SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN :: BHIMAVARAM
(Autonomous)
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure of M.Tech(CSE)
(With effect from 2022-2023)

I Year - I Semester

S. No.	*Course Code*	*Course Title*	*L*	*T*	*P*	*C*	*IM*	*EM*	*TM*
1	PGCS1T0122	ADVANCED DATA STRUCTURES AND ALGORITHMS	3	-	-	3	40	60	100
2	PGCS1T0222	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	3	-	-	3	40	60	100
3	PGCS1T0322	COMPUTER ORGANIZATION AND ARCHITECTURE	3	-	-	3	40	60	100
4	PGCS1T0422	DATABASE MANAGEMENT SYSTEMS	3	-	-	3	40	60	100
5	PGCS1T0522 PGCS1T0622 PGCS1T0722 PGCS1T0822	**ELECTIVE - I** ARTIFICIAL INTELLIGENCE DATA WAREHOUSING AND DATA MINING INTERNET OF THINGS SOFTWARE ENGINEERING	3	-	-	3	40	60	100
6	PGCS1P0922	ADVANCED DATA STRUCTURES LAB	-	-	3	1.5	40	60	100
7	PGCS1P1022	DATABASE MANAGEMENT SYSTEMS LAB	-	-	3	1.5	40	60	100
		Total	**15**	**0**	**6**	**18**	**280**	**420**	**700**

I Year - II Semester

S. No.	*Course Code*	*Course Title*	*L*	*T*	*P*	*C*	*IM*	*EM*	*TM*
1	PGCS2T0122	COMPUTER NETWORKS	3	-	-	3	40	60	100
2	PGCS2T0222	OPERATING SYSTEMS	3	-	-	3	40	60	100
3	PGCS2T0322	FULL STACK DEVELOPMENT	3	-	-	3	40	60	100
4	PGCS2T0422 PGCS2T0522 PGCS2T0622 PGCS2T0722	**ELECTIVE - II** MACHINE LEARNING DATA SCIENCE WITH R BLOCKCHAIN TECHNOLOGIES DEVOPS	3	-	-	3	40	60	100
5	PGCS2T0822 PGCS2T0922 PGCS2T1022 PGCS2T1122	**ELECTIVE - III** DEEP LEARNING BIG DATA TECHNOLOGIES CYBER SECURITY CLOUD COMPUTING	3	-	-	3	40	60	100
6	PGCS2P1222	COMPUTER NETWORKS & OPERATING SYSTEMS LAB	-	-	3	1.5	40	60	100
7	PGCS2P1322	FULL STACK DEVELOPMENT LAB	-	-	3	1.5	40	60	100
		Total	**15**	**0**	**6**	**18**	**280**	**420**	**700**

II Year - I Semester

S. No.	*Course Code*	*Course Title*	*L*	*T*	*P*	*C*	*IM*	*EM*	*TM*
1	PGCS3S0122	COMPREHENSIVE VIVA	-	-	-	2	50	-	50
2		PROJECT WORK	-	-	-	14	-	-	-
		Total				**16**	**50**		**50**

II Year - II Semester

S. No.	*Course Code*	*Course Title*	*L*	*T*	*P*	*C*	*IM*	*EM*	*TM*
1	PGCS4S0122	SEMINAR	-	-	-	2	50	-	50
2	PGCS4J0222	PROJECT WORK	-	-	-	14	-	-	-
		Total				**16**	**50**		**50**

Credits and Total Marks

Year & Semester	*C*	*IM*	*EM*	*TM*
I Year - I Semester	18	280	420	700
I Year - II Semester	18	280	420	700
II Year - I Semester	16	50	-	50
II Year - II Semester	16	50	-	50
Total	**68**	**660**	**840**	**1500**

L – Lectures, T – Tutorials, P – Practicals, C – Credits, IM – Internal Marks, EM – External Marks, TM – Total Marks

I Year

I Semester

ADVANCED DATA STRUCTURES AND ALGORITHMS

Subject Code: PGCS1T0122	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites:
Basic Knowledge on Data Structures, Discrete Mathematics, Advanced Programming Skills and the concept of Abstract Data Types.

Course Objectives:
This course introduces students to a number of highly efficient algorithms and data structures for fundamental computational problems across a variety of areas. Students are also introduced to techniques such as complexity analysis.

Syllabus:

UNIT I: (8 Lectures)
Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists-Algorithms.
Stacks and Queues**:** Algorithm Implementation using Linked Lists.

UNIT II: (10 Lectures)
Searching-Linear and Binary Search Methods, Sorting-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Trees- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees(Infix, prefix, postfix), Graphs-Basic Concepts, Storage Structures and Traversals.

UNIT III: (10 Lectures)
Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate, Chaining, Open Addressing-Linear Probing, Double Hashing.
Priority queues - Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion.

UNIT IV: (10 Lectures)
Search Trees - Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.
AVL Trees, Definition, Height of AVL Tree, Operations, Insertion, Deletion and Searching.

UNIT V: (8 Lectures)
Search Trees - Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Course Outcomes:

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

CO 1. Apply the knowledge of linked list, Stacks & Queues to solve the complex problems and analyze the performance.

CO 2. Assess the performance of Searching & Sorting Techniques and demonstrate the operations of Trees & Graphs to model nonlinear problems.

CO 3. Study essential concepts of ADT and evaluate the performance of various Hashing techniques.

CO 4. Illustrate the concepts of Priority Queues and Binary Search Trees for real world applications.

CO 5. Get the knowledge on necessity of height balanced trees and explore the rotations of AVL trees.

CO 6. Compare the operations of search trees like Red-Black, Splay and B-trees and their performance.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	-	-	-	-	3	-	-
CO2	3	3	3	3	-	-	-	-	3	-	-
CO3	3	3	3	3	-	-	-	-	3	-	-
CO4	3	3	3	3	-	-	-	-	3	-	-
CO5	3	3	3	3	-	-	-	-	3	-	-
CO6	3	3	3	3	-	-	-	-	3	-	-

TEXT BOOKS:

1. Richard F, Gilberg, Forouzan, Data Structures, 2nd edition, Cengage
2. Samanta Debasis, Classic Data Structures, 2nd edition, PHI.
3. Mark Allen Weiss, Data structures and Algorithm Analysis in C, 2nd edition, Pearson Education. Ltd.

REFERENCE BOOKS:

1. Jean-Paul Tremblay Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd edition, Mc Graw Hill Higher Education.
2. Sartaj Sahni, Data Structures, Algorithms and Applications in java, 2/e, University Press.

MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Subject Code: PGCS1T0222	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic knowledge in Mathematics.

Course Objectives: This course will introduce number theory and operations on sets and relations. It acquires the relevance of statements, inference and predicates in computer science. It gives overview of algebraic structures and exposure to graph theory.

Syllabus:

UNIT I: (10 Lectures)

Mathematical Logic:

Propositional Calculus: Statements and Notations, Connectives, Truth Tables, Tautologies, Equivalence of Formulas, Duality law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof.

Predicate calculus: Predicative Logic, Statement Functions, Variables and Quantifiers, Free & Bound Variables, Inference theory for predicate calculus.

UNIT II: (8 Lectures)

Number Theory & Induction: Properties of integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple(without proofs), Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic, Fermat's theorem, Euler's theorem.

Mathematical Induction: Principle of Mathematical Induction**,** Examples.

UNIT III: (12 Lectures)

Set Theory: Introduction, Operations on Binary Sets, Principle of Inclusion and Exclusion. **Relations:** Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations, Hasse Diagrams, Pigeonhole Principle and its Application.

Functions: Bijective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions.

UNIT IV: (9 Lectures)

Graph Theory: Basic Concepts of Graphs, Graph theory and it's applications, Sub graphs, Bipartite and Planar graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and

Hamiltonian Graphs, Multigraphs, (Problems and Theorems without proofs) Planar Graphs, Euler's Formula, Graph Coloring and Covering, Chromatic Number, (Problems and Theorems without proofs) Spanning trees, Prim's and Kruskal's algorithm, BFS and DFS spanning trees.

UNIT V: (8 Lectures)

Algebraic Structures, Lattice: Properties, Lattices as Algebraic Systems, Algebraic Systems with one Binary Operation, Properties of Binary operations, Semi groups and Monoids: Homomorphism of Semi groups and Monoids,

Groups: Abelian Group, Cosets, Subgroups (Definitions and Examples of all Structures) Algebraic Systems with two Binary Operations, Rings.

Course Outcomes:

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

CO1: Build inference theory of mathematical logic and basic algorithms of number theory.

CO2: Illustrate the fundamentals of set theory, relations, functions and graphs.

CO3: Apply principles of number theory, set theory for framing different algebraic structures.

CO4: Analyze mathematical logic statements and number theory concepts.

CO5: Classify algebraic structures based on the concepts of number theory and functions.

CO6: Compare various graph theory concepts to suit to real time applications.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-
CO6	3	3	3	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Tremblay, Manohar, Discrete Mathematical Structures with Applications to Computer Science, TMH.
2. Mott, Kandel, Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2/e, PHI.

REFERENCE BOOKS:

1. JK Sharma, Discrete Mathematics, 2/e, Macmillan.
2. Swapan Kumar Chakrborthy, Bikash Kanti Sarkar, Discrete Mathematics, Oxford.
3. Biswal, Discrete Mathematics and Graph theory, 3rd ed, PHI.
4. CRC Press, Discrete Mathematics, Proofs, Structures and applications, 3rd ed.
5. S.Santha, Discrete Mathematics, Cengage.

COMPUTER ORGANIZATION AND ARCHITECTURE

Subject Code: PGCS1T0322	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Digital Electronics.

Course Objectives: Main objective of the course is to familiarize students about hardware design including logic design, basic structure and behavior of the various functional modules of the modern computer and how they interact to provide the processing needs of the user. It will cover machine level representation of data, instruction sets, computer arithmetic, CPU structure and functions, memory system organization and architecture, system input/output, multiprocessors, and digital logic.

Syllabus:

UNIT I: (8 Lectures)

Basic Structure of Computers: Computer types, functional unit, basic operational concepts, bus structures. Performance - Processor clock, basic performance equation, Pipe line and super scalar operation, clock rate.

Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and memory transfers, Arithmetic Micro operations, logical micro operations, shift micro operations, Arithmetic logic shift unit.

UNIT II: (10 Lectures)

Basic Computer Organization and Design: Instruction codes, Computer Register, Computer Instructions, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-Output and Interrupt.

Central Processing Unit: General Register Organization, STACK Organization, Instruction formats, Addressing modes, Data transfer and manipulation, Program control, Reduced Instruction Set Computer.

UNIT III: (10 Lectures)

Micro Programmed Control: Control memory, Address sequencing.

Computer Arithmetic: Addition and subtraction with Signed Magnitude Data - Hardware implementation, Hardware Algorithm, Multiplication Algorithms - Hardware Implementation for Signed-Magnitude Data, Hardware Algorithm, Booth Multiplication Algorithm, Division algorithms - Hardware implementation for Signed- Magnitude data.

UNIT IV: (8 Lectures)

The Memory System: Memory Hierarchy, Main memory, Auxiliary memory,

Associative memory, Cache memory, Virtual memory.

UNIT V: (8 Lectures)

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of transfer, Priority interrupt - Daisy Chaining Priority, Parallel Priority Interrupt, Direct memory access.

Course Outcomes:

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

CO1: Demonstrate the basic structure, organization and design of a computer.

CO2: Analyze the elements in the RTL and micro operations, CPU organization and micro-programmed controlled unit.

CO3: Experiment with numerous algorithms to perform computer arithmetic and logical operations and propose suitable hardware for them.

CO4: Classify different types of memory structures and organizations.

CO5: Utilize the design characteristics of I/O organization in the modern computer.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. M. Moris Mano, Computer System Architecture, 3rd ed, Pearson.
2. William Stallings, Computer Organization and Architecture, 6th ed, Pearson.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, Structured Computer Organization, 4th ed. Pearson.
2. Sivaraama Dandamudi, Fundamentals of Computer Organization and Design, Springer Int. Edition. John L. Hennessy and David A. Patterson, Computer Organization a quantitative approach, 4th ed, Elsevier.
3. B. Ram, Computer Fundamentals Architecture and Organization, 5th ed., New Age International Publications.
4. Carl Hamacher, Zvonks Vranesic, SafeaZaky, Computer Organization, 5th ed, McGraw Hill.

DATABASE MANAGEMENT SYSTEMS

Subject Code: PGCS1T0422	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with data structures.

Course Objectives:
This course introduces relational data model, entity-relationship modeling, SQL, normalization and database design. This course would examine transaction management, concurrency control, recovery, file organizations and indexing.

Syllabus:

UNIT I: (10 Lectures)
Introduction: Database System Applications, File System Vs Database System, View of Data - Data Abstraction, Instances and Schemas; Data Models, Database Languages - DDL, DML; Database System Architecture - Storage Manager & Query Processor, Database Users and Administrator, History of database systems.
Database Design with E-R Model: Database design and ER Diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model.

UNIT II: (8 Lectures)
Relational Model: Introduction**,** Integrity Constraints over relations, Enforcing Integrity constraints, Querying relational data, Logical database Design, Views.
Relational Algebra: Selection and Projection, Set operations, Renaming, Joins, Division, Examples of Algebra queries.
Basic SQL: Data types and DDL, Specifying Constraints, Insert, Delete and Update Statements, Basic Queries in SQL.

UNIT III: (12 Lectures)
Advanced SQL: Joins, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers.
Schema Refinement: Problems caused by redundancy, Decompositions, Problems related to decomposition, Functional dependencies, Reasoning about FDS, Normal forms - FIRST, SECOND, THIRD Normal forms and BCNF, Properties of Decomposition-Lossless Join Decomposition, Dependency Preserving Decomposition, Multivalued dependencies, Fourth normal form.

UNIT IV: (9 Lectures)
Transaction Management: Properties of transactions, Transactions and Schedules, Concurrent Execution of Transactions.
Concurrency Control: Lock Based Concurrency Control, Serializability and Recoverability, Introduction to Lock Management, Dealing with Deadlocks, Concurrency Control without Locking.

Crash Recovery: Introduction to ARIES, Log, Recovery-Related Structures, Checkpointing.

UNIT V: (8 Lectures)

Overview of Indexing: File organizations and Indexing, Primary and Secondary Indexes, Index specification in SQL.

Tree Structured Indexing: Intuitions for tree Indexes, B+ Trees: Format of a Node, Search, Insert and Delete.

Hash Based Indexing: Static Hashing, Extendable hashing, Linear Hashing, Extendable vs. Linear hashing.

Course Outcomes:

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

CO1: Understand the database system design and its functionality.

CO2: Apply the knowledge of SQL to construct the queries for efficient data access and manipulation.

CO3: Inspect database problems and utilize the normalization theory to refine the database schema.

CO4: Analyse and solve the transaction processing issues through concurrency control and recovery mechanisms.

CO5: Examine different Indexing mechanisms for efficient data access.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	3	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-
CO5	-	3	-	3	-	-	-	-	-	-	-

TEXT BOOKS:

1. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, TATA McGraw hill.
2. Silberschatz, Korth, Database System Concepts, TATA McGraw hill.

REFERENCE BOOKS:

1. C.J.Date, Introduction to Database Systems, 8th Edition, Pearson Education.
2. Peter ROB and Carlos Coronel, Database System Concepts, Cengage Learning.
3. Ramez Elmasri , Shamkant B. Navathe , Fundamentals of Database Systems, 5th Edition,Pearson Education

ARTIFICIAL INTELLIGENCE
(ELECTIVE–I)

Subject Code: PGCS1T0522	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Discrete Mathematics, Linear Algebra and Probability.

Course Objectives: The objective of the course is to present an overview of artificial intelligence principles and approaches.

Syllabus:

UNIT I: (7 Lectures)

Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, development of AI languages, current trends in AI. **Problem solving: state-space search and control strategies:** Introduction, general problem solving, characteristics of problem.

UNIT II: (9 Lectures)

Search Strategies: exhaustive searches, heuristic search techniques, iterative-deepening a*, constraint satisfaction. **Problem reduction and game playing:** Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games.

UNIT III: (12 Lectures)

Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames.

UNIT IV: (8 Lectures)

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, cyc theory.

Expert system and applications: Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems blackboard systems truth maintenance systems, application of expert systems, list of shells and tools.

UNIT V: (8 Lectures)

Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory. **Fuzzy**

sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems.

Course Outcomes:

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

- **CO 1** Summarize and formulate appropriate logic concepts and AI methods for solving a problem.
- **CO 2** Applying various searching, game playing, and knowledge representation techniques to solve the real world problems.
- **CO 3** Analyse different expert systems and its applications.
- **CO 4** Explain the concepts of probability theory, fuzzy sets and fuzzy logic for uncertainty measure.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	3	-	-
CO3	3	3	-	3	-	-	-	-	3	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-

Text Books:

1. Saroj Kaushik, Artificial Intelligence, CENGAGE Learning.
2. Stuart Russel, Peter Norvig ,Artificial intelligence, A modern Approach, 2nd ed, PEA.
3. Rich, Kevin Knight, Shiv Shankar B Nair, Artificial Intelligence, 3rd ed, TMH.
4. Patterson, Introduction to Artificial Intelligence, PHI.

Reference Books:

1. George F Lugar ,Artificial intelligence, structures and Strategies for Complex problem solving, 5th ed, PEA.
2. Ertel, Wolf Gang, Introduction to Artificial Intelligence, Springer.
3. Nils J Nilsson, A new Synthesis Artificial Intelligence, Elsevier.

DATA WAREHOUSING AND DATA MINING
(Elective-I)

Subject Code: PGCS1T0622	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Database Management Systems.

Course Objectives:
The objective of this course is to teach the basic data warehousing and data mining concepts with particular emphasis on the association, classification and clustering techniques. Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining. They will learn how to analyze the data, identify the problems and choose the relevant algorithms for different kinds of data.

Syllabus:

UNIT I: (8 Lectures)
Data Warehousing: Historical developments in data warehousing, Defining data warehousing, Data warehouse architecture, Benefits of data warehousing, Data Marts, Data warehouses versus OLTP, Data Warehouse Schema, Introduction to Online Analytical Processing and OLAP Operations.

UNIT II: (8 Lectures)
Introduction to Data Mining: Data mining, Kinds of Data, Kinds of Patterns, Technologies, Applications, Major issues in data mining.
Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration, Data Transformation, Data Reduction and Data Discretization.

UNIT III: (12 Lectures)
Mining Frequent Patterns and Associations: Basic Concepts, Frequent item set Mining Methods, Pattern Evaluation Methods, Mining Multilevel Association Rules, Mining Multidimensional Association Rules, Constraint-Based Frequent Pattern Mining.
Classification and Prediction: Basic Concepts, Classification by Decision Tree Induction, Bayes Classification, Classification by Back propagation, Support Vector Machines, Model Evaluation and Selection, Techniques to Improve Classification Accuracy, Introduction to Prediction.

UNIT IV: (9 Lectures)
Cluster Analysis: Introduction, Types of Data in Cluster Analysis, Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Model-Based Clustering Methods, Evaluation of Clustering.

UNIT V: (8 Lectures)

Outlier Detection and Data Mining Applications: Outliers and Outlier Analysis, Outlier Detection Methods, Outlier Detection in High-Dimensional Data, Data Mining Applications, Data Mining and Society, Data Mining Trends.

Course Outcomes:

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

CO 1. Apply data warehouse computation techniques on large data set.

CO 2. Outline data mining functionalities and use data preprocessing techniques to improve the overall quality of the pattern mined from the data.

CO 3. Experiment with association, classification and clustering algorithms on different kinds of data to extract knowledge.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	3	-	-	-	2	2	-
CO2	3	3	3	3	3	-	-	-	2	2	-
CO3	3	3	3	3	3	-	-	-	2	2	-

TEXT BOOKS:

1. Jiawei Han, Jian Pei & Michcline Kamber, Data Mining - Concepts and Techniques, Morgan Kauffman Publishers.
2. Parteek Bhatia, Data Mining and Data Warehousing Principles and Practical Techniques, 1st edition, Cambridge University Press.

REFERENCE BOOKS:

1. Pang- Ning tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 1st edition, Pearson.
2. Margaret H.Dunham, Data Mining: Introductory and Advanced Topics, 1st edition Pearson.
3. Arun K Pujari, Data Mining Techniques, Universities Press.
4. Paulraj Ponniah, Data Warehousing Fundamentals, Wiley Student Edition.

INTERNET OF THINGS
(Elective-I)

Subject Code: PGCS1T0722	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Digital Electronics.

Course Objectives: Students will be explored to the interconnection and integration of the physical world and the cyber space. They are also able to design & develop IOT enabled Devices.

Syllabus:

UNIT I: (8 Lectures)

Introduction to Internet of Things: Introduction: Definition of IoT, Fundamental Characteristics of IoT, Design Considerations for IoT Applications.

UNIT II: (8 Lectures)

Basic layered architecture for IoT: Device Layer, Network Layer, Service and Application Support Layer, Application Layer, Structure of IoT, Logical design of IoT.

UNIT III: (8 Lectures)

Key enabling Technologies: Platforms: Hardware, SoC, Sensors, Bluetooth, BT-LE, iBeacon. **Protocols:** Identification and Tracking Technologies: RFID, NFC, Zigbee and GPS Communication Technologies: Wireless Networks, WSN, 3G, LTE, IPv6.

IoT protocols: HTTP, CoAp, Websocket, MQTT, XMPP, DDS, AMQP, SDN and NFV for IoT.

UNIT IV: (10 Lectures)

Services and attributes for IoT: Gateway, Raspberry Pi, Arduino, Cloud Computing and IoT, Big-Data Analytics and Visualization, Dependability, Security, Localization, Maintainability.

Internet of Things in Practice: IoT levels and Deployment templates, IoT for Smart Cities, IoT for Agriculture, IoT for Traffic Management and Transportation, IoT in the Home, IoT in Retail, IoT in Healthcare, IoT in Sports.

UNIT V: (8 Lectures)

Challenges and Future Trends: Research challenges: Technical Challenges, Standardization, Information Security and Privacy Protection, Research Trends.

Course Outcomes:

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

CO1: Learn the fundamentals of IOT.

CO2: Interpret the Architectural layered view of the IOT.

CO3: Analyze the basic protocols of IOT.

CO4: Design IOT applications in various domains and able to analyze the performance.

CO5: Integrate IOT Applications with Embedded Platform to enhance the future.

Mapping of COs to POs:

POs/ Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	2	-	2	2	2	2
CO5	3	3	3	3	3	3	2	2	3	2	3

TEXT BOOKS:

1. Arshadeep Bhaga, Vijay madisetti, IoT A hands on approach,University Press.

2. Ovidiu Vermesan, Peter Friess, Internet of Things – From Research and Innovation to Market Deployment, River Publishers.

3. Ovidiu Vermesan, Peter Friess, Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers.

REFERENCE BOOKS:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley.

2. Ovidiu Vermesan, Peter Friess, Building the Hyperconnected Society, River Publishers.

SOFTWARE ENGINEERING
(Elective-I)

Subject Code: PGCS1T0822	**L**	**T**	**P**	**C**
I Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic concepts of programming and algorithm design.

Course Objectives:
This course enables the learners to have exposure towards software development life cycle and its phases. It focuses on various principles and methods related to identifying project requirements, transforming requirements into design, product development models, product testing and deployment. Learners will get insights to various real time practices and approaches of the software industry through this course.

Syllabus:

UNIT I: (6 Lectures)
Introduction to Software Engineering: The Evolving Role of Software, Changing Nature of Software, Software Myths.
The Software Problem: Cost, Schedule and Quality, Scale and Change.

UNIT II: (8 Lectures)
Software Process: Process and Project, Component Software Process, Software Development Process Models : Waterfall Model, Prototyping, Iterative Development, Relational Unified Process, Time Boxing Model, Extreme Programming and Agile Process, Using process models in a Project, Project Management Process.

UNIT III: (12 Lectures)
Software Requirement Analysis and Specification: Value of Good SRS, Requirement Process, Requirement Specification, Functional Specifications with use-cases, Other approaches for analysis, Validation.
Planning a Software Project: Effort Estimation, Project Schedule and Staffing, Quality Planning, Risk Management Planning, Project Monitoring Plan, Detailed Scheduling.

UNIT IV: (7 Lectures)
Software Architecture and Design: Role of Software Architecture, Components and Connector View, Characteristics of Good Design, Design Principles, Modular Design, Design Methodologies, Detailed design.

UNIT V: (7 Lectures)
Software Implementation and Testing: Coding Techniques, Structural and Object Oriented, Software Quality, CMM Levels, Testing Concepts, Black-Box and White-Box Testing, Art of Debugging.

Course Outcomes:

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

CO 1. Make use of the software development life cycle principles and process models.

CO 2. Construct the software requirements specifications with relevant use-cases.

CO 3. Analyze the project management strategies and various components to build the architecture using suitable design strategies.

CO 4. Estimate the best coding standards and testing strategies to develop high quality software products.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	-	-	2	-	-	-	-	-
CO2	3	-	2	-	2	2	-	-	2	2	-
CO3	3	-	3	-	2	2	3	-	2	2	3
CO4	3	-	2	-	2	2	-	-	-	-	-

TEXT BOOKS:

1. Pankaj Jalote, A Concise Introduction to Software Engineering (Undergraduate Topics in Computer Science), Springer International Edition.
2. Roger S Pressman, "Software Engineering – A Practitioner's Approach", 7th Edition, McGrawHill.
3. Ugrasen Suman, Software Engineering Concepts and Practices, Cengage Learning Publications.

REFERENCE BOOKS:

1. K.K.Agarwal & Yogesh Singh, Software Engineering, New Age International Publishers.
2. Rajesh Naik and Swapna Kishore, Software Requirements and Estimation, 1st edition, Tata Mc Graw Hill.
3. Waman S Jawadekar , Software Engineering Principles and Practice, Tata Mc Graw Hill.
4. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education.

ADVANCED DATA STRUCTURES LAB

Subject Code: PGCS1P0922	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisites:
Students should have the familiarity with the concepts of Programming along with basic constructs of C language to implement the data structure algorithms.

Course objectives:
This course is concerned with the design and analysis of efficient algorithms of linear and non- linear data structures, focusing principally on algorithms for combinatorial optimization problems. The course is intended to Strengthen the ability of the students to identify and implement the suitable data structure for the given real-world problem and gain knowledge in practical applications of data structures.

List of Experiments:

1. To implement the operations of Singly Linked List and Circular Linked List.

2. To implement the operations of Doubly Linked List.

3. To perform various operations of Stack and Queue using Linked List.

4. To implement operations on Graph.
    a. Vertex insertions
    b. Vertex deletions
    c. Finding vertex
    d. Edge addition and deletion

5. a. Write a program to implement BFS traversal on given Graph.
    b. Write a program to implement DFS traversal on given Graph.

6. To implement functions of Dictionary using hashing.
    a. Division Method
    b. Multiplication Method
    c. Universal Hashing

7. Write a program to perform
    a. Linear Probing
    b. Random Probing
    c. Double Hashing

8. Write a program to implement Priority Queue using
    a. Max Heap
    b. Min Heap

9. To perform various operations of Binary Search Trees.

10. To perform various operations of AVL Trees.

Course Outcomes:

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

CO 1. Proficient in writing the programs to implement the operations of SLL, CLL and DLL.
CO 2. Design and develop operations of Stack & Queue using Linked List.
CO 3. Generate code for operations of Graphs and Traversals for real time problems.
CO 4. Enhance the expertise in practice knowledge of Hash Functions and Collision Resolution Methods.
CO 5. Model the contextual solution to a given problem using Search Trees.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	-	3	-	3	-	-	3
CO2	3	3	3	3	-	3	-	3	-	-	3
CO3	3	3	3	3	-	3	-	3	-	-	3
CO4	3	3	3	3	-	3	-	3	3	-	3
CO5	3	3	3	3	-	3	-	3	-	-	3

TEXT BOOKS:

1. Richard F, Gilberg, Forouzan, Data Structures, 2nd edition, Cengage
2. Samanta Debasis, Classic Data Structures, 2nd edition, PHI.
3. Mark Allen Weiss, Data structures and Algorithm Analysis in C, 2nd edition, Pearson Education. Ltd.

REFERENCE BOOKS:

1. Jean-Paul Tremblay Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd edition, Mc Graw Hill Higher Education
2. Sartaj Sahni, Data Structures, Algorithms and Applications in java, 2/e, University Press.

DATABASE MANAGEMENT SYSTEMS LAB

Subject Code: PGCS1P1022	**L**	**T**	**P**	**C**
I Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Basic knowledge in Programming.

Course Objectives:
The objective of the DBMS lab is to understand the practical applicability of database management system concepts. The students also learn how to design the database and apply various operations on it.

List of Experiments:

Experiment 1: Working with ER Diagrams
Example: ER Diagram for Sailors Database
Entities:
1. Sailors(Sid,Sname,Rating,Age)
2. Boats(Bid,Bname,Color)

Relationship: Reserves(Day)
Primary Key Attributes:
1. Sid (Sailors Entity)
2. Bid (Boats Entity)

Experiment 2: Working with DDL, DML, DCL and Key Constraints
Creating, Altering and Dropping of Tables and Inserting Rows into a Table (Use Constraints while Creating Tables), Examples using Select command.

Experiment 3: Working with Queries and Nested Queries
Queries (along with sub Queries) using UNION, INTERSECT and MINUS, ANY, ALL, IN, EXISTS, NOT EXISTS

Experiment 4: Working with Queries using Aggregate Operators & Views
Queries using Aggregate Operators (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING, Creation and Dropping of Views.

Experiment 5: Working with different types of Functions
Queries using Conversion Functions (to_char, to_number and to_date), String Functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), Date Functions (Sysdate, next_day, add_months, last_day, months_between), Numerical Functions(least, greatest, trunc, round).

Experiment 6: Working with Loops using PL/SQL
Develop programs using LOOP, WHILE and FOR loops and Nested loops.

Experiment 7: Working with Triggers using PL/SQL
Develop programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers.

Experiment 8: Working with Procedures using PL/SQL
Develop programs using Procedures, passing Parameters IN and OUT of Procedures.

Experiment 9: Working with Functions using PL/SQL
Develop programs using Functions and invoke Functions in SQL statements.

Experiment 10: Working with Exception Handling using PL/SQL
Develop programs using Error handling, Built-in Exceptions, User defined Exceptions and RAISE_APPLICATION_ERROR.

Experiment 11: Working with Cursors using PL/SQL
Develop programs using Cursors, parameters in a Cursor, FOR UPDATE Cursor, WHERE CURRENT OF clause and Cursor variables.

Course Outcomes:
Upon completion of this course, the students will be able to:

CO 1. Demonstrate the database design using ER Diagrams.

CO 2. Develop SQL Queries to manipulate the data in the database.

CO 3. Apply Procedural Language constructs to execute a block of SQL statements.

CO 4. Inspect and handle errors using exception handling mechanism.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	-	3	-	3	-	3	3	-	3
CO2	3	3	3	3	3	3	-	3	3	-	3
CO3	3	-	3	3	3	3	-	3	3	-	3
CO4	3	3	3	-	3	3	-	3	3	-	3

Text Books:

1 . Benjamin Rosenzweig, Elena Silvestrova Rakhimov, Oracle PL/SQL by Example, 3rd Edition,Pearson Education.

2. Scott Urman, Ron Hardman,Michael Mclaughlin,Oracle Database 10G PL/SQL Programming, Tata Mc-Graw Hill.

3. Dr .P.S. Deshpande, SQL and PL/SQL for Oracle 11g, Black Book.

I Year
II Semester

COMPUTER NETWORKS

Subject Code: PGCS2T0122	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Computer Organization and Architecture.

Course Objectives: Students will be able to master in the computer network terminology and concepts of the OSI model and the TCP/IP model, summarize with wired and wireless networking concepts and routing protocols, and solve current issues in networking technologies.

Syllabus:

UNIT I: (9 Lectures)

Introduction: Data Communication - Components, Representation of data and its flow; Networks – Network Criteria, Physical Structures; Categories of Networks- LAN, WAN, MAN; Protocols and Standards – Protocols, Standards - De facto, De jure; Network Models - OSI model, TCP/IP Model.

Physical Layer: Transmission media – Guided media, Unguided media; Multiplexing - Frequency division, Time division.

UNIT II: (9 Lectures)

Data Link Layer: Data link layer design issues – Services provided to the network layer, Framing, Error control, Flow control; Error Detection and Error Correction – Error correcting codes, Error detecting codes; Data link layer protocols - Stop and wait, Sliding window protocols (Go back – N, Selective Repeat); Wired LANs, Wireless LANs, Bridge, Switch.

UNIT III: (8 Lectures)

Medium Access Sub Layer: Channel allocation problem, dynamic channel allocation in LANs and MANs; Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD; Collision free protocols – A bit map protocol, Binary countdown.

LAN Standards - 802.3, 802.5; Bridges – Transparent bridges, Source routing bridges; Wireless LANs – 802.11, Architecture; MAC sub layer, frame format.

UNIT IV: (8 Lectures)

Network Layer: Network layer design issues – services provided to the transport layer, virtual circuit and datagram subnets; Routing algorithms – The optimality principle, shortest path routing, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing.

Internetworking – Tunneling, fragmentation, firewall, IP Addressing, IPV4 Addressing, IPV6 Addressing, subnets, ICMP; Address mapping – ARP, RARP, BOOTP and DHCP.

UNIT V: (10 Lectures)

Transport Layer: Services provided to upper layer, Quality of Service, Elements of transport protocols – Establishing connection, Releasing connection; User Datagram Protocol (UDP) and its frame format, Transmission Control Protocol (TCP) and its frame format; TCP congestion control - Leaky Bucket and Token Bucket algorithm.
Application Layer: Domain Name System (DNS), TELNET(Remote Login), EMAIL(SMTP,POP3), File Transfer Protocol (FTP), HTTP.

Course Outcomes:

Upon completion of this course, the students will be able to:
CO 1. Interpret the principles of networking protocols and standards, and identify different concepts of layered architectures in networking.
CO 2. Understand the design issues and classify the different framing methods and various multiple access protocols.
CO 3. Analyze various routing algorithms to find optimum routing path, classify various routing protocols and analyze how to assign IP addresses for the devices in the network.
CO 4. Analyze the functionality of transport layer and to demonstrate how to control the congestion.
CO 5. Demonstrate working functionalities of various application layer protocols and design various applications using these protocols.

Mapping of COs to POs:

POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-
CO4	3	3	-	2	-	-	-	-	-	-	-
CO5	3	2	3	3	-	-	3	3	-	-	-

TEXT BOOKS:

1. Andrew S. Tanenbaum, Computer Networks, 8th Edition, Pearson New International Edition.
2. Behrouz A. Forouzan, Data Communication and Networking, 4th Edition, McGraw-Hill.

REFERENCE BOOKS:

1. William Stallings, Data and Computer Communication, 8th Edition, Pearson Prentice Hall India.
2. Douglas Comer, Internetworking with TCP/IP, Volume 1, 6th Edition, Prentice Hall of India.
3. W. Richard Stevens, TCP/IP Illustrated, Volume 1, Addison-Wesley, United States of America.

OPERATING SYSTEMS

Subject Code: PGCS2T0222	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Data Structures and Computer Organization & Architecture.

Course Objectives:
The course teaches the basic operating system abstractions, mechanisms, and their implementations. The core of the course contains concurrent programming (threads and synchronization), inter process communication. Also, gives insight to the concepts including file systems, virtual memory and disk management.

Syllabus:

UNIT I: (7 lectures)
Introduction: What is Operating System, Main Frame Systems, Multiprocessor systems, Distributed system, Clustered system, Real time systems, Hand held systems, Computer System Operations, IO structure, Storage Structure, OS Services, System Calls, System Structure, Virtual Machines, Case study: Microsoft Windows Overview, Traditional and modern Unix Systems.

UNIT II: (8 lectures)
Process Management: Process concept - process scheduling, operations, Inter process communication, Multi Thread programming models. Process scheduling criteria and algorithms (FCFS, SJF, Priority, RR, Multilevel queue Scheduling), and their evaluation.

UNIT III: (10 lectures)
Process Synchronization: The Critical-section problem, Synchronization Hardware, Semaphores, Classic problems of synchronization, Monitors.
Deadlocks: System Models, Deadlock Characterization, Deadlock Prevention, Deadlock Avoidance, Banker's algorithm, Deadlock Detection and Recovery from deadlock.

UNIT IV: (8 lectures)
Memory Management: Swapping, Contiguous memory allocation, Paging, Segmentation, Virtual memory: Demand paging, Page-Replacement algorithms, Allocation of Frames, Thrashing.

UNIT V: (7 lectures)
File Management: File Concepts, Access methods, Directory structure, File System structure, File system implementation, directory implementation, Allocation methods, Free-space management, efficiency and performance.

Disk Management: Disk structure, Disk scheduling, Disk Management, RAID structure.

Course Outcomes:

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

CO1. Demonstrate the Basic Concepts of Operating Systems.

CO2. Analyze various process management concepts, Memory Management strategies.

CO3. Apply Various Process Scheduling Algorithms, Page replacement algorithms and Deadlock detection and avoidance techniques.

CO4. Analyze File Management and Disk Management aspects of operating systems.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, 9th edition, John Wiley.
2. Stallings, Operating Systems-Internal and Design Principles, Pearson education.

REFERENCE BOOKS:

1. D.M.Dhamdhere, Operating systems- A Concept based Approach,TMH.
2. Crowley, Operating System A Design Approach, TMH.
3. Andrew S Tanenbaum, Modern Operating Systems, PHI.
4. Gary J. Nutt, Operating Systems: A Modern Perspective, Addison-Wesley.
5. http://nptel.iitm.ac.in/courses/Webcourse-contents/IISc-BANG/Operating%20Systems /New_index1.html

FULL STACK DEVELOPMENT

Subject Code: PGCS2T0322	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: The students must have knowledge on the concepts of HTML, CSS and JavaScript.

Course Objectives:
Full Stack Development Course covers complete breath of technologies & applications that are extensively used in the industry. This course not only make the students gain expertise in both front end & backend programming applications but also help them to get familiar with the latest web development technologies & also complete web development life cycle.

Syllabus:

UNIT I: (8 Lectures)
React Basics: Introduction, Nesting elements, Creating component classes, Working with properties, Introduction to JSX, States, Component lifecycle events.

UNIT II: (9 Lectures)
React Advanced Concepts: Handling events, Working with forms, Scaling React components, React routing, Working with data using Redux, Unit testing React with Jest.

UNIT III: (10 Lectures)
Node.js: Introduction, Modules and npm, Node's Programming Model, Core Modules, Building the Node Server, Node's Debugger, node-inspector, Testing Node.

MongoDB: History of MongoDB, Installing MongoDB Locally, Cloud Hosting, MongoDB Shell, Inserting New Data, Retrieving Data, Updating Data, Deleting Data, Deleting Collections, Deleting Databases, Interacting with MongoDB Using Mongoose, Alternatives to MongoDB.

UNIT IV: (7 Lectures)
Express.js : Building Blocks of Express, Router, Middleware, Routes, Generating an Express App, Jade, Architecture of an Express Application.

UNIT V: (8 Lectures)
AngularJS: Single-page Applications, SPA Frameworks, Model-View-Controller Architecture, Getting Angular, Data Binding, Angular Directives, Controllers, Client-side Routing, Testing Angular.

Course Outcomes:
Upon completion of this course, the students will be able to:

CO 1. Understand the principles, working methodologies and operations of front end and back end programming applications.
CO 2. Demonstrate the design methodology of MEAN architecture frame works to support real time interactions.
CO 3. Apply the techniques of modern web methodologies for formulating solutions to real world problems.
CO 4. Analyze and integrate all the components of for developing robust and dynamic web applications.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	3	-	-	-
CO3	3	-	3	-	3	3	-	-	-	-	-
CO4	3	3	3	-	-	3	-	-	-	-	-

TEXT BOOKS:

1. Azat Mardan, React Quickly, Manning Publications Co.
2. Colin J. Ihrig and Adam Bretz, Full Stack JavaScript Development with MEAN, SitePoint Pty Ltd.

REFERENCE BOOKS:

1. Kirupa Chinnathambi, Learning React, Pearson Education Inc.
2. Cássio de Sousa Antonio, Pro React, Apress.
3. Vasan Subramanian, Pro MERN Stack, Apress Publications.
4. Simon Holmes, Clive Harber, Getting Mean with Mongo, Express, Angular and Node, Manning Publications Co.
5. Amos Q. Haviv, MEAN Web Development, Packt Publishing.

MACHINE LEARNING
(ELECTIVE–II)

Subject Code: PGCS2T0422	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Basic programming skills, algorithm design and basics of probability & statistics.

Course Objectives:

The main objective of this course is to understand the key algorithms and theory that form the foundation of machine learning and computational intelligence, as well as to identify and apply the appropriate machine learning technique for classification, pattern recognition, optimization and decision problems.

Syllabus:

UNIT I: (8 Lectures)

Introduction : Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning. Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, Find- S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

UNIT II: (8 Lectures)

Linear Regression & Logistic Regression: Predicting numeric values: regression – Finding the best fit lines with linear regression, Locally weighted linear regression, Shrinking Coefficients, The bias / Variance tradeoff. Logistic Regression: Classification with logistic regression and the sigmoid function, Using optimization to find the best regression coefficients.

UNIT III: (10 Lectures)

Decision Tree Learning: Decision tree representation, appropriate problems for decision tree learning, basic decision tree learning algorithm, and hypothesis space search in decision tree learning, inductive bias in decision tree learning, and issues in decision tree learning.

Artificial Neural Networks: Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition, Advanced topics in artificial neural networks.

UNIT IV: (8 Lectures)

Support Vector Machines & Dimensionality Reduction Techniques: Separating data with the maximum margin, finding the maximum margin, efficient optimization with SMO algorithm, speeding up optimization with full platt SMO, Using Kernels for more Complex data. Dimensionality Reduction techniques: Principal Component analysis, Example.

UNIT V: (7 Lectures)

Instance-Based Learning - Introduction, k -Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

Course Outcomes:

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

CO 1. Summarize the concepts and methods related to machine learning such as classification, regression, clustering, bias/variance, kernel functions, and optimization.

CO 2. Predict the expected outcome of the problem based on the training data by applying specific machine learning algorithm.

CO 3. Implement and compare the relevant algorithms using performance metrics.

CO 4. Design and build the model using various machine learning algorithms in a range of real-world applications.

Mapping of COs to POs:

POs/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	3	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	-	3	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, MGH.
2. Peter Harington, Machine Learning in Action, Cengage.
3. Sebastian Raschka, Python Machine Learning, Packt Publishing.

REFERENCE BOOKS:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI.
2. Drew Conway & John Miles Wine, Machine Learing for Hackers, O'Reilly Media.

DATA SCIENCE WITH R
(ELECTIVE–II)

Subject Code: PGCS2T0522	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with the concepts of databases and statistics.

Course Objectives: The objective of this course is to provide insights to learner's about data science process and exploration in real-time perspectives. This course also focuses on various concepts such as types of learning, processes, techniques and models concerned to data science by using R programming language.

Syllabus:

UNIT I: (6 Lectures)
Introduction to Data Science: Data Science, Data Science Applications, Data Science related fields, Relationship between Data Science and Information Science, Computational Thinking, Skills for Data Science, Tools for Data Science, Issues of Ethics, Bias and Privacy in Data Science.

UNIT II: (9 Lectures)
Introduction to R: How to run R, A first R Session, Functions, Important R Data Structures: Vectors, Character strings, Matrices, Lists, Data Frames and Classes, Getting Help.
R Programming Structures: Control Statements, Arithmetic and Boolean Operators and values, Default Values for Arguments, Return Values, Functions are Objects, Environment and Scope Issues, Tools for Composing Function Code.

UNIT III: (9 Lectures)
Doing Math in R: Math Functions, Functions for Statistical Distributions, Sorting, Set Operations, Simulation Programming in R. **Input/Output in R:** Accessing the Keyboard and Monitor, Reading and Writing Files.
Graphics in R: Creating Graphs, Customizing Graphs, Saving Graphs to Files, Creating Three-Dimensional Plots.

UNIT IV: (10 Lectures)
Nature of Data & Pre-processing: Introduction, Data Types, Data Collections, Data Pre-processing.
Data Science Techniques: Introduction, Data Analysis and Data Analytics, Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis.
Association Rules: Overview, Apriori Algorithm, Evaluation of Candidate Rules, Applications of Association Rules, Validation and Testing.

UNIT V: (10 Lectures)
Regression: Linear Regression, Logistic Regression, Reasons to Choose and Cautions.

Classification: Decision Trees - Overview, Decision Tree Algorithms, Evaluating a Decision Tree, Decision Trees in R, Naive Bayes - Bayes' Theorem, Naive Bayes Classifier, Smoothing, Diagnostics and Naive Bayes in R, Diagnostics of Classifiers.
Clustering: Overview of Clustering, K-means - Use Cases, Overview of the Method, Determining the Number of Clusters, Diagnostics.

Course Outcomes:
Upon completion of this course, the students will be able to:
CO-1: Relate the need for the data science process and its applications in real-time perspectives.
CO-2: Demonstrate data exploration, manipulation and visualization by using various functions and packages in the R programming language
CO-3: Interpret data processing and various types of analytics on data streams
CO-4: Analyse the application of data mining algorithms on different data sources to extract data insights.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	3	-	-	-	2	-	-
CO2	3	3	3	3	3	-	-	3	2	-	-
CO3	3	3	3	3	3	-	-	-	2	-	-
CO4	3	3	3	3	3	-	-	-	2	-	-

TEXT BOOKS:
1. Chirag Shah, A Hands-On Introduction to Data Science, Cambridge University Press.
2. Norman Matloff, The Art of R Programming, No Starch Press.
3. David Dietrich, Barry Heller and Beibei Yang, Data Science and Big Data Analytics, Wiley.

REFERENCE BOOKS:
1. Rob Kabacoff, R in Action - Data Analysis and Graphics with R, Manning Publications.
2. Vijay Kotu, Bala Deshpande, "Data Science: Concepts and Practice", Second Edition, Elsevier Publications.
3. C. O'Neil and R. Schutt, Doing Data Science: Straight Talk from the Frontline, O'Reilly.
4. Joel Grus, Data Science from Scratch, O'Reilly.
5. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Addison-Wesley Data& Analytics Series.

BLOCKCHAIN TECHNOLOGIES
(ELECTIVE–II)

Subject Code: PGCS2T0622	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Information Security and Computer Networks.

Course Objectives: This course introduces the fundamentals and implementation issues of Blockchain Technologies.

Syllabus:

UNIT I: (8 Lectures)

Grasping Blockchain Fundamentals

Tracing Blockchain's Origin, The shortcomings of current transaction systems,The emergence of bitcoin,The birth of blockchain,Revolutionizing the Traditional Business Network,Exploring a blockchain application, Recognizing the key business benefits, Building trust with blockchain.

UNIT II: (8 Lectures)

Taking a Look at How Blockchain Works

Why It's Called "Blockchain", What Makes a Blockchain Suitable for Business?, Shared ledger, Permissions, Consensus, Smart contracts ,Identifying Participants and Their Roles.

UNIT III: (12 Lectures)

Propelling Business with Blockchains

Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility.

Blockchain in Action: Use Cases

Financial Services,Commercial financing,Trade finance,Cross-border transactions, Insurance, Government, Supply Chain Management, Healthcare, Electronic medical records Healthcare payments pre-authorization, Internet of Things(IoT).

UNIT IV: (8 Lectures)

Hyperledger, a Linux Foundation Project

Hyperledger Vision, Hyperledger Fabric, How Can IBM Help Developers Innovate With Blockchain? Offering an easily accessible cloud and development platform, Individualized attention and industry expertise.

UNIT V: (8 Lectures)

Problems with Block chain

Security and Safeguards, Protection from attackers, Hacks on exchanges, What is stopping adoption?, Scalability problems, Network attacks to destroy bitcoin, Case Study: Failed currencies & blockchain.

Course Outcomes:

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

CO 1. Infer and summarize the fundamentals of Blockchain.
CO 2. Analyze the working of Blockchain.
CO 3. Explain how business can be easily made with Blockchain.
CO 4. Interpret how Blockchain can be integrated with various current technologies.
CO 5. Examine and test the Blockchain strength in providing solutions.
CO 6. Investigate and understand the Problems with Blockchain.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	3	-
CO5	3	3	3	3	2	-	-	-	-	-	-
CO6	3	3	3	3	3	-	-	-	-	-	-

TEXT BOOKS:

1. Manav Gupta, Blockchain for Dummies, IBM Limited Edition, John Wiley & Sons.

REFERENCE BOOKS:

1. Swan, Melanie. Blockchain: Blueprint for a new economy. O'Reilly Media, Inc.

DEVOPS
(ELECTIVE–II)

Subject Code: PGCS2T0722	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Good exposure to Software Engineering concepts and Software Development Methodologies.

Course Objectives:
To get an expertise on the culture of DevOps in Software Development Methodologies for finding ways to adapt and innovate social structure, culture and technology together in order to work more effectively in the Enterprises.

Syllabus:

UNIT I: (8 Lectures)
Introduction to DevOps: What is DevOps, A History of DevOps, Fundamental Terminology and Concepts – Software Development Methodologies, Operations Methodologies, Systems Methodologies, Development Release and Deployment Concepts, Infrastructure Concepts, Cultural Concepts. DevOps Misconceptions and Anti-Patterns, the Four Pillars of Effective DevOps.

UNIT II: (8 Lectures)
Collaboration: Defining Collaboration, Individual Differences and Backgrounds, Opportunities for Competitive Advantage, Mentorship, Introducing Mindsets, Mindsets and Learning Organizations, The Role of Feedback, Reviews and Rankings, Communication and Conflict Resolution Styles, Empathy and Trust, Humane Staffing and Resources, Misconceptions and Troubleshooting of Collaboration.

UNIT III: (12 Lectures)
Affinity: What Makes a Team, Teams and Organizational Structure, Finding Common Ground Between Teams, Benefits of Improved Affinity, Requirements for Affinity, Measuring Affinity, Misconceptions and Troubleshooting of Affinity.
Tools: Software Development, Automation, Monitoring, Evolution of the Ecosystem,The Value of Tools to People, What Are Tools?, The Right Tools for Real Problems, Embracing Open Source, Standardization of Tools, Consistent Processes for Tool Analysis, Exceptions to Standardization, Irrelevance of Tools, The Impacts of Tools on Culture, Selection of Tools, Auditing Your Tool Ecosystem, Elimination of Tools, Misconceptions and Troubleshooting of Tools.

UNIT IV: (8 Lectures)
Scaling: Understanding Scaling, Considering Enterprise DevOps, Organizational Structure, Team Flexibility, Organizational Lifecycle, Complexity and Change, Scaling for Teams, Team Scaling and Growth Strategies, Scaling for Organizations, Misconceptions and Troubleshooting of Scaling.

UNIT V: **(6 Lectures)**

DevOps Practices: Implementing CI/CD and continuous deployment, Understanding IaC practices, DevOps Best Practices: Automating everything, Choosing the right tool,Writing all your configuration in code, Designing the system architecture, Building a good CI/CD pipeline, Integrating tests, Applying security with DevSecOps, Monitoring your system, Evolving project management.

Course Outcomes:

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

CO 1. Make use the influence of DevOps on Software Development Methodologies along with its Misconceptions and Anti-Patterns.

CO 2. Illustrate the Methodologies of Four Pillars of DevOps and Troubleshoot the common problems that can arise in the effective DevOps.

CO 3. Inference the culture of DevOps to the Enterprises for achieving agility and innovation in its business units.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	-	-	-	-	-	-	-	3
CO2	3	3	3	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Jennifer Davis, RynDaniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, O'Reilly.

2. Mikael Krief, Learning DevOps, Packt Publications.

REFERENCE BOOKS:

1. Verona, Joakim. Practical DevOps. Packt Publishing Ltd.

2. By Jez Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test and Deployment Automation, Addison-Wesley Professional

3. Mandi Walls,Building a DevOps Culture, O'Reilly publications.

4. Sanjeev Sharma, "The DevOps Adoption Playbook – A Guide to Adopting DevOps in a Multi-Speed IT Enterprise", Wiley Publications.

DEEP LEARNING
(ELECTIVE–III)

Subject Code: PGCS2T0822	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Probability & Statistics, Design and Analysis of Algorithms.

Course Objectives: The objective of the course is to provide exposure to these advances and facilitate in depth discussions on deep learning.

Syllabus:

UNIT I: (8 Lectures)

Machine Learning Basics

Learning Algorithms, Capacity, Over fitting and Under fitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Estimation Bayesian Statistics.

Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Descent, Building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

UNIT II: (8 Lectures)

Deep Feedforward Networks

Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms.

UNIT III: (12 Lectures)

Regularization for Deep Learning

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multitask Learning.

Optimization for Training Deep Models

How Learning Differs from 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.

UNIT IV: (8 Lectures)

Convolutional Networks

The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks.

UNIT V: (8 Lectures)

Sequence Modeling: Recurrent and Recursive Nets

Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Optimization for Long-Term Dependencies, Explicit Memory.

Course Outcomes:

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

CO 1. Demonstrate the basics of Machine Learning.

CO 2. Analyze the importance of deep feed forward networks.

CO 3. Summarize the significance of regularization for Deep Learning.

CO 4. Implement optimization in DL.

CO 5. Perceive the importance of Convolutional Networks and its significance.

CO 6. Illustrate the knowledge on Sequence Modelling.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	-	-	-	-	-	3	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	3	-	-	-	3	3
CO5	3	3	-	3	-	-	-	-	-	-	-
CO6	3	3	-	-	-	-	-	-	-	-	-

TEXT BOOKS:

1. Goodfellow, I., Bengio, Y., Courville, A., & Bengio, Y. Deep learning, Vol. 1. Cambridge: MIT press.
2. François Duval , Deep Learning: Deep Learning for Beginners. Practical Guide with Python and Tensorflow, Data Sciences Publishing.

REFERENCE BOOKS:

1. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning: Machine. Learning and Deep Learning with Python, scikit-learn, and TensorFlow, 2nd Edition, Packt Publishing.

BIG DATA TECHNOLOGIES
(ELECTIVE-III)

Subject Code: PGCS2T0922	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: The student should have knowledge of high level programming languages and SQL for analyzing the data.

Course Objectives: The student will be able to understand Big Data as a popular term used to describe the exponential growth, availability and use of information, both structured and unstructured. It is imperative that organizations and IT leaders focus on the ever-increasing volume, variety and velocity of information that forms Big Data. Hadoop is the core platform for structuring BigData, and solves the problem of making it useful for Analytics.

Syllabus:

UNIT I: (8 Lectures)

Introduction to Big Data: What is Big Data and where it is produced? Rise of Big Data, Compare Hadoop vs traditional systems, Limitations and Solutions of existing Data Analytics Architecture, Attributes of Big Data, Types of Data, Use Cases of Big Data, Other technologies vs Big Data.

UNIT II: (9 Lectures)

Hadoop Architecture and HDFS: What is Hadoop? Hadoop History, Distributing Processing System, Core Components of Hadoop, HDFS Architecture, Hadoop Master – Slave Architecture, Daemon Types, Name node, Data node, Secondary Name node.

Hadoop Clusters and the Hadoop Ecosystem- What is Hadoop Cluster? Pseudo Distributed mode, Type of Clusters, Hadoop Ecosystem: Pig, Hive, Flume, SQOOP.

UNIT III: (9 Lectures)

Hadoop MapReduce Framework: Overview of MapReduce Framework, MapReduce Architecture, Job Tracker and Task Tracker, Use Cases of Map Reduce, Anatomy of Map Reduce Program.

MapReduce Programs in Java: Basic MapReduce API Concepts, Writing MapReduce Driver, Mappers, and Reducers in Java, Speeding up Hadoop Development by Using Eclipse, Word Count Example and Weather Dataset Example.

UNIT IV: (10 Lectures)

Hive and HiveQL- What is Hive? Hive vs MapReduce, Hive DDL : Create/Show/Drop Tables, Internal and External Tables, Hive DML : Load Files & Insert Data, Hive Architecture & Components, Difference between Hive and RDBMS, Partitions in Hive.

Pig: Pig vs MapReduce, Pig Architecture & Data types, Shell and Utility components, Pig Latin Relational Operators, Pig Latin: File Loaders and UDF, Programming structure in UDF, Pig Jars Import and limitations of Pig.

UNIT V: (9 Lectures)

Apache SQOOP: Why and What is SQOOP?, SQOOP Architecture, Benefits of SQOOP, Importing Data Using SQOOP.

Apache Flume: Introduction, Flume Model and Goals, Features of Flume, Flume Use Cases.

Course Outcomes:

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

CO 1. Outline importance of Big Data in solving real time problems in data analytics.

CO 2. Illustrate Hadoop ecosystem and its components in detail.

CO 3. Make use of distributed file systems and Hadoop and can write MapReduce programs to solve complex problems.

CO 4. Explore the Hadoop ecosystems core components and apply in real-time scenarios.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	3	3	3	-	-	-	3
CO4	3	3	3	3	3	-	-	-	3	-	-

TEXT BOOKS:

1. Tom White, Hadoop : The Definitive Guide, 3rd Edition, O'reilly

2. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data", 1st Edition, TMH.

REFERENCE BOOKS:

1. Alex Holmes, Hadoop in Practice, MANNING Publications.

2. Srinath Perera, Thilina Gunarathne, Hadoop MapReduce Cookbook, Packt publishing.

CYBER SECURITY
(ELECTIVE-III)

Subject Code: PGCS2T1022	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Computer Networks and Information Security.

Course Objectives: The course will focus on the models, tools, and the techniques for enforcement of cyber security policies, with some emphasis on the use of cryptography.

Syllabus:

UNIT I: (8 Lectures)

Introduction to Computer Security: Definition, Threats to security, Government Requirements, Information Protection and Access Controls, Computer Security Efforts, Standards, Computer Security Mandates and Legislation, Privacy Considerations, International Security Activity.

UNIT II: (7 Lectures)

Cyber Crime Issues: Unauthorized Access to Computers, Computer Intrusions, White Collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Digital Laws and Legislation, Law Enforcement Roles and Responses.

UNIT III: (12 Lectures)

Secure System Planning and Administration: Introduction to the Orange Book, Security Policy Requirements, Accountability, Assurance and Documentation Requirements, Network Security, The Red Book and Government Network Evaluations.

Information Security Policies and Procedures: Corporate Policies, Tier 1, Tier 2 and Tier3 Policies, Process Management, Planning and Preparation, Developing Policies, Asset Classification Policy, Developing Standards.

UNIT IV: (8 Lectures)

Information Security: Fundamentals, Employee Responsibilities, Information Classification, Information Handling, Tools of Information Security, Information Processing, Secure Program Administration.

UNIT V: (7 Lectures)

Organizational and Human Security: Adoption of Information Security Management Standards, Human Factors in Security, Role of Information Security Professionals.

Course Outcomes:

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

CO 1. Specify tools and architectures to help secure computer and information systems both proactively and reactively.

CO 2. Describe how cyber-attacks against an organization can be monitored and investigated for actionable intelligence.

CO 3. Apply skills and knowledge to create new responses to emerging cyber security problems so that they can respond to new attacks as they evolve.

CO 4. Identify components of a modern information system and the threats that challenge their security.

CO 5. Identify the risks an organization faces due to cyber threats and recommend steps to combat those risks.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	2	-	-	-
CO2	3	2	-	2	2	-	-	3	-	-	-
CO3	3	3	3	3	2	-	2	-	3	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	3	2	-	-	-	-	-	-

TEXT BOOKS:

1. Debby Russell and Sr. G.T Gangemi, "Computer Security Basics (Paperback)", 2nd Edition, O' Reilly Media.
2. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi.
3. Thomas R. Peltier, "Information Security policies and procedures: A Practitioner's Reference", 2nd Edition, Prentice Hall.

REFERENCE BOOKS:

1. Kenneth J. Knapp, "Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions", IGI Global.
2. Thomas R Peltier, Justin Peltier and John blackley, "Information Security Fundamentals", 2nd Edition, Prentice Hall.
3. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ", Tata McGraw -Hill, New Delhi.

CLOUD COMPUTING
(ELECTIVE–III)

Subject Code: PGCS2T1122	**L**	**T**	**P**	**C**
I Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: Familiarity with Operating Systems, Computer Networks and Database Management Systems.

Course Objectives: The objective of this course is to provide students with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications.

Syllabus:

UNIT I: (10 Lectures)

Introduction to Cloud Computing: Trends in Computing - Distributed Computing, Grid Computing, Cluster Computing, Utility Computing, Cloud Computing, Definition of Cloud Computing, Characteristics, Service Models, Deployment Models, Cloud Service Models Providers, Advantages and Disadvantages of Cloud Computing, Cloud-based Services & Applications.

UNIT II: (8 Lectures)

Cloud Concepts & Technologies: Virtualization and its types, Software Defined Networking, Network Function Virtualization(NFV).

Cloud Services: Compute Services, Storage Services, Database Services, Application Services.

UNIT III: (10 Lectures)

Cloud Application Design: Design Considerations for Cloud Applications, Reference Architectures for Cloud Applications, Cloud Application Design Methodologies: SOA, Cloud Component Model, and MVC, Data Storage Approaches.

Cloud Security: Cloud Security Architecture(CSA), Authentication, Authorization, Identity & Access Management, Data Security, Key Management.

UNIT IV: (7 Lectures)

Migrating into a Cloud: Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud, Migration Risks and mitigation, Phases of Migrating to Cloud, benefits and risks of Migrating to Cloud.

UNIT V: (9 Lectures)

SLA Management in Cloud Computing: Service Level Agreements(SLA), Considerations for SLA, SLA Requirements, Types of SLA, Life Cycle of SLA, SLA

Management in Cloud. **Case Study:** Amazon AWS: EC2, Amazon Simple DB, Amazon S3, Amazon Cloud Front and Amazon SQS.

Course Outcomes:

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

CO 1. Illustrate key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing.

CO 2. Choose the appropriate methodologies and considerations for Cloud application design.

CO 3. Interpret the core issues of Cloud Computing such as security, Privacy and Interoperability.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	3
CO3	3	3	-	3	-	-	-	-	3	3	3

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, Cloud Computing : A Hands-on Approach, Universities Press.
2. Rajkumar Buyya, James Brogerg, Andrzej Goscinski, Cloud Computing : Principles and Paradigms, WILEY Publication.

REFERENCE BOOKS:

1. Michael Miller, "Cloud Computing – Web Based Applications That Change the way you Work and Collaborate Online", Pearson Education.
2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing : A Practical Approach", McGraw-Hill.

COMPUTER NETWORKS AND OPERATING SYSTEMS LAB

Subject Code: PGCS2P1222	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Familiarity with C or Java Programming.

Course Objectives: The students will learn and implement the Various Error correction, Detection Mechanisms, concepts of routing algorithms, and OS concepts like Processor scheduling and Deadlock mitigation Techniques and Analyze Various file, disk and memory management mechanisms.

List of Experiments:

PART A: Computer Networks Lab

Week 1:

Implement the Data Link Layer Framing methods such as Character Stuffing and Bit Stuffing.

Week 2:

Implement CRC and checksum methods.

Week 3:

Implement one bit error correction in the received frame using Hamming code.

Week 4:

Write a program to implement distance vector routing algorithm.

Week 5:

Write a program to implement Broad cast routing algorithm.

Week 6:

a. Write a program to develop a simple Chat TCP application.
b. Write a program to develop a simple Chat UDP application.

PART B: Operating Systems Lab

Week 7:

Simulate the following CPU Scheduling Algorithms
a. FCFS b. SJF c. Priority

Week 8:

Simulate Bankers Algorithm for Deadlock Avoidance.

Week 9:

Simulate the following Page Replacement Algorithms

a. FIFO b. LRU

Week 10:

Simulate the following File Allocation Strategies

a. Sequential b. Indexed

Week 11:

Simulate the following disk scheduling algorithms

a. SCAN b. SSTF

Course Outcomes:

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

CO1: Use network programming concepts to develop and implement Error Correction and Detection mechanisms.

CO2: Design and implement the routing algorithms in simple networks.

CO3: Implement any topology using network devices.

CO4: Implement various Processor and memory scheduling algorithms.

CO5: Design and implement disk access, file system facilities of Operating system.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	-	3	-	3	3	-	3	-	-	3
CO2	3	3	3	-	3	3	-	3	-	-	3
CO3	3	-	3	-	3	3	-	3	-	-	3
CO4	3	-	3	-	-	3	-	3	-	-	3
CO5	3	3	3	-	-	3	-	3	-	-	3

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, TMH.

2. A.S. Tanenbaum, Computer Networks, 4th Edition, Pearson Education

3. Abraham Silberchatz, Peter B.Galcin,Greg Gagne,Operating System Concepts, 8th Edition, John Wiley.

4. Stallings, Operating systems-internals and design principles, sixth Edition, Pearson education.

FULL STACK DEVELOPMENT LAB

Subject Code: PGCS2P1322	**L**	**T**	**P**	**C**
I Year / II Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Students should have the prior knowledge on HTML, CSS and JavaScript technologies.

Course Objectives: This lab course is aimed to get the hands on experience on complete Full Stack development(MERN) by imparting core concepts of both the frontend and backend development with latest web technologies and NOSQL Databases.

List of Experiments:

1. Develop a React render HTML Student Registration Webpage.
2. Incorporate styles to Student Registration Webpage using React CSS.
3. Create a reusable React Component and implement in any webpage.
4. Develop a React Form that performs the actions click, change, mouseover using React Events.
5. Install Node.js, create Node.js application, make a request to the Node.js Server and display "Hello World" in web browser.
6. Create own modules in Node.js application to process images and to work with Dates, Strings and Colors.
7. Create Node.js application to perform Create, Read, Update and Delete operations on Files.
8. Design a Node.js application that refreshes automatically after using Express.js
9. Perform Create, Read, Update and Delete (CRUD) Operations in MongoDB NOSQL Platform.
10. Develop a Node.js application to store and retrieve the details of students using MongoDB.
11. Design the front-end for a Shopping webpage using AngularJS.

Course Outcomes:

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

- **CO1.** Set-up React and AngularJS environments and design a frontend for Web Pages.
- **CO2.** Create Node.js framework and develop interactive Web applications using the skills of Node.js and Express.js
- **CO3.** Install MongoDB and integrate with the web applications to implement real world applications.

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	3	-	-	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-

TEXT BOOKS:

1. Azat Mardan, React Quickly, Manning Publications Co.

2. Colin J. Ihrig and Adam Bretz, Full Stack JavaScript Development with MEAN, SitePoint Pty Ltd.

REFERENCE BOOKS:

1. Kirupa Chinnathambi, Learning React, Pearson Education Inc.

2. Cássio de Sousa Antonio, Pro React, Apress.

3. Vasan Subramanian, Pro MERN Stack, Apress Publications.

4. Simon Holmes, Clive Harber, Getting Mean with Mongo, Express, Angular and Node, Manning Publications Co.

5. Amos Q. Haviv, MEAN Web Development, Packt Publishing.