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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III

L/T/P	C
3/0/0	3

DISCRETE MATHEMATICS-5PC3EA

Course Objective:

To develop a strong foundation in discrete mathematical concepts including logic, set theory, algebraic structures, combinatorics , and graph theory enabling students to analyze, model, and solve computational and real-world problems using logical and analytical reasoning.

Course Outcomes:

Upon completion of course the student will

1. **Analyze** logical statements using propositional and predicate calculus, and apply inference rules to construct valid mathematical arguments. **L4**
2. **Apply** the concepts of set theory, relations, and functions to model and represent discrete structures used in computer science. **L3**
3. **Study** algebraic structures such as semigroups, monoids, lattices, and Boolean algebras to understand their properties and role in computation and logic design. **L4**
4. **Apply** counting principles, permutations, and combinations to solve elementary combinatorial and enumeration problems in discrete mathematics. **L3**
5. **Explore** various types of graphs, trees, and their properties to solve real-world network problems and understand fundamental graph-theoretical concepts. **L4**

UNIT - I

Mathematical logic: Introduction, Statements and Notation, Connectives, Normal Forms, Theory of Inference for the Statement Calculus, The Predicate Calculus, Inference Theory of the Predicate Calculus.

UNIT - II

Set theory: Introduction, Basic Concepts of Set Theory, Representation of Discrete Structures, Relations and Ordering, Functions.

UNIT - III

Algebraic Structures: Introduction, Algebraic Systems, Semi groups and Monoids, Lattices as Partially Ordered Sets, Boolean Algebra.

UNIT - IV

Elementary Combinatorics: Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutation with Constrained Repetitions, Binomial Coefficient, The Binomial and Multinomial Theorems, The Principle of Exclusion.

UNIT - V

Graph Theory: Basic Concepts, Isomorphism and Subgraphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multi-graphs and Euler Circuits, Hamiltonian Graphs, Chromatic Numbers, The Four-Color Problem.

TEXT BOOKS:

1. Discrete Mathematical Structures with Applications to Computer Science: J.P. Tremblay, R. Manohar, McGraw-Hill, 1st ed.
2. Discrete Mathematics for Computer Scientists & Mathematicians: Joe L. Mott, Abraham Kandel, Theodore P. Baker, Prentice Hall of India, 2nd ed.

REFERENCE BOOKS:

1. Discrete and Combinatorial Mathematics – An Applied Introduction: Ralph P. Grimaldi, Pearson Education, 5th Edition.
2. Discrete Mathematical Structures: Thomas Koshy, Tata McGraw Hill Publishing Co.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III

L/T/P	C
3/0/0	3

COMPUTER ORGANIZATION AND ARCHITECTURE – 5PC3EB

Course Objective:

The purpose of the course is to introduce principles of computer organization and the basic architectural concepts. Emphasizing on the basic organization, design, and programming of a simple digital computer by introducing simple register transfer language to specify various computer operations which include computer arithmetic, instruction set design, micro-programmed control unit, pipe-lining and vector processing, memory organization and I/O systems, and multiprocessors.

Course Outcomes:

Upon completion of course the students will

1. **Make use** of Boolean algebra, number systems, data representation, and logic gates to design and know basic digital circuits and computer organization components **L3**
2. **Investigate** combinational and sequential logic circuits concepts to understand their functions and apply these concepts in arithmetic and control operations. **L4**
3. **Explore** the concepts of register transfers and basic computer organization to understand how instructions are executed. **L4**
4. **Study** CPU and control unit designs to recognize how instructions and arithmetic operations are executed efficiently. **L4**
5. **Analyze** memory and I/O systems to understand data transfer and memory hierarchy. **L4**

UNIT - I

Boolean Algebra and Logic Gates: Binary codes, Binary Storage and Registers, Binary logic.

Digital logic gates. Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.

Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

UNIT - II

Combinational Logic: Combinational Circuits, Analysis procedure Design procedure, Binary Adder- Subtractor, Decimal Adder, Binary multiplier, magnitude comparator, Decoders, Encoders, Multiplexers, HDL for combinational circuits.

Sequential Logic: Sequential circuits, latches, Flip-Flops Analysis of clocked sequential circuits, state Reduction and Assignment, Design Procedure. Registers, shift Registers, Ripple counters, synchronous counters, other counters.

UNIT - III

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

Basic Computer Organization and Design: Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt.

UNIT - IV

Microprogrammed Control: Control memory, Address sequencing, micro program example, design of control unit.

Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

UNIT - V

Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

TEXT BOOKS:

1. Digital Design – M. Morris Mano, Third Edition, Pearson/PHI.
2. Computer System Architecture – M. Morris Mano, Third Edition, Pearson/PHI.

REFERENCE BOOKS:

1. Switching and Finite Automata Theory, ZVI. Kohavi, Tata Mc Graw Hill.
2. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, 5th Edition, Mc-Graw Hill.
3. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
4. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III **L/T/P C**
3/0/0 3

OBJECT ORIENTED PROGRAMMING THROUGH JAVA - 5PC3EC

Course Objective:
To enable students to understand and apply object-oriented programming principles using Java by developing modular, reusable, and event-driven applications; to analyze the use of inheritance, polymorphism, multi-threading, exception handling, I/O, and GUI components (AWT and Swing) for building robust, efficient, and interactive software systems.

Course Outcomes:
Upon completion of the course the students will

1. **Know to Apply** the principles of object-oriented programming and Java fundamentals to develop simple, structured, and reusable programs using classes, objects, and control structures. **L3**
2. **Examine** and implement object-oriented relationships using inheritance, polymorphism, packages, and interfaces to design modular, extensible, and reusable Java applications. **L4**
3. **Analyze** and implement exception handling and multi-threading mechanisms to develop robust, concurrent, and efficient Java applications. **L4**
4. **Study** and implement Java utility, I/O, and event-handling mechanisms to design interactive and efficient graphical user interface (GUI) applications.
5. **Know how to make use** of advanced Java GUI concepts and implement applications using Swing components and know the MVC architecture to design user-friendly, modular, and event-driven interfaces. **L3**

UNIT - I

Object oriented thinking and Java Basics- Need for oop paradigm, summary of oop concepts, coping with complexity, abstraction mechanisms. History of Java, Java buzzwords, data types, variables, scope and lifetime of variables, arrays, operators, expressions, control statements, type conversion and casting, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, nested and inner classes, exploring String class.

UNIT - II

Inheritance, Packages and Interfaces – Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Member access rules, super keyword uses, using final keyword with inheritance, polymorphism- method overriding, abstract classes, the Object class. Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.

UNIT - III

Exception handling and Multithreading– Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception subclasses. Differences between multithreading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads, inter thread communication, thread groups, daemon threads.

UNIT - IV

Exploring String class, Object class, Exploring java.util package, Exploring java.io package

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. graphics, layout manager – layout manager types – border, grid, flow, card and grid bag.

UNIT - V

Swing – Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing-JFrame and JComponent, JLabel, ImageIcon, JTextField, JButton, JCheckBox, JRadioButton, JList, JComboBox, Tabbed Panes, Scroll Panes, Trees, and Tables. Menu Basics, Menu related classes - JMenuBar, JMenu, JMenuItem, JCheckBoxMenuItem, JRadioButtonMenuItem, JSeperator. creating a popup menu

TEXT BOOKS:

1. Java the complete reference, 13th edition, Herbert schildt, Dr. Denny Coward, Mc Graw Hill.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson education.

REFERENCE BOOKS:

1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John Wiley & sons.
2. An Introduction to OOP, third edition, T. Budd, Pearson education.
3. Introduction to Java programming, Y. Daniel Liang, Pearson education.
4. Core Java 2, Vol 1, Fundamentals, Cay.S. Horstmann and Gary Cornell, eighth Edition, Pearson Education.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III **L/T/P C**
3/0/0 3

SOFTWARE ENGINEERING - 5PC3ED

Course Objective:
The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects. Through the concepts of process models, software requirements, software design, software testing, software process/product metrics, risk management, quality management and UML diagrams

Course Outcomes:
Upon completion of the course the students will

1. **Apply** and implement common patterns in software development processes to develop software applications using suitable process models. **L3**
2. **study** the various software requirements, to effectively design and prepare SRS document and know them. **L4**
3. Identify and **apply** an appropriate software design process or model in the development of software solutions. **L3**
4. know how to **apply** appropriate testing strategies to design and develop test cases for software systems. **L3**
5. Demonstrate quality assurance practices and **identify** risk management strategies throughout the Software Development Life Cycle. **L3**

UNIT - I
Introduction to Software Engineering: The evolving role of software, changing nature of software, software myths. A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI).
Process models: The waterfall model, Spiral model, Incremental Process Models, Concurrent Models, Component based development and Agile Development.

UNIT - II
Software Requirements: Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document.
Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management.

UNIT - III
Design Engineering: Design process and design quality, design concepts, the design model.
Creating an architectural design: software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, use

case diagrams, class diagrams, sequence diagrams, collaboration diagrams, activity diagrams and component diagrams.

UNIT - IV

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

Metrics for Process and Products: Software measurement, metrics for software quality.

UNIT - V

Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM.

Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.

TEXT BOOKS:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, McGraw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.
3. The unified modeling language user guide, Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

REFERENCE BOOKS:

1. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley.
2. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.
3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.
4. Fundamentals of Software Engineering-Rajib Mall, PHI.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III **L/T/P C**

3/0/0 3

DATABASE MANAGEMENT SYSTEMS - 5PC3EE

Prerequisites:
A course on "Data Structures".

Course Objective:
To understand the basic concepts and the applications of database systems. To master the basics of SQL and construct queries using SQL. Through the concepts of data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

Course Outcomes:
Upon completion of the course the student will

1. **Study** user requirements and construct accurate ER diagrams by identifying appropriate entities, attributes, relationships, and constraints during conceptual database design. **L4**
2. **Apply** relational model principles to enforce integrity constraints and design logical database schemas including creation, modification, and deletion of relations and views. **L3**
3. **Explore** database schemas to detect redundancy and anomalies, and evaluate normalization techniques to achieve optimized and lossless schema design. **L4**
4. know transaction management principles and recovery techniques and **apply** them to ensure consistent, isolated, and reliable execution of database transactions. **L3**
5. **Study and utilize** different indexing and file organization methods to compare their performance and determine the most suitable technique for storage management. **L4**

UNIT - I

Database System Applications: A Historical Perspective, File Systems versus a DBMS, the Data Model, Levels of Abstraction in a DBMS, Data Independence, Structure of a DBMS **Introduction to Database Design:** Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model

UNIT - II

Introduction to the Relational Model: Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical database design, introduction to views, destroying/altering tables and views. Relational Algebra, Tuple relational Calculus, Domain relational calculus.

UNIT - III

SQL: QUERIES, CONSTRAINTS, TRIGGERS: form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, triggers and active databases.

Schema Refinement: Problems caused by redundancy, decomposition, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi valued dependencies, FOURTH normal form, FIFTH normal form.

UNIT - IV

Transaction Concept, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock Based Protocols, Timestamp Based Protocols, Validation- Based Protocols, Multiple Granularity, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions.

UNIT - V

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree based Indexing, Comparison of File Organizations, Indexes- Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM) B+ Trees: A Dynamic Index Structure.

TEXT BOOKS:

1. Database System Concepts, Silberschatz, Korth, McGraw hill, V edition, 3rd Edition.
2. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata Mc Graw Hill.

REFERENCE BOOKS:

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel, 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate, Pearson Education.
3. Introduction to Database Systems, C. J. Date, Pearson Education.
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, SPD.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III

L/T/P	C
2/0/0	2

INNOVATION AND ENTREPRENEURSHIP - 5HS3EF

Course Objective:

To impart comprehensive knowledge on innovation and entrepreneurship, encompassing opportunity identification, idea generation, prototyping, MVP development, business-financial planning, Go-to-market strategies, startup establishment, venture pitching, and IPR.

Course Outcomes:

Upon completion of course the students will

1. **Understand** the entrepreneurship and the entrepreneurial process and its significance in economic development. **L2**
2. **Assess** the problem from an industry perspective and generate solutions using the design thinking principles. **L3**
3. **Assess** market competition, estimate market size, and develop a prototype. **L3**
4. **Analyze** Business and financial planning models and Go-to-Market strategies. **L4**
5. **Learn** to build a start-up, register IP and identify funding opportunities. **L3**

UNIT - I

Fundamentals of Innovation and Entrepreneurship

Innovation: Introduction, need for innovation, Features, Types of innovations, innovations in manufacturing and service sectors, fostering a culture of innovation, planning for innovation.
Entrepreneurship: Introduction, types of entrepreneurship attributes, mindset of entrepreneurial and intrapreneurial leadership, Role of entrepreneurs in economic development. Woman Entrepreneurship, Importance of on-campus startups. Understanding to build entrepreneurial mindset, attributes and networks individuals while on campus.
Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity.

UNIT - II

Problem and Customer Identification

Identification of gap, problem, analyzing the problem from a industry perspective, real-world problems, market and customer segmentation, validation of customer problem fit, Iterating problem-customer fit, Competition and Industry trends mapping and assessing initial opportunity, Porter's Five Force Model. Idea generation, Ideation techniques: Brainstorming, Brain writing, Round robin, and SCAMPER, Design thinking principles, Mapping of solution to problem.
Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

UNIT - III

Opportunity assessment and Prototype development

Identify and map global competitors, review industry trends, and understand market sizing: TAM, SAM, and SOM. Assessing scope and potential scale for the opportunity. Understanding prototyping and Minimum Viable Product (MVP). Developing a prototype: Testing, and validation.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity.

UNIT - IV

Business & Financial Models

Introduction to Business Model and types, Lean Canvas Approach: 9-block lean canvas model, building lean canvas for your startup. Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, Economies of Scale. and analyzing financial performance. Go-To-Market (GTM) approach -– Selecting the Right Channel, creating digital presence, and building customer acquisition strategy.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

UNIT - V

Startups and IPR

Startup requirements, building founding team members and mentors, pitch preparation, start-up registration process, funding opportunities and schemes, institutional support to entrepreneurs, startup lifecycle, documentation, legal aspects in startup, venture pitching readiness, National Innovation Startup Policy (NISP) and its features. Patents, Designs, Patentability, Procedure for grants of patents. Indian Scenario of Patenting, International Scenario: International cooperation on Intellectual Property. Patent Rights: Scope of Patent Rights. Copyright, trademark, and GI. Licensing and transfer of technology.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

SUGGESTED READINGS:

1. John R Bessant, Joe Tidd, Innovation and Entrepreneurship, 4E, Wiley, Latest Edition.
2. Ajay Batra, The Stratup Launch Book- A Practical Guide for Launching Customer Centric Ventures, Wiley, 2020. (For Core Teaching Tool).
3. Entrepreneurship Development and Small Business Enterprises, Poornima M Charantimath, 3E, Pearson, 2018.
4. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.
5. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III **L/T/P C**
0/0/2 1

OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB - 5PC351

Course Objective:

To provide hands-on experience in applying object-oriented programming concepts using Java for developing modular, reusable, and interactive applications; to enable students to implement exception handling, multi-threading, GUI development, and file management techniques; and to analyze and design efficient, event-driven, and concurrent software solutions through practical experimentation.

Course Outcomes:

Upon completion of the course the students will

1. **Apply** object-oriented programming principles using Java to develop, test, and debug programs involving classes, objects, constructors, and control structures.
2. **Develop** interactive GUI-based applications using AWT, Swing, and applets to build event-driven and user-responsive programs.
3. **Analyze** and implement multi-threading, exception handling, and inter-thread communication to create concurrent and fault-tolerant Java applications.
4. **Implement** and manipulate data structures and file handling techniques in Java for efficient data storage, retrieval, and organization.
5. **Analyze** the design and re-usability of Java applications through abstraction, inheritance, and polymorphism to implement extensible and maintainable software solutions.

Note:

1. Use LINUX and MySQL for the Lab Experiments. Though not mandatory, encourage the use of the Eclipse platform.

List of Experiments:

1. Use Eclipse or Net bean platform and acquaint yourself with the various menus. Create a test project, add a test class, and run it. See how you can use auto suggestions, auto fill. Try code formatter and code refactoring like renaming variables, methods, and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
2. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -, *, % operations. Add a text field to display the result. Handle any possible exceptions like divided by zero.
3. **A)** Develop an applet in Java that displays a simple message.

   B) Develop an applet in Java that receives an integer in one text field, and computes its factorial value and returns it in another text field, when the button named “Compute” is clicked.

4. Write a Java program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the exception in a message dialog box.
5. Write a Java program that implements a multi-thread application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
6. Write a Java program for the following: Create a doubly linked list of elements. Delete a given element from the above list. Display the contents of the list after deletion.
7. Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with “Stop” or “Ready” or “Go” should appear above the buttons in the selected color. Initially, there is no message shown.
8. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area() that prints the area of the given shape.
9. Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are separated by commas.
10. Write a java program to display the table using Labels in Grid Layout.
11. Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired (Use Adapter classes).
12. Write a Java program that loads names and phone numbers from a text file where the data is organized as one line per record and each field in a record are separated by a tab (\t). It takes a name or phone number as input and prints the corresponding other value from the hash table (hint: use hash tables).
13. Write a Java program that correctly implements the producer – consumer problem using the concept of inter thread communication.
14. Write a Java program to list all the files in a directory including the files present in all its sub-directories.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III

L/T/P	C
0/0/2	1

SOFTWARE ENGINEERING LAB - 5PC352

Course Outcomes:

Upon completion of the course the students will

1. **Apply** and implement common patterns in software development processes to develop software applications using suitable process models. **L3**
2. **study** the various software requirements, to effectively design and prepare SRS document and know them. **L4**
3. Identify and **apply** an appropriate software design process or model in the development of software solutions. **L3**
4. know how to **apply** appropriate testing strategies to design and develop test cases for software systems. **L3**
5. Demonstrate quality assurance practices and **identify** risk management strategies throughout the Software Development Life Cycle. **L3**

List of Experiments

Do the following exercises for the list of any four sample projects:

1. **WEEK 1,2:** Development of problem statements.
2. **WEEK 3,4:** Preparation of Software Requirement Specification Document, Design Documents and Testing Phase related documents.
3. **WEEK 5,6:** Preparation of Software Configuration Management and Risk Management related documents.
4. **WEEK 7,8:** Study and usage of any Design phase CASE tool. (Example Star UML)
5. **WEEK 9,10,11,12:** Performing the Design by using any Design phase CASE tools.
6. **WEEK 13:** Develop test cases for unit testing and integration testing.
7. **WEEK 14,15:** Develop test cases for various white box and black box testing techniques.

1. Book bank
2. Online exam registration
3. Online course reservation system
4. E-ticketing
5. Passport Automation System
6. Stock Maintenance System
7. Software Personal Management System
8. Credit Card Processing
9. E-Book Management System
10. Recruitment System

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III

L/T/P	C
0/0/2	1

DATABASE MANAGEMENT SYSTEMS LAB - 5PC353

Course Outcomes:

Upon completion of the course the students will

1. **Study** user requirements and construct accurate ER diagrams by identifying appropriate entities, attributes, relationships, and constraints during conceptual database design. **L4**
2. **Apply** relational model principles to enforce integrity constraints and design logical database schemas including creation, modification, and deletion of relations and views. **L3**
3. **Explore** database schemas to detect redundancy and anomalies, and evaluate normalization techniques to achieve optimized and lossless schema design. **L4**
4. know transaction management principles and recovery techniques and **apply** them to ensure consistent, isolated, and reliable execution of database transactions. **L3**
5. **Study and utilize** different indexing and file organization methods to compare their performance and determine the most suitable technique for storage management. **L4**

List of Experiments:

1. **Week 1:** Concept design with E-R Model.
2. **Week 2:** Relational Model.
3. **Week 3:** Creation and dropping of Views.
4. **Week 4:** Practicing DDL commands.
5. **Week 5:** Queries on DDL commands.
6. **Week 6:** Practicing DML commands.
7. **Week 7:** Queries on DML commands.
8. **Week 8:** Querying (using ANY, ALL, UNION, INTERSECT, JOIN, Constraints etc.)
9. **Week 9:** Nested, Correlated subqueries.
10. **Week 10:** Queries using Aggregate functions, GROUP BY, HAVING.
11. **Week 11:** Normalization (1NF, 2NF, 3NF).
12. **Week 12:** Normalization (BCNF, 4NF, 5NF).
13. **Week 13:** Triggers (Creation of insert trigger, delete trigger, update trigger)
14. **Week 14:** Procedures.
15. **Week 15:** Usage of Cursors.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III **L/T/P C**
0/0/2 1

NODE JS/ REACT JS/ DJANGO (Skill Development Course) - 5PC354

Course Objective:

To implement the static web pages using HTML and do client-side validation using JavaScript. Design and work with databases using Java. Develop an end to end application using java full stack. Introduce Node JS implementation for server-side programming. To experiment with single page application development using React.

Course Outcomes:

At the end of the course, the student will be able to,

1. **Build** a custom website with HTML, CSS, and Bootstrap and little JavaScript. **L3**
2. **Make use** of Advanced features of JavaScript and learn about JDBC. **L3**
3. **Experiment** with java technologies like JDK, JRE and implement the same across a Server – side. **L3**
4. **Develop** the server – side implementation using Node JS. **L3**
5. **Construct** a Single Page Application using React JS. **L3**

Exercises:

1. Build a responsive web application for shopping cart with registration, login, catalog and cart pages using CSS3 features, flex and grid.
2. Make the above web application responsive web application using Bootstrap framework.
3. Use JavaScript for doing client – side validation of the pages implemented in Exercises 1 and 2.
4. Explore the features of ES6 like arrow functions, callbacks, promises, async/await. Implement an application for reading the weather information from openweathermap.org and display the information in the form of a graph on the web page.
5. Develop a java stand alone application that connects with the database (Oracle / mySql) and perform the CRUD operation on the database tables.
6. Create an xml for the bookstore. Validate the same using both DTD and XSD.
7. Design a controller with servlet that provides the interaction with application developed in experiment 1 and the database created in experiment 5.
8. Maintaining the transactional history of any user is very important. Explore the various session tracking mechanism (Cookies, HTTP Session)
9. Create a custom server using http module and explore the other modules of Node JS like OS, path, event.

10. Develop an express web application that can interact with REST API to perform CRUD operations on student data. (Use Postman)
11. For the above application create authorized end points using JWT (JSON Web Token).
12. Create a react application for the student management system having registration, login, contact, about pages and implement routing to navigate through these pages.
13. Create a service in react that fetches the weather information from openweathermap.org and the display the current and historical weather information using graphical representation using chart.js
14. Create a TO DO application in react with necessary components and deploy it into GitHub.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER III **L/T/P C**
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ENVIRONMENTAL SCIENCE (Value Added Course) - 5PC355

Course Objectives:

To impart comprehensive knowledge on environmental ecosystems, natural resource management, biodiversity conservation, pollution control, and global challenges, including their societal relevance, sustainable strategies, legislative frameworks, and the role of policy, law, and Environmental Impact Assessment (EIA) in fostering sustainable development.

Course Outcomes:

Upon completion of the course the students will

1. **Study** the structure, function, and significance of ecosystems, including energy flow, biogeochemical cycles, and biodiversity conservation through field experiences. **L4**
2. **Explore** the classification, utilization, and sustainable management of natural resources, along with alternative energy options. **L4**
3. **Evaluate** biodiversity at genetic, species, and ecosystem levels, its values, threats, and conservation methods under national and international frameworks. **L3**
4. **Identify** types, sources, and impacts of environmental pollution, and apply suitable control technologies while assessing global environmental challenges and protocols. **L3**
5. **Interpret** environmental policies, legislation, and the EIA process to propose management plans addressing contemporary environmental and sustainability issues. **L2**

UNIT - I

Ecosystems: Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio magnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources.
water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems.
Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources.
Land resources: Forest resources.
Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic

and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies:

Environmental Pollution: Classification of pollution.

Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards.

Water pollution: Sources and types of pollution, drinking water quality standards.

Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil.

Noise Pollution: Sources and Health hazards, standards.

Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management.

Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation.

Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification.

International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio- economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan(EMP). Contemporary Environmental Issues Climate change; Sustainable development goals (SDGs); Global environmental challenges; Environmental policies and international agreements.

TEXT BOOKS:

1. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.
2. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV **L/T/P C**
3/0/0 3

COMPUTER ORIENTED STATISTICAL METHODS - 5 B S 4 E A

Pre-requisites:
Mathematics courses of first year .

Course Objective:
To enable students to understand and apply the concepts of random variables, probability distributions (discrete and continuous), sampling theory, estimation of population parameters, hypothesis testing for means, proportions and variances, and the fundamentals of stochastic processes and Markov chains for effective statistical data analysis and modeling of real-world systems.

Course outcomes:
After learning the contents of this paper, the student must be able to:

1. **Apply** the concepts of Random variable and distributions to compute mean and variance for discrete and continuous cases. **L3**
2. **Apply** continuous probability distributions and sampling theory to analyze data and make statistical inferences. **L3**
3. **Apply** statistical estimation methods to determine population parameters for means, proportions, and variances from sample data. **L3**
4. **Analyze** and perform hypothesis tests for means, proportions and variances using suitable large and small sample techniques. **L4**
5. **Analyze** stochastic processes and markov chains to model and evaluate systems using transition probabilities and steady-state behavior. **L4**

UNIT-I: Random Variables and Probability Distributions

Concept of a Random Variable – Discrete Probability Distributions – Continuous Probability Distributions – Mean of a Random Variable – Variance of a Random Variable
Discrete Probability Distributions: Binomial Distribution – Poisson distribution

UNIT-II: Continuous Distributions and sampling

Uniform Distribution – Normal Distribution – Areas under the Normal Curve – Applications of the Normal Distribution – Normal Approximation to the Binomial Distributions.
Fundamental Sampling Distributions: Random Sampling – Some Important Statistics – Sampling Distributions – Sampling Distribution of Means – Central Limit Theorem.

UNIT-III: Estimation

Introduction – Statistical Inference – Classical Methods of Estimation – Single Sample: Estimating the Mean, Estimating the Proportion, Estimating the Variance – Two Samples: Estimating the Difference Between Means, Estimating the Difference Between Proportions, Estimating the Ratio of Variances.

UNIT-IV: Tests of Hypothesis

Introduction – Hypothesis testing – Tests on Means – Tests on Proportions – Tests on Variances – Test for Goodness of Fit – Chi-Square Test – Large Sample Tests – Small Sample Tests – Student's t-distribution – F-distribution.

UNIT-V: Stochastic Processes and Markov Chains

Introduction to Stochastic Processes – Classification of Stochastic Processes – Markov Process – Markov Chains – Transition Probability Matrix – Chapman-Kolmogorov Equations – Steady State Probabilities – Applications of Markov Chains.

TEXT BOOKS:

1. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Pearson Education.
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons.
3. Introduction to Probability Models, Sheldon M. Ross, Academic Press.

REFERENCE BOOKS:

1. Probability, Statistics and Random Processes, T. Veerarajan, Tata McGraw Hill.
2. Applied Statistics and Probability for Engineers, Douglas C. Montgomery and George C. Runger, Wiley.
3. Introduction to Mathematical Statistics, Robert V. Hogg and Allen T. Craig, Pearson Education.
4. Stochastic Processes, J. Medhi, New Age International Publishers.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV **L/T/P C**
3/0/0 3

OPERATING SYSTEMS - 5PC4EB

Prerequisites:

1. A course on "Computer Programming and Data Structures", and course on "Computer Organization and Architecture".

Course Objectives:

To introduce fundamental operating system concepts—including processes, threads, scheduling, synchronization, deadlocks, memory management, file/I/O subsystems, and protection—along with design challenges and Unix/Linux primitives for process management, IPC, and I/O, enabling students to analyze and implement basic OS functionalities.

Course Outcomes:

upon completion of the course the students will

1. **Explore** various operating system structures, components, services, and process management techniques—including process scheduling, cooperating processes, and threads—to effectively know and manage services across modern computing environments. **L4**
2. **Make use** of CPU scheduling algorithms and system call interfaces for process management, and evaluate various deadlock handling techniques including prevention, avoidance, detection, and recovery in operating systems. **L3**
3. **Study** process synchronization techniques and interprocess communication mechanisms like semaphores, monitors, pipes, message queues, and shared memory—to solve critical section problems and enable effective communication in single and distributed systems. **L4**
4. **Learn** to infer memory management techniques including paging, segmentation, demand paging, and page replacement algorithms to efficiently manage logical and physical address spaces in operating systems. **L4**
5. **Apply** file system concepts and operations—including access methods, directory structures, allocation, and free-space management—using system calls like open, create, read, write, close, lseek, stat, and ioctl in an operating system environment. **L3**

UNIT - I

Operating System – Introduction, Structures - Simple Batch, Multiprogrammed, Time-shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, Operating System services, System Calls

Process – Process concepts and scheduling, Operations on processes, Cooperating Processes, Threads

UNIT - II

CPU Scheduling – Scheduling Criteria, Scheduling Algorithms, Multiple -Processor Scheduling. System call interface for process management-fork, exit, wait, waitpid, exec

Deadlocks – System Model, Deadlocks Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock

UNIT - III

Process Management and Synchronization – The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, Critical Regions, Monitors

Inter-process Communication Mechanisms: IPC between processes on a single computer system, IPC between processes on different systems, using pipes, FIFOs, message queues, shared memory.

UNIT - IV

Memory Management and Virtual Memory – Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Page Replacement, Page Replacement Algorithms.

UNIT - V

File System Interface and Operations – Access methods, Directory Structure, Protection, File System Structure, Allocation methods, Free-space Management. Usage of open, create, read, write, close, lseek, stat, ioctl system calls.

TEXT BOOKS:

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley.
2. Advanced programming in the UNIX environment, W.R. Stevens, Pearson education.

REFERENCE BOOKS:

1. Operating Systems- Internals and Design Principles, William Stallings, Fifth Edition–2005, Pearson Education/PHI.
2. Operating System A Design Approach- Crowley, TMH.
3. Modern Operating Systems, Andrew S. Tanenbaum 2nd edition, Pearson/PHI.
4. UNIX programming environment, Kernighan and Pike, PHI/ Pearson Education.
5. UNIX Internals -The New Frontiers, U. Vahalia, Pearson Education.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV

L/T/P	C
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ALGORITHMS DESIGN AND ANALYSIS - 5PC4EC

Prerequisites:
Programming for problem solving and Data Structures

Course Objectives

1. To understand the fundamentals of algorithmic concepts, and enable students to design, apply, and analyze efficient algorithms.

Course Outcomes upon completion of course the students will

1. **Make use** of mathematical analysis methods to analyze the performance of algorithms and apply divide and conquer technique to solve the computing problems. **L3**
2. **Be able to implement** disjoint set operations, heap-based priority queues to solve data organization and retrieval problems efficiently and backtracking algorithms for real world problems. **L3**
3. **Study** dynamic-programming technique and demonstrate it to analyze efficiency of algorithms in common engineering design situations. **L4**
4. **Apply** greedy algorithm strategies to solve various optimization problems and Implement traversal and search techniques for binary trees and graphs. **L3**
5. **Solve** complex problems using branch and bound technique and analyze differences between NP hard, NP complete problems. **L3**

UNIT - I

Introduction: Algorithm, Performance Analysis-Space complexity, Time complexity, Asymptotic Notations- Big oh notation, Omega notation, Theta notation, and Little oh notation.
Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

UNIT - II

Disjoint Sets: Disjoint set operations, union and find algorithms, Priority Queue- Heaps, Heapsort
Backtracking: General method, applications, n-queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

UNIT - III

Dynamic Programming: General method, applications- Optimal binary search tree, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT - IV

Greedy method: General method, applications- Job sequencing with deadlines, knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

Basic Traversal and Search Techniques: Techniques for Binary Trees, Techniques for Graphs, Connected components, Biconnected components.

UNIT - V

Branch and Bound: General method, applications - Travelling salesperson problem, 0/1 knapsack problem - LC Branch and Bound solution, FIFO Branch and Bound solution.

NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.

TEXT BOOK:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni, and Rajasekaran, University Press.

REFERENCE BOOKS:

1. Design and Analysis of algorithms, Aho, Ullman, and Hopcroft, Pearson education.
2. Introduction to Algorithms, second edition, T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C.Stein, PHI Pvt. Ltd./ Pearson Education.
3. Algorithm Design: Foundations, Analysis and Internet Examples, M.T. Goodrich and R. Tamassia, John Wiley and Sons.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV | **L/T/P C** | **3/0/0 3**

COMPUTER NETWORKS - 5PC4ED

Prerequisites:
A course on "Operating Systems".

Course Objectives:
To understand the fundamental concepts of computer networking, including layered architectures, communication protocols, data transmission, routing, congestion control, and application services. The course also aims to provide practical knowledge of network design, management, and security mechanisms to enable efficient and reliable communication in distributed systems.

Course Outcomes:
Upon completion of the course the students will

1. **Understand** the basic concepts of computer networks, layered architecture, and reference models used in data communication systems. **L2**
2. **Analyze** data transmission techniques, switching methods, and error detection/correction mechanisms for reliable communication. **L4**
3. **Apply** routing algorithms, congestion control techniques, and transport layer protocols to establish efficient network communication. **L3**
4. **Explore** network layer functionalities including IP addressing, subnetting, and routing protocols in interconnected systems. **L4**
5. **Study** application layer services, network security concepts, and modern networking technologies for distributed applications. **L4**

UNIT - I
Introduction: Uses of Computer Networks, Network Hardware, Network Software, Reference Models – OSI, TCP/IP, Example Networks: Internet, Connection-Oriented and Connectionless Services, Service Primitives.
Physical Layer: Guided Transmission Media, Wireless Transmission, Communication Satellites, Digital Modulation and Multiplexing.

UNIT - II
Data Link Layer: Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols.
Medium Access Control Sub Layer: Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Bluetooth.

UNIT - III
Network Layer: Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, Internetworking.

Internet Protocols: IP Protocol, IP Addressing, Subnetting, IPv4 and IPv6, ICMP, ARP, DHCP.

UNIT - IV

Transport Layer: Transport Service, Elements of Transport Protocols, UDP, TCP, Congestion Control in TCP.
Application Layer: DNS, Electronic Mail, World Wide Web, HTTP, Multimedia Networking.

UNIT - V

Network Security: Cryptography, Symmetric-Key Algorithms, Public-Key Algorithms, Digital Signatures, Firewalls.
Emerging Technologies: Mobile Networks, Wireless Sensor Networks, Cloud Networking, Internet of Things (IoT).

TEXT BOOKS:

1. Computer Networks, Andrew S. Tanenbaum, 5th Edition, Pearson Education.
2. Data Communications and Networking, Behrouz A. Forouzan, 5th Edition, McGraw Hill.

REFERENCE BOOKS:

1. Computer Networking: A Top-Down Approach, James F. Kurose and Keith W. Ross, Pearson Education.
2. Data and Computer Communications, William Stallings, Pearson Education.
3. Internetworking with TCP/IP, Douglas E. Comer, Pearson Education.
4. Computer Networks and Internets, Douglas E. Comer, Pearson Education.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV

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MACHINE LEARNING - 5PC4EE

Prerequisites:
A course on "Computer Oriented Statistical Methods".

Course Objectives:
To introduce the fundamental concepts, algorithms, and techniques of Machine Learning, including supervised and unsupervised learning, model evaluation, optimization, and real-world applications. The course aims to equip students with the ability to design, implement, and analyze machine learning models for solving practical problems.

Course Outcomes:
Upon completion of the course the students will

1. **Understand** the fundamentals of machine learning, different learning paradigms, and the process of building intelligent systems. **L2**
2. **Apply** supervised learning algorithms such as regression and classification techniques to solve predictive problems. **L3**
3. **Analyze** unsupervised learning methods including clustering and dimensionality reduction for discovering hidden patterns in data. **L4**
4. **Evaluate** machine learning models using appropriate performance metrics and optimization techniques to improve model accuracy. **L4**
5. **Explore** advanced machine learning concepts and real-world applications in areas such as NLP, computer vision, and recommendation systems. **L4**

UNIT - I
Introduction to Machine Learning: Definition, Types of Learning – Supervised, Unsupervised and Reinforcement Learning, Applications of Machine Learning, Steps in Machine Learning System Design, Challenges in Machine Learning.
Data Preprocessing: Data Cleaning, Data Integration, Data Transformation, Data Reduction, Feature Selection and Feature Extraction.

UNIT - II
Supervised Learning – Regression: Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression.
Classification Techniques: K-Nearest Neighbor (KNN), Decision Trees, Naive Bayes Classifier, Support Vector Machines (SVM).

UNIT - III
Unsupervised Learning: Clustering – K-Means Clustering, Hierarchical Clustering, DBSCAN.

Dimensionality Reduction: Principal Component Analysis (PCA), Singular Value Decomposition (SVD).

UNIT - IV

Model Evaluation and Optimization: Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC Curve, Cross Validation.
Optimization Techniques: Gradient Descent, Overfitting and Underfitting, Regularization Techniques, Bias-Variance Tradeoff.

UNIT - V

Advanced Machine Learning Concepts: Artificial Neural Networks, Deep Learning Basics, Reinforcement Learning Basics.
Applications of Machine Learning: Natural Language Processing, Computer Vision, Recommendation Systems, Healthcare Applications, Financial Forecasting.

TEXT BOOKS:

1. Machine Learning, Tom M. Mitchell, McGraw Hill Education.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media.

REFERENCE BOOKS:

1. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer.
2. Introduction to Machine Learning with Python, Andreas C. Müller and Sarah Guido, O'Reilly Media.
3. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.
4. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV **L/T/P C**
0/0/2 1

COMPUTATIONAL MATHEMATICS LAB - 5BS451

Course Objective:
To provide practical exposure to numerical and statistical computation techniques using programming tools for solving mathematical problems arising in engineering and scientific applications.

Course Outcomes:
Upon completion of the course the students will

1. **Apply** numerical methods to solve algebraic and transcendental equations using computational techniques. **L3**
2. **Implement** interpolation and curve fitting methods for approximating data and mathematical functions. **L3**
3. **Analyze** numerical differentiation and integration techniques for solving engineering problems. **L4**
4. **Apply** statistical and probabilistic methods using computational tools for data analysis and interpretation. **L3**
5. **Develop** programs for solving mathematical models and validating computational results efficiently. **L3**

List of Experiments:

1. Implementation of Bisection Method for solving algebraic and transcendental equations.
2. Implementation of Newton-Raphson Method.
3. Implementation of Gauss Elimination Method for solving system of linear equations.
4. Implementation of Gauss-Seidel Iteration Method.
5. Implementation of Lagrange's Interpolation Method.
6. Implementation of Newton's Forward and Backward Interpolation Methods.
7. Implementation of Numerical Differentiation techniques.
8. Implementation of Trapezoidal Rule and Simpson's Rule for numerical integration.
9. Implementation of Euler's Method for solving ordinary differential equations.
10. Implementation of Runge-Kutta Method.
11. Programs for calculation of Mean, Median and Standard Deviation.
12. Programs for fitting a straight line using Least Squares Method.

13. Programs for Probability Distributions such as Binomial and Poisson distributions.
14. Implementation of Correlation and Regression Analysis.
15. Mini Project using computational mathematics concepts for engineering applications.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV **L/T/P C**
0/0/2 1

OPERATING SYSTEMS LAB - 5BS452

Course Objective:

To provide practical exposure to operating system concepts such as process management, CPU scheduling, synchronization, deadlocks, memory management, file systems, and inter-process communication through implementation and experimentation using system programming tools in Linux/Unix environments.

Course Outcomes:

Upon completion of the course the students will

1. **Implement** process creation, scheduling, and management techniques using Unix/Linux system calls. **L3**
2. **Analyze** CPU scheduling algorithms and synchronization mechanisms for efficient resource utilization. **L4**
3. **Apply** deadlock handling and inter-process communication techniques to solve concurrent programming problems. **L3**
4. **Develop** memory management and page replacement algorithms for efficient memory allocation and utilization. **L3**
5. **Explore** file handling operations and shell programming concepts in Unix/Linux operating systems. **L4**

List of Experiments:

1. Write C programs to simulate Unix/Linux commands like ls, cp, mv, rm, cat and mkdir.
2. Write a C program to implement the system calls fork, exec, wait and exit.
3. Write a C program to implement inter-process communication using pipes.
4. Write a C program to simulate CPU Scheduling Algorithms: FCFS, SJF, Priority and Round Robin Scheduling.
5. Write a C program to solve the Producer-Consumer problem using semaphores.
6. Write a C program to solve the Dining Philosophers problem.
7. Write a C program to simulate Banker's Algorithm for deadlock avoidance.
8. Write a C program to implement memory allocation techniques: First Fit, Best Fit and Worst Fit.
9. Write a C program to simulate Page Replacement Algorithms: FIFO, LRU and Optimal.
10. Write a C program to implement file organization techniques.

11. Write Shell Scripts for basic file operations and process management.
12. Write Shell Scripts using loops, conditional statements and command line arguments.
13. Write a C program to demonstrate shared memory and message queue communication.
14. Write a C program to simulate Disk Scheduling Algorithms: FCFS, SSTF, SCAN and C-SCAN.
15. Mini Project based on Operating System concepts.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV

L/T/P	C
0/0/2	1

COMPUTER NETWORKS LAB - 5BS453

Course Objective:

To provide practical knowledge of computer networking concepts including socket programming, routing, congestion control, network protocols, and network simulation tools for designing, implementing, and analyzing communication systems and distributed applications.

Course Outcomes:

Upon completion of the course the students will

1. **Implement** basic networking concepts and communication models using socket programming techniques. **L3**
2. **Analyze** error detection, flow control, and routing mechanisms in data communication systems. **L4**
3. **Develop** client-server applications using TCP and UDP protocols for network communication. **L3**
4. **Apply** network simulation tools and routing algorithms to evaluate network performance. **L3**
5. **Explore** modern networking technologies and protocols through practical experimentation and implementation. **L4**

List of Experiments:

1. Study of networking commands and configuration tools such as ping, tracert, ipconfig, ifconfig, netstat and nslookup.
2. Write a program to implement CRC error detection technique.
3. Write a program to implement Hamming Code for error detection and correction.
4. Write a program to simulate Stop-and-Wait Protocol.
5. Write a program to simulate Sliding Window Protocol.
6. Write a program to implement shortest path routing using Dijkstra's Algorithm.
7. Write a program to simulate Distance Vector Routing Algorithm.
8. Write a program to implement TCP Client-Server communication using sockets.
9. Write a program to implement UDP Client-Server communication using sockets.
10. Write a program for File Transfer using TCP sockets.
11. Write a program to simulate congestion control algorithms.

12. Write a program to implement DNS lookup service.
13. Simulation of network topologies and protocols using NS2/NS3 or Packet Tracer.
14. Implementation of simple chat application using socket programming.
15. Mini Project based on Computer Networks concepts.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV **L/T/P C**
0/0/2 1

MACHINE LEARNING LAB - 5BS454

Course Objective:
To provide practical exposure to machine learning techniques and tools for data preprocessing, model building, evaluation, and deployment using supervised and unsupervised learning algorithms to solve real-world problems.

Course Outcomes:
Upon completion of the course the students will

1. **Apply** data preprocessing and feature engineering techniques for preparing datasets suitable for machine learning models. **L3**
2. **Implement** supervised learning algorithms such as regression and classification models using machine learning libraries. **L3**
3. **Analyze** unsupervised learning algorithms including clustering and dimensionality reduction techniques. **L4**
4. **Evaluate** machine learning models using appropriate validation and performance metrics to improve prediction accuracy. **L4**
5. **Develop** real-world machine learning applications using Python-based frameworks and tools. **L3**

Software Requirements:
Python, Jupyter Notebook / Google Colab, NumPy, Pandas, Matplotlib, Scikit-learn.

List of Experiments:

1. Study of Python libraries used in Machine Learning: NumPy, Pandas, Matplotlib and Scikit-learn.
2. Perform data preprocessing operations such as handling missing values, normalization, encoding and feature scaling on a dataset.
3. Implementation of Linear Regression for prediction analysis.
4. Implementation of Logistic Regression for classification problems.
5. Implementation of K-Nearest Neighbors (KNN) algorithm.
6. Implementation of Decision Tree Classifier.
7. Implementation of Naive Bayes Classification algorithm.
8. Implementation of Support Vector Machine (SVM) classifier.
9. Implementation of K-Means Clustering algorithm.

10. Implementation of Hierarchical Clustering techniques.
11. Perform Dimensionality Reduction using Principal Component Analysis (PCA).
12. Evaluation of machine learning models using Confusion Matrix, Accuracy, Precision, Recall and F1-Score.
13. Implementation of Cross Validation and Hyperparameter Tuning techniques.
14. Mini Project based on Machine Learning applications such as prediction systems, recommendation systems or classification systems.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SEMESTER IV **L/T/P C**
0/0/2 1

DATA VISUALIZATION - R PROGRAMMING/ POWER BI - 5BS455

Course Objective:
To provide practical exposure to data visualization techniques using R Programming and Power BI for analyzing, interpreting, and presenting data effectively through graphical representations and dashboards.

Course Outcomes:
Upon completion of the course the students will

1. **Understand** the fundamentals of data visualization and graphical representation techniques. **L2**
2. **Apply** R programming concepts for data manipulation, analysis, and visualization. **L3**
3. **Develop** interactive visualizations and dashboards using Power BI tools. **L3**
4. **Analyze** datasets using charts, graphs, and statistical visualization techniques for meaningful insights. **L4**
5. **Build** real-time and business-oriented visualization applications using R and Power BI. **L3**

Software Requirements:
R Programming, RStudio, Power BI Desktop.

List of Experiments:

1. Introduction to R Programming environment and basic data structures.
2. Perform data importing, cleaning, and preprocessing using R.
3. Create basic visualizations using R: Bar charts, Pie charts, Histograms and Box plots.
4. Generate Line graphs and Scatter plots using ggplot2 package.
5. Perform statistical analysis and visualize the results using R.
6. Create correlation and regression plots using R Programming.
7. Design interactive dashboards using Power BI.
8. Import datasets into Power BI and perform data transformation.
9. Create visual reports using tables, charts, slicers, and maps in Power BI.
10. Perform DAX operations and calculations in Power BI.
11. Create KPI dashboards and business intelligence reports.
12. Visualize real-time datasets and publish reports in Power BI Service.

13. Mini Project using R Programming for statistical data visualization.
14. Mini Project using Power BI for business analytics and dashboard creation.