems, describe and apply various knowledge representation techniques.
CO5: Review knowledge based Artificial Intelligent systems and approaches.

INTRODUCTION

Foundation of AI – Agents and Environments- Concept of Rationality – Nature of Environments – Structure of Agents.

(6)

PROBLEM SOLVING

Problem-Solving Agents and examples – Uninformed and Informed Search Strategies - Heuristic Functions - Local Search Algorithms and Optimization Problems – Local search in Continuous spaces – Searching with Nondeterministic actions and Partial Observations.

(12)

ADVERSARIAL SEARCH AND CONSTRAINT SATISFACTION PROBLEMS

Games - Optimal Decisions in Games - Alpha-Beta Pruning. Constraint Satisfaction Problems (CSP) - Backtracking Search for CSPs - Local Search for Constraint Satisfaction Problems - Structure of Problems.

(8)

KNOWLEDGE AND REASONING

Knowledge based Agents – The Wumpus World - Logic – Propositional Logic- Syntax and Semantics of First-Order Logic - Using First-Order Logic - Knowledge Engineering in First-Order Logic - Unification and Lifting - Forward Chaining – Backward Chaining - Resolution - Knowledge Representation.

(12)

PLANNING

Definition of classical planning - Algorithms for Planning as State-Space Search - Planning Graphs - Hierarchical Task Network Planning - Planning and Acting in Nondeterministic Domains – Multi agent Planning.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. Stuart J Russell and Peter Norvig, “Artificial Intelligence- A Modern Approach”, Pearson Education Series, Third Edition, 2010. (Chapters 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

REFERENCES

1. Dan W.Patterson "Introduction to AI and ES", Pearson Education, First Edition , 2007
2. Nilis J Nilsson “AI A new Synthesis” Morgan Kaufmann publishers, 1998

19MAM32 - THEORY OF COMPUTING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Develop designs for different machine types: finite automata, pushdown automata.
CO2: Illustrate the mechanism of Turing machine and state its applications
CO3: Recognize partial recursive functions and its relationship to programs
CO4: Design different types of grammars and develop grammars to produce specific solutions.
CO5: Formulate methods to check the correctness of algorithms

FINITE STATE MACHINES
Deterministic finite state machine, Non-deterministic finite state machine, Pumping lemma for Regular grammar. Applications of Finite State Machines.

(8)

PUSH DOWN AUTOMATA
Deterministic push down automata. Recognizing context free grammars. Non deterministic push down automata and Ambiguous context free grammars. Applications of Push down Automata.

(8)

TURING MACHINES AND COMPUTABILITY
Turing Machines, recognizing Context sensitive grammars. Types of Turing machines, Halting problem. Effective procedure for algorithm and computability. Applications of Turing Machine.

(9)

FUNCTIONS
Basic functions and strategy set, Partial and Primitive recursive functions, Computability. McCarthy's formalism, Programs and Recursive functions.

(6)

PRODUCTIONS
Production system, Acceptors and Generators, Markov algorithms.

(8)

GRAMMARS
Rules, formalization, Ambiguity, Reduced Form, Derivation on Rule Tree, Chomsky hierarchy, Derivation graphs, Grammars and Compiler Design, Programming languages and Compilers, Sentential forms and Derivation trees, Parsing algorithms Stochastic grammars.

(8)

COMPUTATION

Approaches for checking correctness, Partial total correctness, Proof methods. Floyd Hoare Manna Inductive assertion. Functional methods.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. EV Krishnamoorthy, "Introduction to Theory of Computation", East West Press,1983. (Sections 2 to 5)
2. KLP Mishra, N.Chandrashekar “Theory of Computer Science -Automata, Languages and Computation” Second edition, PHI, 1998

REFERENCES

1. John E Hopcroft, Jeffrey D Ullman,"Introduction to Automata theory languages and computation", Addision Wesley 2006.
2. Michael Sipser "Introduction to the theory of computation" PWS Publishing, 2006.

19MAM33 - DATABASE MANAGEMENT SYSTEMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Describe the purpose and architecture of database systems from the perspective of persistent storage of real world data.
CO2: Analyze the problem statement, construct the Entity Relationship model and map it into relational model by applying normalization.
CO3: Generate Relational Algebra, Relational Calculus and SQL statements to perform queries of real world applications
CO4: Evaluate the indexing techniques and choose the suitable technique by analyzing the given application
CO5: Determine the concurrency control and recovery mechanisms based on the criticality of the transaction

INTRODUCTION
Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Architecture, Database Users and Administrators.
Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Language, Relational operations.

(10)

DATABASE DESIGN
Database Design and the E-R Model, Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Extended E-R Features. Relational Database Design: Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory.

(11)

INTRODUCTION TO SQL
Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database. **Intermediate SQL:** Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization.
Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers. **Formal Relational Query Languages:** The Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.

(10)

DATA STORAGE AND INDEXING

File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer. Indexing and Hashing: Basic Concepts, Ordered Indices, Overview of B+-Tree Index Files and Hashing Comparison of Ordered Indexing and Hashing, Bitmap Indices, Index Definition in SQL.

(7)

TRANSACTION, CONCURRENCY CONTROL AND RECOVERY

Concept, Simple Transaction Model, Atomicity and Durability, Isolation, Serializability, Isolation and Atomicity, Isolation Levels. Lock-based Concurrency Control, Time Stamp based Concurrency Control, Failure Classification, Recovery and Atomicity.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2010.

REFERENCES

1. Ramez Elmasri, Shamkant B. Navathe Durvasula, V.L.N. Somayajulu, Shyam K. Gupta, "Fundamentals of Database Systems", Fourth Edition, Pearson Education, 2006.
2. Christopher Allen, Simon Chatwin, Catherine A. Creary, "Introduction to Relational Databases and SQL Programming", Tata McGraw-Hill,2003.

19MAM34 - PREDICTIVE ANALYTICS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM13, 19MAM22

COURSE OUTCOMES
CO1: Analyze time series data and apply it to forecast the future.
CO2: Formulate and compute multiple linear regression model and understand its properties.
CO3: Classify objects into different groups using discriminant function, logistic regression equation.
CO4: Identify underlying factors in multivariate data sets using principal component analysis.
CO5: Understand the terminology of factor analysis, factor rotation and interpret factor loadings using R programming.

MULTIPLE REGRESSION ANALYSIS (MLR)
Variables in Multivariate Data-Mean Vector, Covariance and Correlation Matrices and their properties-Estimation of missing values. Multiple Linear Regression Equation and Polynomial Regression Models-Estimation of the coefficients using method of least squares–Linear Regression using Matrices-Properties of Least Squares-Inferences in Multiple Linear Regression: ANOVA and testing the partial regression coefficients- Interpretation of R^2-Standardized Regression Coefficient and its interpretation-Inclusion of categorical or indicator variables in MLR –Multi-collinearity problem-Stepwise Regression.

(10)

TIME SERIES FORECASTING
Regression Model for forecasting-Forecasting Time Series data with Seasonal Variation-Auto-Regressive(AR) Models- AR Model Identification: ACF and PACF, Moving Average -MA(q)) and ARMA(p,q) Models-Auto-Regressive Integrated Moving Average (ARIMA) Process-Dickey Fuller Test-Augmented Dickey-Fuller Test-Transforming Non Stationary Process to Stationary Process using Differencing-ARIMA(p,d,q) model building-Ljung-box test for Auto-Correlations-Power of Forecasting: Theil's Coefficient.

(12)

DISCRIMINATION AND CLASSIFICATION
Discriminant Function Analysis- Fisher's discriminant function –Fitting discriminant functions using R and interpreting the results. Logistic Regression: Logistic Model-Definitions of Odds and Logit-Estimation of the logistic regression coefficients-Making Predictions-Multiple Logistic Regression-Fitting logistic regression equation using R and interpreting the results.

(9)

PRINCIPAL COMPONENT ANALYSIS
Data Reduction Techniques-Definition of Population Principal Components –Principal Components obtained by Standardized variables -Rules to retain number of Principal Components using Scree Plot-Graphing the Principal Components-Testing the equal correlation structure-Geometric and Algebraic bases of Principal Components.

(7)

FACTOR ANALYSIS

Factor Analysis -Definitions-The Orthogonal Factor Model-Its Covariance Structure- Estimation of loadings and communalities-Principal component method and Principal factor method-Factor Loadings and Interpretations- Rotation- Orthogonal and Oblique rotation-Exploratory and Confirmatory Factor Analysis- Estimation of PCA and FA using R.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. Alvin C.Rencher, William F. Christensen "Methods of Multivariate Analysis",3rd Edition, Wiley Inter-science, 2012
2. Dinesh Kumar U, " Business Analytics", Wiley, First Edition, 2017
3. Richard A.Johnsonand Dean W.Wichern, " Applied Multivariate Statistical Analysis", 6th Edition, Pearson Prentice Hall, 2007.

REFERENCES

1. R.E.Walpole, R.H.Myers,S.L.Myers and K.Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Prentice Hal, 2012.
2. Joseph F. Hair Jr., William C. Black, Barry J.Babin and Rolph E.Anderson, "Multivariate Data Analysis", 7th Edition, Pearson, 2010.
3. G.James,D.Witten, T.Hastie and R.Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2015.

19MAM35 - HUMAN COMPUTER INTERACTION

Contact Hours

L	T	P	C
3	1	0	4

PRE-REQUISITES
Consent of instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Learn the foundations of Human Computer Interaction (HCI)
CO2: Be familiar with the design technologies for individuals and persons with disabilities
CO3: Be familiar with models and theories of HCI
CO4: Develop an understanding of the intricacies of mobile HCI
CO5: Develop an understanding of the intricacies of web HCI

FOUNDATIONS OF HCI
The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices –Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles –elements – interactivity- Paradigms.

(9)

DESIGN & SOFTWARE PROCESS
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

(9)

MODELS AND THEORIES
Cognitive models –Socio-Organizational issues and stakeholder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

(9)

MOBILE HCI
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

(9)

WEB INTERFACE DESIGN
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Pearson Education, 2004.
2. Brian Fling, “Mobile Design and Development”, First Edition, O‟Reilly Media Inc., 2009.
3. Bill Scott and Theresa Neil, “Designing Web Interfaces”, First Edition, O‟Reilly, 2009.

19MAM36 - ARTIFICIAL INTELLIGENCE LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Design and implement heuristic search procedures
CO2: Develop solutions for constraint satisfaction problem
CO3: Design and implement solutions for classical Artificial Intelligence problems
CO4: Design and implement knowledge-based system
CO5: Become familiar with use of Artificial Intelligence tools.

CONCEPTS TO BE COVERED

1. Implementing state space search algorithms for solving puzzle problems.
    a. A* Search
    b. Hill-climbing Search.
2. Implementation of Min-Max Search Procedure with alpha beta pruning for finding the solutions of games.
3. Implementation of Constraint Satisfaction Problem for solving Crypt-arithmetic.
4. Implementation of Unification algorithm by considering Resolution concept.
5. Solve the classical Water Jug problem.
6. Solve the classical Monkey Banana problem.
7. Solve the classical Blocks World problem.
8. Develop a knowledge base system/ expert system consisting of facts and rules about some specialized knowledge domain of your choice.
9. Designing a Chatbot application
10. Development of programs for simulation of computer games like: Tic-Tac-Toe, N-queens Problems, travelling salesman problem, Chess, etc.

Softwares: Use of PROLOG/LISP, CLIPS or any open source framework

19MMA37 - DATABASE MANAGEMENT SYSTEMS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Design the conceptual data model as Entity Relationship diagram and create the database using DDL statements for a given application.
CO2: Formulate simple DML SQL queries to retrieve the required data for real world applications.
CO3: Generate DML queries with Subqueries, Joins, Group By, Order By and Aggregate functions to filter and aggregate the data of the real world applications.
CO4: Construct reusable PL/SQL blocks with Functions, Procedures, Packages, Triggers, Exception Handling, and Cursors as required by OLTP applications.
CO5: Develop a database project by constructing the ER model, creating Tables and generating SQL and PL/SQL blocks using RDBMS platform.

CONCEPTS TO BE COVERED
1. Designing a database for an application and representing it through ER diagram
2. Creating and managing tables
3. Basic SQL SELECT statements
4. Restricting and sorting data
5. Single row functions
6. Displaying data from multiple tables
7. Aggregating data using Group function - Group By
8. Subqueries
9. Views, Sequence, Index, Synonym
10. SET operators, Date and Time functions
11. PL / SQL Programs
12. Exception Handling, Cursors, Functions, Procedures, Package, Triggers

Softwares: MySQL/Oracle

19MAM38 - PREDICTIVE ANALYTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Use R software to analyze multivariate data using multiple linear regression, discriminant function, logistic regression equation models and cluster analysis tools.
CO2: Using R software to analyze Time Series Models
CO3: Identify underlying factors in multivariate data by applying factor analysis and principal component analysis models using R software packages.
CO4: Use R software to retain the components and loading of the Principal Components.
CO5: Use R to verify the data and to estimate the parameters of a factor model.

CONCEPTS TO BE COVERED

1. Reading and plotting Multivariate Data–Matrix scatter plot and Scatter plot with the data points labeled by their group.
2. Calculating summary statistics for Multivariate Data-Means and variances per group, Between-groups Variance and within-groups variance for a variable.
3. Calculating Covariances, Correlations and Standardizing Multivariate data fitting Multiple Regression Equation using MS-Excel and interpreting the output.
4. Writing Script files in R for Fitting Multiple Regression Equation: Summary, extracting β coefficients, Covariance matrix, standard errors, residuals and fitted values and plotting, Normal Probability Plot of residuals, Predictions-Compare the results using lm command.
5. Stepwise regression: forward, backward and stepwise.
6. Differencing a Time Series, selecting a Candidate ARIMA Model, Forecasting using ARIMA Model.
7. Fitting logistic regression equation: Prediction, goodness of fit and Plotting ROC Curve.
8. Discriminant function analysis and loadings for the discriminant functions.
9. Principal component Analysis : screen plot to decide on the number of components to retain and loadings for the PCs and Scatter Plots for PCs.
10. Factor Analysis using R

19MAM41 - OPERATIONS RESEARCH

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Solve Linear Programming, Transportation and Assignment based problems.
CO2: Discuss the elementary Inventory models, Price break models and Safety stock problems.
CO3: Solve Job sequencing and replacement problems.
CO4: Categorize the Queuing models and also simulate the problems using Monte - Carlo Technique.
CO5: Analyze the network models using CPM and PERT.

LINEAR PROGRAMMING
Linear programming problem - canonical and standard forms - formulation - graphical solution – simplex method-Big M method using artificial variables- **Transportation model** – Initial Basic Feasible Solution using Northwest Corner method, Matrix Minima method and Vogels approximation method – Optimal solution by Modified Distribution Method-Unbalanced Transportation problems and Degeneracy - **Assignment model**-Solution by using Hungarian method.

(12)

SEQUENCING AND REPLACEMENT
Sequencing: Basic assumptions – Johnson's procedure for Sequencing of: i) n jobs on 2 machines ii) n jobs in 3 machines and iii) n jobs on m machines. **Replacement:** Need for replacement of equipments - failure mechanism of items - Replacement policy - Replacement of items that deteriorates gradually - Replacement of items that fail suddenly.

(7)

INVENTORY
Need for the inventory - Costs involved in inventory - Concepts of average inventory, economic order quantity - Deterministic model: Fixed ordering quantity models - EOQ model with uniform demand, finite and infinite replacement with or without shortages -EOQ with one price break. Inventory control - Buffer stock - Determination of optimum buffer stock - EOQ system of ordering - Multi item order model - ABC analysis.

(9)

QUEUING THEORY
Queuing system characteristics-Describing a queuing system by input pattern, service mechanism, queue discipline and customer behaviour- Steady, transient and explosive states in queuing systems-Designation of queue and symbols used in queuing models- M/M/1 (∞/FIFO) model-Steady State solutions-Finite Queue Length Model: (M / M / 1) : (N/FIFO).

(8)

PERT and CPM NETWORKS

Activities and events-Rules for forming a Network- Critical Path Method(CPM) for computing project completion time- network – Time estimation in CPM-Project Cost Analysis- critical path -Crashing-Least cost schedule algorithm- PERT - Network – Difference between PERT and CPM-Time estimates in PERT-Critical Path estimation - Probability of meeting a scheduled date of completion of the project.

(9)

TOTAL HOURS: 45

TEXTBOOK

1. Hamdy, A Taha, "Operations Research - An introduction", Pearson Education India, 2004.

REFERENCES

1. Rama Murthy P. Operations Research, New Age International, Second Edition, 2007.
2. S. D. Sharma "Operations Research ", Kedar Nath Ram Nath & Co publishers, 10th edition, 1995.
3. Kanti Swarup, P.K. Gupta, Mani Mohan, "Operations Research", Sultan Chand & Sons, 2001.
4. Hillier & Lieberman, "Operations Research - An Introduction", Tata McGraw-Hill, 2004

19MAM42 - MACHINE LEARNING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM13, 19MAM22

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Recognize fundamental issues and challenges of machine learning: data, model selection, model complexity, supervised and unsupervised learning.
CO2: Apply Decision trees and Artificial Neural Networks in classification
CO3: Distinguish the strength and weakness of Bayesian learning.
CO4: Analyze and use Instance based learning and reinforcement learning in real time problems.
CO5: Learn association rules and clustering methods and apply to derive insights from data.

INTRODUCTION
Basics of Machine Learning-Examples of Machine Learning Applications-Designing a Learning System.

(3)

CONCEPT LEARNING AND GENERAL TO SPECIFIC ORDERING

Concept Learning Task- Concept Learning as Search- Find-S- Version Space and Candidate Eliminate Algorithm-Inductive bias.

(5)

DECISION TREE LEARNING
Decision tree representation, Decision tree Learning Algorithm- Inductive bias-Issues in Decision Tree learning.

(6)

ARTIFICIAL NEURAL NETWORKS
Introduction- Neural Network Representations- Perceptron- Multi-layer Networks and Back Propagation Algorithm- Remarks on the Back propagation Algorithm- Face Recognition Example.

EVALUATING HYPOTHESIS
Motivation, Estimating Hypothesis Accuracy, Basis of Sampling Theory- Difference in Error of Two Hypothesis- Comparing Learning Algorithms

(8)

BAYESIAN LEARNING
Bayes Theorem - Bayes theorem and Concept Learning- Maximum Likelihood and Least Square Error Hypothesis- Bayes Optimal Classifier- Naive Bayes Classifier-Bayesian Belief Networks- EM Algorithm.

(8)

INSTANCE BASED LEARNING

k-Nearest Neighbour Learning, locally weighted Regression- Radial Basis Functions- Case based Reasoning. **Reinforcement Learning:** The learning task – Non-deterministic Rewards and Actions - Relationship to Dynamic Programming.

(8)

UNSUPERVISED LEARNING

Introduction-k-means Clustering-Hierarchical Clustering. Association Rules - Apriori Algorithm.

(7)

TOTAL HOURS: 45

TEXTBOOKS

1. Tom M Mitchell, "Machine Learning", Indian Edition, McGraw Hill, 2013.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 3rd Edition, 2014. (First and Last Para).
3. Jaiwei Han, Micheline Kamber Data Mining-concepts and techniques, 2/e, Morgan Kaufmann Publishers, San Francisco,2006. (Last Para)

REFERENCES

1. Bishop, C. Pattern Recognition and Machine Learning. Berlin: Springer-Verlag, 2006.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Chapman and Hall,2014.

19MAM43 - DESIGN AND ANALYSIS OF ALGORITHMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM14, 19MAM24

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Able to apply divide and conquer, greedy methods in problem solving
CO2: Able to use dynamic programming in real time problems and derive efficient solutions.
CO3: Able to understand the concepts of backtracking and branch-bound techniques.
CO4: Able to differentiate between NP, NP hard and NP Complete problems.
CO5: Able to analyze the efficiency of different algorithm design techniques and their proper usage in application problems.

INTRODUCTION
Fundamentals of algorithmic problem solving – Method of specifying an algorithm – proving the correctness – Analyzing an algorithm - Asymptotic Notations.

(5)

DIVIDE AND CONQUER
General Method- Binary Search - Finding the Maximum and Minimum- Merge Sort - Quick Sort - Strassen's Matrix Multiplication.

GREEDY METHOD
General Method - Knapsack Problem - Tree Vertex Splitting - Minimum-cost spanning trees- Single Source Shortest Paths.

(7)

DYNAMIC PROGRAMMING
General Method - Multistage Graphs - All-Pairs Shortest Paths - Single Source Shortest Path - Traveling Salesperson Problem.

(7)

BACKTRACKING
General Method - 8 Queens Problem – Sum of Subsets- Graph Coloring -Hamiltonian Cycles.

(7)

BRANCH AND BOUND
General Method - 0/1 Knapsack Problem - Traveling Salesperson Problem.

(5)

NP-HARD, NP-COMPLETE CLASSES
Basic concepts – Non-deterministic algorithms – Satisfiability Problem – NP-hard and NP-complete Problems.

(7)

TOTAL HOURS: 45

TEXTBOOK

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, “Fundamental of Computer Algorithms”, Galgotia Publications, 1998.

REFERENCES

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivert, Clifford Stein “Introduction to Algorithms”, Second Edition, Prentice Hall of India, Publications, New Delhi, 2007.
2. Anany Levitin, “Introduction: The Design & Analysis of Algorithm”, Pearson Education Inc., 2003.
3. Michael T.Goodrich, Roberto Tamassia, “Algorithm Design, Foundations, Analysis and Internet Examples”, Wiley, 2011.
4. Jon Kleinberg and Eve Tardos, “Algorithm Design”, Pearson Education, 2012.

19MAM44 - DATA COMMUNICATIONS AND NETWORKING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Enumerate the layers of the OSI model and TCP/IP and compare the models.
CO2: Describe the relationship between data and signals, and distinguish among their types, behavior, properties, characterization, and transmission.
CO3: Given an inter-network topology configuration, can demonstrate how a packet reaches the destination.
CO4: Explain the services offered by each layer of TCP/IP protocol suite and the role of each protocol.
CO5: Given an application, can explain the role of the protocols involved.

INTRODUCTION
Data Communications – Networks – The Internet – Protocols and Standards – OSI Model – TCP/IP Protocol Suite – Addressing.

(9)

PHYSICAL LAYER AND MEDIA
Data and Signals – Digital Transmission: Digital to Digital Conversion – Analog to Digital Conversion – Transmission Modes – Analog Transmission: Digital -to -Analog Conversion – Multiplexing Techniques.

(10)

DATA LINK CONTROL
Framing – Flow and Error Control – Protocols – Noiseless Channels – Noisy Channels. Multiple Access: Random Access Protocols – Ethernet - IEEE 802.11.

(7)

NETWORK LAYER
Switching – Packet switching at Network Layer – Network layer Services – Issues – IP Addresses – Delivery and Forwarding of Packets – Internet Protocol IPv4 - Address Resolution Protocol – Internet Control Message Protocol.

(9)

HIGHER LAYERS
Transport Layer: Services – User Datagram Protocol: User Datagram – UDP services – Transmission Control Protocol: TCP services – Features – Segment – TCP connection Management.
Application Layer: DNS – Worldwide Web.

(10)
TOTAL HOURS: 45

TEXTBOOKS

1. Behrouz A Forouzan, "Data Communications and Networking", Tata McGrawHill, 5th Edition, 2017. (Para 1-III)
2. Behrouz A Forouzan, "TCP/ IP Protocol Suite", Tata McGraw Hill, 2010. (Para IV-V)

REFERENCES

1. Kevin Fall R and Richard Stevens W, "TCP/IP Illustrated, Volume 1: The Protocols", Addison-Wesley, 2011.
2. James F Kurose and Keith Ross, "Computer Networking: A Top-Down Approach", Pearson Addison-Wesley, 2012.
3. Douglas Comer, "Internetworking with TCP/IP", Prentice Hall, 2013. 4. William Stallings, "Data and Computer Communications", Pearson, 2013.

19MAM45 - OPERATING SYSTEMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Demonstrate the structure of operating system, batch programming, system calls and virtual machines.
CO2: Demonstration of Kernel Management specific to concurrent process for Inter Process Communication systems.
CO3: Estimate system performance through scheduling algorithms - FIFO, round robin, priority, shortest job first.
CO4: Recognize memory allocation and deallocation for both static and dynamic storage.
CO5: Design and develop a new simple File System using Disk and File System Management

INTRODUCTION

Abstract view of an Operating system - Extended view of resource manager - Overview: Simple Batch system - Multi programmed batch systems - Time Sharing Systems - Parallel Systems - distributed systems - Real time systems - System structure: IO structure- memory- CPU-Kernels and microkernels - Dual-mode operation - operating - system services - system calls - Structure of Operating system- Various components of Operating system.

(9)

PROCESS MANAGEMENT

Process Concepts - Process Creation - Process Termination - Process States - Process Description - Process Control - Relationship between process and threads - Thread State - Thread Scheduling- Thread Synchronization-Multithreading model - Concurrent Process -process synchronization: critical section problem - Mutual Exclusion - Dekker's algorithm -synchronization hardware - semaphore - classical problem of ynchronization - critical regions - monitors - atomic transaction - race condition. Deadlock characterization - handling deadlocks - prevention - avoidance - detection and recovery - combined approach.

(10)

PROCESSOR MANAGEMENT

Basic Concepts - Scheduling Criteria – Pre-emptive versus non-preemptive scheduling - Scheduling algorithms: FIFO - Shortest job first, priority, round robin, multi-level queue - Multi level feedback queue - multiprocessor scheduling.

(9)

MEMORY MANAGEMENT

Basic Concepts - Logical versus Physical address - Swapping - Fixed Partition and Dynamic Partition - Simple Paging - Multi Level Paging - Inverted Paging – Paging algorithms-Simple segmentation- Virtual Memory - Demand Paging - Thrashing-Working Set Model -Demand Segmentation.

(9)

I/O AND FILE MANAGEMENT

I/O: hardware - Application I/O interface - Logical Structure of I/O Functions -I/O Buffering - Disk I/O - Disk Scheduling. File Management: File Concepts - Access methods - Directory Structure - File System Structure - Allocation methods - Free Space Management.

CASE STUDIES

Mobile Operating System-Cloud and IoT Operating Systems.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Abraham Silberschatz. A, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", John Wiley, 2013.
2. William Stallings, "Operating Systems: Internals and Design Principles", Prentice-Hall, Ninth edition, 2018.

REFERENCES

1. H.M.Dietel, "An Introduction to Operating Systems", Addison Wesley, 2nd Edition,2007.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall of India Pvt. Ltd, 2008.

19MAM46 - MACHINE LEARNING LAB

Contact Hours

L	T	P	C
0	0	4	2

PREREQUISITES

19MAM18

COURSE OUTCOMES

CO1: Able to prepare the data for machine learning using data pre-processing and dimension reduction techniques.

CO2: Able to build regression and classification models using benchmark datasets and give insights.

CO3: Able to evaluate the performance of models using different performance measures.

CO4: Able to use clustering techniques to group data and analyse the clusters.

CO5: Able to design and develop prediction systems by choosing appropriate machine learning algorithms on real-time datasets.

CONCEPTS TO BE COVERED

1. Perform descriptive analysis on different types of datasets
2. Apply pre-processing techniques on the dataset.
3. Build Regression models to predict future values for datasets like rainfall, earthquake etc.
4. Build Classification models and infer the results
    a. Decision tree classifier
    b. Naïve Bayes Classifier
    c. k-Nearest Neighbor Classifier
5. Apply cross validation techniques and evaluate the models using various performance metrics
6. Implement Perceptron and Artificial Neural Network for simple problems
7. Implement the non-parametric Locally Weighted Regression algorithm to fit data points.
8. Clustering
    a. Implement K-Means Clustering
    b. Implement Hierarchical clustering
9. Use market basket dataset and mine association rules using Apriori algorithm.
10. Build a complete Machine Learning pipeline with data visualization capabilities for a given prediction problem.

Note: *Benchmark datasets may be downloaded from UCI machine learning repository, Kaggle etc for each of the above problems.*

19MAM47 - DESIGN AND ANALYSIS OF ALGORITHMS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM17,19MAM27

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Ability to analyze the efficiency of different algorithm design techniques and their proper usage in application problems.
CO2: Implementing string matching and network flow algorithms.
CO3: Able to apply data structure concepts in any applications of the dynamic programming
CO4: Implement the design technique of backtracking in application to analyze the types of problem solved using backtracking
CO5: Skill to compare, contrast, and understand the choice of various design techniques to solve a given problem.

CONCEPTS TO BE COVERED

1. Problem using closest pair algorithm
2. Prim's minimum cost spanning tree
3. Kruskal's minimum cost spanning tree using min heap data structure, union and find operation
4. Problem related to greedy methods
5. Applications of dynamic programming
6. Application of all pairs shortest path problem
7. Application of graph coloring using backtracking
8. Applications of branch and bound technique
9. String matching algorithms

19MAM48 - NETWORK PROGRAMMING LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM14

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Understand key protocols that support communication.
CO2: Develop and implement connection-oriented and connectionless communication using Socket API for a given set of requirements.
CO3: Develop and implement concurrent and iterative servers and analyze their functionality.
CO4: Apply advanced programming techniques such as Broadcasting and Multicasting.
CO5: Develop and implement simple network applications using NS-2 API for a given set of requirements and demonstrate its working.

CONCEPTS TO BE COVERED

1. Basic networking commands
2. TCP one-way communication
3. TCP two-way communication
4. UDP one-way communication
5. UDP two-way communication
6. Concurrent, Iterative Server Implementation
7. IP header setting by kernel and displaying IP header
8. IP header setting by user and displaying IP header
9. IP Checksum Computation
10. Ping Implementation
11. Broadcasting using UDP
12. Multicast Communication using UDP
13. Simulations / Developing networking applications

19MAM51 - ADVANCED MACHINE LEARNING

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM42

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Use ensemble techniques and dimensionality reduction methods for building machine learning models.
CO2: Understand the optimization techniques and regularization adopted in machine learning algorithms.
CO3: Learn the properties of kernels, kernel functions and apply them in pattern analysis.
CO4: Recognize the application of markov chain approaches for random sampling and model probabilities and use them in applications.
CO5: Apply the concept of graphical models in machine learning problems

ENSEMBLE LEARNING
Introduction to multiple models-Bagging: Bagged Decision Tree-Random Subspaces-Random Forest. Boosting: AdaBoost-Gradient Boosting Machines-Stochastic Gradient Boosting-XGBoost. Stacking: Voting.
Dimensionality Reduction Techniques: Principal Component Analysis- Factor Analysis-Multidimensional Scaling-Linear Discriminant Analysis- Singular Value Decomposition.

(10)

MODEL EVALUATION AND OPTIMIZATION
Classification Performance Metrics: ROC, PR Curves, Precision at K. Class Imbalance: Over and Under sampling, SMOTE. Bias-Variance Trade-offs-Cross Validation: Stratified Splits and Temporal CV. Model Tuning: Grid and Random Search Regularization: L1 and L2 Norm Methods-LASSO and Ridge Regression.

(11)

KERNEL MACHINES
Kernels-Optimal Separating Hyperplane-Kernel Trick-Vectorial Kernels-Multiclass Kernel Machines. Support Vector Classification-Support Vector Regression -Application of Support Vector Machines.

(9)

MARKOV CHAIN MONTE CARLO METHODS
Sampling-Markov Chains-The metropolis-Hastings Algorithm-Gibbs Sampling.

(7)

GRAPHICAL MODELS
Bayesian Networks-Belief Propagation-Undirected Graphs: Markov Random Fields-Hidden Markov Models: Forward algorithm.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Stephen Marsland, Machine Learning- An Algorithmic Perspective, CRC Press, Second Ed.,2015. (Para-I)
2. Henrik Brink, Joseph Richards, Mark Fetherolf, Real World Machine Learning, Manning Publishers,2016. (Para-II)
3. Ethem Alpaydin, Introduction to Machine Learning, Fourth Ed., PHI Publication,2015. (Para III,IV,V)

REFERENCES

1. Scholkopf, B. and Smola, A. J., Learning with Kernels: Support Vector Machines, Regu- larization, Optimization, and Beyond, The MIT Press 2001.
2. Koller D. and Friedman, N., Probabilistic Graphical Models: Principles and Techniques, The MIT Press 2009.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2010

19MAM52-ARTIFICIAL NEURAL NETWORKS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

CO1: Learn the fundamentals concepts of the early Neural Network architectures and its applications.
CO2: Implement Perceptron and Backpropagation learning rules to solve problems.
CO3: Understand the different types of unsupervised learning techniques of Artificial Neural Networks.
CO4: Apply Radial Belief Network for Classification problems
CO5: Design and implement associative memories networks.

INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS

Artificial neural networks Vs Biological neural networks, ANN architecture, Basic building block of an artificial neuron, Activation functions, Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE-Feed forward neural network, feed backward neural network.

(5)

ARTIFICIAL NEURAL NETWORKS-SUPERVISED LEARNING

Perceptron and its learning law- Learning rule: Perceptron Learning Rule-Gradient Descent and the Delta learning rule- Limitations-Multi-Layer Perceptron-Backpropagation networks: Architecture, Backpropagation Learning Algorithm-Derivation-Training and Convergence-Accelerated learning in multilayer perceptron.

(9)

ARTIFICIAL NEURAL NETWORKS-UNSUPERVISED LEARNING

Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning. Self- Organizing Computational Maps: Kohonen Network- Hopfield Networks-Boltzmann Machine.

(11)

RADIAL BASIS FUNCTION (RBF) NETWORKS

Introduction-RBF regularization theory-Generalized RBF Networks-Learning in RBFs- RBF application to Face Recognition

(10)

ADAPTIVE RESONANCE THEORY

Network and learning rules. **Associative memory:** auto-associative memory, bi-directional associative memory (BAM). Regularization in ANNs-Applications of Neural Networks.

(10)

TOTAL HOURS: 45

TEXTBOOKS

1. Simon O. Haykin, Neural Networks and Learning Machines, Pearson Education, 2016.

REFERENCES

1. L. Fausett, *Fundamentals of Neural Networks*, Prentice Hall,2004
2. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.
3. C. Bishop, Neural Networks and Machine Learning, Springer, 1998.

19MAM53 - KNOWLEDGE BASED SYSTEMS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the concepts central to the creation of knowledge bases and expert systems.
CO2: Identify the components of a knowledge based systems (KBS)
CO3: Explore the issues involved in the design and development of Artificial Intelligence Based Decision Support Systems and discuss the role these systems play in the business environment.
CO4: Select an appropriate knowledge representation and reasoning method, and anticipate potential difficulties in developing and introducing the expert systems.
CO5: Examine properties of knowledge search techniques and understand the application domains of KBS.

INTRODUCTION TO KNOWLEDGE-BASED SYSTEMS (KBS)
Definition- Types of Knowledge -Comparing with Decision Support Systems-From File Server to Knowledge Server-Applications of Knowledge-based Systems-Limitations-Future of KBS- Artificial Intelligence and Expert Systems: Basics of Artificial Intelligence-Components of Expert Systems-Modes and Applications-Advantages and Limitations-Expert Systems vs Traditional Systems.

(10)

DEVELOPMENT OF KNOWLEDGE-BASED SYSTEMS
Development Strategies-Feasibility Study-Design and User Specification-Activities of Detailed Design. Knowledge Acquisition: Overview-Organization for Knowledge Acquisition-Decision Tables and Production Rules-Testing the Knowledge Base-Distribution of Repository.

(8)

DATA AND KNOWLEDGE REPRESENTATION
From Files to Knowledge Bases- -Knowledge Coding and Representation Methods- Database and Knowledge Bases-Intelligent Systems.

(7)

INFERENCES AND UNCERTAINTY
Strategies for Reasoning and Searching-Control-Conflict Resolution-Rule Based Systems-Uncertainty Rules-Approaches to Uncertainty Management-Fuzzy Logic.

(10)

RESOURCES FOR KBS
Processors-Programming for KBS: LISP and PROLOG-CLIPS framework. Selected Expert System Applications: Marketing-Software Engineering-Management of Natural Resources-Medicine-Agriculture.

(10)

TOTAL HOURS: 45

TEXTBOOKS

1. D.Partridge, Hussain,K.M. Knowledge Based Information Systems, Mc Graw Hill, 1996.
2. Jay Liebowitz, The Handbook of Applied Expert Systems, 2019 (Para V).

REFERENCES

1. Joseph Giarrantano, Gary Riley, Expert Systems: Principles and Programming, PWS Publishing Company,Paperback,2007
2. Dan.W. Patterson, Introduction to Artificial Intelligence and Expert Systems,PHI, 2007.
3. Rajendra Arvind Akerkar, Priti Srinivas Sajja, Knowledge Based Systems, Jones & Bartlette Publishers,2010.

19MAM54 - AI SYSTEMS ENGINEERING

Contact hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Understand the concept of an Intelligent System (IS) and goals of AI-Enabled Systems
CO2: Create intelligence using different approaches including machine learning
CO3: Implement production-quality systems that are robust to mistakes of AI components
CO4: Compare the intelligence and evaluate the accuracy of the AI-based systems using appropriate methods.
CO5: Build an AI based system from end to end and leverage machine learning in practice.

APPROACHING AN INTELLIGENT SYSTEMS (IS) PROJECT
Elements of Intelligent Systems-Examples-Making an Intelligent System-Problems that need Information Systems- Working with data. Goals and Success Measure for AI-Enabled Systems: Defining Goals-Types of Goals-Measuring Goals-Component of Intelligent Experience-Modes of Intelligent Interaction-Properties of good data-Understand Outcomes-Verifying Intelligent Experiences.

(12)

MODELS TO AI-ENABLED SYSTEMS
Presenting Intelligence to Users-Achieving System Objectives-Minimizing Intelligence Flaws-Create Data to Grow the System-Trade-offs among modeling techniques.

(8)

RISKS AND PLANNING FOR MISTAKES
Mistakes made by IS-Changes in Intelligence-The Human Factor-Balancing Intelligent Experience-Dealing with Mistakes.

(8)

MODEL QUALITY AND TESTING
Evaluating Accuracy-Evaluating Other Types of Predictions-Using Data for Evaluation-Comparing Intelligence-Common Challenges-Quality Assessment in Production.

(9)

SOFTWARE ARCHITECTURE FOR AI-ENABLED SYSTEMS
Considerations for Positioning Intelligence-Static Intelligence in the Product-Client side and Server-side Intelligence-Backend and Hybrid Intelligence-An Intelligent System Checklist.

(8)

TOTAL HOURS: 45

TEXTBOOK

1. Building Intelligent Systems: A Guide to Machine Learning Engineering, Geoff Hulten, APress,2018. (Chap.1,2,4,5,6,7,13,15,17,18,19,24)

REFERENCES

1. https://ckaestne.github.io/seai/F2020/
2. https://github.com/ckaestne/seai/blob/F2020/assignments/I1_case_study.md

19MAM55 - DISTRIBUTED AND CLOUD COMPUTING

Contact hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1: Explain the core concepts of the cloud computing paradigm
CO2: Compare the service models offered by different service providers and choose appropriate platforms for implementing cloud computing solutions considering management, security and trust requirements.
CO3: Analyze various cloud programming models and apply them to solve problems on the cloud.
CO4: Elucidate the concept, features, use cases, and benefits of containers, and the difference between containers and virtual machines.
CO5: Explain the basic concepts of microservices and container orchestration.

DISTRIBUTED SYSTEM MODELS AND ENABLING TECHNOLOGIES
Technologies for Network-Based Systems - System Models for Distributed and Cloud Computing - Software Environments for Distributed Systems and Clouds - Performance, Security, and Energy Efficiency.

(6)

CLUSTERS and VIRTUALIZATION OF CLUSTERS
Clustering for Massive Parallelism - Computer Clusters and MPP Architectures -Design Principles of Computer Cluster. Implementation Levels of Virtualization -Virtualization Structures/Tools and Mechanisms -Virtualization of CPU, Memory, and I/O Devices -Virtual Clusters and Resource Management -Virtualization for Data-Center Automation.

(9)

COMPUTING CLOUDS AND SERVICE ORIENTED ARCHITECTURE
Cloud Platform Architecture: Cloud Computing and Service Models -Data Center Design and Interconnection Networks - Architectural Design of Compute and Storage Clouds - Public Cloud Platforms: GAE, AWS, and Azure - Inter-cloud Resource Management - Cloud Security and Trust Management.
Service-Oriented Architecture for Distributed Computing: Services and Service oriented Architecture - Message- oriented Middleware - Service Registries - Basic Workflow.

(12)

CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS
Features of Cloud and Grid Platforms - Parallel and Distributed Programming Paradigms - Programming Support of Google App Engine - Programming on Amazon AWS and Microsoft Azure - Emerging Cloud Software Environments.

(9)

MICROSERVICES AND CONTAINERS

Introduction to Microservices - Migrating and Implementing Microservices - Containerization: Docker Container - Container Orchestration - Container Management.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Kai Hwang,Geoffrey C Fox, John J Dongarra, Distributed and Cloud Computing From Parallel Processing to the Internet of Things", Morgan Kaufmann, 2012.(Para I-IV)
2. Parminder Singh Kocher, "Microservices and Containers", Addison Wesley, 2018. (Para V)

REFERENCES

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", Apress Series 2005.
3. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, "Cloud Computing - A practical Approach", Tata McGrawHill, 2010.

19MAM56 - ADVANCED MACHINE LEARNING LAB

Contact hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Implement bagging, boosting and Random Forest methods for classification and regression problems.

CO2: Apply hyper-parameter tuning and dimensionality reduction techniques to improve the performance of the models.

CO3: Use support vector machines, Hidden Markov Models and Bayesian Belief networks on real-time datasets and draw insights.

CO4: Implement various neural network models like perceptron, associative nets, Self-organizing maps (SOM) etc without using libraries for simple problems.

CO5: Design and implement Artificial Neural Networks and Radial Belief Network to classify images.

CONCEPTS TO BE COVERED

1. Ensemble learning methods in building classifiers
    - Bagging
    - Boosting and
    - Stacking algorithms
2. Download a large dataset with more dimensions and apply dimensionality reduction techniques like PCA, LDA, SVD etc on it and compare the classifier performance using various metrics.
3. Dealing with class imbalance in ML models using SMOTE methods
4. Improving model performance through hyper-parameter tuning methods
    - Cross Validation
    - GridSearchCV, Random SearchCV, Optimization algorithms etc
    - Optimizing the models using L1 and L2 regression
5. Support Vector Machine for classification and Regression
6. Bayesian Belief network implementation
7. Sequence classification using Hidden Markov Model

Artificial Neural Networks (ANN)

1. Design a perceptron for logic gates
2. Implementing back propagation algorithm
3. Implement Auto-associative Neural network and
4. SOM
5. Classification using Radial Basis Networks
6. Design and implement an ANN model to classify images. (with and without library)
7. Simple image classification applications using ANN with datasets from Kaggle and performance tuning.

19MAM57 - FULL STACK WEB DEVELOPMENT LAB

Contact hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM17

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Develop web pages that function using external data -HTML and CSS.
CO2: Use Javascript to implement client-side validations and perform AJAX calls
CO3: Apply AngularJS and /ReactJS to develop frontend dynamic web UI
CO4: Implement CRUD operations on database (MongoDB) in NODE.js
CO5: Build end-to-end web applications handling all the areas of the tech-stack and any of the web frameworks.

CONCEPTS TO BE COVERED

1. **Front-End**
    - HTML Basics
    - CSS-styling, selectors, box model, border, margin, padding
        - Develop responsive websites using HTML and CSS. (Eg.Video Player, Educational Game)
    - JavaScript
        - Fundamentals, Hoisting, Callbacks, Asynchronous JavaScript, DOM Manipulation, JSON, AJAX Calls, JQuery etc.
2. **Front-End Frameworks and Libraries**
    - Angular JS or React JS
        - Single page web application development
3. **Back-end**

- Node.Js
    - Building a HTTP Server with Node.JS using HTTP APIs
    - Buffers, Streams, and Events

4. **Work with MongoDB**
    - Create a database and set up function to interface with it in a CRUD pattern
5. **Work with APIs**
    - Build an endpoint that can send out a tweet using the Twitter API

Note: Development of complete web application end-to end may be the final exercise

19MAM58- CLOUD COMPUTING LAB

Contact hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Demonstrate knowledge on creating, cloning, migrating virtual machines using VirtualBox, a virtualization tool.

CO2: For a given system configuration, can use EC2 to acquire instances.

CO3: Develop applications, launch it on Google App Engine, and access it with proper authentication mechanisms.

CO4: Construct a private cloud using the open-source cloud technologies such as OpenStack/CloudStack/OpenNebula for a given requirement.

CO5: Given an application, can create Micro services, can containerize, and deploy.

VIRTUALIZATION - VIRTUAL BOX

- Create virtual machines of different configurations
- Communication between host and virtual machine
- Communication between virtual machine to virtual machine
- Show the virtual machine migration from one node to the other.

PRIVATE CLOUD

Use Eucalyptus or OpenStack or CloudStack or equivalent to set up a private cloud and demonstrate:

- Create virtual machines of different configurations. Check how many virtual machines can be utilized at a particular time.
- Attach a virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.
- Install a C compiler in the virtual machine and execute a sample program.
- Show the virtual machine migration from one node to the other.
- Install storage controller and interact with it.

PUBLIC CLOUD

Explore any public cloud to access various services provided by it.

CONTAINERIZATION

- Implement Docker and Kubernetes based application development and deployment
- Choose a ML Application, Containerize and deploy in Cloud.
- Adapt DevOps for basic testing (unit test) and deployment

19MAM59 - PERSONALITY DEVELOPMENT

Contact hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Ascertain the various concepts of Self like the Physical Self – Energy Self – Intellectual Self –Mental Self – Blissful Self with respect to the Western (Occidental) and Eastern (Oriental) theories of Self and Personality Development.

CO2: Outline the significant effects of Self Confidence to build team confidence, given the foundation principles of Self-Motivation and Confidence.

CO3: Assess the various personalities and Attitudes and choose the best attitude for making bold decisions in personal and professional contexts.

CO4: Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.

CO5: Set Career goals and formulate strategies by Prioritizing, organizing and scheduling the required tasks. Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.

PERSONALITY DEVELOPMENT

One's Personality Sends Out a Signal That Others Read – Same Person: Consciously Different Personalities can be Powerful – There isn't One Right Personality; It Differs by Role – Learning about Personality Development from the Three Cases – Personality Analysis – Freudian Analysis of Personality Development – Swami Vivekananda's Concept of Personality – Development: Physical Self – Energy Self – Intellectual Self – Mental Self – Blissful Self – Personality Begets.

(7)

LEADERSHIP QUALITIES & INTERPERSONAL SKILLS

Resolving Conflict – A Smiling Face – Appreciative Attitude – Assertive Nature –Communication Skills – Listening Skills – Developing Empathy – The Personality Attribute of Taking Bold Decisions – Personality Types and Leadership Qualities – Mapping the Different Personality Types – Personality Tests: Example of a Personality Test: Jung Typology Test – Personality Assessment.

(7)

ETIQUETTE

Social Etiquette – Corporate Etiquette - Personal Grooming – Using minimal Body Language –Leadership and Entrepreneurship: Corporate Training – Professionalism - Self awareness –Creativity skills – Cognitive Development – Assertiveness – Positive Thinking and Attitude.

(8)

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.

(8)

TOTAL HOURS: 30

REFERENCE BOOKS

1**.** Mitra K.Barun, “Personality Development and Soft Skills”, Oxford University Press, 2011.
2. Krishna Mohan, Meera Banerji. “Developing Communication Skills” Macmillan Publishers, 2012.
3. Sai Lakshmi. B, “Poly Skills- A Course in Communication and Life Skills” Cambridge University Press, 2012.
4. Simon Sweeney, English for Business Communication, Cambridge University Press, 2013.
5. Meenakshi Raman, Sangeeta Sharma, Technical Communication - Principles and Practice,2nd Edition, Oxford University Press, New Delhi, 2015.

19MAM61 - INTELLIGENT AGENTS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES:
19MAM31,19MAM53

COURSE OUTCOMES
CO1: Understand agents. agent types, structure and their interactions
CO2: Appreciate the utility of different types of AI agents.
CO3: Learn and use multi agent systems and their interactions to reach agreements.
CO4: Demonstrate communication language used by the agents for their coordination and coherence.
CO5: Review the cooperative distributed problem-solving techniques used by agents with task and result sharing.

INTELLIGENT AGENTS
Introduction-Environments of Intelligent Agents-Agents and Objects-Agents and Expert Systems-Agents as Intentional Systems-Abstract Architectures for Intelligent Agents-Synthesizing Agents-Deductive Reasoning Agents.

(8)

PRACTICAL REASONING AGENTS
Practical Reasoning- Means-Ends Reasoning-The Blocks World- Implementing a Practical Reasoning Agent-Commitment to Ends and Means-The Procedural Reasoning System.
Reactive and Hybrid Agents: Brooks and the Subsumption Architecture-The Limitations of Reactive Agents, Hybrid Agents.

(10)

MULTI-AGENT INTERACTIONS
Utilities and Preferences- Multiagent Encounters- Dominant Strategies and Nash Equilibria-Competitive and Zero-Sum Interactions-The Prisoner's Dilemma.
Reaching Agreements
Mechanism Design, Auctions, Negotiation, Task-Oriented Domains, Worth-Oriented Domains, Argumentation.

(12)

COMMUNICATION AND CO-OPERATION
Speech Acts - Agent Communication Languages-KIF-KQML-The FIPA Agent Communication Languages-Ontologies for Agent Communication-Coordination Languages.
Cooperative Distributed Problem Solving-Coherence and Coordination-Task Sharing and Result Sharing-Task Sharing in the Contract Net-Result Sharing-Handling Inconsistency- Coordination-Multiagent Planning and Synchronization.

(10)

CASE STUDY
Applications of Agents in Various Domains-Building multi-agent systems.

(5)

TOTAL HOURS: 45

TEXTBOOKS

1. Michael Wooldridge, “An Introduction to Multi Agent Systems”, 2nd Edition, John Wiley & Sons, 2009.
2. G. Weiss. “Multiagent Systems--A Modern Approach to Distributed Artificial Intelligence”, 2nd Edition, MIT Press, Cambridge,2013. (Last Para)

REFERENCES

1. Praveen Palanisamy, “Hands-On Intelligent Agents with OpenAI Gym: Your Guide to Developing AI Agents Using Deep Reinforcement Learning”, Packt, 2018.
2. Fabio Luigi Bellifemine, Giovanni Caire, Dominic Greenwood, “Developing Multi-Agent Systems with JADE” , John Wiley & Sons, 2007.
3. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2015.

19MAM62 - DEEP LEARNING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM52

COURSE OUTCOMES
CO1: Understand the concepts of feedforward and deep networks and regularization principles.
CO2: Implement and visualize Convolutional Neural Networks algorithms for classification problems.
CO3: Identify Recurrent Neural Network algorithms which are more appropriate for various types of learning tasks in various domains.
CO4: Review the unsupervised deep learning models- deep generative models and autoencoders for predictive learning.
CO5: Apply the optimization techniques and fine tune the deep neural networks while designing deep learning algorithms for varied applications.
CO6: Learn the basics of transfer learning and its application in deep learning

DEEP FEEDFORWARD NETWORKS
Feed Forward Networks-Learning XOR-Gradient Based Learning Hidden Units-Architectural Design-Empirical Risk Minimization-Backpropagation.

(8)

REGULARIZATION FOR DEEP LEARNING
Parameter Norm Penalties - Norm Penalties as Constrained Optimization - Regularization and Under - Constrained Problems - Dataset Augmentation - Noise Robustness - Semi-Supervised Learning - Multi-Task Learning - Early Stopping - Parameter Tying and Parameter Sharing - Sparse Representations - Bagging and Other Ensemble Methods – Dropout.

(7)

OPTIMIZATION FOR TRAINING DEEP MODELS
Learning vs Pure Optimization-Challenges in Neural Network Optimization-Basic Algorithms- Parameter Initialization Strategies-Algorithms with Adaptive Learning Rates-Approximate Second-Order Methods-Optimization Strategies and Meta-Algorithms.

(7)

CONVOLUTIONAL NEURAL NETWORKS(CNN)
Basic Structure of a Convolution Network-Training a CNN-Case Studies of CNN Architecture-Visualization and Unsupervised Learning -Applications of CNNs. **Autoencoders:** Architecture-Applications.

(8)

RECURRENT NEURAL NETWORKS (RNN)
Architecture of RNN-Challenges in Training NN- Echo state Networks-Long Short-Term Memory-Applications of RNN. Transformers in Deep Learning: Architecture-Comparison to RNN and CNN-Applications.

(7)

TRANSFER LEARNING

Fundamentals of Transfer Learning: Definition-Transfer Learning Types-Methodologies-Need and Challenges. Fundamentals of Pre-Trained Models-Examples-Image Classification using Pre-trained Models.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017. (Para I-III).
2. Charu C Aggarwal, "Neural Networks and Deep Learning", Springer, 2018. (Para IV,V)
3. Dipanjan Sarkar, Raghav Bali, "Transfer Learning in Action", Manning. 2021.(Para VI)

REFERENCES

1. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications,2017
2. Dipanjan Sarkar, Raghav Bali, T. Ghosh, "Hands-on Transfer Learning with Python", Packt,2018.
3. https://theaisummer.com/transformer/

19MAM63 - INFORMATION RETRIEVAL AND WEB SEARCH

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Understand the basic concepts and techniques in information retrieval
CO2: Apply the information retrieval models.
CO3: Evaluate an information retrieval system based on the relevance of the documents it retrieves.
CO4: Analyze the documents and query performances of system
CO5: Explore the techniques in text and multimedia retrieval process

INFORMATION RETRIEVAL AND SEARCH PROCESS
Introduction to Information Retrieval(IR) – The IR Problem –The IR system – The web – User Interface for Search – Search by Users – Search Interfaces Today – Visualization in Search Interfaces – Design and Evaluation of Search Interfaces.

(7)

MODELING AND RETRIEVAL EVALUATION
IR Models – Classic Information retrieval-Boolean Model- Term weighting – TF-IDF Weight – Document Length Normalization – Vector Model – The Hypertext Model – Web based Models – Structured Text Retrieval – Multimedia Retrieval – Enterprise and Vertical Search - Retrieval Evaluation: The Cranfield paradigm – Retrieval Metrics – User Based Evaluation.

(10)

RELEVANCE FEEDBACK AND QUERY EXPANSION
Framework for Feedback Methods – Explicit Relevance Feedback – Explicit Feedback Through Clicks – Implicit Feedback Through Local Analysis.

(8)

DOCUMENTS AND QUERIES-LANGUAGES
Meta data – Document formats – Mark-up Languages and Properties– Document Pre-processing – Queries: Languages and Properties – Query Languages – Query Properties –Indexing and Searching- Inverted Indexes.

(8)

WEB RETRIEVAL AND CRAWLING
Search Engine Architecture – Search Engine Ranking- Managing Web Data –Search Engine User Interaction –Web Crawling: Applications of Web Crawler-Taxonomy of Crawlers – Crawler Architecture

(7)

TEXT AND MULTIMEDIA RETRIEVAL
Structuring Power – XML Retrieval – Multimedia Information Retrieval – Challenges – Content Based Image Retrieval

(5)

TOTAL HOURS: 45

TEXTBOOK

1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval", Second Edition, ACM Press Books, 2011.

REFERENCES

1. C. Manning, P. Raghavan, and H. Schütze, “Introduction to Information Retrieval”, Cambridge University Press, 2009.
2. Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormac, “Implementing and Evaluating Search Engines”, MIT Press, 2016.

19MAM64 - BIG DATA ANALYTICS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM42

COURSE OUTCOMES
CO1: Learn the concepts of big data characteristics and its applications
CO2: Apply map-reduce programming to parallelize data centric problems using Hadoop and HDFS
CO3: Exposure to data analytics using various Hadoop ecosystem tools.
CO4: Understand stream processing and perform stream analytics on real-time problems.
CO5: Implement real-time streaming analytics using Spark Streaming API.

INTRODUCTION TO BIG DATA
Big Data Characteristics - Scalability and Parallel Processing - Designing Data Architecture - Data Sources and Quality - Data Storage and Analysis - Big Data Analytics Applications and Case Studies. Data Analytics Lifecycle - Six Phases: Discovery-Data Preparation-Model Planning-Model Building-Communicate Results-Operationalize.

(6)

HADOOP AND MAP REDUCE
Hadoop and its Ecosystem– Installing Hadoop-Understanding Hadoop Features-Learning HDFS and MapReduce Architecture-Understanding Hadoop MapReduce Fundamentals-Writing a Hadoop MapReduce-Examples.

(9)

BIG DATA TECHNOLOGIES
NoSQL- Big Data Management using NoSQL, MangoDB and Cassandra, Hadoop Ecosystem Tools - Hive, HiveQL, Pig, Spark and Big Data Analytics – Apache Mahout Machine Learning Applications.

(10)

DATA STREAM MINING
Data Stream Concepts and Data Stream Management: Data stream concepts - Data Stream Model - Architecture - Data Stream Management System (DSMS) - Examples of sources of streams - Stream Queries - Stream Processing Issues - Real-time Processing, Stream Processing and Batch Processing - Stream Computing Aspects - Frequent Itemsets Mining in a Stream.

(10)

REAL-TIME ANALYTICS
Apache Spark Streaming-Real-time Analytics Platform (RTAP) Applications-Case Studies: Real-Time Sentiment Analysis, Positive Negative Sentiments Prediction and Stock Market Prediction.

(10)

TOTAL HOURS: 45

TEXTBOOKS

1. Raj Kamal and Preeti Saxena, "Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning", McGraw-Hill Education, 2019. (Para I, III-V)
2. Vignesh Prajapathi, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013. (Para II)
3. Data Science and Big Data Analytics, EMC Educational Services, Wiley, 2015. (Para I)

REFERENCES

1. Kai Hwang and Min Chen, "Big-Data Analytics: for Cloud, IoT and Cognitive Computing", Wiley Edition, 2018.

2. Bill Chambers and Matei Zaharia, “Spark: The Definitive Guide”, O’Reilly, 2018.

19MAM65 - DEEP LEARNING LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Design single and multi-layer feed-forward deep networks and tune various hyper-parameters.
CO2: Build classification models using convolutional neural networks, recurrent neural networks for real-time applications.
CO3: Implement hyperparameter tuning and optimization techniques to improve the performance of the Deep neural networks.
CO4: Use of LSTM network in real-time prediction problems.
CO5: Apply pretrained models in practice with large image datasets and perform classification efficiently.

CONCEPTS TO BE COVERED

- Image pre-processing for NN
- Data augmentation
- Convolutional NN
    - Simple CNN with parameters settings.
    - Classify images (faces, melanomas, etc.) based on patterns and objects that appear in them.
- Pre-trained models/Transfer learning (VGG-16, Resnet etc)
- Recurrent NN
    - Text Translation
    - Sentiment Analysis
- Predict the next word using a sample text
- Hyper parameter tuning and optimization of the model
    - Demonstrate the use of different optimization techniques and hyper-parameter tuning techniques
- Applications of Long Short-Term Memory Networks

Datasets: Benchmark datasets for image and text processing may be used. (Imagenet, CIFAR-10 etc)

REFERENCES

1. Francois Chollet, “Deep Learning with Python”, Kindle Edition,2021.
2. Dipanjan Sarkar, Raghav Bali, T. Ghosh, “Hands-on Transfer Learning with Python”, Packt,2018.

19MAM66 - MOBILE APPLICATION DEVELOPMENT LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1: Understand the components and structure of mobile application development frameworks for Android and windows OS-based mobiles.
CO2: Work with various mobile application development frameworks and develop mobile apps.
CO3: Apply the basic UI and important design concepts and issues of development in mobile applications.
CO4: Develop mobile apps for Android OS using GPS, Storage and RSS feed.
CO5: Design mobile applications based on the capabilities and limitations of mobile devices.

CONCEPTS TO BE COVERED

1. Develop an application that uses GUI components, Font and Colors
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases or back-end storage for mobile apps.
5. Develop an application that makes use of notification manager
6. Implement an application that uses multi-threading
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed
11. Develop a mobile application to send an email.

Suggested Softwares: Android SDK/Kotlin

19MAM67 - BIG DATA ANALYTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

PRE-REQUISITES
19MAM46

COURSE OUTCOMES
CO1: Write MapReduce programs to work on Hadoop clusters.
CO2: Work with NoSQL -MongoDB for learning basic CRUD operations.
CO3: Learn and apply basic Hadoop commands and read/write data to HDFS
CO4: Implement supervised and unsupervised machine learning algorithms using SparkML library.
CO5: Perform stream analytics using real time Spark framework.

CONCEPTS TO BE COVERED

1. MapReduce Programming exercises
2. NoSQL operations (MongoDB and Cassandra)
3. Preparing data with Hadoop
4. Basic HDFS commands, Direct file transfer to HDFS
5. Importing data (CSV,Jason) into Hive Tables, using Spark
6. Data import and export with Sqoop
7. Work with Data Streams using Flume (Eg.Web Log Creation)
8. Creating Visualizations using comparison charts, composition, distribution and relationship charts.
9. Data Modelling with SparkML
    a. Applications of machine learning algorithms-Supervised and Unsupervised
    b. Evaluate Model (Cross-Validation, Model Tuning) and Prediction
10. Real-Time Analytics using SparkStreaming
11. Real-Time Sentiment Analysis
12. Collaborative Filtering

REFERENCES

1. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.

19MAM68 - COMMUNICATION SKILLS

Contact Hours

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

PRE-REQUISITES:
Consent of the Instructor

COURSE OUTCOMES

CO1: Conceive appropriate verbal responses from the learners to a given social situation, using the guidelines to effective speaking skills and body language.

CO2: Generate troubleshooting solutions to develop team building and interpersonal skills with case studies that focus on body language and empathy.

CO3: Develop appropriate responses for business phone calls and formulate effective resolutions to professional conflicts that arise out of cross-cultural communication gaps in a given managerial context.

CO4: Compose appropriate written responses to professional problems faced by a team at the workplace arising out of ineffective communication skills.

CO5: Generate valid points for and against a HR topic and present them with appropriate group behavior. For any job requirement, plan and prepare for a 20-minute mock interview.

INTRODUCTION

Introduction – Code and Content – Stimulus and Response: Source – The Encoding Process – The Channel – The Decoding Process – The Receiver – Speaking Skills – Effective Speaking Guidelines – Communicating Soft Skills: A Self-assessment – Closing Tips

(4)

SOFT SKILLS

Introduction to Soft Skills – Lessons from the Three Case Studies – Change in Today's Workplace: Soft Skills as a Competitive Weapon – Antiquity of Soft Skills – Classification of Soft Skills: Time Management - Attitude – Responsibility – Ethics, Integrity, Values and Trust – Self-confidence and Courage – Consistency and Predictability – Teamwork and Interpersonal Skills - Communication and Networking – Empathy and Listening Skills – Problem Solving, Troubleshooting and Speed reading – Leadership – Body Language

(8)

TELEPHONING SKILLS & NEGOTIATIONS

Preparing to make a telephone call – Receiving calls – Taking and leaving messages – Asking for and giving repetition – The secretarial barrier – Cross-cultural communication on the telephone – Setting up appointments – Changing arrangements – Ending a call – Cross-cultural communication on the telephone – Problem-solving on the telephone – Complaints – Negotiations: Types of negotiation – Preparation for a negotiation – Making an opening statement – Bargaining and making concessions – Accepting and confirming – Summarizing and looking ahead – Types of negotiator – Dealing with conflict - Rejecting – Ending the negotiation

(8)

WRITING SKILLS TO CREATE AN IMPRESSION

Fifteen Principle to Increase Clarity in Communication – Edit-Edit-Edit: The Reader's Perspective – Clarity of Thought – Clarity of Text.

(3)

SPEAKING

Job Interviews: Types of Interviews - Groundwork before the Interview -Importance of body Language in Interview - Need for proper Articulation - Concluding an Interview - Telephonic or Video Interview - A Mock Interview - Group Discussion: Introduction - Ability to Work as a Team – Communication Skills - Active Listening - Non-verbal Communication - Leadership and Assertiveness - Reasoning – Ability to Influence - Innovation. Creativity, and Lateral Thinking - Flexibility - Key Steps to Succeed in a Group Discussion - The Responsibility of the First Speaker - Concluding the Discussion - Dos and Don'ts during a Group Discussion

(7)

TOTAL HOURS:30

19MAM69 - HACKATHON

Contact Hours

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

PRE-REQUISITES:
Consent of the Instructor

COURSE OUTCOMES

CO1: To familiarize students about the various programming challenges in Hackathons and encourage the students to participate in it.
CO2: To gain experience in devising solutions to real-time problems and challenges of industry in the domain of AI/ML.
CO3: To explore research problems in the area of AI/ML and implement it.

Idea Submission and Evaluation Process

- Students are unveiled of problems on various hackathon portals, Kaggle competitions and similar challenges as given below.

Sl.No	Name of Hackathon
1.	Codevita / Hackerearth/AnalyticsVidhya
2.	Tata Cruicible Campus Hackathon
3.	Leetcode
4.	Smart India Hackathon
5	Kaggle Competitions

- The evaluation is done as continuous assessment based on the participation, problem and the solution implementation.

TOTAL HOURS: 30

19MAM81 - GRAPH REPRESENTATION LEARNING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES:
19MAM21,19MAM42, 19MAM61

COURSE OUTCOME
CO1 : Understand the fundamental concepts of graph theory.
CO2 : Familiarize with the different graph reconstruction methods.
CO3 : Model Graph Neural Networks to solve real-time problems
CO4 : Apply Graph Generative Models for finding solutions for complex data problems
CO5 : Learn about knowledge graph and its representation

GRAPH THEORY AND CONCEPTS
Graphs -Graph Structures-Types of Graphs- -Machine learning on Graphs – Background and Traditional Approaches: Graph Statistics and Kernel Methods - Neighborhood Overlap Detection - Graph `

(8)

NODE EMBEDDINGS
Neighborhood Reconstruction Methods - Encoder-Decoder Perspective - Factorization-based approaches - Random Walk Embeddings -Limitations of Shallow Embeddings - Multi-relational Data and Knowledge Graphs

(9)

GRAPH NEURAL NETWORKS(GNNS)
The Graph Neural Network Model - Neural Message Passing - Generalized Neighborhood Aggregation - Generalized Update Methods - Edge Features and Multi-relational GNNs - Graph Pooling. Graph Neural Network in Practice: Applications and Loss Functions - Efficiency Concerns and Node Sampling - Parameter Sharing and Regularization.

(10)

GENERATIVE GRAPH MODELS
GNNs and Graph Convolutions – Graph Classification using GCNNs-GNNs and Probabilistic Graphical Models - GNNs and Graph Isomorphism. Generative Graph Models: Traditional Graph Generation Approaches - Deep Generative Models

(9)

KNOWLEDGE GRAPH
Emergence of the Knowledge Graph -Data and Graphs: Introduction-Representing Data and Knowledge in Graphs. Architecture: Creation of Knowledge Graphs - Reasoning in Knowledge Graphs.

(9)
TOTAL HOURS: 45

TEXTBOOKS

1. William L. Hamilton, ‘Graph Representation Learning’, Morgan & Claypool publishers, 2020. (Para I-IV)
2. Sean Martin, Ben Szekely, and Dean Allemang, ‘The Rise of the Knowledge Graph: Toward Modern Data Integration and the Data Fabric Architecture’, O’Reilly Media, Inc. I Edition, 2021. (Para V)

REFERENCES

1. Aldo Marzullo, Claudio Stamile, and Enrico Deusebio, Graph Machine Learning, Packt Publishing, 2021.
2. Mark Needham, Amy E. Hodler, Graph Algorithms: Practical Examples in Apache Spark and Neo4j, O’Reilly, 2019.
3. Mayank Kejriwal, Craig A. Knoblock and Pedro Szekely, ‘Knowledge Graphs: Fundamentals, Techniques, and Applications, MIT Press, 2021.

19MAM82 - REINFORCEMENT LEARNING

Contact Hours

L	T	P	C
3	0	2	4

ASSESSMENT:THEORY

PRE-REQUISITES
19MAM18,19MAM22

COURSE OUTCOMES
CO1: Familiarize with the fundamentals of Reinforcement Learning.
CO2: Understand and apply basic RL algorithms for simple sequential decision-making problems in uncertain conditions.
CO3: Examine the various model-based and model-free methods for model planning and learning.
CO4: Review the application of approximation-based algorithms for Reinforcement Learning
CO5: Learn the applications and latest trends in Reinforcement Learning
CO6: Implement reinforcement learning algorithms to solve a cognitive task

REINFORCEMENT LEARNING PROBLEM
Reinforcement Learning-Examples-Elements of Reinforcement Learning-Limitations and Scope-An Extended Example: Tic-Tac-Toe-History of Reinforcement Learning

(10)

TABULAR SOLUTION METHODS
Bandit Problems and Online Learning-Markov Decision Processes and Value Functions-Dynamic Programming-Monte Carlo Methods-Temporal Difference Learning.

(12)

PLANNING AND LEARNING
Models and Planning with Tabular Methods-Eligibility Traces

(8)

APPROXIMATE SOLUTION METHODS
Function Value Approximation-On Policy Approximation of Action Values-Off Policy Approximation of Action Values.

(10)

CASE STUDIES: Examples of Reinforcement Learning System-Applications in different domains-Alpha Go-IBM Watson-Frontiers in Reinforcement Learning-Introduction to Deep Reinforcement Learning.

(5)

PRATICALS
Implement the reinforcement learning algorithms using OpenAI Gym and Tensor flow or any RL platform.

(15)

TOTAL HOURS: 60

TEXTBOOKS

1. Richard Sutton & Andrew G. Barto, 'Reinforcement Learning: An Introduction', 1st Edition, MIT Press,2015.
2. Sudharshan Ravichandran, Sean Saito, Rajalingappa Shanmugamani and Yang Wenzhao, "Python Reinforcement Learning", Packt, 2019. (Practicals)

REFERENCES

1. Csaba Szepersvani, ‘Algorithms for Reinforcement Learning’, Morgan and Claypool Publishers, 2010.
2. Maxim Lapan, “Deep Reinforcement Learning”, Packt2, 2018.
3. Parag Kulkarni, “Reinforcement and System Machine Learning for Decision Making”, Wiley, 2012.

19MAM83 - META-HEURISTIC OPTIMIZATION TECHNIQUES

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES
CO1 : Understand the basic concepts of heuristic optimization .
CO2 : Familiarize with genetic and evolutionary algorithm and its applications in real world problem solving.
CO3 : Apply Ant colony optimization algorithmic models for various optimization problems.
CO4 : Implement particle swam optimization algorithm and Firefly algorithms for problem solving.
CO5 : Solve computational problems using Honeybee optimization techniques.

OVERVIEW OF OPTIMIZATION
Optimization - Objective Function - Decision Variables - Solutions of an Optimization Problem - Decision Space - Constraints or Restrictions - State Variables - Local and Global Optima - Near-Optimal Solutions

(6)

INTRODUCTION TO META-HEURISTIC AND EVOLUTIONARY ALGORITHMS
Searching the Decision Space for Optimal Solutions - Definition of Terms of Meta-Heuristic and Evolutionary Algorithms Principles of Meta-Heuristic and Evolutionary Algorithms - Classification of Meta-Heuristic and Evolutionary Algorithms - Meta-Heuristic and Evolutionary Algorithms in Discrete or Continuous Domains - Generating Random Values of the Decision Variables - Dealing with Constraints -Selection of Solutions in Each Iteration - General Algorithm - Performance Evaluation of Meta-Heuristic and Evolutionary Algorithms.

(8)

GENETIC ALGORITHMS
Introduction - Mapping the Genetic Algorithm (GA) to Natural Evolution - Creating an Initial Population - Selection of Parents to Create a New Generation - Population Diversity and Selective Pressure - Reproduction - Termination Criteria - User-Defined Parameters of the GA.

(8)

THE ANT COLONY OPTIMIZATION METAHEURISTIC
Combinatorial Optimization - The ACO Metaheuristic - How Do I Apply ACO? - Other Metaheuristics - **Ant Colony Optimization Algorithms for the Traveling Salesman Problem :** The Traveling Salesman Problem - ACO Algorithms for the TSP - Ant System and Its Direct Successors - **Particle Swarm Optimization :** Introduction - Mapping Particle Swarm Optimization (PSO) to the Social Behavior of Some Animals - Creating an Initial Population of Particles - The Individual and Global Best Positions - Velocities of Particles - Updating the Positions of Particles - Termination Criteria - User-Defined Parameters of the PSO.

(10)

HONEY-BEE MATING OPTIMIZATION

Introduction - Mapping Honey-Bee Mating Optimization (HBMO) to the Honey-Bee Colony Structure - Creating an Initial Population - The Queen - Drone Selection - Brood (New Solution) Production - Improving Broods (New Solutions) by Workers - Termination Criteria - User-Defined Parameters of the HBMO.

(7)

FIREFLY ALGORITHM

Introduction - Mapping the Firefly Algorithm (FA) to the Flashing Characteristics of Fireflies - Creating an Initial Population – Attractiveness - Distance and Movement - Termination Criteria 200 16.7 User-Defined Parameters of the FA

(6)

TOTAL HOURS : 45

TEXTBOOKS

1. Omid Bozorg-Haddad, Iran Mohammad Solgi, Iran Hugo A. Loaiciga, "Meta-Heuristic and Evolutionary Algorithms for Engineering Optimization", John Wiley & Sons, 2017.
2. Marco Dorrigo, Thomas Stutzle, "Ant Colony Optimization", PHI,2005 (Para IV)

REFERENCES

1. Leandro Nunes de Castro, "Fundamentals of Natural Computing: Basic concepts, Algorithms and Applications ", CRC Press,2007.

2. Carlos A. Coello Coello Gary B. Lamont David A. Van Veldhuizen, "Evolutionary Algorithms for Solving Multi-Objective Problems", Second Edition, Springer, 2007.

3. Kwang Y. Lee and Mohamed A. El-Sharkawi, "Modern Heuristic Optimization Techniques Theory and Applications to Power Systems", Wiley, 2008.

19MAM84 - META-HEURISTIC OPTIMIZATION LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Implement optimization techniques on specific applications
CO2: Understand and perform Binary and Continuous Genetic Algorithm in real time application
CO3: Apply evolutionary computation methods to solve complex problems
CO4: Learn and use various Extreme Learning Machine techniques for real time application
CO5: Summarize current research in Genetic Algorithms and Evolutionary Computing

TOPICS TO BE COVERED

1. Implement ANT Colony Optimization.
2. Implement Particle Swarm Optimization (PSO).
3. Multi objective optimization in Genetic Algorithm.
4. Adaptive mutation in Genetic Algorithm.
5. Binary Genetic Algorithm
6. Continuous Genetic Algorithm
7. Build Extreme Learning Machine (ELM).
8. ELM for Multi-Class Classification.
9. Genetic Algorithm Based Approach in attribute weighting for a Medical Data Set.
10. Elementary Operations on L-R Fuzzy number.

Suggested Software: Python/Matlab

REFERENCES

1. Fister Jr., X.-S. Yang, I. Fister, J. Brest, "Memetic firefly algorithm for combinatorial optimization in Bioinspired Optimization Methods and their Applications", Slovenia, 2012.
2. Marco Dorigo and Thomas Stützl, "Ant Colony Optimization", The MIT Press, 2004.

19MAM91 - COMPUTER VISION

Contact hours

L	T	P	C
3	0	0	3

PRE-REQUISITES:
19MAM42

ASSESSMENT : THEORY

COURSE OUTCOMES

CO1: Understand and use the vision technology in conjunction with real world applications.
CO2: Detecting features, discuss feature correspondences across different images and review image segmentation techniques like Active contours, Split and merge, Mean shift and mode finding.
CO3: Investigate techniques like shading and focus, merging multiple range or depth images into 3D models, and reconstructing them.
CO4: Perform pose estimation, camera's intrinsic calibration, estimate 3D point structure from 2D matches, 3D geometry, camera motion and the motion between two or more images.
CO5: Reconstruct the 3D shape of a scene from images taken from different views.

IMAGE FORMATION AND FILTERING

Introduction to computer vision - Photometric image formation - The digital camera - Point operators - Linear filtering, neighborhood operators - Fourier transforms - Pyramids and wavelets.

(9)

FEATURE DETECTION AND SEGMENTATION

Feature Detection: Points and patches – Edges - Lines.
Segmentation: Active contours - Split and merge - Mean shift and mode finding

(8)

3D RECONSTRUCTION

Shape from X - Active range finding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

(8)

MOTION ESTIMATION

Feature-based alignment: 2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration. Structure from motion: Triangulation - frame structure from motion – Factorization - Bundle adjustment - Constrained structure and motion. Dense motion estimation: Translational alignment - Parametric motion - Spline-based motion – Optical flow, Layered motion.

(12)

RECOGNITION

Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding.

(8)

TOTAL HOURS: 45

TEXTBOOK

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer-Verlag London Limited, 2011.

REFERENCES

1. Forsyth, D. and Ponce, J, "Computer Vision: a modern approach", Prentice Hall, 2002.
2. Vaibhav Verdhan, “Computer Vision Using Deep Learning: Neural Network Architectures with Python and Keras”, APress, 2021.
3. V Kishore Ayyadevara, Yeshwanth Reddy, “Modern Computer Vision with PyTorch”, 2020.

19MAM92 - CYBER THREAT INTELLIGENCE

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
19MAM42

COURSE OUTCOMES
CO1: Familiarize with the concepts of cyber threat intelligence and its requirements.
CO2: Identify methods to collect cyber threat intelligence Requirements
CO3: Analyze and Disseminate Cyber Threat Intelligence
CO4: Understand the role of cyber threat intelligence partner
CO5: Apply machine learning techniques to detect cyber security threats in web, network, emails etc.

FUNDAMENTALS OF CYBER THREAT INTELLIGENCE (CTI)
The Need for Cyber Threat Intelligence: The menace of targeted attacks - Monitor and respond strategy - Cyber Threat Intelligence Defined, Key Characteristics: Adversary based, Risk focused - Process oriented - Tailored for diverse consumers -Benefits of Cyber Threat Intelligence.
Developing Cyber Threat Intelligence Requirements: Assets that must be Prioritized: Personal information - Intellectual property - Confidential business information - Credentials and IT systems information - Operational systems. Adversaries: Cybercriminals - Competitors and cyber espionage agents - Hacktivists. Intelligence Consumers: Tactical users - Operational users - Strategic users.

(9)

CYBER THREAT INFORMATION COLLECTION
Level One Threat Indicators - File hashes and reputation data - Technical sources: honeypots and scanners - Industry sources: malware and reputation feeds. Level Two Threat: Data Feeds - Cyber threat statistics - reports and surveys - Malware analysis. Level Three: Strategic Cyber Threat Intelligence - Monitoring the underground - Motivation and intentions - Tactics, techniques, and procedures - Analyzing and Disseminating Cyber Threat Intelligence: Information versus Intelligence - Validation and Prioritization: Risk scores - Tags for context - Human assessment. Interpretation and Analysis: Reports, Analyst skills, Intelligence platform - Customization. Dissemination: Automated feeds and APIs - Searchable knowledge base - Tailored reports.

(9)

ANALYZING AND DISSEMINATING CTI
Information versus Intelligence, Validation and Prioritization: Risk scores - Tags for context - Human Assessment. Interpretation and Analysis: Reports - Analyst Skills - Intelligence Platform - Customization. Dissemination: Automated Feeds and APIs - Searchable Knowledge Base - Tailored Reports.

(7)

CYBER THREAT INTELLIGENCE PARTNER
Types of Partners: Providers of Threat Indicators - Providers of Threat Data Feeds - Providers of Comprehensive Cyber Threat Intelligence. Important Selection Criteria: Global and Cultural Reach- Historical Data and Knowledge - Range of Intelligence Deliverables - APIs and Integrations - Intelligence Platform - Knowledge Base and Portal - Client Services - Access to Experts. Intelligence - Driven Security.

(8)

DETECTING CYBER SECURITY THREATS WITH AI

Email Cyber Security Threats with AI: Detecting Spam with Perceptron, Support Vector Machines and Naïve Bayes-Spam Detection with Logistic Regression and Decision Trees- Bayesian Spam Detector.

Malware Threat Detection: AI for Malware Analysis-Decision Tree Malware Detectors-Detecting Metamorphic Malware with Hidden Markov Models-Malware and Deep Learning.

Network Anamoly Detection Techniques: Network Attacks-BotNet Topology-Machine Learning for Botnet Detection.

(12)

TOTAL HOURS: 45

TEXTBOOKS

1. Jon Friedman. Mark Bouchard, CISSP. Foreword by John P. Watters, Cyber Threat Intelligence, Definitive Guide TM, 2015. (Para I to IV).
2. Alessandro Parisi, “Hands-on Artificial Intelligence for Cyber Security”, Packt, 2019. (Para V)

REFERENCES

1. Christ Pace, Andrei Barysevich, Levi Gundert, Allan Liska, Maggie McDaniel, John Wetzel, “The Threat Intelligence Handbook : A Practical Guide for Security Teams to unlocking the power of Intelligence”, CyberEdge Group, 1997. (Para 4 : Chapters 2 and 4, Para 5 : Chapters 6,7, and 10)
2. Henry Dalziel, How to Define and Build an Effective Cyber Threat Intelligence Ca pability Elsevier Science & Technology, 2014.
3. John Robertson , Ahmad Diab , Ericsson Marin , Eric Nunes , Vivin Paliath , Jana Shakarian , Paulo Shakarian, DarkWeb Cyber Threat Intelligence Mining Cambridge University Press, 2017.

19MAM93 - COMPUTER VISION LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM65

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Explore the process of image construction and blending
CO2: Apply Image formation techniques and feature based process
CO3: Extract features from Images and do analysis of Images
CO4: Perform object detection and face recognition using CNNs and RCNNs.
CO5: Implement image classification using benchmark image datasets like CIFAR-10 and other types of images.

CONCEPTS TO BE COVERED

1. Create a set of rectangles and then modify their "pose" (2D transform)
2. Image blending, Feature-based morphing, Edge editing and enhancement
3. Interest point detector Implement one or more keypoint detectors and compare their performance
4. Implement 2D and 3D multi-object detection and segmentation
5. Combine CV with NLP to perform OCR, image captioning
6. Perform Object Detection with YOLOv3, Object Detection with Mask R-CNN,
7. Develop a New Object Detection Model
8. Feature-based image alignment for flip-book animations (Eg.Take a set of photos of an action scene or portrait (preferably in motor-drive—continuous shooting—mode) and align them to make a composite or flip-book animation.)
9. Deep Learning for Face Recognition: Detect Faces in Photographs, Face Identification and Verification with VGGFace2
10. Face Classification with FaceNet
11. Classify Black and White Photos of Clothing
12. Classify Small Photos of Objects, Label Satellite Photographs of the Amazon Rainforest

Suggested Software/Tools: PyTorch**,** OpenCV library, YOLO

REFERENCE

1. Jan Erik Solem, "Programming Computer Vision with Python", O'Reilly, 2012.
2. Jason Brownee, "Deep Learning for Computer Vision", Ebook, 2019.

19MAM94 - INTELLIGENT CYBER SECURITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAM46,19MAM65

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Apply classification techniques for detection
CO2: Perform Preprocessing technique in face detection
CO3: Perform clustering technique for cyber security
CO4: Implement various techniques and security algorithms on specific problems.
CO5: Develop intelligent solutions/tools to detect and protect against cyber threat through data analytics for an enterprise.

CONCEPTS TO BE COVERED

- Email Spam filtering using machine learning techniques, Bayesian spam detector
- Phishing detection using ML.
- Protection against credential stuffing campaigns, a common threat tactic in the ecommerce and online services sector.
- Malware Detection using ML, PDF malware detection
- Windows Ransomware detection, Crypto Ransomware detection
- Communication Network Analysis to identify Anomalies, ML for Botnet detection
- Behavior Analytics
- Collect information from multiple sources(dark web, social media, cyber security research feeds etc) to create a reliable repository of threat-related knowledge and derive insights.
- Dynamic Intelligence feed
- Bio-metric authentication with facial recognition

Suggested Software/Tools: Python, OpenCTI

REFERENCES

1. Ali Dehghantanha, Mauro Conti, Tooska Dargahi, Cyber Threat Intelligence, Springer, 2018
2. Alessandro Parisi, “Hands-on Artificial Intelligence for Cyber Security”, Packt, 2019. (Para V)

ELECTIVE

19MAME01 - ETHICS IN AI

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

CO1: Understand the concept of building ethics in machines
CO2: Develop and designs test cases for hypothetical cases in Self driving cars
CO3: Able to build the methodologies for ethical AI
CO4: Identify Ethical priorities in AI systems
CO5: Design AI with rights, consciousness, and freedom

ETHICAL LEARNING, NATURAL AND ARTIFICIAL

Introduction - A Social Perspective -A Developmental Perspective - Default Trust and Default Cooperation - Ethical Development and Ethical Judgment - Artificial Ethical Psychology.

(8)

USE TROLLEY AND ETHICAL OPT-OUT PROBLEM

A Hypothetical Case - Standard Trolley Cases - Other Cases - New and Old Threats - Particular Moral Issues in Self Driving Cars – Case studies - Passengers and Other Drivers - Introduction - Methodological Challenges - Second-Order Ethical Challenges.

(12)

REASONING PREFERENCES AND ETHICAL PRIORITIES IN AI SYSTEMS

Introduction - Background: Frameworks to Model Constraints and Preferences - Modeling Ethical Theories via Hard and Soft Constraints - Using CP-nets to Model Preferences and Ethical Priorities - A Notion of Distance between (Orderings Induced by) CP-nets - Using Distance to Support Ethical Decisions - Distance and Meta preference.

(8)

AUTONOMOUS WEAPONS AND ETHICS OF ARTIFICIAL INTELLIGENCE

Defining Autonomous Weapons - The Moral Problems Raised by Autonomous Weapons - Arguments for the Moral Desirability of Autonomous Weapons.

(5)

DESIGNING AI WITH RIGHTS, CONSCIOUSNESS, SELF-RESPECT, AND FREEDOM

Public policy and Super intelligent AI : The Prospect of Radically Transformative AI - A "Vector Field" Approach to Normative Analysis - The No- Relevant- Difference Argument and Its Two Central Parameters - Two Broad Moral Theories and the Ethical Precautionary Principle - The Puzzle of Consciousness and the Design Policy of the Excluded Middle - Cheerfully Suicidal AI Servants and the Self- Respect Design Policy – Case studies

(12)

TOTAL HOURS: 45

TEXTBOOKS

1. Y S. Matthew Liao, “Ethics of Artificial Intelligence”, First Edition, Oxford University Press,2020.
2. John C. Havens, “Heartificial Intelligence: Embracing Our Humanity to Maximize Machines”, Tarcher Perigee, 2016

REFERENCE

1. Mark Coeckelbergh, “AI Ethics”, The MIT Press, 2020.

19MAME02 – HEALTHCARE ANALYTICS

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: To understand the various sources of healthcare data analyze it.
CO2: To gain a overall understanding about the electronic healthcare records.
CO3: To process the different types of healthcare data stored in health data sources.
CO4: To apply the appropriate biomedical image and text analysis techniques for analyzing biomedical image and clinical text data.
CO5: To generate the prediction health care model using temporal, sensor and text mining techniques.

INTRODUCTION
Introduction to Healthcare Data Analytics – Healthcare Data Sources and Basic Analytics - Advanced Data Analytics for Healthcare - Applications and Practical Systems for Healthcare - Resources for Healthcare Data Analytics.

(5)

HEALTHCARE DATA SOURCES AND BASIC ANALYTICS
Electronic Health Records: A Survey – History and components of EHR - Coding systems - Benefits of EHR – Challenging of Using EHR Data.

(4)

HEALTHCARE DATA ANALYTICS
Biomedical Image Analysis – Biomedical Imaging Modalities – Object Detection - Image Segmentation - Image Registration - Feature Extraction. Natural Language Processing and Data Mining for Clinical Text – Natural Language Processing - Mining Information from Clinical Text - Challenges of Processing Clinical Reports - Clinical Applications. Social Media Analytics for Healthcare – Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks - Social Media Analysis for Public Health Research - Analysis of Social Media Use in Healthcare.

(8)

ADVANCED DATA ANALYTICS FOR HEALTHCARE
Temporal Data Mining for Healthcare Data – Association Analysis, Temporal Pattern Mining - Sensor Data Analysis - Other Temporal Modelling Methods. Information Retrieval for Healthcare – Knowledge-Based Information in Healthcare and Biomedicine - Content of Knowledge-Based Information Resources – Indexing – Retrieval - Evaluation. Privacy-Preserving Data Publishing Methods in Healthcare – Data Overview and Pre-processing - Privacy-Preserving Publishing Methods - Challenges with Health Data

(8)

APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE
Fraud Detection in Healthcare, Mobile Imaging and Analytics for Biomedical Data – Image Formation, Data Visualization - Image Analysis - Image Management and Communication

(5)

PRACTICALS

Analysis of Healthcare (EHR) Data-Analysis of prescriptions-Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks-Analyzing healthcare images-Data Visualization of biomedical data.

(15)

TOTAL HOURS: 45

TEXTBOOK

1. Chandan K. Reddy and Charu C. Aggarwal, "HealthCare Data Analytics", CRC Press, 2015.

REFERENCES

1. Laura B. Madsen, "Data-Driven Healthcare: How Analytics and BI are Transforming the Industry", Wiley and SAS Business Series, 2014.
2. Trevor L. Strome, "Healthcare Analytics for Quality and Performance Improvement", John Wiley & Sons, Inc., 2013.
3. Surbi Bhatia, Ashutosh Kumar Dubey, Rita Chikara, Poonam Chaudhary, Abishek Kumar, "Intelligent Healthcare-Applications of AI in eHealth". EAI/Springer Innovations in Communication and Computing, 2021.

19MAME03 - SMART APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Provides Comprehensive understanding of Artificial Intelligence and Intelligent Systems in the context of Knowledge Engineering.

CO2: Recognize the technologies behind AI and software-defined network/network function virtualization, highlighting the exciting opportunities to integrate those two worlds.

CO3: To get familiar with the various applications of these techniques in manufacturing systems.

CO4: Highlights the avionics and satellite communication systems and aerospace platforms

CO5: Provide an invaluable resource for artificial intelligence, and machine learning researchers.

ARTIFICIAL INTELLIGENCE FOR INTELLIGENT SYSTEMS

Introduction – Intelligent Machines – Dark ages to Knowledge based systems-Neural Expert systems-ANFIS-– Models of Hybrid Computational Intelligence Architectures- Integrated Intelligent Systems - Neuro Fuzzy Systems- Evolutionary Fuzzy systems-EvoNF systems- Evolutionary Neural Network – General Framework Search of Connection weights- Architectures – Learning rules – Meta learning– Hybrid Evolutionary Algorithms.

(9)

ARTIFICIAL INTELLIGENCE FOR NETWORK AUTOMATION

Introduction- Generations of network transformation- From automation to AI- The role of artificial intelligence for network operations- zero-touch network - identifies SDN and AI are together providing the core technology and intelligences - Background overview of the tasks involved in operating a network- use of automation autonomous network run on data- Defined Network-Self-contained- self-optimizes-Software and hardware platforms-AI system architectures.

(9)

ARTIFICIAL INTELLIGENCE FOR MANUFACTURING SYSTEMS

Introduction - Traditional Manufacturing Systems - Changes in Manufacturing Systems: a Historical Perspective -Artificial Intelligence and Intelligent Manufacturing Systems - Technologies of Artificial Intelligence- Intelligent Manufacturing Systems- Properties of Intelligent Manufacturing Systems- Architecture of Intelligent Manufacturing Systems - Holonic Manufacturing Systems- Applications of Intelligent Manufacturing Systems.

(9)

ARTIFICIAL INTELLIGENCE FOR AEROSPACE

Planning - Applications of planning - Planning algorithms- The classical framework - STRIPS language and its extensions (ADL, PDDL...)- state - space search, plan-space search- GRAPHPLAN methods, SATPLAN and CSP-PLAN methods -Algorithmic Decision Theory ; Markov Decision - Processes Case study and Exercises Game Theory Formalization : Normal Form ; Pure and Mixed Strategies -Equilibrium (Nash, (iterated) Dominant Strategy Equilibrium) Algorithms -Condorcet Winner, Arrow's Theorem-Collective decision Applications.

(9)

ADVANCED TOPICS IN AI - PRESENT AND FUTURE

Introduction – AI and Concurrency – Agent-based Concurrent Engineering-Cloud computing and Intelligent Agents- Planning and logic –Business Intelligence and Analytics- Sentiment Analysis- Big data and sensory processing (SP) – Theory of Intelligence – Future of Intelligent Systems.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Crina Grosan and Ajith Abraham , "Intelligent Systems: A Modern Approach (Intelligent Systems Reference Library)", Springer – Verlag Berlin Heidelberg, 2011.(Para I)
2. Mazin Gilbert, "Artificial Intelligence for Autonomous Networks", CRC press Publications, 2018.(Para II)
3. Parag Kulkarni and Prachi Joshi "Artificial Intelligence: Building Intelligent Systems", PHI Learning Private Limited, 2015. (Para III)
4. E. Oztemel, Lyes Benyoucef, Bernard Grabot , "Artificial Intelligence Techniques for Networked Manufacturing Enterprises Management", Springer-Verlag**,** 2010.(Para IV&V)

REFERENCES

1. Michael Negnevitsky "Artificial Intelligence A Guide to Intelligent Systems" , 2nd Edition Pearson Education Limited, 2005.
2. Martin Osborne, "Introduction to Game Theory", Oxford University Press, 2009.

19MAME04 - SPATIAL DATA MODELING AND ANALYSIS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Use the fundamental concepts of Geographic Information Science and Technology
CO2: Design Geo Spatial Database
CO3: Describe the geospatial system and represent various data models.
CO4: Analyze Geospatial data using spatial and raster analysis techniques.
CO5: Create and design principles, including thematic map display, map projections, and cartographic design

INTRODUCTION TO GIS
Introduction – GIS Components – GIS in Organizations. Data Models - Introduction – Common Spatial Data Models – Raster Data Models – Other Data Models – Data File and Structures. Geodesy, Datums, Map Projections and Coordinate Systems

(9)

DESIGNING GIS DATABASE WITH DIGITAL DATA
Maps, Data Entry, Editing and Output – Building GIS Database – Digitizing Coordinate capture – Coordinate
Transformation – Output : Maps – Data – Meta Data. Digital Data - Introduction –National and Global Digital Data. Tables

(9)

GEOSPATIAL NAVIGATION SYSTEM AND DATA MODEL
Global Satellite Navigation System and Coordinate Surveying - Introduction – Differential Correction – Optical and Laser Coordinate Surveying – GNSS Applications. Aerial and Satellite Images - Basic Principles – Aerial Images – Satellite Images – Air born LiDAR

(9)

SPATIAL AND RASTER ANALYSIS
Basic Spatial Analysis - Introduction – Selection and Classification – Dissolve – Proximity Functions and Buffering – Overlay – Network Analysis. Topics in Raster Analysis - Map Algebra – Local Functions – Neighborhood, Zonal and Global Functions. Terrain Analysis

(9)

SPATIAL MODELING AND ESTIMATION
Spatial Estimation: Interpolation, Prediction, Core Area - Sampling – Spatial Interpolation Methods – Spatial Prediction –Core Area Mapping. Spatial Models and Modelling - Cartographic Modeling. Data Standards and Data Quality. New Developments in GNSS – GNSS – Datum Modernization–Improved Remote Sensing – Cloud Based GIS–Open GIS

(9)

TOTAL HOURS: 45

TEXTBOOK

1. Paul Bolstad, “GIS Fundamentals: A First Text on Geographic Information Systems”, 6th edition, 2019

REFERENCES

1. Robert Haining, “Spatial Data Analysis Theory and Practice”, Cambridge University, 2010.
2. Jay Gao, “Fundamentals of Spatial Analysis and Modelling”, CRC Press, 2021.

19MAME05 – AUGMENTED AND VIRTUAL REALITY

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Learn the fundamentals of Augmented Reality(AR)
CO2: Implement AR tools and predict the approximate future direction of Mixed Reality.
CO3: Explore the concept of Virtual Reality
CO4: Demonstrate appropriate perceptual model for building a virtual reality system
CO5: Design various stages for Virtual reality process

INTRODUCTION TO AUGMENTED REALITY(AR)
Definition of Augmented Reality-Components of Augmented Reality-History of Augmented Reality-Augmented Reality vs Virtual Reality - Challenges with AR - Opportunities for Augmented Reality- Types of Augmented Reality - Augmented Reality Methods - AR Display Technology - Interaction in AR Applications.

(11)

INNOVATORS AND ORGANIZATIONS
Innovators and Organizations- Innovators in AR- Companies Specializing in AR- AR Tools- AR Blogs- Visions of the Future- The Big Trends- Technical Trends- Future Concepts for Augmented Reality.

(9)

VIRTULA REALITY(VR)
Introduction to VR: Definition of Virtual Reality-History of VR- Overview of Various Realities-Immersion, Presence and Reality Trade-Offs- Design Guidelines.

(9)

PERCEPTION
Objective and Subjective Reality-Perceptual Models and Processes: Distal and Proximal Stimuli-Sensation versus Perception - Bottom-Up and Top-Down Processing-Perceptual Modalities: Sight-Hearing-Touch-Proprioception-Balance and Physical Motion.

(10)

ITERATIVE DESIGN
Philosophy of Iterative Design-The Define Stage- The Make Stage: Task Analysis- Design Specification-System Considerations-Simulation-The Learn Stage.

(8)

TOTAL HOURS:45

TEXTBOOKS

1. Gregory Kipper, Joseph Rampolla Chris Katsaropoulos "Augmented Reality-An Emerging Technologies Guide to AR", 2013. [Para I, II]
2. Jason Jerald, "The VR Book-Human-Centered Design for Virtual Reality", ACM Books, 2016 [Para III, IV, V]

REFERENCES

1. John Vince, “Virtual Reality Systems”, Pearson Education, 2002
2. Paul Mealy, “Virtual & Augmented Reality for Dummies”, Kindle Publication, 2018

19MAME06 - MEDICAL IMAGE PROCESSING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISTES
19MAME17

COURSE OUTCOMES
CO1: Understand the fundamentals of medical imaging techniques
CO2: Learn various noise reduction filters and feature extraction for medical data analysis.
CO3: Apply various image restoration techniques on medical image data.
CO4: Familiarize with the bio-medical image segmentation methods
CO5: Use machine learning methods on MRI data to derive insights.

INTRODUCTION TO MEDICAL IMAGES
Digital Image-Components-Vision Fundamentals-Modalities of Medical Imaging-Problems-Image Enhancement Methods-Radiography-PET-CTA-Echocardiogram.

(9)

NOISE REDUCTION FILTERS AND FEATURE EXTRACTION
Spatial Domain Filters-Frequency Domain Filters-Selection of Features-Space Related Features-Texture Analysis-Analysis of Tissue Structure.

(9)

MEDICAL IMAGE RESTORATION
Image Restoration-Degradation Model-Estimation of Degradation Function-Blur Model-Blur Identification-Image Restoration Techniques-Applications.

(8)

BIOMEDICAL IMAGE SEGMENTATION
Points Detection-Line Detection-Edge Detection and Methods-Histogram Based-Split and Merge Method-Region Growing Method-k-Means Clustering Method

(10)

BIG DATA and Magnetic Resonance Imaging
Magnetic Resonance Imaging Techniques: MRI Signal Types-Machine Learning for Structural and Functional Imaging Data.

(9)

TOTAL HOURS:45

TEXTBOOKS

1. G.R. Sinha, Bhagwati Charan Patel, “Medical Image Processing”, PHI India, 2014.
2. Ervin Sejdic, Tiago H.Falk, “Signal Processing and Machine Learning for Biomedical Big Data, CRC,Press,2018.(Para V).

REFERENCES

1. AtamP.Dhawan, ‘Medical Image Analysis’, Wiley Interscience Publication, 2003.
2. KavyanNajarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC,2006.

19MAME07 – NATURAL LANGUAGE PROCESSING

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM51,19MAM62

COURSE OUTCOMES
CO1: Learn and understand the fundamental units of language and its models.
CO2: Use vector semantics and implement vector models for texts.
CO3: Design and develop NLP systems using machine learning models like Naïve Bayes, Neural Networks.
CO4: Use Hidden Markov Model and Conditional Random fields in tagging parts-of-speech tagging
CO5: Apply the principles of deep learning techniques to process speech and texts based applications.

REGULAR EXPRESSIONS AND NORMALIZATION
Introduction - Regular Expressions-words – Corpora – Text Normalization – Minimum edit distance – N gram Language Models: N-Grams - Evaluating Language Models- Sampling sentences from a language model- Generalization and Zeros- Smoothing- Kneser-Ney Smoothing- Huge Language Models and Stupid Backoff- Advanced: Perplexity's Relation to Entropy

(8)

VECTOR SEMANTICS AND EMBEDDINGS
Lexical Semantics-Vector Semantics-Words and Vectors-Cosine for Measuring Similarity-TF-IDF-Pointwise Mutual Information (PMI)-Applications of TF-IDF and PMI-Word2vec: Visualizing Embeddings-Semantic Properties of Embeddings-Evaluating Vector Models

(7)

NAIVE BAYES AND SENTIMENT CLASSIFICATION
Naive Bayes Classifiers - Training the Naive Bayes Classifier-Worked Example-Optimizing for Sentiment Analysis - Naive Bayes for other text classification tasks-Naive Bayes as a Language Model - Evaluation: Precision, Recall, F-measure - Test sets and Cross-validation - Statistical Significance Testing - Avoiding Harms in Classification-Applications.

(7)

NEURAL NETWORKS AND NEURAL LANGUAGE
Overview of Feedforward Neural Networks-Feedforward networks for NLP: Classification-Feedforward Neural Language Modelling-Training Neural Nets-Training the neural language model-Applications.

(7)

SEQUENCE LABELLING FOR PARTS OF SPEECH NAMED ENTITIES
English Word Classes- Parts of Speech Tagging-Named Entities and Named Entity Tagging. HMM parts of Speech Tagging: Markov Chains-Hidden Markov Model-Components of HMM tagger-HMM tagging as decoding-Viterbi Algorithm-Example. Conditional Random Fields (CRFs): Features in CRF

POS Tagger-Features for POS Named Entities Recognizers-Inference and Training for CRFs-Evaluation of Named Entity Recognition.

(8)

DEEP LEARNING ARCHITECTURES FOR SEQUENCE PROCESSING

Overview of Recurrent Neural Networks (RNN)-RNNs as Language Models-RNNs for other NLP tasks-Stacked and Bidirectional RNN architectures-LSTM- Transformers as Language Models-Contextual Generations and Summarization. Machine Translation: Language Divergences and Typology-Encoder Decoder Models with RNNs.

(8)

TOTAL HOURS:45

TEXTBOOK

1. Jurafsky and Martin, “Speech and Language Processing”, Pearson, 2022

REFERENCES

1. Manning and Schutze, "Foundations of Statistical Natural Language Processing" MIT Press Cambridge, MA, 1999.
2. Denis Rothman “Transformers for Natural Language Processing”,Packt, 2021

19MAME08 - PROBABILISTIC GRAPHICAL MODELS

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES:
19MAM13, 19MAM22,19MAM47

COURSE OUTCOMES
CO1: Understand the mathematical framework of probabilistic graphical models
CO2: Apply various representation models
CO3: Understand the basic concepts of probabilistic inference in graphical models
CO4: Apply the inference of Probabilistic models
CO5: Familiarize with the learning process of graphical models like Bayesian and Hidden Markov Model.
CO6: Implement Probabilistic graphical Models and draw inference for real world problems using Python libraries

FOUNDATIONS
Structured Probabilistic Models – Foundations: Probability Theory – Graphs. Bayesian Network Representation: Exploiting Independence Properties – Bayesian Networks – Independencies in Graphs – From Distributions to Graphs.

(5)

UNDIRECTED GRAPHICAL MODELS
Parameterization -Markov Network Independencies – Parameterization Revisited – Bayesian Networks and Markov Networks – Partially Directed Models.

(5)

LOCAL PROBABILISTIC MODELS
Tabular CPDs – Deterministic CPDs – Context-Specific CPDs – Independence of Causal influence – Continuous Variables – Conditional Bayesian Networks. Gaussian Network Models: Multivariate Gaussians – Gaussian Bayesian Networks – Gaussian Markov Random Fields.

(6)

INFERENCE
Analysis of Complexity- Variable Elimination – Complexity and Graph Structure-Conditioning – Inference with Structured CPDs. Variable Elimination and Clique Trees – Message Passing: Sum Product – Message Passing : Belief Update – Constructing a Clique Tree

(6)

LEARNING GRAPHICAL MODELS
Goals of Learning – Learning as Optimization – Learning Tasks. Structure Learning in Bayesian Networks: Constraint-based Approaches – Structure Scores – Structure Search – Bayesian Model Averaging – Learning Models with Additional Structure. Specialized Models: Naïve Bayes and Hidden Markov Model.

(8)

PRACTICALS
Problems based on the above modules using Python library pgmpy and Tensorflow.

(15)

TOTAL HOURS: 45

TEXTBOOKS

1. Daphne Koller and Nir Friedman, “Probabilistic Graphical Models Principles and Techniques”, MIT Press, Cambridge, Massachusetts, Lond, 2009.
2. Ankur Ankan and Abinash Panda, “Mastering Probabilistic Graphical Model in Python”, Packt,2015. (Practicals)

REFERENCES

1. Qiang Ji, “Probabilistic Graphical Models for Computer Vision”, First Edition, Elsevier, 2019.
2. Luis Enrique Sucar, “Probabilistic Graphical Model”, Springer, 2015.

19MAME09 - COGNITIVE COMPUTING

CONTACT HOURS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the instructor

COURSE OUTCOMES

CO1: Learn and understand the basics concepts of cognitive computing and its applications.

CO2: Identify the building blocks of a cognitive system and use it to design cognitive system for various business requirements.

CO3: Determine the role of NLP and knowledge representation in cognitive systems.

CO4: Build a complete cognitive system and test it successfully

CO5: Familiarize with the latest trends and case studies on cognitive computing systems.

FOUNDATIONS OF COGNITIVE COMPUTING

Cognitive Computing as a New Generation-Uses of Cognitive Systems-Characteristics of a Cognitive System-Domains of Cognitive Computing-Artificial Intelligence as the Foundation of Cognitive Computing-Understanding Cognition-Two Systems of Judgment and Choice-Understanding Complex Relationships Between Systems-Types of Adaptive Systems-Elements of a Cognitive System-Infrastructure and Deployment Modalities-Data Access, Metadata, and Management Services-Data Analytics Services-Continuous Machine Learning-Hypothesis Generation and Evaluation-The Learning Process-Presentation and Visualization Services-Cognitive Applications.

(8)

DESIGN PRINCIPLES AND BUSINESS IMPLICATIONS

Components of a Cognitive System-Building the Corpus-Corpus Management Regulatory and Security Considerations-Bringing Data into the Cognitive System-Leveraging Internal and External Data Sources-Data Access and Feature Extraction Services-Analytics Services-Infrastructure.

Preparing for Change-Advantages of New Disruptive Models-The Difference with a Cognitive Systems Approach-Using Business Knowledge to Plan for the Future-Answering Business Questions in New Ways-Building Business Specific Solutions-Making Cognitive Computing a Reality.

(8)

NATURAL LANGUAGE PROCESSING IN COGNITIVE COMPUTING

The Role of NLP in a Cognitive System: Context-Connecting Words for Meaning-Understanding Linguistics-Language Identification and Tokenization-Phonology-Morphology-Lexical Analysis-Syntax and Syntactic Analysis-Construction Grammars-Discourse Analysis-Pragmatics-Techniques for Resolving Structural Ambiguity-Importance of Hidden Markov Models-Word-Sense Disambiguation (WSD)-Semantic Web-Applying Natural Language Technologies-to Business Problems: Enhancing the Shopping Experience-Leveraging the Connected World of Internet of Things-Voice of the Customer-Fraud Detection.

(9)

REPRESENTING KNOWLEDGE IN TAXONOMIES AND ONTOLOGIES

Representing Knowledge-Developing a Cognitive System: Defining Taxonomies and Ontologies-Representing Knowledge-Managing Multiple Views of Knowledge-Models for Knowledge Representation-Taxonomies, Ontologies, Other Methods of Knowledge Representation: Simple Trees-Persistence and State-Implementation Considerations.

(7)

BUILDING A COGNITIVE APPLICATION

The Emerging Cognitive Platform-Defining the Objective, Domain, Users and Attributes-Exploring Insights-Typical Question-Answer Pairs-Anticipatory Analytics-Acquiring the Relevant Data Sources-Importance of Leveraging Structured Data Sources-Analyzing Dark Data -Leveraging External Data-Creating and Refining the Corpora-Preparing the Data-Ingesting the Data-Refining and Expanding the Corpora-Governance of Data-Training and Testing.

(7)

EMERGING COGNITIVE COMPUTING APPLICATIONS

Characteristics of Ideal Markets for Cognitive Computing-Vertical Markets and Industries-Retail-Travel-Transportation and Logistics-Telecommunications-Security and Threat Detection-Other Areas That Are Impacted by a Cognitive Approach.

Case Studies: IBM'S Watson as a Cognitive System- Building a Cognitive Healthcare Application-Smarter Cities: Cognitive Computing in Government.

(6)

TOTAL HOURS: 45

TEXTBOOK

1. Judith S. Hurwitz, Marcia Kaufman, Andrian Bowles, "Cognitive Computing and Big Data Analytics", Wiley Publications, 2015

REFERENCES

1. Pradeep Kumar Mallick, Samarjeet Borah, "Emerging Trends and Applications in Cognitive Computing", IGI Global,2019.
2. Rob High, Tanmay Bakshi, "cognitive Computing with IBM Watson, Packt Publishers, 2019.

19MAME10- RECOMMENDER SYSTEMS

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM42

COURSE OUTCOMES
CO1: Familiarize with the basics concepts and applications of recommender systems.
CO2: Review the different methods of neighborhood based collaborative filtering.
CO3: Demonstrate the use of machine learning models for collaborative filtering.
CO4: Examine content based and knowledge-based systems and its categories to build recommender systems.
CO5: Develop new Recommender Systems for a number of domains like, Education, Health-care etc and evaluate its performance.

INTRODUCTION TO RECOMMENDER SYSTEMS
Goals-Applications-Basic Models of Recommender Systems-Domain Specific Challenges-Advanced topics and applications.

(5)

NEIGHBOURHOOD BASED COLLABORATIVE FILTERING
Key Properties of Rating Matrices-Predicting Ratings with Neighborhood Based Methods-Clustering and Neighborhood Based Methods-Dimensionality Reduction and Neighborhood Methods-Regression Modelling View of Neighborhood Methods-Graph Models for Neighborhood Based Methods.

(6)

MODEL BASED COLLABORATIVE FILTERING
Extending Decision Trees for Collaborative Filtering-Rule Based Filtering-Naïve Bayes Collaborative Filtering-Latent Factor Models.

(6)

CONTENT AND KNOWLEDGE BASED RECOMMENDER SYSTEMS
Preprocessing and Feature Extraction-Learning User Profiles and Filtering-Content Based vs Collaborative Filtering-Using Content Based Models for Collaborative Filtering. Constraint Based Systems-Case Based Recommenders

(7)

EVALUATING RECOMMENDER SYSTEMS
Evaluation Paradigms-Goals of Evaluation Design. Evaluation Metrics for Offline Recommender Systems.

(6)

PRACTICALS
Predicting Ratings with Neighborhood Based Methods-Clustering and Neighborhood Based Methods-Regression Modelling View of Neighborhood Methods-Graph Models for Neighborhood Based Methods-Implement Collaborative Filtering Algorithms-Applications of Recommender Systems such as Recommending movies, music, books, websites, etc.

(15)

TOTAL HOURS: 45

TEXTBOOKS

1. Charu C.Aggarwal, “Recommender Systems”, Springer, 2016.
2. Rounak Banik, “Hands on Recommender System Using Python, Packt, 2019 (Practicals)

REFERENCES

1. Kim Falk, “Practical Recommender Systems”, Manning Publications,2019.
2. Frank Kane, “Building Recommender System with Machine Learning and AI”,2018.
3. Michael Schrage,“ Recommendation Engines”, 2020.

19MAME11 - ROBOTICS AND ITS APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
19MAM12, 19MAM21

COURSE OUTCOMES
CO1: Learn the basic components and building blocks of Robots.
CO2: Develop the robot construction skills.
CO3: Acquire skills to program the robots.
CO4: Integrate the features and operations of automation products
CO5: Explore the broad scope of robotic applications

FUNDAMENTALS OF ROBOTICS
Robot Meaning – History of Robots – Classification of Robots - Fundamentals of Robot Technology, Programming, and Applications - Robot Anatomy - Robot Drive Systems - Control Systems - Precision of Movement - End Effectors - Robotic Sensors - Robot Programming and Work Cell Control - Robot Applications

(9)

ROBOT TECHNOLOGY: THE ROBOT AND ITS PERIPHERALS
Control Systems and Components - Basic Control Systems Concepts and Models – Controllers - Control System Analysis - Robot Sensors and Actuators - Velocity Sensors - Actuators - Power Transmissions Systems - Modeling and Control of a Single Joint Robot

(9)

ROBOT PROGRAMMING AND LANGUAGES
Robot Programming - Methods of Robot Programming – Lead through Programming Methods - A Robot Program as a Path in Space - Motion Interpolation - Wait, Signal, and Delay Commands – Branching. Robot Languages – Artificial Intelligence

(9)

APPLICATIONS ENGINEERING FOR MANUFACTURING
Robot Cell Design and Control - Robot Cell Layouts - Multiple Robots and Machine Interference - Other Considerations in Workcell Design - Workcell Control - Interlocks - Error Detection and Recovery - The Workcell Controller - Robot Cycle Time Analysis. Economic Analysis for Robotics - Economic Analysis: Basic Data Required - Methods of Economic Analysis - Subsequent use of the Robot - Differences in Production Rates - Robot Project Analysis Form.

(9)

ROBOT APPLICATIONS IN MANUFACTURING
Material Transfer and Machine Loading/Unloading - General Considerations in Robot Material Handling - Material Transfer Applications - Machine Loading and Unloading. Processing Operations - Spot Welding - Continuous Arc Welding - Spray Coating - Other Processing Operations using Robots. Assembly and Inspection

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, “Industrial Robotics Technology, Programming and Applications", 2nd Edition, 2012. (Para I-V)
2. S.K. Saha, “Introduction to Robotics”, Tata McGraw Hill Education, 4th Edition, 2011. (Para - I)

REFERENCES

1. Danny Staple, “Learn Robotics Programming: Build and Control AI-enabled Autonomous Robots Using the Raspberry Pi and Python”, Packt Publishing, 2nd Edition, 2021
2. Robert J. Schilling, “Fundamentals of Robotics, Analysis & Control", PHI Learning, 2010.
3. Robin R. Murphy, “Introduction to AI Robotics”, Prentice, Hall of India, New Delhi, 2007.

19MAME12 - CONVERSATIONAL AI

Contact Hours

L	T	P	C
3	0	0	3

ASSESMENT: THEORY

PRE-REQUISITES
19MAME07

COURSE OUTCOMES
CO1: Understand the basics of a dialogue system.
CO2: Learn rules to develop dialogue systems.
CO3: Develop statistical data driven dialogue systems
CO4: Design and evaluate the dialogue systems.
CO5: Explore the challenges and future scope.

INTRODUCTION TO DIALOGUE SYSTEMS
Dialogue Systems – History of Dialogue Systems – Present Day Dialogue Systems – Modeling Conversation – Designing and Developing Dialogue Systems

(8)

RULE BASED DIALOGUE SYSTEMS: ARCHITECTURE, METHODS, TOOLS
Typical Dialogue Systems Architecture – ASR, NLU, Dialogue Management, NLG, TTS – Designing a Dialogue System, Tools for Developing Dialogue Systems – Visual Design Tools, Scripting Tools for Handcrafting Dialogue System, Advanced Toolkits and Frameworks, Research Based Toolkits

(9)

STATISTICAL DATA-DRIVEN DIALOGUE SYSTEMS
Motivating the Statistical Data Driven Approach – Dialogue Components – Natural Language Understanding – Dialogue Management – Natural Language Generation – Reinforcement Learning – Representing Dialogue a Markov Decision Process – From MDPs to POMDPs – Dialogue State Tracking – Dialogue Policy – Problems and Issues

(10)

EVALUATING DIALOGUE SYSTEMS
Conducting Evaluation – Evaluating Task-Oriented Dialogue Systems – Evaluating Open-Domain Dialogue Systems – Evaluation Frameworks – PARADISE, QoE, Interaction Quality

(9)

CHALLENGES AND FUTURE DIRECTIONS
Multimodality in Dialogue – Visual Dialogue and Visually Grounded Language – Data Efficacy – Reasoning and Collaborative Problem Solving in Dialogue Systems – Hybrid Dialogue Systems – Dialogue with Social Robots – Dialogue and the Internet of Things – Social and Ethical Issues

(9)

TOTAL HOURS: 45

TEXTBOOK
1. Michael F. McTear – "Conversational AI: Dialogue Systems, Conversational Agents and Chatbots", Morgan & Claypool Publishers, 2021.

REFERENCES

1. Andrew R. Freed, “Conversational AI”, Manning Publications, 2021
2. Srini Janarthanam, “Hands-On Chatbots and Conversational UI Development: Build chatbots and Voice User Interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills”, Packt Publishing, 2017

19MAME13 – GAME THEORY

CONTACT HOURS

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Model a 2 x2 evolutionary games in dynamical systems.
CO2: Develop model for applications using Network reciprocity
CO3: Analyse the evolution of communication in Constructivism Approach
CO4: Design and perform Cellular Automaton Model in realistic Traffic flow
CO5: Examine pandemic analysis as application to which evolutionary game theory can be applied.

EVOLUTIONARY GAME THEORY AND ITS FUNDAMENTALS
Modeling a Real Complex World - Modeling a Real Complex World - Fundamental Theory for Evolutionary Games: Linear Dynamical Systems - Non-linear Dynamical Systems - 2-Player & 2-Stratey Games - Dynamics Analysis of the 2 x 2 Game - Multi-player Games - Social Viscosity; Reciprocity Mechanisms - Universal Scaling for Dilemma Strength in 2 x 2 Games – R- Universal Scaling for Dilemma Strength in 2 x 2 Games.

(12)

NETWORK RECIPROCITY
Most Influential to Enhance Network Reciprocity - Model Description - Effect of the Initial Fraction of Co-operators on Cooperative Behavior in the Evolutionary Prisoner's Dilemma Game - Several Applications of Stronger Network Reciprocity - Discrete, Mixed and Continuous Strategies Bring Different Pictures of Network Reciprocity – A Substantial Mechanism of Network Reciprocity

(10)

EVOLUTION OF COMMUNICATION
Communication as an Authentication Mechanism - An Evolutionary Hypothesis Suggested by Constructivism Approach

(6)

TRAFFIC FLOW ANALYSIS
Modelling and Analysis of the Fundamental Theory of Traffic Flow - A Cellular Automaton (CA) Model to Reproduce Realistic Traffic Flow - Social Dilemma Structure Hidden Behind Various Traffic Contexts

(9)

PANDEMIC ANALYSIS AND EVOLUTIONARY GAMES
Modeling the Spread of Infectious Diseases and Vaccination Behavior - Vaccination Games in Complex Social Networks.

(8)

TOTAL HOURS:45

TEXTBOOK

1. Jun Tanimoto, "Fundamentals of Evolutionary Game Theory and its Applications", Springer 2016

REFERENCES

1. Michael Maschler, Eilon Solan, Shmuel Zamir, “Game Theory”, Cambridge University Press, 2013
2. Martin Osborne, “An Introduction to Game Theory”, Oxford University Press, 2003

19MAME14 - AGILE SOFTWARE DEVELOPMENT

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PREREQUISITES
Consent of the Instructor

COURSE OUTCOMES
CO1: Understand the key principles of agile management.
CO2: Learn agile Project Management process and agile project planning.
CO3: Apply agile development management and product management in system development.
CO4: Identify the need for scrum and use scrum tools.
CO5: Compare scrum with conventional project management and waterfall methods.

TRADITIONAL SOFTWARE DEVELOPMENT AND AGILE
Traditional Software Development – History of Project Management – Waterfall Approach – Project Management Triangle – Modified Waterfall Models. Overview of Agile Software Development – Lean Software Development – Project Management 2.0 – Agile Manifesto – Scrum – Test Driven Development – Extreme Programming – Rational Unified Process - Agile Unified Process – Agile Model Driven Development

(7)

AGILE PROJECT MANAGEMENT AND PLANNING
Software Production Metrics - Agile Project Management - Agile Project Planning - The Agile Manager's New Work - Considerations on Teaming and Leadership - Considerations on Planning and Architecture.

(7)

AGILE DEVELOPMENT MANAGEMENT AND PRODUCT MANAGEMENT
Agile Development Management – Software Resource Planning – An Agile Maturity Model – Setting the Governing Rules – Staffing Decisions – Operations Review – Agile Product Management – Financial Metrics for Software Services – Business Benefit of Agile Methods - Considerations on Project Execution.

(10)

FOUNDATIONS OF SCRUM
Need for Scrum- Scrum Team – Agile Product or Process Development – Eliminate Waste and Save Money – Improved Control or Assurance – Schedule and Budget Maintenance – Managing Changing User Requirements – Projects Candidates for Scrum. Overview of Scrum principles– Requirements – Product Backlog – Planning and Estimation – Release Backlog – Sprint – Sprint Retrospective – Iterative Product Delivery – Burndown Chart and Scope Changes – Meetings – Project Human Resources.

(12)

SCRUM AND PROJECT MANAGEMENT
Scrum and Conventional Project Management – Complex Project Management – Scrum and the Waterfall Method. Case Study: Scrum and Education – Scrum and Hospitals. **Agile Tools :** Scrumblr, Trello, Yodiz, ScrumDesk.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Thomas Stober, Uwe Hansmann, “Agile Software Development - Best Practices for Large Software Development Projects”, Springer, June 2009. (Para I, II, III)
2. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results”, Prentice Hall, 2003. (Para II, III)
3. Kim H. Pries, Jon M. Quigley, “Scrum Project Management”, CRC Press, 2011. (Para IV,V)

REFERENCES

1. Sudipta Malakar, “Agile Methodologies In – Depth: Delivering Proven Agile, SCRUM and Kanban Practices for High – Quality Business Demands”, BPB Pubilcations, 2021
2. Mike Cohn, “Succeeding with Agile: Software Development Using Scrum”, Addison Wesley, 2010.
3. Robert C. Martin ,”Agile Software Development, Principles, Patterns, and Practices”, Alan Apt Series,2011.

19MAME15 - SOA AND WEB SERVICES

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: Examine the requirements of distributed applications and design web services.
CO2: Apply the concepts of Service Oriented Architecture in designing platform independent real time distributed applications.
CO3: Design and develop simple to complex web services that meet the specified requirements.
CO4: Develop web services based on requirements of the web application using Java APIs and also consume them in web applications.
CO5: Determine the security requirements of web services and incorporate them in building web applications.

INTRODUCTION TO SOA
Introducing SOA: Fundamental SOA - Common Characteristics of Contemporary SOA – Common Misperceptions about SOA – Common Tangible Benefits of SOA – Common Pitfalls of Adopting SOA - Evolution of SOA

(5)

WEB SERVICES AND SOA
Web Services and Primitive SOA: The Web Service Framework - Services (as Web Services) - Service Descriptions (with WSDL) - Messaging (with SOAP); Web Services and Contemporary SOA (Part I: Activity Management and Composition): Message Exchange Patterns - Service Activity - Coordination - Atomic Transactions - Business Activities – Orchestration – Choreography

(7)

SOA AND SERVICE-ORIENTATION
Principles of Service-Orientation: Anatomy of a Service-Oriented Architecture - Common Principles of Service-Orientation – How Service-Oriented Principles Inter-relate; Service Layers.

(6)

BUILDING SOA
Service Oriented Analysis: Introduction – Service Modelling Guidelines; Service Oriented Design: Introduction to Service-Oriented Design, WSDL-Related XML Schema Language Basics - WSDL Language Basics - SOAP Language Basics, SOA Composition Guidelines,
Service Design: Service Design Overview, Business Process Design: WS-BPEL Languages Basics - WS-Coordination Overview - Service-Oriented Business Process Design; Fundamental WS-* Extensions: WS-Security Language Basics.

(6)

WEB SERVICES IN JAVA
Building Web Services with JAX-WS - Binding between XML Schema and Java Classes – Streaming API for XML - SOAP with Attachments API for Java - Generating Client-Support Code from a WSDL - Building RESTful Web Service with JAX-RS.

(6)

PRACTICALS

Modelling the business services-Implement the Service Interface and Service Implementation Classes - Write WSDL document to describe services-Publish web services. Create Web Service Client-Create and send messages using SOAP Attachment API. Build RESTful APIs and Microservices using Flask/Django **(15)**

TOTAL HOURS: 45

TEXTBOOKS

1. Thomas Eri, "Service-Oriented Architecture- Concepts, Technology and Design", Pearson Education, Second Edition, 2008. (Para I to IV)
2. Eric Jendrock, Jennifer Ball, Debbie Carson, Ian Evans and Kim Haase, "The Java EE5 Tutorial", Oracle Corporation Press, 2010 (Para V)

REFERENCES

1. Gaston C. Hillar, “Hands-On RESTful Python Web Services”,Packt,2018.
2. Martin Kalin, "Java Web Services: Up and Running", O'Reily Media Inc., First Edition, 2009.
3. Eric Newcomer, Greg Lemow, “Understanding SOA with Web Services”, Pearson Education, Inc, 2005.

19MAME16 – INTERNET OF THINGS

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: Assess the different IoT technologies that suits an application.
CO2: Recognize the challenges for smart object.
CO3: Demonstrate knowledge of main architectures and paradigms for the Internet of Things.
CO4: Demonstrate knowledge of MAC and routing protocols developed for Low Power and lossy networks.
CO5: Design simple IoT systems for the given requirements comprising sensors- edge devices- wireless network connections and data analytics capabilities.

INTRODUCTION
Definition and Characteristics of IoT - Physical Design of IoT - Logical Design of IoT – Enabling Technologies - IoT Levels - Domain specific IoTs

(5)

SENSORS- PARTICIPATORY SENSING- RFIDS AND WIRELESS SENSOR NETWORK
Introduction-Sensor technology - Sensing the real world-Analog sensors- Examples of sensors – Reading temperature from Resistance sensor- capacitive sensor-Examples of sensors-Temperature-humidity-distance light-acceleration-vibrations and shocks-Gyroscope for angular acceleration- Magnetic sensors-Magnetometer Sound -Sensing the Things-bar code-QR code- Motion sensors-Pressure sensors-Location and LIDAR-Industrial IoT - in bicycle manufacturing process and Automotive IoT - Connected cars technology

(10)

DEVELOPING INTERNET OF THINGS
IoT and M2M - IoT System Management with NETCONF-YANG - IoT Design Methodology - Case Study: Weather monitoring - Motivation for using Python- Logical design using Python: Programming constructs - Python packages for IoT

(6)

IOT PHYSICAL DEVICES AND ENDPOINTS
Building Blocks of an IoT device - Intel Galileo Board - Raspberry pi

(6)

IOT CLOUD BASED SERVICES USING THE XIVELY- NIMBITS
Cloud storage models and communication API - WAMP-AutoBahn for IoT - Xively cloud for IoT - Django -Designing a RESTful Web API - Amazon Web services for IoT- Data collection-storage-Computing using Xively and Nimbits- Data channels using advanced features-security tokens-Alerts-Jabbing-Subscriptions-Public cloud IoT platforms like Paas and SaaS

(10)

DATA ANALYTICS FOR IOT

Apache Hadoop - Using map-reduce for batch data analytics

(4)

CASE STUDIES ILLUSTRATING IoT DESIGN

Home Automation - Cities - Environment - Agriculture - Productivity Applications

(4)

TOTAL HOURS: 45

TEXTBOOK

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2014.

REFERENCES

1. Andy King, “Programming the Internet of Things: An Introduction to Building Integrated Device-to-Cloud IOT Solutions”, O’Reilly, 2021
2. Agus Kuniawa, “Getting started with Intel IoT and Intel Galileo”, Kindle edition, 2015.
3. Raj Kamal, “Internet of Things - Architecture and Design Principles”, McGraw Hill,2017

19MAME17 – DIGITAL SIGNAL AND IMAGE PROCESSING

Contact Hours

L	T	P	C
2	0	2	3

ASSESSMENT: THEORY

PRE-REQUISITES:
Consent of the Instructor

COURSE OUTCOMES
CO1: Learn the basic concepts of Signals and Images
CO2: Illustrate various filtering methods.
CO3: Evaluate continuous and discrete spectra estimation
CO4: Understand steps in image processing such as Image perception and sensing
CO5: Explore Image estimation and restoration methods.

DETERMINISTIC SIGNALS
Signal Fundamentals: The concept of signal – The concept of system – Discrete Time Signals and sampling: The sampling theorem – Plotting a signal as a function of time – Spectral representation – Fast Fourier Transform

(8)

LINEAR FILTERS
Definitions and properties – The z-transform – Transforms and linear filtering – Different equations and rational TF filters – Minimum phase filters – Filter Design methods – Oversampling and Undersampling.

(8)

CONTINUOUS SPECTRA ESTIMATION
Non-parametric estimation of the PSD – Parametric estimation – Discrete Spectra Estimation: Estimating the amplitudes and the frequencies – High resolution methods

(9)

IMAGE PERCEPTION AND SENSING
Light and Luminance – Still Image Visual Properties – Time-variant Human Visual System Properties – Color - Color spaces – Image Sensors and Displays – Image Enhancement and Analysis: Simple Image processing filters – Image Enhancement – Image Analysis – Object detection.

(10)

IMAGE ESTIMATION AND RESTORATION
Two Dimensional random fields – Estimation for Random fields – Two-Dimensional Recursive Estimation - Inhomogeneous Gaussian Estimation – Estimation in the Sub band or Wavelet Domain – Bayesian and Maximum A Posteriori Estimation - Image Identification and Restoration.

(10)

PRACTICALS
Implementation of FFT, DFT of Signals-Wavelet Transformation-Image Enhancement -Histogram Equalization-Smoothing-Sharpening-Compression-Segmentation-Morphology-Restoration-Edge Detection-Restoration.

(15)

TOTAL HOURS: **45**

TEXTBOOKS

1. Gérard Blanchet, Maurice Charbit, “Digital Signal and Image Processing Using MATLAB”, ISTE Ltd, 2006. (Para I-III)
2. John W. Wood, “Multidimensional Signal, Image, and Video Processing and Coding”, Second Edition, Academic Press. (Para IV).

REFERENCES

1. R.Ramanathan and K.P. Soman, “Digital Signal and Image Processing”, Elsevier Science, 2012.
2. Sandipan Dey, “Image Processing with Python”, BPB, 2021.

19MAME18 - CYBER SECURITY

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1 : Understand the theoretical concept of Cyber crime
CO2 : Enumerate the different legal responses to Cybercrime
CO3 : Understand and apply cyber forensics to detect threats and crimes.
CO4 : Analyze and evaluate the cyber security needs of an organization.
CO5 : Familiarize with case studies on cybercrimes and digital evidences

INTRODUCTION TO CYBER CRIME

Role of Electronic Communication Devices and Information and Communication Technologies in Cybercrime – Types of Cyber Crime – Classification of Cyber Criminals – Tools used in Cyber Crime – Factors influencing Cybercrime - Challenges to Cybercrime – Strategies to prevent Cybercrimes - Terms and Terminologies associated with Cybercrime.

(9)

CYBERCRIME - THE PRESENT AND THE FUTURE

Cryptocurrency – Bitcoin - Ethereum – Blockchain - Ransomware. **Cyber forensics:** Interrelations among Cybercrime, Cyber Forensics and Cyber Security - Cyber Forensics - Definition – Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics.

(10)

TOOLS AND METHODS USED IN CYBERCRIME

Proxy Servers and Anonymizers - Phishing - Password Cracking - Keloggers and Spywares - DoS and DDoS attacks - SQL Injection - Buffer Overflow - Attacks on Wireless Networks.

(9)

ORGANIZATIONAL IMPLICATIONS

Web threats for Organizations - Security and Privacy implications from Cloud Computing - Social Media Marketing: Security Risks and Perils for Organizations - Social Computing and the Associated Challenges for Organizations – Protecting People's Privacy in the Organization-Forensics best practices for organizations.

(9)

DIGITAL EVIDENCE

Introduction to Digital Evidence and Evidence Collection Procedure - Sources of Evidence - Impediments to collection of Digital Evidence - Challenges with Digital Evidence.
Cybercrime: Real-Life Examples -Mini-Cases- Illustration of Financial Frauds in Cyber Domain - Digital Signature-related Crime Scenarios - Digital Forensics Case Illustrations-Online Scams.

(8)

TOTAL HOURS: 45

TEXTBOOKS

1. Dejey and S.Murugan, 'Cyber Forensics', Oxford University Press, 2018. (Para I, II, V)

2. Nina Godbole and Sunil Belapure, ‘Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives’, Wiley India. (Para III, IV, V)

REFERENCES

1. James Graham, Richard Howard and Ryan Otson, ‘Cyber Security Essentials’, CRC Press.
2. Mead, Nancy, R.Woody, Carol, ‘ Cyber Security Engineering : A Practical Approach for Systems and Software Assurance’, Pearson Education Asia, 2017.

19MAME19 - BUSINESS INTELLIGENCE

Contact Hours

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

PRE-REQUISITES
Consent of the instructor

COURSE OUTCOMES
CO1: Apply Engineering approach to make better business decisions by analyzing risk factors.
CO2: Devise efficient managerial decisions based on mathematical models for real time business intelligence applications.
CO3: Develop strategic project planning by analyzing customer requirements in various dimensions with cost and time efficiency.
CO4: Differentiate various prototyping models and their applicability for data modeling based on real time requirements and infrastructure.
CO5: Specify ETL operations for real time business intelligence projects using tools and analyze the feasibility in terms of strengths and weaknesses.

BASICS OF BUSINESS INTELLIGENCE(BI)
Decision Support Systems: Definition - Representation of the decision-making process - Evolution of information systems - Development of DSS. Mathematical models for decision making: Structure - Development of a model - Classes of models.

(10)

BUSINESS INTELLIGENCE STAGES AND STEPS
BI definition - BI decision support initiatives - Development approaches - Engineering stages and the development steps - Parallel development tracks - BI project team structure.
Business Case Assessment: Justification - Drivers - Business Analysis issues - Risk assessment -Activities - Deliverables – Roles.

(9)

BI PROJECT PLANNING AND REQUIREMENTS
BI project: managing-Defining-Planning - Activities - Deliverables - Roles. Project Requirements Definition: General and specific requirements - Activities - Deliverables – Roles.

(8)

DATA ANALYSIS AND APPLICATION PROTOTYPING
Data Analysis: Business focused data analysis - Top-down logical data modeling -Bottom-up source data analysis - Data cleansing - Activities - Deliverables-Roles.
Prototyping: Purpose - Best practices - Types - Building successful prototypes - Application prototyping Activities - Deliverables - Roles.

(9)

DATABASE AND ETL DESIGN
Differences in database design - Logical and physical database design - Activities - Deliverables - Roles. ETL Design: Implementation strategies - Preparing for ETL process - Designing the extract programs, Transformation programs, Load programs, ETL process flow - Evaluating ETL tools - Activities - Deliverables- Roles.

(9)

TOTAL HOURS: 45

TEXTBOOKS

1. Carlo Vercellis, "Business Intelligence: Data mining and Optimization for Decision Making", John Wiley and Sons, 2009. (Para- I).

2. Larissa T.Moss and Shaku Atre, "Business Intelligence Roadmap: The Complete project life cycle for decision support applications", Addison Wesley, 2003. (Para II, III, IV & V).

REFERENCE

1. Efraim Turban, Ramesh Sharda, DursunDelen and Janine E. Aronson, "Business Intelligence – A Managerial Approach", Global Edition, Pearson, 2017

19MAMEL01 - SPATIAL DATA MODELLING AND ANALYSIS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Acquire skills to carry out analysis on spatial data.
CO2: Create databases for spatial data and onscreen digitization.
CO3: Demonstrate the applications of raster and vector data.
CO4: Implement raster analysis and vector analysis.
CO5: Model the spatial variability

CONCEPTS
1. Rectification and Spatial Referencing of Digital Map
2. Onscreen Digitization and Database Creation
3. Projection and Re-projection of spatial data
4. Data Conversion – Vector to Raster, Raster to Vector
5. Populating Attribute data base and querying on attribute data
6. Generation of DEM: from contours, spot heights, GRID and TIN, Isometric mapping
7. Vector Analysis – Buffering, Overlay and Network analysis, flood mapping
8. Raster Analysis – Measurement - Arithmetic overlaying, Logical overlaying, Class interval selection, choropleth maps
9. Map Output - Bar charts, Pie charts and symbols
10. Map compilation
11. Modelling spatial variability
12. Weighted Theisson polygon and districting
13. Customization and scripting

Tools: Python,QGIS,Neighborvis

REFERENCE
1. Joel Lawhead, “Learning Geospatial Analysis with Python”, Second Edition, Packt Publications, 2015.

19MAMEL02 – AUGMENTED AND VIRTUAL REALITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
19MAME05

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Create and deploy a AR-VR application
CO2: Explore the physical principles of VR
CO3: Create a comfortable, high-performance VR application using Unity.
CO4: Identify, examine and develop software that reflects fundamental techniques for the design and deployment of VR experiences.
CO5: Develop real time applications using AR/VR techniques

CONCEPTS TO BE COVERED

1. Simple programs on Unity for VR development, and Image blending
2. Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
3. Develop a scene in Unity that includes: i. A cube, plane and sphere, apply transformations on the 3 game objects. ii. Add a video and audio source
4. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene.
5. Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
6. Include animation and interaction in the immersive environment created in 3D game objects.
7. Create a virtual environment for any use case. The application must include at least 4 scenes which can be changed dynamically including good UI, animation and interaction with game objects. (e.g. VR application to visit a zoo)

Suggested Software/Tool: Unity

REFERENCE
1. Jeff W Murray, Taylor & Francis, "Building Virtual Reality with Unity And Steamvr", 2nd Edition, 2020.

19MAMEL03 – NATURAL LANGUAGE PROCESSING LAB

Contact Hours

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

PRE-REQUISITES
19MAME07,19MAM65

COURSE OUTCOMES
CO1: Practice text and word representations in NLP
CO2: Use text segmentation, text summarization and categorization to process text data
CO3: Implement and evaluate different NLP applications using machine learning and deep learning methods
CO4: Design and develop chatbot applications and machine translations
CO5: Develop NLP based applications for various domains

CONCEPTS TO BE COVERED

- Representing and computing with Text data: Simple statistics
- Accessing text corpora and lexical resources
- Processing raw text from web: regular expressions for finding patterns, tokenizing text
- Text segmentation
- Categorizing and tagging words: N-Gram
- Text classification using supervised machine learning algorithms like Naïve Bayes, Deep Neural Networks etc.)
- Speech to text, Text to Speech
- Language modelling
- Analyzing meaning of sentence
- Building chatbots/Question answering
- Machine transaction, Text summarization
- Use of transformer models

Suggested Software: NLTK(Python)

REFERENCES

1. Denis Rothman “Transformers for Natural Language Processing”,Packt, 2021
2. Sowmya Vajjala , Bodhisattwa Majumder, Anuj Gupta “Practical Natural Language Processing”, BPO, 2020.

19MAMEL04- GRAPH ANALYTICS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Implement Graph creation and detection
CO2: Implement machine learning techniques and algorithms in graph data
CO3: Use different node embedding methods for real time problems
CO4: Implement Graph Neural Networks and Implement Graph Convolution Network
CO5: Extracting data from social networks, financial transaction systems, and more and analyze it to derive patterns.

CONCEPTS TO BE COVERED

- Graph Creation and Analysis (Statistical) , Plotting graphs and Graph properties, Extracting features using graphs
- Node Embedding -Shallow Embedding and Random walk Embedding
- Implementation of graph algorithms-(Pathfinding & Graph Search, Centrality)
- Applications of Graph Neural Networks
- Graph Convolution Network (GCN) for graph-structured data
- Machine learning on graphs- Node Classification, Link Prediction, Clustering and Community Detection.
    - Social network analysis using Graphs (Yelp Social Network Data)
    - Text Analytics and NLP using graphs
    - Graph analysis for credit card transaction

Suggested Software: Python (Networkx), Neo4j, GraphX, Gephi

REFERENCE:

1. Aldo Marzullo, Claudio Stamile, and Enrico Deusebio, Graph Machine Learning, Packt Publishing, 2021.
2. Mark Needham, Amy E. Hodler, Graph Algorithms: Practical Examples in Apache Spark and Neo4j, O'Reilly, 2019

19MAMEL05 - INTERNET OF THINGS LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES
CO1: Choose the required sensor and perform input output operations for a given requirement.
CO2: Devise interface circuit for connecting a chosen sensor to Arduino board.
CO3: Develop software for Arduino board to interact with the sensor to meet requirements.
CO4: Develop software to interact (send/receive data) with Web/Application server located in the Internet.
CO5: Use data analytics tool to analyse the data collected and present the report to the end user.

CONCEPTS TO BE COVERED
1. Familiarize with Arduino/Raspberry Pi
2. To interface LED/Buzzer and turn on/off LED
3. To interface with digital sensor like IR/LDR and push button to on/off the LED
4. To interface with DTH11 sensor and read and print temperature and humidity readings.
5. To interface Bluetooth and send sensor data to smartphone using Bluetooth.
6. Program to interact with Thingspeak Cloud
7. Program to interact with MQTT broker
8. Perform analytics on sensor data and visualize the results in mobile UI
9. Develop end-to-end intelligent IoT applications

REFERENCE
1. Pooja Baraskar, “Practical Internet of Things for Beginners: IOT Projects with Realsense, Azure, Arduino and Intel Edition”, Apress, 2020

19MAMEL06 - CYBER SECURITY LAB

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

CO1 : Perform Encryption and Decryption techniques
CO2 : Implement detection and prevention process
CO3 : Perform detection method against various attack mechanism
CO4 : Understand the implementation of various techniques and security algorithms
CO5 : Apply different tools used for secure data transmission and for creating digital signature.

TOPICS TO BE COVERED

1. Perform Encryption and Decryption using Substitution techniques
   a) Caesar Cipher b) Playfair Cipher c) Hill Cipher
2. Perform Encryption and Decryption using Transposition techniques
   a) Rail Fence row & Column Transformation
3. Implement Diffie-Hellman Key Exchange mechanism
4. Implement the following attacks
   a) Dictionary Attack b) Brute- Force attack
5. Calculate the message digest of a text using the SHA-1 algorithm
6. Detect ARP Spoof Attack using Scapy in Python
7. Demonstrate Intrusion Detection System using any tool
8. Implement for providing secure storage and secure data transmission
9. Implement RSA Digital Signature Scheme
10. Defeating Malware - Building Trojans, Rootkit Hunter

ONE CREDIT COURSES

19MAMOC01- ECONOMETRICS AND MACHINE LEARNING IN FINANCE

Contact Hours

L	T	P	C
1	0	0	1

PRE-REQUISITES

Consent of the Instructor

COURSE OUTCOMES

CO1: Understand the fundamentals of econometrics and financial markets.

CO2: Select and implement linear regression, logistic regression and random forest models as per business requirement.

CO3: Understand the techniques of fine tuning the model parameters to improve its performance.

CO4: Apply machine learning models to financial data and derive insights.

ECONOMETRICS

Review of Probability and Statistics-Fundamentals of Economics

Financial Institutions, Products and Markets-Introduction to Financial Institutions-Introduction to Financial Products and Markets

(5)

MACHINE LEARNING IN FINANCE

Review of R programming language-Review of machine learning

Building a multiple linear regression model

Building a logistic regression model

Validating Regression Models – Performance Diagnostics

Building a regression model to forecast losses for a trading desk

Building a logistic regression model to assess the credit quality of the borrower

Building a model using KNN, K-means and Naive Bayes classifier and understanding the testing the performance of the models

Building Prudential Life Insurance Assessment using Multinomial Logit and Random Forest.

Discussing resources for having a career in model development, validation, quantitative research and data science.

(10)

TOTAL HOURS: **15**

19MAMOC02 – JAVA PROGRAMMING

Contact Hours

L	T	P	C
0	0	2	1

ASESSMENT: PRACTICALS

COURSE OUTCOMES

CO1: Able to learn and implement classes and objects in Java.
CO2: Able to apply inheritance and create interfaces for the given requirement.
CO3: Able to handle the different kinds of exceptions arising in a Java program.
CO4: Able to use IO streams for reading and writing data in Java.
CO5: Able to write socket programs in Java to create network applications.

INTRODUCTION TO OBJECT ORIENTED PROGRAMMING

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance – Polymorphism.
OOP in Java –Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation- Fundamental Programming Structures in Java –Objects and Classes - Strings

(6)

INHERITANCE AND INTERFACES

Inheritance – Using Super - Creating a Multilevel Hierarchy – Constructors – Method Overriding – Using Abstract Classes – Using Final with Inheritance – The Object Class
Packages and Interfaces – Packages – Access Protection – Importing Packages - Interfaces

(10)

EXCEPTION HANDLING AND I/O

Exceptions – Exception Hierarchy - Throwing and Catching Exceptions – Built-in exceptions - Creating own exceptions. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

(8)

SOCKET PROGRAMMING

Basic Concepts- Protocols and Terminology-Starting Network Programming in Java-Multithreading and Multiplexing. **Database Connectivity:** JDBC

(6)

Programming exercises based on the above concepts

TOTAL HOURS: 30

REFERENCES

1. Herbert Schildt, “Java The complete reference”, 11th Edition, McGraw Hill Education, 2020

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF COMPUTING

M.Sc. DECISION AND COMPUTING SCIENCES

Curriculum from the Academic Year 2017 - 2018 onwards

Semester I

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC11	Technical English	3	0	0	3	HS
17MDC12	Applied Algebra and Calculus	3	2	0	4	BS
17MDC13	Basic Statistical Methods	3	2	0	4	BS
17MDC14	Human Behavior	3	0	0	3	PC
17MDC15	Programming in C	3	0	0	3	PC
	PRACTICALS					
17MDC16	Computing Laboratory I (Algebra, Calculus and Statistics in SciLab and Excel)	0	0	4	2	PC
17MDC17	Programming Laboratory in C	0	0	4	2	PC
17MDC18	English Language Laboratory	0	0	2	1	EEC / HS
	Total Credits				**22**	

Semester II

Course Code	Course Name	L	T	P	C	Category
	THEORY					
	Language Elective	3	0	0	3	HS
17MDC21	Probability and Applications	3	2	0	4	BS
17MDC22	Principles of Management	4	0	0	4	PC
17MDC23	Web Technology	3	0	0	3	PC
17MDC24	Data Structures and Algorithms	3	0	0	3	PC
	PRACTICALS					
17MDC25	Computing Laboratory II (Probability in Excel and SciLab)	0	0	4	2	PC
17MDC26	Web Technology Laboratory	0	0	4	2	PC
17MDC27	Data Structures Laboratory using Python	0	0	4	2	PC
	Total Credits				**23**	

Semester III

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC31	Applied Statistics for Business Decisions	3	2	0	4	BS
17MDC32	Financial Analysis and Reporting	4	0	0	4	PC
17MDC33	Computer Systems	3	0	0	3	PC
17MDC34	Database Management Systems	3	0	0	3	PC
17MDC35	Object Oriented Programming	3	0	0	3	PC
	PRACTICALS					
17MDC36	Business Statistics Laboratory using R	0	0	4	2	PC
17MDC37	Business Database Design Laboratory	0	0	4	2	PC
17MDC38	Object Oriented Programming Laboratory using Java	0	0	4	2	PC
	Total Credits				**23**	

Semester IV

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC41	Predictive Analytics	3	0	0	3	BS
17MDC42	Operations Research for Business	3	2	0	4	BS
17MDC43	Corporate Finance	3	0	0	3	PC
17MDC44	Production and Operations Management	3	0	0	3	PC
17MDC45	Computer Networks	3	0	0	3	PC
	PRACTICALS					
17MDC46	Predictive Analytics Laboratory	0	0	4	2	PC
17MDC47	Business Process Optimization Laboratory (OR & POM)	0	0	4	2	PC
17MDC48	Financial Analysis Laboratory (Spreadsheets and Python)	0	0	4	2	PC
17MDC49	Managerial Communication Skills*					EEC
	Total Credits				**22**	

Semester V

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC51	Organisational Behavior	3	0	0	3	PC
17MDC52	Digital Marketing	3	0	0	3	PC
17MDC53	Software Engineering	3	0	0	3	PC
17MDC54	Enterprise Resource Planning	3	0	0	3	PC
	Elective I	3	0	0	3	PE
	PRACTICALS					
17MDC55	Human Resources System Development Laboratory (Python,R studio)	0	0	4	2	PC
17MDC56	Digital Marketing Design Laboratory (R Studio, Visualisation, Graphical)	0	0	4	2	PC
17MDC57	Enterprise Application Development Laboratory (J2EE)	0	0	4	2	PC
17MDC58	Personality Development*					EEC
	Total Credits				**21**	

Semester VI

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC61	Economic Foundations of Business	3	0	0	3	PC
17MDC62	Computational Intelligence	3	0	0	3	PC
17MDC63	Mobile and Cloud Computing	3	0	0	3	PC
17MDC64	Data Warehousing and Mining	3	0	0	3	PC
	Elective - II	3	0	0	3	PE
	PRACTICALS					
17MDC65	Mobile and Cloud Application Development Laboratory	0	0	4	2	PC
17MDC66	Data Mining Laboratory	0	0	4	2	PC
	Elective Laboratory - I	0	0	4	2	EEC
	Total Credits				**21**	

Semester VII

Course Code	Course Name	L	T	P	C	Category
17MDC71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC81	Modeling and Simulation	3	0	0	3	PC
17MDC82	Decision Support Systems	3	0	0	3	PC
17MDC83	Game Theory and Decision Analysis	3	0	0	3	PC
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
	PRACTICALS					
17MDC84	Business Intelligence Laboratory	0	0	4	2	PC
17MDC85	Decision Analysis Laboratory (Game Theory)	0	0	4	2	EEC
17MDC86	Entrepreneurship Development*					EEC
	Elective - Laboratory II	0	0	4	2	PC
	Total Credits				**21**	

Semester IX

Course Code	Course Name	L	T	P	C	Category
	THEORY					
17MDC91	Principles of Information Security	3	0	0	3	PC
17MDC92	Project Management	3	0	0	3	PC
17MDC93	Human Computer Interface and Interaction	3	0	0	3	PC
	Elective - V	3	0	0	3	PE
	Elective - VI	3	0	0	3	PE
	PRACTICALS					
17MDC94	Human Computer Interface and Interaction Laboratory	0	0	4	2	PC
17MDC95	Minor Project - Decision Tool Development	0	0	8	4	EEC
17MDC96	Business Ethics *					EEC
	Total Credits				**21**	

Semester X

Course Code	Course Name	L	T	P	C	Category
17MDC101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
	Grand Total of Credits				**210**	

*Pass is required

PROFESSIONAL ELECTIVES - THEORY COURSES

Course Code	Course Name	L	T	P	C	Category
	MANAGEMENT STREAM					
	Finance					
17MDCE01	Security Analysis and Portfolio Management	3	0	0	3	PE
17MDCE02	Equity Valuation	3	0	0	3	PE
17MDCE03	Derivatives and Risk Management	3	0	0	3	PE
17MDCE04	Credit Risk Analytics and Management	3	0	0	3	PE
	Marketing					
17MDCE11	Consumer Behavior	3	0	0	3	PE
17MDCE12	Services Marketing	3	0	0	3	PE
17MDCE13	Customer Relationship Management	3	0	0	3	PE
17MDCE14	Brand Management	3	0	0	3	PE
	Human Resources					
17MDCE21	Strategic Human Resource Management	3	0	0	3	PE
17MDCE22	Organisational Development	3	0	0	3	PE
17MDCE23	Performance Management	3	0	0	3	PE
17MDCE24	Compensation Management	3	0	0	3	PE
	Operations & Logistics					
17MDCE31	Total Quality Management	3	0	0	3	PE
17MDCE32	Logistics Strategy and Planning	3	0	0	3	PE
17MDCE33	Supply Chain Management	3	0	0	3	PE
17MDCE34	Warehouse and Distribution Management	3	0	0	3	PE
	General Management					
17MDCE41	Business Environment	3	0	0	3	PE
17MDCE42	Legal Aspects of Business	3	0	0	3	PE
17MDCE43	Information Technology for Managers	3	0	0	3	PE
17MDCE44	Direct and Indirect Tax	3	0	0	3	PE
17MDCE45	Technology and Innovation Management	3	0	0	3	PE
17MDCE46	Business Process Management	3	0	0	3	PE
	COMPUTER SCIENCE STREAM					
	Data Analytics					
15MSSE34	Machine Learning	3	0	0	3	PE
16MDSE53	Big Data Architecture	3	0	0	3	PE
16MDSE2	Web Mining	3	0	0	3	PE
16MDS83	Data Visualization	3	0	0	3	PE
16MDSE6	Information Security Analytics	3	0	0	3	PE
16MDSE20	Data Centric Computing	3	0	0	3	PE
16MDSE8	Bio-Informatics	3	0	0	3	PE
16MDSE3	Social Network Analysis	3	0	0	3	PE

PROFESSIONAL ELECTIVES - THEORY COURSES

Course Code	Course Name	L	T	P	C	Category
16MDSE4	Geographical Information Analysis	3	0	0	3	PE
16MDSE11	Econometric Analysis	3	0	0	3	PE
16MDS92	Deep Learning	3	0	0	3	PE
	Distributed and Network Systems					
15MSSE19	SOA and Web Services	3	0	0	3	PE
15MSSE35	BlockChain Technology	3	0	0	3	PE
15MSSE17	Internetworking Protocols	3	0	0	3	PE
17MDCE51	Distributed Systems	3	0	0	3	PE
	Software Systems					
15MSSE09	Graphics and Multimedia Technologies	3	0	0	3	PE
15MSS63	Software Testing and Quality Assurance	3	0	0	3	PE
16MDSE7	Image Processing	3	0	0	3	PE
15MSSE06	Software Requirements Engineering	3	0	0	3	PE
15MSSE07	Software Reliability	3	0	0	3	PE
15MSSE08	Open Source Software Development	3	0	0	3	PE
16MDSE25	Software Architecture and Design Patterns	3	0	0	3	PE
15MSSE24	Real Time Systems	3	0	0	3	PE
15MSSE25	Analysis and Design of Real Time Systems	3	0	0	3	PE
15MSSE27	Computer vision	3	0	0	3	PE
15MSSE14	Design Thinking	3	0	0	3	PE
15MSSE36	Advanced Web Technology	3	0	0	3	PE

PROFESSIONAL ELECTIVES - LABORATORY COURSES

Course Code	Course Name	L	T	P	C	Category
17MDCEL1	Minor Project in Business / Data Analytics	0	0	4	2	PE
17MDCEL2	Modeling and Simulation Laboratory	0	0	4	2	PE
15MSSL08	Image Processing Laboratory	0	0	4	2	PE
15MSSL03	Graphics and Multimedia Laboratory	0	0	4	2	PE
15MSSL13	Advanced Web Technology Laboratory	0	0	4	2	PE
16MDS55	Machine Learning Laboratory	0	0	4	2	PE
16MDS56	Big Data Modeling Laboratory	0	0	4	2	PE
16MDS85	Data Visualization Laboratory	0	0	4	2	PE
16MDS94	Deep Learning Laboratory	0	0	4	2	PE
15MSS65	Software Testing Laboratory	0	0	4	2	PE
16MDSEL2	Web Mining Laboratory	0	0	4	2	PE

17MDC49 - MANAGERIAL COMMUNICATION SKILLS

Course Code	Course Name	L	T	P	C	Category
16MDSLE01	Professional English	3	0	0	3	HS
16FY22F	Basic French	3	0	0	3	HS
16FY22G	Basic German	3	0	0	3	HS

* Pass is required

\# FC - Foundation Course, PC - Professional Core, PE - Professional Elective, EEC - Employability Enhancement Course.

NOTE :

- Equal weightage for Decision Science and Computer Science is given in the design of the curriculum, which complement each other to address the industry needs.
- Students of this Programme can specialize in Decision Science and/or Computing Science by choosing interested elective courses given under different streams.

17MDC49 - MANAGERIAL COMMUNICATION SKILLS

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : PRACTICAL

COURSE OUTCOME

- *Conceive appropriate verbal responses from the learners to a given social situation, using the guidelines to effective speaking skills and body language.*
- *Generate trouble shooting solutions to develop team building and interpersonal skills with case studies that focus on body language and empathy.*
- *Develop appropriate responses for business phone calls and formulate effective resolutions to professional conflicts that arise out of cross cultural communication gaps in a given managerial context.*
- *Compose appropriate written responses to professional problems faced by a team at the workplace arising out of ineffective communication skills.*

INTRODUCTION

Introduction - Code and Content - Stimulus and Response: Source - The Encoding Process - The Channel - The Decoding Process - The Receiver - Speaking Skills - Effective Speaking Guidelines - Communicating Soft Skills: A Self-assessment - Closing Tips **(6)**

SOFT SKILLS

Introduction to Soft Skills - Lessons from the Three Case Studies - Change in Today's Workplace: Soft Skills as a Competitive Weapon - Antiquity of Soft Skills - Classification of Soft Skills: Time Management - Attitude - Responsibility - Ethics, Integrity, Values and Trust - Self-confidence and Courage - Consistency and Predictability - Teamwork and Interpersonal Skills - Communication and Networking - Empathy and Listening Skills - Problem Solving, Troubleshooting and Speed reading - Leadership - Body Language **(7)**

TELEPHONING SKILLS & NEGOTATIONS

Preparing to make a telephone call - Receiving calls - Taking and leaving messages - Asking for and giving repetition - The secretarial barrier - Cross-cultural communication on the telephone - Setting up appointments - Changing arrangements - Ending a call - Cross-cultural communication on the telephone - Problem-solving on the telephone - Complaints - Negotiations: Types of negotiation - Preparation for a negotiation - Making an opening statement - Bargaining and making concessions - Accepting and confirming - Summarizing and looking ahead - Types of negotiator - Dealing with conflict - Rejecting - Ending the negotiation **(10)**

WRITING SKILLS TO CREATE AN IMPRESSION

Introduction- Fifteen Principle to Increase Clarity in Communication - Edit-Edit-Edit: The Reader's Perspective - Clarity of Thought - Clarity of Text. **(7)**

Total : 30

REFERENCE BOOKS

1. *Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press, 2011.*
2. *Krishna Mohan, Meera Banerji. "Developing Communication Skills" Mac Million Publishers, 2012.*
3. *Sai Lakshmi. B, "Poly Skills- A Course in Communication and Life Skills" Cambridge University Press, 2012.*

17MDC58 - PERSONALITY DEVELOPMENT

PRE-REQUISITES

PERSONALITY DEVELOPMENT

One's Personality Sends Out a Signal That Others Read - Same Person: Consciously Different Personalities can be Powerful - There isn't One Right Personality; It Differs by Role - Learning about Personality Development from the Three Cases - Personality Analysis - Freudian Analysis of Personality Development - Swami Vivekananda's Concept of Personality - Development: Physical Self - Energy Self - Intellectual Self - Mental Self - Blissful Self - Personality Begets. **(10)**

LEADERSHIP QUALITIES & INTERPERSONAL SKILLS:

Resolving Conflict - A Smiling Face - Appreciative Attitude - Assertive Nature - Communication Skills - Listening Skills - Developing Empathy - The Personality Attribute of Taking Bold Decisions - Personality Types and Leadership Qualities - Mapping the Different Personality Types - Personality Tests: Example of a Personality Test: Jung Typology Test - Personality Assessment **(10)**

ETIQUETTE

Social Etiquette - Corporate Etiquette - Personal Grooming - Using minimal Body Language - Leadership and Entrepreneurship: Corporate Training - Professionalism - Self awareness - Creativity skills - Cognitive Development - Assertiveness - Positive Thinking and Attitude.
(10)

Total : 30

REFERENCE BOOKS

1. *Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press, 2011.*
2. *Krishna Mohan, Meera Banerji. "Developing Communication Skills" Mac Million Publishers, 2012.*

Sai Lakshmi. B, "Poly Skills- A Course in Communication and Life Skills" Cambridge University Press, 2012.

17MDC95 - MINOR PROJECT - DECISION TOOL DEVELOPMENT

L	T	P	C
0	0	8	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : PRESENTATION AND

VIVA VOCECOURSE OUTCOME

- *Investigate the business problem in detail*
- *Identify the logical and ordered process to address all the critical elements of the business problem*
- *Analyze various alternatives and select the best alternative for the problem*
- *Develop the decision tool with the help of the analysis*

Effectiveness in managing the business decision making will ultimately determine the success of the company. But this is a problem for companies of all sizes particularly with the companies that are growing rapidly. At this point a clear mechanism for managing, communicating and confirming decision implementation is essential. Hence this minor project concentrates on developing a decision tool for the Chosen business process.

In this minor project students have to :

- Choose a business problem and develop a decision tool for to address the same.

COIMBATORE INSTITUTE OF TECHNOLOGY

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

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

Department of Computing

M.Sc. DATA SCIENCE

Curriculum and Syllabi

FIRST TO TENTH SEMESTER

Under Choice Based Credit System

(For the students admitted during the academic year 2016 - 2017 and onwards)

INDEX

S.No	Contents	Page No.
1.	Vision and Mission of the Institute	1
2.	Vision and Mission of the Department	2
3.	Programme Outcomes (POs)	3
4.	Programme Eductional Objectives (PEOs)	4
5.	Curriculum	5
6.	List of Electives	9
7.	Syllabus for Core Courses	11

COIMBATORE INSTITUTE OF TECHNOLOGY

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

VISION AND MISSION OF THE INSTITUTE

VISION

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

MISSION

The mission of CIT is to "impart high quality education and training to its students to make them world - class engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large".

DEPARTMENT OF COMPUTING
COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF DEPARTMENT OF COMPUTING

VISION

Department of Computing endeavors to make the students, world class software engineers, data scientists and decision makers with prudence of pioneering the solutions to the challenges of the nation and the world.

MISSION

The Mission of Department of Computing is

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

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

M3 : To establish Industry Institute Interaction program to provide exposure of latest tools and technologies used in the IT organizations and enhance the entrepreneurship skills.

DEPARTMENT OF COMPUTING

FIVE YEAR INTEGRATED M.Sc. (DATA SCIENCE)

PROGRAMME OUTCOMES (POS)

Students in the M.Sc.(Data Science) should possess the following abilities:

PO1 : Develop mathematical models and their computational solutions to reason and interpret massive amount of data in wide range of domains.

PO2 : Collect and Analyze large quantities of data to discover new knowledge pattern and facilitate decision making.

PO3 : Apply techniques and tools of data science to design and develop the systems for analyzing the rapidly growing data in the fields of medicine, business, geosciences and scientific research.

PO4 : Develop scalable techniques for data analysis and decision making in many areas, including machine learning, algorithms, statistics, operations research, databases, complexity analysis, visualization, and privacy and security.

PO5 : Communicate effectively with decision makers to derive intelligent analytical systems.

PO6 : Work with professional, and ethical values.

PO7 : Understand and solve legal and security issues of analytical applications.

PO8 : Recognize the importance of research to develop leading innovative analytical products.

PO9 : Self learning and adaptation to the emerging technologies to address the challenging issues.

DEPARTMENT OF COMPUTING

FIVE YEAR INTEGRATED M.Sc. (DATA SCIENCE)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will:

PEO 1 : **Expertise in Analytical solution :** Be uniquely positioned to pioneer new developments in the data science field, and to be leaders in industry, the public sector, and academia

PEO 2 : **Research :** Promote research in the development of leading innovative products

PEO 3 : **Leadership :** Inspire and guide the groups they work with in bringing their ideas to fruition, with managerial skills, self-assurance and integrity

PEO 4 : **Social Responsibility :** commit to social ethical and professional responsibilities

PEO 5 : **Life-long Learning :** Participate in life-long learning to enhance knowledge and skills necessary to contribute to the betterment of profession

PEO 6 : **Entrepreneurship :** Become Successful entrepreneurs with the strong business managerial skills

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF COMPUTING

M.Sc. DATA SCIENCE

CHOICE BASED CREDIT SYSTEM

Curriculum from the Academic Year 2016 - 2017 and onwards

Semester I

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS11	Technical English	3	0	0	3	HS
16MDS12	Algebra and Applications	3	2	0	4	BS
16MDS13	Basic Statistical Methods	3	2	0	4	BS
16MDS14	Problem Solving and Programming in C	3	0	0	3	PC
16MDS15	Digital Electronics	3	0	0	3	ES
	PRACTICALS					
16MDS16	Programming Laboratory in C	0	0	4	2	PC
16MDS17	Digital Electronics Laboratory	0	0	4	2	ES
16MDS18	Computing Laboratory I	0	0	4	2	BS
16MDS19	English Language Laboratory	0	0	2	1	HS
	TOTAL CREDITS				**24**	

Semester II

Course Code	Course Name	L	T	P	C	Category
	THEORY					
	Language Elective	3	0	0	3	HS
16MDS21	Calculus and Applications	3	2	0	4	BS
16MDS22	Probability and Applications	3	2	0	4	PC
16MDS23	Data Structures and Algorithms	3	0	0	3	PC
16MDS24	Object Oriented Programming	3	0	0	3	PC
	PRACTICALS					
16MDS25	Data Structures and Python Programming Laboratory	0	0	4	2	PC
16MDS26	Object Oriented Programming Laboratory	0	0	4	2	PC
16MDS27	Computing Laboratory II	0	0	4	2	PC
	TOTAL CREDITS				**23**	

Semester III

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS31	Business Statistics	3	0	0	3	BS
16MDS32	Discrete Structures and Automata Theory	3	0	0	3	PC
16MDS33	Computer Architecture	3	0	0	3	PC
16MDS34	Operating Systems	3	0	0	3	PC
16MDS35	Database Management Systems	3	0	0	3	PC
	PRACTICALS					
16MDS36	Computing Laboratory III	0	0	4	2	PC
16MDS37	Database Management Systems Laboratory	0	0	4	2	PC
16MDS38	Operating Systems Laboratory	0	0	4	2	PC
16MDS49*	Communication Skills and Personality Development					EEC
	Total Credits				**21**	

* A pass is required

Semester IV

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS41	Multivariate Data Analysis	3	0	0	3	BS
16MDS42	Modeling and Simulation	3	0	0	3	PC
16MDS43	Advanced Data Structures and Algorithms	3	0	0	3	PC
16MDS44	Computer Networks	3	0	0	3	PC
16MDS45	Software Engineering	3	0	0	3	PC
	PRACTICALS					
16MDS46	Computing Laboratory IV	0	0	4	2	PC
16MDS47	Network Programming Laboratory	0	0	4	2	PC
16MDS48	Algorithms Laboratory in Java	0	0	4	2	PC
16MDS49*	Communication Skills and Personality Development					EEC
	Total Credits				**21**	

* A pass is required

Semester V

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS51	Operations Research	4	0	0	4	PC
16MDS52	Machine Learning	3	0	0	3	PC
16MDS53	Big Data Architecture	3	0	0	3	PC
16MDS54	Artificial Intelligence	3	0	0	3	PC
	Elective - I	3	0	0	3	PE
	PRACTICALS					
16MDS55	Machine Learning Laboratory	0	0	4	2	PC
16MDS56	Big Data Modeling Laboratory	0	0	4	2	PC
	Elective Laboratory - I	0	0	4	2	PE
	Total Credits				**22**	

Semester VI

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS61	Graph Theory	3	0	0	3	PC
16MDS62	Computational Intelligence	3	0	0	3	PC
16MDS63	Data Mining	3	0	0	3	PC
16MDS64	Advanced Databases	3	0	0	3	PC
	Elective- II	3	0	0	3	PE
	PRACTICALS					
16MDS65	Data Mining Laboratory	0	0	4	2	PC
16MDS66	Computational Intelligence Laboratory	0	0	4	2	PC
	Elective Laboratory - II	0	0	4	2	PE
	Total Credits				**21**	

Semester VII

Course Code	Course Name	L	T	P	C	Category
16MDS71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS81	Advanced Predictive Analytics	3	0	0	3	PC
16MDS82	Data Privacy and Security	3	0	0	3	PC
16MDS83	Data Visualization	3	0	0	3	PC
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
	PRACTICALS					
16MDS84	Data Privacy and Security Laboratory	0	0	4	2	PC
16MDS85	Data Visualization Laboratory	0	0	4	2	PC
	Elective Laboratory - III	0	0	4	2	PE
	Total Credits				**21**	

Semester IX

Course Code	Course Name	L	T	P	C	Category
	THEORY					
16MDS91	Information Retrieval	3	0	0	3	PC
16MDS92	Deep Learning	3	0	0	3	PC
	Elective - V	3	0	0	3	PC
	Elective - VI	3	0	0	3	PE
	Elective - VII	3	0	0	3	PE
	PRACTICALS					
16MDS93	Information Retrieval Laboratory	0	0	4	2	PC
16MDS94	Deep Learning Laboratory	0	0	4	2	PC
	Elective Laboratory - IV	0	0	4	2	PE
	Total Credits				**21**	

Semester X

Course Code	Course Name	L	T	P	C	Category
16MDS101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
	Grand Total of Credits				**210**	

Language Elective

Course Code	Course Name	L	T	P	C	Category
16MDSLE01	Professional English	3	0	0	3	HS
16FY22F	Basic French	3	0	0	3	HS
16FY22G	Basic German	3	0	0	3	HS

Professional Electives

Course Code	Course Name	L	T	P	C	Category
	DATA ANALYTICS APPLICATION STREAM					
16MDSE1	Business Intelligence	3	0	0	3	PE
16MDSE2	Web Mining	3	0	0	3	PE
16MDSE3	Social Network Analysis	3	0	0	3	PE
16MDSE4	Geographical Information Analysis	3	0	0	3	PE
16MDSE5	Health Care Analytics	3	0	0	3	PE
16MDSE6	Information Security Analytics	3	0	0	3	PE
16MDSE7	Image Processing	3	0	0	3	PE
16MDSE8	Bio Informatics	3	0	0	3	PE
16MDSE9	Knowledge Engineering	3	0	0	3	PE
16MDSE10	Natural Language Processing	3	0	0	3	PE
16MDSE11	Econometric Analysis	3	0	0	3	PE
16MDSE12	Business Process Management	3	0	0	3	PE
16MDSE13	Accounting for Decision Making	3	0	0	3	PE
16MDSE14	Business Economics	3	0	0	3	PE
	TECHNOLOGY STREAM					
16MDSE15	Parallel and Distributed Computing	3	0	0	3	PE
16MDSE16	Cloud Computing	3	0	0	3	PE
16MDSE17	Mobile Computing	3	0	0	3	PE
16MDSE18	GPU Computing	3	0	0	3	PE
16MDSE19	Cloud Security and Privacy	3	0	0	3	PE
16MDSE20	Data Centric Computing	3	0	0	3	PE
16MDSE21	Embedded Systems	3	0	0	3	PE
16MDSE22	Internet of Things	3	0	0	3	PE
16MDSE23	Human Computer Interaction	3	0	0	3	PE
16MDSE24	Enterprise Computing	3	0	0	3	PE
16MDSE25	Software Architecture and Design Patterns	3	0	0	3	PE

Professional Electives- Labs

Course Code	Course Name	L	T	P	C	Category
16MDSEL1	Business Intelligence Laboratory	0	0	4	2	PE
16MDSEL2	Web Mining Laboratory	0	0	4	2	PE
16MDSEL3	Image Processing Laboratory	0	0	4	2	PE
16MDSEL4	Cloud Computing Laboratory	0	0	4	2	PE
16MDSEL5	Mobile Application Development Laboratory	0	0	4	2	PE
16MDSEL6	Embedded Systems Laboratory	0	0	4	2	PE
16MDSEL7	Internet of Things Laboratory	0	0	4	2	PE
16MDSEL8	Enterprise Application Development Laboratory	0	0	4	2	PE
16MDSEL9	Parallel and Distributed Computing Laboratory	0	0	4	2	PE

CAT - Category, BS - Basic Sciences, HS - Humanities and Social Sciences,

ES - Engineering Sciences, PC - Professional Core, PE - Professional Elective,

EEC - Employability Enhancement Course, MC - Mandatory Course

COIMBATORE INSTITUTE OF TECHNOLOGY

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

DEPARTMENT OF COMPUTING

M.Sc. (Software Systems)

Curriculum - For the Students admitted during 2020 - 2021 and onwards

Semester I

Course Code	Course Name	L	T	P	C	CAT
Theory						
20MSS11	Technical English	2	0	1	2	HS
20MSS12	Applied Algebra and Calculus	3	1	0	4	BS
20MSS13	Structured Systems Analysis and Design	3	0	0	3	PC
20MSS14	Digital Electronics	3	0	0	3	PC
20MSS15	Problem Solving using C Programming	3	1	0	4	PC
Practicals						
20MSS16	Computing Lab	0	0	4	2	PC
20MSS17	Programming Lab in C	0	0	4	2	PC
20MSS18	Digital Electronics Lab	0	0	2	1	PC
20MSS19	Employability Skills	0	0	2	1	EEC
	Total Credits				**22**	

Semester II

Course Code	Course Name	L	T	P	C	CAT
Theory						
	Language Elective	2	0	1	2	HS
20MSS21	Probability and Statistics - I	3	1	0	4	BS
20MSS22	Data Structures and Algorithms	3	1	0	4	PC
20MSS23	Fundamentals of Web Technology	3	0	0	3	PC
20MSS24	Object Oriented Programming	3	0	0	3	PC
Practicals						
20MSS25	Web Application Development Laboratory	0	0	4	2	PC
20MSS26	Data Structures and Algorithms Laboratory	0	0	4	2	PC
20MSS27	Object Oriented Programming Laboratory	0	0	4	2	PC
20MSS28	English for Employability	0	0	2	1	EEC
	Total Credits				**23**	

Semester III

Course Code	Course Name	L	T	P	C	CAT
Theory						

20MSS31	Theoretical Computer Science	3	0	0	3	BS
20MSS32	Probability and Statistics – II	3	1	0	4	BS
20MSS33	Advanced Data Structures	3	0	0	3	PC
20MSS34	Computer Architecture	3	0	0	3	PC
20MSS35	Operating Systems	3	0	0	3	PC
Practicals						
20MSS36	Python Programming Lab	0	0	4	2	PC
20MSS37	Advanced Data Structures Lab	0	0	4	2	PC
20MSS38	Operating Systems Lab	0	0	4	2	PC
	Total Credits				**22**	

Semester IV

Course Code	**Course Name**	**L**	**T**	**P**	**C**	**CAT**
Theory						
20MSS41	Resource Management Techniques	3	0	0	3	BS
20MSS42	Microprocessors and Microcontrollers	3	0	0	3	PC
20MSS43	Software Engineering	3	0	0	3	PC
20MSS44	Database Management Systems	3	0	0	3	PC
20MSS45	Java Programming	3	0	0	3	PC
Practicals						
20MSS46	Microprocessors and Microcontrollers Lab	0	0	4	2	PC
20MSS47	Database Management Systems Lab	0	0	4	2	PC
20MSS48	Java Programming Lab	0	0	4	2	PC
20MSS49	Personality Development	0	0	2	1	EEC
	Total Credits				**22**	

Semester V

Course Code	**Course Name**	**L**	**T**	**P**	**C**	**CAT**
Theory						
20MSS51	Full Stack Application Development	3	0	0	3	PC
20MSS52	Computer Networks	3	0	0	3	PC
20MSS53	Design and Analysis of Algorithms	3	1	0	4	PC
20MSS54	Machine Learning	3	0	0	3	PC
	Elective I	3	0	0	3	PC
Practicals						
20MSS55	Full Stack Application Development Lab	0	0	4	2	PC
20MSS56	Network Programming Lab	0	0	4	2	PC
	Elective Lab I	0	0	4	2	PC
20MSS57	Communications Skills	0	0	2	1	EEC
	Total Credits				**23**	

Semester VI

Course Code	Course Name	L	T	P	C	CAT
Theory						
20MSS61	Software Testing and Quality Assurance	3	0	0	3	PC
20MSS62	Mobile Computing	3	0	0	3	PC
20MSS63	Cloud Computing	3	0	0	3	PC
20MSS64	Software Architecture	3	0	0	3	PC
	Elective II	3	0	0	3	PC
Practicals						
20MSS65	Software Engineering Lab	0	0	4	2	PC
20MSS66	Cloud and Mobile Application Development Lab	0	0	4	2	PC
	Elective Lab II	0	0	4	2	PC
20MSS67	Hackathon	0	0	2	1	EEC
	Total Credits				**22**	

Semester VII

Course Code	Name	L	T	P	C	CAT
20MSS71	Project Work and Viva Voce-I	0	0	0	18	EEC
	TOTAL CREDITS				**18**	

Semester VIII

Course Code	Course Name	L	T	P	C	CAT
Theory						
20MSS81	Software Project Management	3	0	0	3	PC
20MSS82	Smart Sensors and Internet of Things	3	0	0	3	PC
20MSS83	Artificial Intelligence	3	0	0	3	PC
	Elective III	3	0	0	3	PC
	Elective IV	3	0	0	3	PC
Practicals						
20MSS84	Internet of Things Lab	0	0	4	2	PC
20MSS85	Artificial Intelligence Lab	0	0	4	2	PC
	Elective Lab III	0	0	4	2	PC
	Total Credits				**21**	

Semester IX

Course Code	Course Name	L	T	P	C	CAT
Theory						
20MSS91	Agile Methods for Software Development	3	0	0	3	PC
20MSS92	Information Security	3	0	0	3	PC
20MSS93	Professional Ethics	3	0	0	3	EEC
	Elective V	3	0	0	3	PC
	Elective VI	3	0	0	3	PC
Practicals						
20MSS94	Information Security Lab	0	0	4	2	PC
	Elective Lab IV	0	0	4	2	PC
	Elective Lab V	0	0	4	2	PC
	Total Credits				**21**	

Semester X

Course Code	Name	L	T	P	C	CAT
20MSS101	Project Work and Viva Voce-II	0	**0**	**0**	**18**	**EEC**
	TOTAL CREDITS				**18**	
	GRAND TOTAL OF CREDITS				**212**	

Elective Theory Courses

Subject code	Subject Name	L	T	P	C	CAT
	Distributed and Networked Systems Stream					
20MSSE01	SOA and Web Services	3	0	0	3	PE
20MSSE02	Distributed Computing	3	0	0	3	PE
20MSSE03	Parallel Computing	3	0	0	3	PE
20MSSE04	Blockchain Technologies	3	0	0	3	PE
	Data Analytics Stream					
20MSSE05	Big Data Architecture	3	0	0	3	PE
20MSSE06	Information Retrieval	3	0	0	3	PE
20MSSE07	Advanced Database Management Systems	3	0	0	3	PE
20MSSE08	Predictive Analytics	3	0	0	3	PE
20MSSE09	Data Mining	3	0	0	3	PE
	Intelligent Systems Stream					
20MSSE10	Computer Vision	3	0	0	3	PE
20MSSE11	Natural Language Processing	3	0	0	3	PE
20MSSE12	Meta-Heuristic Learning	3	0	0	3	PE
20MSSE13	Deep Learning	3	0	0	3	PE
20MSSE14	Decision Support Systems	3	0	0	3	PE
20MSSE15	Business Intelligence	3	0	0	3	PE
	General Stream					
20MSSE16	Virtual and Augmented Reality	3	0	0	3	PE
20MSSE17	Compiler Design	3	0	0	3	PE
20MSSE18	Software User Interface Design	3	0	0	3	PE
20MSSE19	Enterprise Application Development	3	0	0	3	PE
20MSSE20	Design Thinking	3	0	0	3	PE
20MSSE21	Business Process Management	3	0	0	3	PE
20MSSE22	Software Language Engineering	3	0	0	3	PE
20MSSE23	Accounting and Financial Management	3	0	0	3	PE
20MSSE24	Human Computer Interaction and Interface	3	0	0	3	PE
20MSSE25	Quantum Computing	3	0	0	3	PE
20MSSE26	Real Time Systems	3	0	0	3	PE

Elective Labs

Subject code	Subject Name	L	T	P	C	CAT
	Distributed and Networked System Stream					
20MSSL01	S0A and Web Services Lab	0	0	4	2	PE
20MSSL02	Parallel Computing Lab	0	0	4	2	PE
20MSSL03	Blockchain Technologies Lab	0	0	4	2	PE
	Data Analytics Stream					
20MSSL04	Data Mining Lab	0	0	4	2	PE
20MSSL05	Big Data Architecture Lab	0	0	4	2	PE
20MSSL06	Predictive Analytics Lab	0	0	4	2	PE
	Intelligent Systems Stream					
20MSSL07	Natural Language Processing Lab	0	0	4	2	PE
20MSSL08	Meta-Heuristic Learning Lab	0	0	4	2	PE
20MSSL09	Deep Learning Lab	0	0	4	2	PE
20MSSL10	Business Intelligence Lab	0	0	4	2	PE
20MSSL11	Computer Vision Lab	0	0	4	2	PE
20MSSL12	Machine Learning Lab	0	0	4	2	PE
	General Stream					
20MSSL13	Virtual and Augmented Reality Lab	0	0	4	2	PE
20MSSL14	Compiler Construction Lab	0	0	4	2	PE
20MSSL15	Enterprise Application Development Lab	0	0	4	2	PE
20MSSL16	Accounting and Financial Management Lab	0	0	4	2	PE
20MSSL17	Quantum Computing Lab	0	0	4	2	PE

20MSS19- EMPLOYABILITY SKILLS

Contact Hours

L	T	P	C
0	0	2	1

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOME

- *Given strictly timed objective questions on logical reasoning and verbal ability solve within the given time.*
- *For a given specific speaking task on topics like describing a picture, movie reviews, storytelling, and extempore generate ideas and speak confidently.*
- *For a given social situation viz., greeting, thanking, congratulating, apologizing and giving directions, demonstrate command over conversations using appropriate functional expressions.*
- *For a given 2 to5 minutes speaking activity like Extempore and Debate, produce language structures accurately and fluently. For a given technical topic, prepare a power point presentation for 15 minutes.*
- *Given short conversations and monologues for listening, specify appropriate responses and construct a summary. Construct dialogues for a given social scenario and interpret the given graphic information and write creative paragraphs.*

UNIT – 1

Self Introduction - Barriers to Speaking and Listening - Introduction to Spoken English, Greetings, Thanking - Apologizing, Congratulating - Giving Directions, Shopping – Role Play **(6)**

UNIT – 2

Activity based on newspaper articles - Word Building - A picture and a few words activity - Current Events. **(4)**

UNIT -3

Alphabet test – Alphabet Order, Alphabet Series - Letter Word Problem, Word Formation and Scramble - Series Completion –Para Jumbles- Synonyms and Antonyms- Types and Exercises- Sentence Completion –Types and Exercises. **(8)**

UNIT -4

Reading Comprehension- Skimming and Scanning - Reading Prose – Bacon's Essays (Speaking Activity based on the essays) - Story Building- Extempore - Movie Reviews. **(4)**

UNIT – 5

Speech Sounds - Word Vocabulary - Reading Comprehension - Listening Practice- I -Dialogue Writing - Conversational Exercise – I - Focus on Language - Creative Writing - Conversational Exercise – II - Listening Practice – II **(8)**

TOTAL: 30 Hours

20MSS28- ENGLISH FOR EMPLOYABILITY

Contact Hours

L	T	P	C
0	0	2	1

PRE-REQUISITES

Consent of the instructor

COURSE OUTCOME

- *Given strictly timed objective questions on logical sequence of words, sequential order of things, comparison, and sentence correction, solve within the given time.*
- *For a given specific speaking task on topics like JAM, Describing an object, book review and extempore generate ideas and speak confidently.*
- *For a given social situation viz., Travel and Transport, complaining, giving instructions, advising and sympathizing, requesting and warning people, communicate effectively to peer using appropriate functional language.*
- *For a given HR topic, generate valid points for and against the topic and present them with appropriate group behaviour. For any job requirement, plan and prepare a 20 min HR mock interview.*

UNIT – 1

Ice Breakers - Just a Minute - Book Reviews - Describing an object – Extempore Paraphrasing. (**6)**

UNIT – II

Spoken English - Travel and Transport, Complaining - Giving Instructions, Advising and Sympathizing – Requesting and warning people (**5)**

UNIT – III

Logical Sequence of Words- Exercises - Sequential Order of Things - Comparison Type Questions –Introduction and Exercises - Idioms and Phrases - Types and Exercises - Vocabulary through Mythology - One word Substitutes, Word Power Exercises - Common Errors in English - Sentence Correction (**7)**

UNIT – IV

Activity based on newspaper articles - Vocabulary – Homophones and Homonyms - Reading Prose –Reading Comprehension Activity (**4)**

UNIT – V

Professional Communication - Mock Group Discussion – Mock Interview – Telephoning Skills – Personality Development Activities. (**8)**

TOTAL: 30 Hours

20MSS49 - PERSONALITY DEVELOPMENT

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOME

- *Ascertain the various concepts of Self like the Physical Self – Energy Self – Intellectual Self – Mental Self – Blissful Self with respect to the Western(Occidental) and Eastern(Oriental) theories of the Self and Personality Development.*
- *Outline the significant effects of Self Confidence to build team confidence, given the foundation principles of Self-Motivation and Confidence.*
- *Assess the various personalities and Attitudes and choose the best attitude for making bold decisions in personal and professional contexts.*
- *Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.*
- *Set Career goals and formulate strategies by Prioritizing, organizing and scheduling the required tasks. Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.*

PERSONALITY DEVELOPMENT

One's Personality Sends Out a Signal That Others Read – Same Person: Consciously Different Personalities can be Powerful – There isn't One Right Personality; It Differs by Role – Learning about Personality Development from the Three Cases – Personality Analysis – Freudian Analysis of Personality Development – Swami Vivekananda's Concept of

Personality – Development: Physical Self – Energy Self – Intellectual Self – Mental Self – Blissful Self – Personality Begets. **(7)**

LEADERSHIP QUALITIES & INTERPERSONAL SKILLS

Resolving Conflict – A Smiling Face – Appreciative Attitude – Assertive Nature – Communication Skills – Listening Skills – Developing Empathy – The Personality Attribute of Taking Bold Decisions – Personality Types and Leadership Qualities – Mapping the Different Personality Types – Personality Tests: Example of a Personality Test: Jung Typology Test – Personality Assessment **(7)**

ETIQUETTE

Social Etiquette – Corporate Etiquette - Personal Grooming – Using minimal Body Language – Leadership and Entrepreneurship : Corporate Training – Professionalism - Self-awareness – Creativity skills – Cognitive Development – Assertiveness – Positive Thinking and Attitude. **(8)**

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 - TimeManagement –Identifying Time Wasters – Time Management Skills. **(8)**

Total: 30 Hours

REFERENCE BOOKS

1.Mitra K.Barun, “Personality Development and Soft Skills”, Oxford UniversityPress, 2011.

2.Krishna Mohan, Meera Banerji. “Developing Communication Skills” MacMillion Publishers, 2012.

3.Sai Lakshmi. B, “Poly Skills- A Course in Communication and Life Skills”Cambridge University Press, 2012.

4.Simon Sweeney, "English for Business Communication", Cambridge UniversityPress, 2013.

5.Meenakshi Raman, Sangeeta Sharma, "Technical Communication - Principlesand Practice", 3rd edition, Oxford University Press, New Delhi, 2015.

20MSS57 - COMMUNICATION SKILLS

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: PRACTICAL

COURSE OUTCOME

CO1 : Conceive appropriate verbal responses from the learners to a given social situation, using the guidelines to effective speaking skills and body language.
CO2 : Generate troubleshooting solutions to develop team building and interpersonal skills with case studies that focus on body language and empathy.
CO3 : Develop appropriate responses for business phone calls and formulate effective resolutions to professional conflicts that arise out of cross-cultural communication gaps in a given managerial context.
CO4 : Compose appropriate written responses to professional problems faced by a team at the workplace arising out of ineffective communication skills.
CO5 : Generate valid points for and against a HR topic and present them with appropriate group behavior. For any job requirement, plan and prepare for a 20 minute mock interview.

INTRODUCTION

Introduction – Code and Content – Stimulus and Response: Source – The Encoding Process – The Channel – The Decoding Process – The Receiver – Speaking Skills – Effective Speaking Guidelines – Communicating Soft Skills: A Self-assessment – Closing Tips **(4)**

SOFT SKILLS

Introduction to Soft Skills – Lessons from the Three Case Studies – Change in Today's Workplace: Soft Skills as a Competitive Weapon – Antiquity of Soft Skills – Classification of Soft Skills: Time Management - Attitude – Responsibility – Ethics, Integrity, Values and Trust – Self-confidence and Courage – Consistency and Predictability – Teamwork and Interpersonal Skills - Communication and Networking – Empathy and Listening Skills – Problem Solving, Troubleshooting and Speed reading – Leadership – Body Language. **(8)**

TELEPHONING SKILLS & NEGOTIATIONS

Preparing to make a telephone call – Receiving calls – Taking and leaving messages – Asking forand giving repetition – The secretarial barrier – Cross-cultural communication on the telephone – Fixing appointments – Changing arrangements – Ending a call – Cross-cultural communication on the telephone – Problem-solving on the telephone – Complaints – Negotiations: Types of negotiation – Preparation for a negotiation – Making an opening statement – Bargaining and making concessions – Accepting and confirming – Summarizing and looking ahead – Types of negotiator – Dealing with conflict - Rejecting – Ending the negotiation. **(8)**

WRITING SKILLS TO CREATE AN IMPRESSION

Introduction- Fifteen Principle to Increase Clarity in Communication – Edit-Edit-Edit: The Reader's Perspective – Clarity of Thought – Clarity of Text. **(3)**

SPEAKING

Job Interviews: Introduction - Types of Interviews – Planning and Preparing for an Interview

-Importance of body Language in Interview - Need for proper Articulation - Concluding an Interview - Telephonic or Video Interview - A Mock Interview - Group Discussion: Introduction

- Ability to Work as a Team – Communication Skills - Active Listening - Non-verbal Communication - Leadership and Assertiveness - Reasoning – Ability to Influence - Innovation. Creativity, and Lateral Thinking - Flexibility - Key Steps to Succeed in a Group Discussion - TheResponsibility of the First Speaker - Concluding the Discussion - Dos and Don'ts during a Group Discussion. **(7)**

Total : 30 Hours

REFERENCE BOOKS

1. *Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press,2011.*
2. *Krishna Mohan, Meera Banerji. "Developing Communication Skills" MacmillanPublishers, 2012.*
3. *Sai Lakshmi. B, "Poly Skills- A Course in Communication and Life Skills" CambridgeUniversity Press, 2012.*
4. *Simon Sweeney, "English for Business Communication", Cambridge University Press,2013.*
5. *Meenakshi Raman, Sangeeta Sharma, "Technical Communication - Principles andPractice", 3rd edition, Oxford University Press, New Delhi, 2015.*