

**M.Tech-CSE- Course Structure, w.e.f 2020-21****SEMESTER-I**

Cat.	Course Title	Contact Periods per week				Credits
		L	T	P	Total	
PC	Advanced Data Structures	3	0	0	3	3
PC	Advanced Database Management Systems	3	0	0	3	3
PE	Professional Elective I	3	0	0	3	3
PE	Professional Elective II	3	0	0	3	3
HS	Research Methodology and IPR	2	0	0	2	2
PC	Advanced Data Structures Lab	0	0	3	3	1.5
PC	Advanced Database Management Systems Lab	0	0	3	3	1.5
AC	Audit Course - I	2	0	0	2	0
SOC	Value added course/Certificate course I	0	0	0	0	1
	Activity Point Programme	During the Semester				
	Total	16	0	6	22	18

**SEMESTER-II**

Cat.	Course Title	Contact Periods per week				Credits
		L	T	P	Total	
PC	Data Science	3	0	0	3	3
PC	Advanced Operating Systems	3	0	0	3	3
PE	Professional Elective III	3	0	0	3	3
PE	Professional Elective IV	3	0	0	3	3
PC	Data Science Lab	0	0	3	3	1.5
PC	Advanced Operating Systems Lab	0	0	3	3	1.5
AC	Audit Course - II	2	0	0	2	0
EEC	Mini Project	0	0	4	4	2
SOC	Value added course/Certificate course II	0	0	0	0	1
	Activity Point Programme	During the Semester				
	Total	14	0	10	24	18

### SEMESTER-III

Cat.	Course Title	Contact Periods per week				Credits
		L	T	P	Total	
PE	Professional Elective V	3	0	0	3	3
OE	Open Elective	3	0	0	3	3
EEC	Teaching Assignment	-	-	-	-	2
PR	Project I	0	0	16	16	8
	Activity Point Programme	During the Semester				
	Total	6	0	16	22	16

### SEMESTER-IV

Cat.	Course Title	Contact Periods per week				Credits
		L	T	P	Total	
PR	Project II	0	0	32	32	16
	Activity Point Programme	During the Semester				
		0	0	32	32	16

## M.Tech Subjects and Syllabus approved in the BoS Meeting

S.No	Subjects for department of CSE	Year/Sem	Category
1	Advanced Data Structures	I Year I Sem	PC
2	Advanced Database Management Systems	I Year I Sem	PC
3	Research Methodology and IPR	I Year I Sem	HS
4	Advanced Data Structures Lab	I Year I Sem	PC
5	Advanced Database Management Systems Lab	I Year I Sem	PC
6	Data Science	I Year II Sem	PC
7	Advanced Operating Systems	I Year II Sem	PC
8	Data Science Lab	I Year II Sem	PC
9	Advanced Operating Systems Lab	I Year II Sem	PC
<b>Professional Electives</b>			
1	Machine Learning	I Year I Sem	PE
2	Advanced Computer Networks	I Year I Sem	PE
3	Introduction to Intelligent Systems	I Year I Sem	PE
4	Software Testing Methodologies	I Year I Sem	PE
5	Wireless Sensor Networks	I Year I Sem	PE
6	Object Oriented Software Engineering	I Year I Sem	PE
7	Internet of Things	I Year II Sem	PE
8	Secure Software Design & Enterprise Computing	I Year II Sem	PE
9	Computer Vision	I Year II Sem	PE
10	Full Stack Technologies	I Year II Sem	PE
11	Big Data Analytics	I Year II Sem	PE
12	Digital Forensics	I Year II Sem	PE
13	Mobile Applications and Services	II Year I Sem	PE
14	Deep Learning	II Year I Sem	PE
15	Optimization Techniques	II Year I Sem	PE
<b>Audit Courses</b>			
1	Business Analytics	II Year II Sem	OE
2	Industrial Safety	II Year II Sem	OE
3	Operations Research	II Year II Sem	OE
4	Cost Management of Engineering Projects	II Year II Sem	OE
5	Composite Materials	II Year II Sem	OE
6	Waste to Energy	II Year II Sem	OE



<b>S.No</b>	<b>Subjects for department of CSE</b>	<b>Year/Sem</b>	<b>Category</b>
1	Advanced Data Structures	I Year I Sem	PC
2	Advanced Database Management Systems	I Year I Sem	PC
3	Research Methodology and IPR	I Year I Sem	HS
4	Advanced Data Structures Lab	I Year I Sem	PC
5	Advanced Database Management Systems Lab	I Year I Sem	PC
6	Data Science	I Year II Sem	PC
7	Advanced Operating Systems	I Year II Sem	PC
8	Data Science Lab	I Year II Sem	PC
9	Advanced Operating Systems Lab	I Year II Sem	PC

## 1. ADVANCED DATA STRUCTURES

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

### **MODULE 1: -9H**

Algorithms, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big Oh, Omega and Theta notations, Complexity Analysis Examples. Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array representation, Linked representation, Vector representation, singly linked lists -insertion, deletion, search operations, doubly linked lists-insertion, deletion operations, circular lists. Representation of single, two dimensional arrays, sparse matrices and their representation.

### **MODULE 2: -8H**

Stack and Queue ADTs, array and linked list representations, infix to postfix conversion using stack, implementation of recursion, Circular queue-insertion and deletion, Dequeue ADT, array and linked list representations, Priority queue ADT.

### **MODULE 3: -7H**

Implementation using Heaps, Insertion into a Max Heap, Deletion from a Max Heap, java.util package-ArrayList, Linked List, Vector classes, Stacks and Queues in java.util, Iterators in java.util.

### **MODULE 4: -8H**

Searching-Linear and binary search methods, Hashing-Hash functions, Collision Resolution methods-Open Addressing, Chaining, Hashing in java.util-HashMap, HashSet, Hashtable. Sorting -Bubble sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort, comparison of sorting methods.

### **MODULE 5 -8H**

Trees- Ordinary and Binary trees terminology, Properties of Binary trees, Binary tree ADT, representations, recursive and non recursive traversals, Java code for traversals, Threaded binary trees. Graphs- Graphs terminology, Graph ADT, representations, graph traversals/search methods-dfs and bfs, Java code for graph traversals, Applications of Graphs-Minimum cost spanning tree using Kruskal's algorithm, Dijkstra's algorithm for Single Source Shortest Path Problem.

### **MODULE6 -8H**

Search trees- Binary search tree-Binary search tree ADT, insertion, deletion and searching operations, Balanced search trees, AVL trees-Definition and examples only, Red Black trees - Definition and examples only, B-Trees-definition, insertion and searching operations, Trees in java.util- TreeSet, Tree Map Classes, Tries(examples only),Comparison of Search trees.

### **Text Book(s):**

1. S. Sahni, Data structures, Algorithms and Applications in Java, Universities Press.
2. Adam Drozdek, Data structures and Algorithms in Java, 3<sup>rd</sup> edition, Cengage Learning.

### **Reference Book(s):**

1. R.Lafore, Data structures and Algorithms in Java, Pearson education.
2. J.P.Tremblay and G.A.Cheston, Data structures and Software Development in an Object-Oriented Domain, Pearson.

## 2. ADVANCED DATABASE MANAGEMENT SYSTEMS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

**MODULE-1: -9H**

**Enhanced entity-relationship and object modeling:** Subclasses, Super classes, and Inheritance, Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization, Modeling of UNION Types Using Categories, An Example university ER Schema and Formal Definitions for the ER Model, Conceptual Object Modeling Using UML Class Diagrams, Relationship Types of Degree Higher Than Two, Data Abstraction and Knowledge Representation Concepts, Relational Database Design Using ER-to-Relational Mapping, Mapping ER Model Concepts to Relations

**MODULE-2: -7H**

**Concepts for object-oriented databases:** Overview of Object-Oriented Concepts, Object Identity, Object Structure, and Type Constructors, Encapsulation of Operations, Methods, and Persistence, Type Hierarchies and Inheritance.

**MODULE-3: -8H**

Overview of the Object Model of ODMG, The Object Definition Language Object-Relational Features of Oracle, An Overview of SQL3, Implementation and Related Issues for Extended Type Systems, The Nested Relational Data Model.

**MODULE-4: -8H**

**Storage and indexing:** Overview of storage and indexing - Data on External Storage, File organizations and Indexing, Index Data Structures, Comparison of File Organizations. Storing data: disks and files - The Memory Hierarchy, Redundant Arrays of Independent Disks, Disk Space Management, Buffer Manager, Files of Records, Page Formats, Record Formats.

**MODULE-5: -8H**

**Tree - hash indexing:** Tree - structured indexing - Intuition For Tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete, Duplicates, B+ Trees in Practice.

**MODULE-6: -8H**

**Hash-based indexing** - Static Hashing, Extendible Hashing, Linear Hashing, Extendible vs. Linear Hashing.

**Text Book(s):**

1. Elmasri & Navathe, Fundamentals of Database Systems (Third edition) by –Pearson Education
2. Raghuram Ramakrishna and J. Gehrke, Database Management System (III Edition)

**Reference Book(s):**

1. Silber Schatz, Korth G. Sudarshan, Database system concepts (iv edition).
2. R.P. Mahapatra & Govind Verma, 2016, Database Management Systems, Khanna Publishing House.
3. Carlos Coronel and Steven Morris, Database Systems: Design, Implementation, and Management, 12<sup>th</sup> edition, 2016, Cengage Learning.
4. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, Database System Implementation, Pearson Education, United States, 1<sup>st</sup> Edition, 2000.

### 3. RESEARCH METHODOLOGY AND IPR

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	2	0	0	32	2	40	60	100

**MODULE 1: -6H**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**MODULE 2: -5H**

Effective literature studies approach, analysis Plagiarism, Research ethics,

**MODULE 3: -5H**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**MODULE 4: -6H**

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, Patenting under PCT.

**MODULE 5: -5H**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**MODULE 6: -5H**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**Text Book(s):**

1. Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students,
2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction,

**Reference Book(s):**

1. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, 2<sup>nd</sup> Edition
2. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd, 2007.
3. Robert P. Merges, Peter S. Menell, Mark A, Intellectual Property in New Technological Age, Lemley, 2016.

#### 4. ADVANCED DATA STRUCTURE LAB

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100

#### List of Programs:

- Task 1:** -3h  
1. Write a program to implement the following using an array.  
a) Stack ADT b) Queue ADT
- Task 2:** -3h  
2. Write a program to implement the following using a singly linked list.  
a) Stack ADT b) Queue ADT
- Task 3:** -3h  
3. Implement the deque (double ended queue) ADT using a doubly linked list
- Task 4:** -6h  
4. Create a Program to perform the following operations.  
a) Insert an element into a binary search tree.  
b) Delete an element from a binary search tree.  
c) Search for a key element in a binary search tree.
- Task 5:** -3h  
5. Design a program to implement circular queue ADT using an array.
- Task 6:** -6h  
6. Write a program that traverse the given binary tree in.  
a) Preorder                      b) Inorder and                      c) Postorder.
- Task 7:** -6h  
7. implementation of BFS and DFS for a given graph.
- Task 8:** -6h  
8. Write programs for implementing the following sorting methods.  
a) Quick sort                      b) Merge sort                      c) Heap sort  
d) Selection sort                      e) Exchange sort                      f) Insertion sort.
- Task 9:** -3h  
9. Write a program to perform the following operations.  
a) Insertion into a 2-3 tree                      b) Deletion from a 2-3 tree
- Task 10:** -3h  
10. Create a program which uses indexing on railway reservation system
- Task 11:** -3h  
11. Implement conversion of infix expressions to post fix notation simple expression evaluator that can handle +, -, /, \*.
- Task 12:** -3h  
12. Implement all String Operations using Linked lists.



**Additional Experiments:****Task 1:**

1. Implement Polynomial Operations using Linked lists.

**Task 2:**

- 2 write a program to create a RED-BLACK tree.

**Text Book(s):**

1. S. Sahni, Data structures, Algorithms and Applications in Java, Universities Press.
2. Adam Drozdek, Data structures and Algorithms in Java, 3<sup>rd</sup> edition, Cengage Learning.

**Reference Book(s):**

1. R.Lafore, Data structures and Algorithms in Java, Pearson education.
2. J.P.Tremblay and G.A.Cheston, Data structures and Software Development in an Object-Oriented Domain, Pearson.

## 5. ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100

### List of Programs:

- Task 1:** -6h  
Design a Table for Library information System using Object Data Base Concept.
- Task 2:** -6h  
Create a Nested Table for Exam Results processing using the Concept of Nested Tables.
- Task 3:** -6h  
Implement the concept of functions to Display top Five Ranks in each branch.
- Task 4:** -6h  
Create a Trigger to avoid INSERT/DELETE/UPDATE operations on Results table.
- Task 5:** -6h  
Design a Trigger that handles operations on a Bank Data Base so that DML operations should work between 10:00 AM to 5:00 PM only. System should not accept query on SUNDAY.
- Task 6:** -6h  
Implement Stored Procedure Concept to generate Employee payslip.
- Task 7:** -6h  
Generate a Report of Student results in all the subjects using Reporting commands.
- Task 8:** -6h  
Upload the materials prepared by the Faculty into Notes Tables by using BFILE.

### Additional Experiments:

- Task 1:**  
Create a Student data base which should contains the student Image by using BLOB.
- Task 2:**  
Write a PL/SQL Procedure for Exception Handling for marks processing.

### Text Book(s):

1. Elmasri&Navathe, Fundamentals of Database Systems (Third edition),Pearson Education
2. Raghu Ramakrishna and J.Gehrke, Database Management System (III Edition)

### Reference Book(s):

1. Silber Schatz, Korth G. Sudarshan,Database system concepts (iv edition)
2. R.P. Mahapatra & Govind Verma, Database Management Systems, 2016, Khanna Publishing House.
3. Carlos Coronel and Steven Morris,Database Systems: Design, Implementation, and Management, 12<sup>th</sup>edition, 2016, Cengage Learning.
4. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, Database System Implementation, Pearson Education, United States, 1<sup>st</sup>Edition, 2000.

## 6. DATA SCIENCE

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

### **MODULE1: -8H**

PYTHON Basics and Programming Concepts: Introducing Python, Types and Operations - Numbers, Strings, Lists, Tuples, Dictionaries, Files, Numeric Types, Dynamic Typing; Statements and Syntax - Assignments, Expressions, Statements, Loops, iterations, comprehensions; Functions - Function Basics, Scopes, Arguments, Advanced Functions; Modules - Module Coding Basics, Module Packages, Advanced Module Topics;

### **MODULE 2: -8H**

Classes and OOP - Class, Operator Overloading, Class Designing; Exceptions and Tools - Exception Basics, Exception Coding Details, Exception Objects, Designing With Exceptions, Parallel System Tools

### **MODULE 3: -9H**

GUI Programming: Graphical User Interface - Python gui development options, Adding Widgets, GUI Coding Techniques, Customizing Widgets; Internet Programming - Network Scripting, Client-Side scripting, Pymailgui client, server-side scripting, Pymailcgi server; Tools and Techniques -databases and persistence, data structures, text and language, python/c integration

### **MODULE 4: -8H**

Pandas and NumPy: Numpy Basics - Fast Element wise array functions, Multidimensional Array, Data Processing using arrays, file i/o with arrays; Pandas - Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data, Hierarchical Indexing

### **MODULE 5: -7H**

Data Preprocessing: Data Loading, Storage, and FileFormats - Reading and Writing data in text format, binary data formats, interacting with html and web apis, interacting with databases;

### **MODULE 6: -8H**

Data Wrangling: Clean, Transform, Merge, Reshape - Combining and Merging Data Sets, Reshaping and Pivoting, Data Transformation, String Manipulation; Data Aggregation and Group Operations – Group by Mechanics, Data Aggregation, Groupby Operations and and Transformations, Pivot Tables and Cross-Tabulation

### **Text Book(s):**

1. Mark Lutz, Learning Python ,OReilly.
2. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education

### **Reference Book(s):**

1. Wes Mckinney, Python For Data Analysis, O Reilly.
2. Mark Lutz, Programming Python, OReilly.
3. Paul Barry, Head First Python, O'Reilly

## 7. ADVANCED OPERATING SYSTEMS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

### MODULE-1

-8H

Architectures of Distributed Systems, System Architecture types, issues in distributed operating systems, communication networks, communication primitives. Theoretical Foundations, inherent limitations of a distributed system, lamp ports logical clocks, vector clocks, casual ordering of messages, global state, cuts of a distributed computation, termination detection. Distributed Mutual Exclusion, introduction, the classification of mutual exclusion and associated algorithms, a comparative performance analysis.

### MODULE-2

-8H

Distributed Deadlock Detection, Introduction, deadlock handling strategies in distributed systems, issues in deadlock detection and resolution, control organizations for distributed deadlock detection, centralized and distributed deadlock detection algorithms, hierarchical deadlock detection algorithms. Agreement protocols, introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, and applications of agreement algorithms. Distributed resource management: introduction-architecture, mechanism for building distributed file systems design issues, log structured file systems.

### MODULE-3

-8H

Distributed shared memory, Architecture, algorithms for implementing DSM, memory coherence and protocols, design issues. Distributed Scheduling, introduction, issues in load distributing, components of a load distributing algorithm, stability, load distributing algorithm, performance comparison, selecting a suitable load sharing algorithm, requirements for load distributing, task migration and associated issues. Failure Recovery and Fault tolerance: introduction, basic concepts, classification of failures, backward and forward error recovery, backward error recovery, recovery in concurrent systems, consistent set of check points, synchronous and asynchronous check pointing and recovery, check pointing for distributed database systems, recovery in replicated distributed databases.

### MODULE-4

-8H

Protection and security, preliminaries, the access matrix model and its implementations.-safety in matrix model, advanced models of protection. Data security, cryptography: Model of cryptography, conventional cryptography modern cryptography, private key cryptography, data encryption standard public key cryptography, multiple encryptions, authentication in distributed systems.

### MODULE-5

-8H

Multiprocessor operating systems, basic multiprocessor system architectures, inter connection networks for multiprocessor systems, caching hypercube architecture. Multiprocessor Operating System, structures of multiprocessor operating system, operating system design issues, threads, process synchronization and scheduling.

### MODULE-6

-8H

Database Operating systems: Introduction, requirements of a database operating system Concurrency control :Theoretical aspects, introduction, database systems, a concurrency control model of database systems, the problem of concurrency control, serializability theory, distributed database systems, concurrency control algorithms, introduction, basic synchronization primitives, lock based algorithms, timestamp based algorithms, optimistic algorithms, concurrency control algorithms, data replication.

**Text Book(s):**

1. Mukesh Singhal, Niranjana and G.Shivaratri, Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems, TMH, 2001
2. Andrew S.Tanenbaum, Modern operating system, PHI, 2003

**Reference Book(s):**

1. Pradeep K.Sinha, Distributed operating system-Concepts and design, PHI, 2003
2. Andrew S.Tanenbaum, Distributed operating system, Pearson education, 2003

## 8. DATA SCIENCE LAB

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	0	0	3	48	1.5	40	60	100

### List of Experiments:

<b>Task 1:</b> Write a Python Program to Split the array and add the first part to the end	<b>-6h</b>
<b>Task 2:</b> Write a Python Program to Create a List of Tuples with the First Element as the Number and Second Element as the Square of the Number	<b>-3h</b>
<b>Task 3:</b> Write a program to implement permutation of a given string using inbuilt function.	<b>-3h</b>
<b>Task 4:</b> Write a python program to sort list of dictionaries by values in Python – Using lambda function.	<b>-6h</b>
<b>Task 5:</b> Write a Python Program to Reverse a String Using Recursion	<b>-3h</b>
<b>Task 6:</b> Write a Python Program to Count the Number of Words in a Text File	<b>-6h</b>
<b>Task 7:</b> Write a Python Program to Read the Contents of a File in Reverse Order	<b>-6h</b>
<b>Task 8:</b> Write a program to Merge and Join DataFrames with Pandas in Python	<b>-3h</b>
<b>Task 9:</b> Write a program to implement Merge and Join DataFrames with Python Pandas	<b>-6h</b>
<b>Task 10:</b> Write a Python Program to Append the Contents of One File to Another File	<b>-6h</b>

### Additional Experiments:

<b>Task 1:</b> How to install and Load CSV files to Python Pandas	
<b>Task 2:</b> Write a program to implement Data analysis and Visualization with Python using pandas.	
<b>Task 3:</b> Write a program to Implement Plotting Functions in python pandas.	

### Text Book(s):

1. Mark Lutz, Learning Python, O'Reilly.
2. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education

### Reference Book(s):

1. Wes McKinney, Python For Data Analysis, O'Reilly.
2. Mark Lutz, Programming Python, O'Reilly.
3. Paul Barry, Head First Python, O'Reilly

## 9. ADVANCED OPERATING SYSTEMS LAB

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	0	0	3	48	1.5	40	60	100

### List of Experiments:

- Task 1:** -6h  
Simulate the following CPU scheduling algorithms  
a) Round Robin b) SJF c) FCFS d) Priority.
- Task 2:** -6h  
Simulate all file allocation strategies  
a) Sequential b) Indexed c) Linked.
- Task 3:** -6h  
Implement process strategies: creation of child, zombie, orphan process.
- Task 4:** -6h  
Implement file organization strategies  
a) single level b) Two level c) Hierarchical.
- Task 5:** -6h  
Simulate Bankers Algorithm for Dead Lock Avoidance.
- Task 6:** -6h  
Simulate Bankers Algorithm for Dead Lock Prevention.
- Task 7:** -6h  
Simulate all page replacement algorithms  
a)FIFO b) LRU c) LFU
- Task 8:** -6h  
Implement shared memory and semaphore concepts for inter process communication.

### Text Book(s):

1. Mukesh Singhal, Niranjana and G.Shivaratri, Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems, TMH, 2001
2. Andrew S.Tanenbaum, PHI, Modern operating system, 2003

### Reference Book(s):

1. Pradeep K.Sinha, Distributed operating system-Concepts and design, PHI, 2003
2. Andrew S.Tanenbaum, Distributed operating system, Pearson education, 2003
3. Andrew S. Tanenbaum, Distributed Operating System, 1st Edition, PHI, 1994



S.No	BoS Subjects from department of CSE	Year/Sem	Category
<b>Professional Electives</b>			
1	Machine Learning	I Year I Sem	PE
2	Advanced Computer Networks	I Year I Sem	PE
3	Introduction to Intelligent Systems	I Year I Sem	PE
4	Software Testing Methodologies	I Year I Sem	PE
5	Wireless Sensor Networks	I Year I Sem	PE
6	Object Oriented Software Engineering	I Year I Sem	PE
7	Internet of Things	I Year II Sem	PE
8	Secure Software Design & Enterprise Computing	I Year II Sem	PE
9	Computer Vision	I Year II Sem	PE
10	Full Stack Technologies	I Year II Sem	PE
11	Big Data Analytics	I Year II Sem	PE
12	Digital Forensics	I Year II Sem	PE
13	Mobile Applications and Services	II Year I Sem	PE
14	Deep Learning	II Year I Sem	PE
15	Optimization Techniques	II Year I Sem	PE



## 1. MACHINE LEARNING

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

### **MODULE 1: -8H**

#### **Supervised Learning (Regression/Classification)**

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, NaiveBayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

### **MODULE 2: -8H**

#### **Unsupervised Learning**

Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

### **MODULE 3 -7H**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

### **MODULE 4 -8H**

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

### **MODULE 5 -9H**

Scalable Machine Learning (Online and Distributed Learning), A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

### **MODULE 6: -8H**

Recent trends in various learning techniques of machine learning and classification methods for IOT applications, various models for IOT applications.

#### **Text Book(s):**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009.

#### **Reference Book(s):**

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

## 2. ADVANCED COMPUTER NETWORKS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

**MODULE 1: -7H**

Network layer: Network Layer design issues: store-and forward packet switching, services provided transport layers, implementation connection less services, implementation connection oriented services, comparison of virtual –circuit and datagram subnets,

**MODULE 2: -9H**

Routing Algorithms-shortest path routing, flooding, distance vector routing, link state routing, Hierarchical routing, congestion control algorithms :Approaches to congestion control, Traffic aware routing, Admission control, Traffic throttling, choke Packets, Load shedding, Random early detection, Quality of Service, Application requirements, Traffic shaping, Leaky and Token buckets

**MODULE 3: -8H**

Internetworking and IP protocols: How networks differ, How net works can be connected, internetworking, tunneling, The network layer in the internet,IPV4 Protocol, IP addresses, Subnets, CIDR, classful and Special addressing, network address translation (NAT),IPV6 Address structure address space, IPV6 Advantages, packet format, extension Headers, Transition from IPV4 to IPV6 , Internet Control Protocols-IMCP, ARP, DHCP

**MODULE 4: -8H**

Transport Layer Protocols: Introduction, Services, Port numbers, User Datagram Protocol: User datagram, UDP services, UDP Applications, Transmission control Protocol: TCP services, TCP features, Segment, A TCP connection, State transition diagram, Windows in TCP, Flow control and error control, TCP Congestion control, TCP Timers, SCTP: SCTP services SCTP features, packet format, An SCTP association, flow control, error control.

**MODULE 5: -8H**

Wireless LANS: Introduction, Architectural comparison, Access control, The IEEE 802.11 Project: Architecture, MAC sub layer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Bluetooth Layers Other Wireless Networks: WIMAX: Services, IEEE project 802.16, Layers in project 802.16, Cellular Telephony: Operations, First Generation (1G), Second Generation (2G), Third Generation (3G), Fourth Generation (4G), Satellite Networks: Operation, GEO Satellites, MEO satellites, LEO satellites.

**MODULE 6: -8H**

Mobile computing: Motivation for mobile computing, Protocol stack issues in mobile computing environment, mobility issues in mobile computing, security issues in mobile networks, MOBILE Ad Hoc Networks: Applications of Ad Hoc Networks, Challenges and Issues in MANETS, MAC Layer Issues Routing Protocols in MANET, Transport Layer Issues, Ad hoc Network Security.

**Text Book(s):**

1. Behrouz A Fourzan,Data communications and networking 4th edition TMH
2. Andrew S Tanenbaum, Computer networks 4th edition Pearson

**Reference Book(s):**

1. Mayank Dave, Computer networks, CENGAGE
2. Larry L Peterson and Bruce S Davie,Computer networks, A system Approach, 5th ed, Elsevier

### 3. INTRODUCTION TO INTELLIGENT SYSTEMS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

**MODULE 1: -7H**

Biological foundations to intelligent systems I: Artificial neural networks, Back- propagation networks, Radial basis function networks, and recurrent networks.

**MODULE 2: -7H**

Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

**MODULE 3: -9H**

Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill- climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

**MODULE 4: -9H**

Knowledge representation and logical inference Issues in knowledge representation. Structured representation such as frames and scripts, semantic networks and conceptual graphs, Formal logic and logical inference, Knowledge-based systems structures, its basic components, Ideas of Blackboard architectures.

**MODULE 5: -8H**

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning,

**MODULE 6: -8H**

A study of different learning and evolutionary algorithms, such as statistical learning and induction learning. Recent trends in Fuzzy logic, Knowledge Representation

**Text Book(s):**

1. Luger G.F. and Stubblefield W.A. (2008), Addison Wesley, Artificial Intelligence: Structures and strategies for Complex Problem Solving, 6th edition.
2. Russell S. and Norvig P. Artificial Intelligence: A Modern Approach, (2009). Prentice-Hall, 3rd edition.

**Reference Book(s):**

1. Saroj Kaushik, Artificial Intelligence- CENGAGE Learning,
2. Stuart Russel, Peter Norvig, Artificial intelligence: A modern Approach, 2nd ed, PEA

#### 4. SOFTWARE TESTING METHODOLOGIES

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

**MODULE 1: -9H**

Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and Path testing:- Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

**MODULE 2: -7H**

transaction flows, transaction flow testing techniques.

Dataflow testing:- Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

**MODULE 3: -8H**

domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

**MODULE 4: -8H**

Paths, Path products and Regular expressions- path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

Logic Based Testing:- overview, decision tables, path expressions, kv charts, specifications.

**MODULE 5: -8H**

State, State Graphs and Transition testing- state graphs, good & bad state graphs, state testing, Testability tips.

**MODULE 6: -8H**

Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. Introduction to a tool like JMeter or Win-runner.

**Text Book(s):**

1. Boris Beizer, Software Testing techniques –Dreamtech, second edition.
2. Dr.K.V.K.K.Prasad, Software Testing Tools –Dreamtech.

**Reference Book(s):**

1. N.Chauhan, Software Testing, Oxford University Press.
2. P.Ammann&J.Offutt, Introduction to Software Testing, Cambridge Univ.Press.
3. John Wiley, Effective methods of Software Testing, Perry, 2nd Edition, 1999.
4. P.Nageswara Rao, Software Testing Concepts and Tools, dreamtech Press.
5. M.G.Limaye, Software Testing, TMH.
6. S.Desikan, G.Ramesh, Software Testing, Pearson.
7. D.Graham& Others Foundations of Software Testing, Ceng

## 5. WIRELESS SENSOR NETWORKS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

**MODULE 1: -8H**

Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors

Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture

Hardware Platforms: Motes, Hardware parameters

**MODULE 2: -7H**

Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

**MODULE 3: -9H**

Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled

Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis

MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)

**MODULE 4: -8H**

Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution

**MODULE 5: -8H**

Routing protocols: Introduction, MANET protocols

Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast

Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain)

Advanced topics in wireless sensor networks.

**MODULE 6: -8H**

ADVANCED TOPICS: Recent development in WSN standards, software applications

**Text Book(s):**

1. W. Dargie and C. Poellabauer, Fundamentals of Wireless Sensor Networks –Theory and Practice, Wiley2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, wireless sensor networks -Technology, Protocols, and Applications, Wiley Interscience2007

**Reference Book(s):**

1. Takahiro Hara, Vladimir I. Zadorozhny, and Erik Buchmann, Wireless Sensor Network Technologies for the Information Explosion Era, springer2010

## **6. OBJECT ORIENTED SOFTWARE ENGINEERING**

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

**MODULE 1: -8H**

Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges.

**MODULE 2: -7H**

Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models, Process, use, applicability and Advantages/limitations.

**MODULE 3: -9H**

Object oriented Paradigm, Object oriented Concepts, Classes, Objects, Attributes, Methods and services, Messages, Encapsulation, Inheritance, Polymorphism, Identifying the elements of object model, management of object-oriented Software projects, Object Oriented Analysis, Domain Analysis, Generic Components of OOA model, OOA Process, Object Relationship model, Object Behavior Model.

**MODULE 4: -8H**

Object Oriented Design: Design for Object- Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Design Patterns, Object Oriented Programming.

**MODULE 5: -8H**

Object Oriented testing: Broadening the view of Testing, Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software, testing methods applicable at the class level, Interclass test case design.

**MODULE 6: -8H**

Technical Metrics for Object Oriented Systems: The Intent of Object-Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented metrics, Operation-Oriented Metrics, Metrics for Object Oriented testing, Metrics for Object Oriented projects. CASE Tools.

**Text Book(s):**

1. Stephen R. Schach, Object oriented and Classical Software Engineering, 7/e,
2. Timothy Lethbridge, Object oriented and Classical Software Engineering,

**Reference Book(s):**

1. Robert Laganier, Software Engineering by Roger S Pressman, Tata McGraw Hill Edition. TMH. TMH.
2. Ivica Crnkovic, Component based software engineering: 7th International symposium, Springer, CBSE 2004

## 7. INTERNET OF THINGS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

### **MODULE 1: -8H**

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples OF IoTs, Design Principles For Connected Devices. Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

### **MODULE 2: -8H**

Business Models for Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High-level capabilities, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability

### **MODULE 3: -8H**

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

### **MODULE 4: -8H**

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/Services/Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

### **MODULE 5: -8H**

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform,Everything as a service and Cloud Service Models,

### **MODULE 6: 8H**

IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.

### **Text Book(s):**

1. Rajkamal, Internet of Things: Architecture, Design Principles And Applications, McGraw Hill Higher Education
2. A.Bahgya and V.Madisetti, Internet of Things, Univesity Press, 2015

### **Reference Book(s):**

1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley
2. CunoPfister ,Getting Started with the Internet of Things Oreilly.

## 8. SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

### **MODULE 1: -8H**

#### **Secure Software Design**

Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

### **MODULE 2: -9H**

#### **Enterprise Application Development**

Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprisesystem, Present software solution.

### **MODULE 3: -8H**

#### **Enterprise Systems Administration**

Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/ DHCP/ Terminal Services/ Clustering/ Web/Email).

### **MODULE 4: -8H**

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

### **MODULE 5: -8H**

Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum vulnerabilities andflaws.

### **MODULE 6: -7H**

Case study of DNS server, DHCP configuration and SQL injection attack.

#### **Text Book(s):**

1. Theodor Richardson, Charles N Thies,Secure Software Design,Jones &Bartlett Pub.
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security,AddisonWesley.

#### **Reference Book(s):**

1. Julia H. Allen, Software Security Engineering: Pearson Education



## 9. COMPUTER VISION

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

**MODULE 1: -8H**

Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis

**MODULE 2: -8H**

Edge detection, Edge detection performance, Hough transform, corner detection

**MODULE 3: -7H**

Segmentation, Morphological filtering, Fourier transform

**MODULE 4: -8H**

Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing

**MODULE 5: -10H**

Pattern Analysis: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, and Non-parametric methods.

**MODULE 6: -7H**

Recent trends in Activity Recognition, computational photography, Biometrics.

**Text Book(s):**

1. RichardSzeliski, Computer Vision: Algorithms and Applications
2. Goodfellow, Bengio, andCourville, Deep Learning

**Reference Book(s):**

1. Fisher, Dictionary of Computer Vision and Image Processing.

## 10. FULL STACK TECHNOLOGIES

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

### **MODULE 1: -8H**

HTML - Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers. Markup Languages: XHTML an Introduction to HTML, History, Versions, Basic, XHTML Syntax and Semantics Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-HTML 5.0.

### **MODULE 2: -8H**

Cascading Style Sheets (CSS) - Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML- Style Rule Cascading and Inheritance-Text Properties-Box Model Normal Flow Box Layout beyond the Normal Flow-CSS3.0, Boot strap basics, Boot strap CSS3, Introduction to Java Script, Jscript basics, JScripts objects, JSON, Don.

### **MODULE 3: -8H**

Jscript - Separating Programming and Presentation: JSP Technology, Introduction to JSP and Servlets-Running JSP Applications, Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm- Mongo DB, JQuery, Mean stack Fundamentals

### **MODULE 4: -8H**

Angular Js - Introducing AngularJS, Starting Out with AngularJS, Basic AngularJS, Directives and Controllers, AngularJS Modules, Creating First Controller, working with and Displaying, Arrays, more Directives, working with ng-repeat, unit Testing in AngularJS,

### **MODULE 5: -8H**

Forms, Inputs, and Services, Working with ng-model, Working with Forms, Leverage Data-Binding and Models, Form Validation and States, Error Handling with Forms, ngModelOptions, Nested Forms with ng-form, Other Form Controls.

### **MODULE 6: -8H**

React JS - Introduction to React, Obstacles and Roadblocks, keeping Up with the Changes, Working with the Files, Pure React, Page Setup, The Virtual DOM, React Elements, ReactDOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories.

### **Text Book(s):**

1. Jeffrey C. Jackson, Web Technologies--A Computer Science Perspective, Pearson Education, 2006
2. Robert. W. Sebesta, Programming the World Wide Web, Fourth Edition, Pearson Education, 2007

### **Reference Book(s):**

1. Brad Green, Shyam Seshadri,AngularJS: Up and Running Enhanced Productivity with Structured Web Apps By Publisher: O'Reilly Media
2. Alex Banks, Eve Porcello,Learning React Functional Web Development with React and Redux By Publisher: O'Reilly Media
3. Bert Bates, Kathy Sierra,Head First Java, 2nd Edition, Publisher: O'Reilly Media, Inc

## 11. BIG DATA ANALYTICS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

### **MODULE 1: -8H**

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

### **MODULE 2: -8H**

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer- peer replication, sharding and replication, consistency, relaxing consistency, version stamps, Working with Cassandra, Table creation, loading and reading data.

### **MODULE 3: -8H**

Data formats, analyzing data with Hadoop, scaling out, Architecture of Hadoop distributed file system (HDFS), fault tolerance ,with data replication, High availability, Data locality , Map Reduce Architecture, Process flow, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization. Introduction to Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, Logical joins, Window functions, Optimization, Table partitioning, Bucketing, Indexing, Join strategies.

### **MODULE 4: -8H**

Apache spark- Advantages over Hadoop, lazy evaluation, In memory processing, DAG, Spark context, Spark Session, RDD, Transformations- Narrow and Wide, Actions, Data frames ,RDD to Data frames, Catalyst optimizer, Data Frame Transformations, Working with Dates and Timestamps, Working with Nulls in Data, Working with Complex Types,

### **MODULE 5: -8H**

Working with JSON, Grouping, Window Functions, Joins, Data Sources, Broadcast Variables, Accumulators, Deploying Spark- On-Premises Cluster Deployments, Cluster Managers- Standalone Mode, Spark on YARN , Spark Logs, The Spark UI- Spark UI History Server, Debugging and Spark First Aid

### **MODULE 6: -8H**

Spark-Performance Tuning, Stream Processing Fundamentals, Event-Time and State full Processing - Event Time, State full Processing, Windows on Event Time- Tumbling Windows, Handling Late Data with Watermarks, Dropping Duplicates in a Stream, Structured Streaming Basics - Core Concepts, Structured Streaming in Action, Transformations on Streams, Input and Output.

### **Text Book(s):**

1. Michael Minnelli, Michelle Chambers, and Ambiga Dhiraj, Big Data, Big Analytics: Emerging,
2. Bill Chambers & Matei Zaharia, SPARK: The Definitive Guide, O'Reilley, 2018 Edition

**Reference Book(s):**

1. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
2. P. J. Sadalage and M. Fowler, NoSQL Distilled: A Brief Guide to the Emerging World Polyglot Persistence, Addison-Wesley Professional, 2012
3. Tom White,Hadoop: The Definitive Guide, Third Edition, O'Reilley, 2012

## 12. DIGITAL FORENSICS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

**MODULE 1: -8H**

Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics

**MODULE 2: -8H**

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

**MODULE 3: -9H**

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

**MODULE 4: -8H**

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation and complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

**MODULE 5: -8H**

Mobile Forensics: mobile forensics techniques, mobile forensics tools.  
Legal Aspectsof Digital Forensics:IT Act 2000, amendment of IT Act 2008.

**MODULE 6: -7H**

Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

**Text Book(s):**

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

**Reference Book(s):**

1. Nihad A. Hassan, Digital Forensics Basics: A Practical Guide Using Windows OS Paperback, February 26, 2019.
2. Nelson Phillips and Enfinger Steuart, Computer Forensics and Investigations, Cengage Learning, New Delhi, 2009.

### 13. MOBILE APPLICATIONS AND SERVICES

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

**MODULE 1: -8H**

Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User.

**MODULE 2: -9H**

More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

**MODULE 3: -8H**

Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony. Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics

**MODULE 4: -8H**

Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android. Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia.

**MODULE 5: -8H**

Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, More on Security, Hacking Android.

**MODULE 6: -7H**

Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT

**Text Book(s):**

1. Asoke K Telukder, Roopa R Yavagal, Mobile Computing Technology, Applications and service creation, TMH.
2. Raj Kamal, Mobile Computing, Oxford University Press

**Reference Book(s):**

1. William Stallings, Wireless Communications & Networks, Second Edition, Pearson
2. Kumkum Garg- Mobile Computing Theory and Practice- Pearson
3. Behrouz A Forouzan, TCP/IP Protocol Suite by Third Edition, TMH

## 14. DEEP LEARNING

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

**MODULE 1:** -7H

Introduction: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

**MODULE 2:** -8H

Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network

**MODULE 3:** -9H

Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and optimization. Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.

**MODULE 4:** -8H

Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolution Neural Network, Recurrent Neural Network, and Deep Belief Network.

**MODULE 5:** -8H

Probabilistic Neural Network: Hopfield Net, Boltzmann machine, RBMs, Sigmoid net, Auto encoders.

**MODULE 6:** -8H

Applications: Object recognition, sparse coding, computer vision, natural language processing. Introduction to Deep Learning Tools: Tensor Flow, Caffe, Theano, Torch.

**Text Book(s):**

1. I., Bengio, Y., and Courville, A., Deep Learning, Goodfellow, MIT Press, 2016..
2. C. ,M., Springer, Pattern Recognition and Machine Learning, Bishop, 2006.

**Reference Book(s):**

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, TMH Education, 2004
4. Raúl Rojas, Neural Networks: A Systematic Introduction, 1996
5. Christopher Bishop, Pattern Recognition and Machine Learning, 2007

## 15. OPTIMIZATION TECHNIQUES

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

**MODULE 1:** -8H  
Engineering applications of Optimization, Formulation of design problems as mathematical programming problems.

**MODULE 2:** -8H  
General Structure of Optimization Algorithms, Constraints, The Feasible Region.

**MODULE 3:** -8H  
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

**MODULE 4:** -8H  
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization and Ant-Colony Optimization.

**MODULE 5:** -8H  
Real life Problems and their mathematical formulation as standard programming problems.

**MODULE 6:** -8H  
Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

### Text Book(s):

1. S. S. Rao, Engineering Optimization - Theory and Practice, 2000, Wiley, 3rd illustrated edition
2. Andreas Antoniou. Practical Optimization Algorithms and Engineering Applications

### Reference Book(s):

1. Deb K, Optimization for Engineering Design Algorithms and Examples, PHI - 2000
2. Arora J., Introduction to Optimization Design, Elsevier Academic Press, New Delhi – 2004
3. Edwin K., P. Chong & Stanislaw h. Zak. An Introduction to Optimization
4. Dimitris Bertsimas; Optimization over integers. Dynamic Ideas. Robert Weismantel (2005).





<b>S.No</b>	<b>Subjects for department of CSE</b>	<b>Year/Sem</b>	<b>Category</b>
<b>Audit Courses</b>			
<b>1</b>	<b>Business Analytics</b>	<b>II Year II Sem</b>	<b>OE</b>
<b>2</b>	<b>Industrial Safety</b>	<b>II Year II Sem</b>	<b>OE</b>
<b>3</b>	<b>Operations Research</b>	<b>II Year II Sem</b>	<b>OE</b>
<b>4</b>	<b>Cost Management of Engineering Projects</b>	<b>II Year II Sem</b>	<b>OE</b>
<b>5</b>	<b>Composite Materials</b>	<b>II Year II Sem</b>	<b>OE</b>
<b>6</b>	<b>Waste to Energy</b>	<b>II Year II Sem</b>	<b>OE</b>

## 1. BUSINESS ANALYTICS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

### **Module 1:** **-8H**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

### **Module 2:** **-8H**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple LinearRegression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

### **Module3:** **-8H**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

### **Module4:** **-9H**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

### **Module5:** **-8H**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

### **Module6:** **-7H**

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

### **Text Book(s):**

- 1.Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications by Pearson FT Press.
- 2.James Evans, Business Analytics by persons Education

## 2. INDUSTRIALSAFETY

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

**Module 1:** -8H

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

**Module 2:** -8H

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**Module 3:** -8H

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**Module 4:** -8H

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of faultfinding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

**Module 5:** -8H

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

**Module 6:** -8H

Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

**Text Book(s):**

- 1.Higgins & Morrow, Maintenance Engineering Handbook, Da InformationServices.
- 2.H. P. Garg, Maintenance Engineering, S. Chand andCompany.

**Reference Book(s):**

1. Audels, Pump-hydraulic Compressors, McGraw Hill Publication.
2. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London.

### 3. OPERATIONS RESEARCH

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

**Module 1:** **-8H**

Optimization Techniques, Model Formulation, models, General L.R Formulation,

**Module 2:** **-8H**

Simplex Techniques, Sensitivity Analysis, Inventory Control Models

**Module 3:** **-8H**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

**Module 4:** **-8H**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

**Module 5:** **-8H**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**Module 6:** **-8H**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**Text Book(s):**

1.H.A. Taha, Operations Research, An Introduction, PHI,2008

2.H.M. Wagner, Principles of Operations Research, PHI, Delhi,1982.

**Reference Book(s):**

1.J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi,2008

2.Hitler Libermann Operations Research: McGraw Hill Pub.2009

3.Pannerselvam, Operations Research: Prentice Hall of India2010

4.Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010

#### 4. COST MANAGEMENT OF ENGINEERING PROJECTS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

**Module 1:** **-8H**

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**Module 2:** **-8H**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member.

**Module 3:** **-8H**

Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

**Module 4:** **-8H**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

**Module 5:** **-**  
**8H** Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transferpricing.

**Module 6:** **-8H**  
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

**Text Book(s):**

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, NewDelhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting

**Reference Book(s):**

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd.

## 5. COMPOSITE MATERIALS

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

**Module 1: -8H**

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

**Module 2: -9H**

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

**Module 3: -7H**

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic

**Module 4: -8H**

Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

**Module 5: -**

**8H** Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

**Module 6: -8H**

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

**Text Book(s):**

1. R.W.Cahn – Material Science and Technology – Vol 13 – Composites by VCH, West Germany.
2. WD Callister, Jr., Materials Science and Engineering, An introduction. John Wiley & Sons, NY, Indian edition, 2007.

**Reference Book(s):**

1. Hand Book of Composite Materials-ed-Lubin.
2. K.K.Chawla, Composite Materials.
3. Deborah D.L.Chung, Composite Materials Science and Applications.
4. Danial Gay, Suong V. Hoa, and Stephen W.Tasi, Composite Materials Design and Applications.

## 6. WASTE TO ENERGY

Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

**Module 1:** **-7H**

Introduction to Energy from Waste: Classification of waste as fuel ,Agro based, Forest residue, Industrial waste, MSW , Conversion devices , Incinerators, gasifiers, digestors

**Module 2:** **-8H**

Biomass Pyrolysis: Pyrolysis , Types, slow fast , Manufacture of charcoal , Methods, Yields and application , Manufacture of pyrolytic oils and gases, yields and applications.

**Module 3:** **-8H**

Biomass Gasification: Gasifiers , Fixed bed system , Downdraft and updraft gasifiers , Fluidized bed gasifiers , Design, construction and operation , Gasifier burner arrangement for thermal heating , Gasifier engine arrangement and electrical power , Equilibrium and kinetic consideration in gasifier operation.

**Module 4:** **-8H**

Biomass Combustion: Biomass stoves , Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation, Operation of all the above biomass combustors.

**Module 5:** **-8H**

Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes.

**Module 6:** **-9H**

Thermo chemical conversion, Direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, Types of biogas Plants , Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

**Text Book(s):**

- 1.Desai, Ashok V., Non Conventional Energy, Wiley Eastern Ltd.,1990.
- 2.Khandelwal, K. C. and Mahdi, Biogas Technology - A Practical Hand Book - S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.

**Reference Book(s):**

- 1.Challal, D. S., Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd.,1991.
- 2.C. Y. WereKo-Brobby and E. B. Hagan, Biomass Conversion and Technology, John Wiley & Sons, 1996.