LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF CSE-DATA SCIENCE
SCHEME OF INSTRUCTION & EXAMINATION [LR-23]
(W.E.F Academic Year 2025-26)
B.E. V-Semester (Tentative)

S. No.	Course Code	Course Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Wee	CIE	SEE	Duration in Hours	
Theory Course											
1	U23CD501	PCC	Software Engineering	3	-	-	3	40	60	3	3
2	U23CD502	PCC	Full Stack Web Development	3	-	-	3	40	60	3	3
3	U23CM502	PCC	Artificial Intelligence	3	-	-	3	40	60	3	3
4	-	PEC	Professional Elective-I	3	-	-	3	40	60	3	3
5	-	OEC	Open Elective-I	3	-	-	3	40	60	3	3
Practical / Laboratory Course											
6	U23CD5L1	PCC	Software Engineering Lab	-	-	3	3	25	50	3	1.5
7	U23CD5L2	PCC	Full Stack Web Development Lab	-	-	3	3	25	50	3	1.5
8	U23CM5L2	PCC	Artificial Intelligence Lab	-	-	3	3	25	50	3	1.5
Project											
9	U23CD5P1	PROJ	Internship (During vacation period after 4Sem.)	-	-	3	3	50	-	-	1.5
Total				**15**	**-**	**12**	**27**	**325**	**450**	**-**	**21**

L: Lecture *(Hrs/Wk/Sem)* **T**: Tutorial *(Hrs/Wk/Sem)* **P**: Practical **D**: Drawing *(Hrs/Wk/Sem)*
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination **BSC**: Basic Science Course
ESC: Engineering Science Course **PCC:** Program core course
HSMC: Humanities & Social Science Including Management Course
CM: CSE-AIML **CD**: CSE-Data Science **PEC:** Professional Elective Course
OEC: Open Elective Course **PROJ:** Project **CS**: Computer Science and Engineering

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

PEC 1	U23CD504	Computer Networks
	U23CD505	Information Retrieval Systems
	U23CD506	Design and Analysis of Algorithms
	U23CD507	Discrete Mathematics

Course Code	Course Title						Core/Elective
U23CD501	**SOFTWARE ENGINEERING**						**Core**
Prerequisite	**Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
OS	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1. To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product.
2. To impart knowledge on various phases, methodologies and practices of software development.
3. To understand the importance of testing in software development and study various testing strategies and software quality metrics.
4. To impart knowledge on various phases, methodologies and practices of software development
5. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics

Course Outcomes:

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

1. Describe and compare alternative approaches and techniques used across various phases of the software development lifecycle.
2. Develop a complete software project independently by applying appropriate design principles, tools, and methodologies.
3. Identify and analyze the real-world challenges involved in developing large-scale software systems.
4. Design and construct software architecture independently or in a team by recognizing recurring problems and applying relevant design patterns.
5. Evaluate software product quality using appropriate metrics while addressing practical development challenges.

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 and Agile methodology

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, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, 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

Suggested Readings:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 8th edition, McGraw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.

Course Code	Course Title						Core/Elective
U23CD502	**Full Stack Web Development**						**Core**
	Hours Per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
C & C++	**3**	**2**	**–**	**–**	**40**	**60**	

Course Objectives:

1. To provide a fundamental understanding of web technologies and how the web works.
2. To implement the structure and design of web pages using HTML and CSS.
3. To apply client-side scripting using JavaScript to create dynamic web applications.
4. To develop server-side scripting concepts with technologies such as Python or Ruby.
5. To familiarize students with database integration for web-based applications.

Course Outcomes:

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

1. Explain how the World Wide Web works, including web browsers and web servers.
2. Design responsive and structured web pages using HTML, CSS, Flexbox, and Grid.
3. Use JavaScript to add interactivity, form validation, and DOM manipulation to web pages.
4. Create dynamic web applications using server-side scripts with Python or Ruby.
5. Connect web pages with databases to build interactive and data-driven websites.

UNIT – I

HTML - What is HTML, Basic Structure of HTML Page, Basic Tags, Types of Tags, Lists, Tables, Images, Forms, Frames, Buttons, and Moving Images. **Cascading Style Sheet** - Introduction , A Simple Specification , Types of Style Sheets , Style Classes , Font Properties , Background properties ,Border properties , text properties , margin properties , padding properties, table properties , line/marker properties.

UNIT – II

JAVA SCRIPT - Introduction , Usage of variables , operations , control structures , looping structures , predefined keywords , arrays , predefined functions , arrays and functions , mathematical functions , string functions , expressions ,pattern matching using RegEXp Class , String Class , Exception Handling, Bgcolor/Fgcolor , Date Object , Form Validation, DOM Manipulation.

UNIT – III

Front-end Frameworks/Libraries- Introduction- React, Angular. JQuery and Vue, Angular- Features and Benefits, Components, Angular CLI, Data Binding, Angular application, **JQuery :** String, Numbers, Boolean, Objects, Arrays, Functions, Arguments, Scope, JQuery Effect Methods, Hide and Show, jQuery Toggle, jQuery Slide – slideDown, slideUp, slideToggle.

UNIT – IV

Server-Side Languages- Introduction- Node js, Python and Ruby on Rails, Node JS Features and Drawbacks, Setup Environment for Node.js, Node JS Program architecture, Node JS Web Server, Node JS Global Objects, Node JS Error Handling, Node JS Event Loop, Node JS File System, Connecting with Database, Handling CRUD Operations,

UNIT – V

Databases: Introduction on MySQL, PostgreSQL, MangoDB and **MangoDB-** MongoDB, Configuring Server and Client, MongoDB Compass, Creating Database, MongoDB Commands, MongoDB CRUD Operations, **REST API -** Introduction to REST API,REST Architecture, GraphQL.

Suggested Readings:

1. Mayur Ramgir, “Full Stack Java Development with Spring MVC, Hibernate, jQuery, and Bootstrap”, Packt Publishing, 2020.
2. Ketan Agnihotri, Pranali Dahale, " React Development using Typescript: Modern web app development using advanced React techniques ", English Edition, 2024.
3. Nabendu Biswas, “Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS”, 1st Edition, 2023.

Course Code	Course Title						Core/Elective
U23CM502	ARTIFICIAL INTELLIGENCE						Core
Prerequisite	Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Data Structures, Basics of probability	3	-	–	–	40	60	3

Course Objectives:

1. To understand the various characteristics of Intelligent agents
2. To learn the different search strategies in AI
3. To learn to represent knowledge in solving AI problems
4. To understand the different ways of designing software agents
5. To know about the various applications of AI.

Course Outcomes:

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

1. Use appropriate search algorithms for any AI problem
2. Represent a problem using first order and predicate logic
3. Provide the apt agent strategy to solve a given problem
4. Design software agents to solve a problem
5. Design applications for NLP that use Artificial Intelligence.

UNIT - I

INTRODUCTION : Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT-II

PROBLEM SOLVING METHODS

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games

UNIT-III

KNOWLEDGE REPRESENTATION

First Order Predicate Logic – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

UNIT-IV

SOFTWARE AGENTS :Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems

UNIT-V

APPLICATIONS

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

SUGGESTED READINGS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, ―Prolog Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008

Course Code	Course Title						Core / Elective
U23CD504	COMPUTER NETWORKS						Professional Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
C	3	-	-	-	40	60	3

Course Objectives

1. To introduce the fundamental various types of computer networks.
2. To demonstrate the TCP/IP and OSI models with merits and demerits.
3. To explore the IP Addressing Mechanisms
4. To Understand the World Wide Web concepts.
5. Classify the routine protocols and analyze how to assign the IP address for the given network.

Course Outcomes:

1. Explain & design the various reference models and networks.
2. Identify the different types of network devices and Multiple Access Protocols.
3. Use IP addressing Scheme and to interconnect various networks and Routing mechanism
4. Explain transport layer protocols: TCP, UDP.
5. Explain and use various application layer protocols: HTTP, DNS, and SMTP, FTP etc

UNIT – I

Data Communications: Components – Direction of Data flow – Networks, Components and Categories, Network devices, Types of Connections, Topologies, Protocols, OSI model, TCP/IP Protocol Suite, Wireless LAN**,** VPN
Physical layer: Transmission modes, Multiplexing, Transmission Media, Switching, Types of Switching

UNIT – II

Data link layer: Introduction, Framing, Error Detection and Correction – Parity, CRC, Hamming code, Flow and Error Control: Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols.
Medium Access Protocols: Random access, Controlled access, Channelization, LAN– Ethernet IEEE 802.3, IEEE 802.5, IEEE 802.11

UNIT – III

Network layer: Logical Addressing - IPv4, IPv6 protocol, Subnetting, Internetworking, Tunneling, Address mapping, Packet fragmentation, , Delivery, Forwarding, **Routing**-Static routing, Default routing, Dynamic routing, Hierarchical Routing

UNIT – IV

Transport Layer: Process to Process Delivery, UDP and TCP protocols, TCP Services, TCP Segment Format, connection establishment, The TCP connection release, Data Traffic, Congestion, TCP Congestion Control, Quality of Services, Integrated Services, Differentiated Services

UNIT – V

Application Layer: Application layer services**,** Domain name space, electronic mail, FTP, WWW, Uniform Resource Locator, HTTP, SNMP, TELNET, SSH, VOIP, Bluetooth Proxy Server

Suggested Readings

1. Computer Networking: A Top Down Approach, 8th Edition , 2021
2. Computer Networks, Andrew S Tanenbaum, 4th Edition. Pearson Education, PHI.
3. Data communications and Computer Networks, P.C .Gupta, PHI.
4. An Engineering Approach to Computer Networks, S. Keshav, 2nd Edition, Pearson Education.

Course Code	Course Title						Core / Elective
U23CD505	Information Retrieval systems						Professional Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

Course Objectives:

1. To learn about the relationships to data base management systems and libraries.
2. To understand the important concepts, algorithms, and data/file structures
3. To learn about clusters, searching techniques and visualization.
4. To expose the students to find the searching algorithms and Evaluation systems.
5. To facilitate design, and implementation of Information Retrieval (IR) systems.

Course Outcomes:

1. Analyze the retrieval information systems and its capabilities.
2. Analyze and apply appropriate data structures and indexing concepts.
3. Use the various searching techniques for improving the information visualization.
4. Apply the searching algorithms to evaluate information systems.
5. Use the multimedia information retrieval of query languages

UNIT-I:

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview: Item Normalization, Selective Dissemination of Information, Document, Index and Multimedia Database Search, Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities, Z39.50 and WAIS Standards

UNIT – II:

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Scope of Indexing, Linkages and Precoordination, Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages, Information Extraction, Index Compression: Dictionary Compression, Posting File Compression

UNIT – III:

User Search Techniques and Scoring: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext, Computing Scores in a Complete Search System: Efficient Scoring and Ranking, Components of an Information Retrieval System

UNIT – IV:

Evaluation and Information Visualization: Evaluation in Information Retrieval, Standard Test Collections, Evaluation of Unranked Retrieval Sets, Evaluation of Ranked Retrieval Results, Assessing Relevance, System Quality and User Utility, Information Visualization: Cognition and Perception, Aspects of Visualization Process, Information Visualization Technologies.

UNIT – V:

Multimedia Information Retrieval: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems, Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Image Retrieval, Video Retrieval, Challenges in Multimedia IR, Applications and Future Trends

Suggested Readings:

1. W.B. Frakes, Ricardo Baeza-Yates, *Information Retrieval: Data Structures and Algorithms*, Prentice Hall, 1992.
2. Robert Korfhage, *Information Storage & Retrieval*, John Wiley & Sons.
3. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, *Modern Information Retrieval*, Pearson Education.

Course Code	Course Title						Core/Elective
U23CD506	DESIGN AND ANALYSIS OF ALGORITHMS						Core
	Contact Hours per Week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
Data Structures	3	-	-	-	40	60	3

Course Objectives:

This course will enable students to

1. Acquire the knowledge of Algorithm and problem-solving technique, limitations of algorithms.
2. Understand different techniques like divide and conquer, transfer and conquer etc., to solve problems.
3. Understand different techniques like greedy method and dynamic programming
4. Understand the concepts of Np-Hard and Np-Complete.
5. Illustrating the methods of backtracking and branch bound techniques to solve the problems like N-queens problem, graph coloring

Course Outcomes:

On completion of this course, the students are able to :

1. Identify asymptotic notations and basic efficiency classes.
2. Solve problems using various techniques like divide-and-conquer and transfer-and-conquer.
3. Use different algorithms like TSP, Floyd's etc. to solve real world problems.
4. Introduce the P and NP classes.
5. Develop solutions for n - Queens problem, Subset – Sum Problem, Assignment problem, Knapsack problem etc.

UNIT - I

Introduction: Algorithm, Fundamentals of algorithmic problem solving, Fundamentals of the analysis of algorithm efficiency, Asymptotic Notations and basic efficiency classes, Mathematical Analysis of Non-Recursive and Recursive Algorithms, The substitute method, Recursion tree method, Master method.

UNIT - II

Divide and conquer: Divide and Conquer: General Method, Binary Search, finding minimum and maximum Merge Sort analysis, Quick Sort analysis, Strassen's matrix multiplication.
Transfer and conquer: Introduction, Balanced search trees, Heap and Heap sort.

UNIT - III

The greedy method: The General Method, Knapsack problem, Job Sequencing with Deadlines, Minimum- Cost Spanning Trees: Prim's Algorithm, Kruskal's Algorithm, Single Source Shortest Path
Dynamic programming: The General Method, multistage graph, Wars hall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest Paths Problem, single source shortest path, The Travelling Salesperson problem, optimal binary search,0/1 knapsack.

UNIT – IV

Pattern Matching: The naïve string-matching algorithm, Brute Force String Matching, KMP algorithm.
Np-Hard and Np-Complete Problems: Basic concepts: non-deterministic algorithms, the classes NP - Hard and NP, NP Hard problems, clique decision problem, chromatic number decision problem, Cook's theorem.

UNIT V

Backtracking: n - Queens Problem, Subset – Sum of Subsets Problem, graph coloring.
Branch and bound: Assignment problem, Knapsack problem, 15 puzzle problem, travelling salesman problem
Tries: Standard Tries, Compressed Tries, Suffix Tries, Search Engine Indexing.

Suggested Readings:

1. "Introduction to The Design and Analysis of Algorithms", Anany Levitin (Chapters 1-5,7,9,11), Pearson Education, Delhi, 2nd Edition, 2007, ISBN: 9780321358288.
2. "Fundamentals of Computer Algorithms", Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran: (Chapters 1,3-8,10-12), Universities Press, Hyderabad, 2nd Edition, 2007, ISBN: 10: 8173716129.
3. "Introduction to Algorithms", Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein: PHI, London, England, 3rd Edition, 2010, ISBN: 9780262033848.
4. "Introduction to the Design and Analysis of Algorithms A Strategic Approach", R.C.T. Lee, S.S. Tseng, R.C. Chang and Y.T. Tsai: McGraw-Hill Higher Edu.

Course Code	Course Title						Core/Elective
U23CD507	DISCRETE MATHEMATICS						Core
Prerequisite	Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Basic Maths	3	-	_	_	40	60	3

Course Objectives:

Develop ability to

1. Understand concepts of Mathematical Logic, mechanisms of inference rules for propositional and predicate logic and their applications
2. Understand the concepts of Sets, Relations, Functions and their applications.
3. Learn the concepts of Algebraic Structures, basics of counting, Principles of inclusion/exclusion and the pigeonhole methodology.
4. Understand Generating Functions, Recurrence Relations and various ways of solving them.
5. Understand basic definitions and properties of graphs and their applications in computer science and engineering.

Course Outcomes:

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

1. Distinguish between Propositional Logic and Predicate Logic, deriving valid proofs of inference and checking the validity of inferences.
2. Illustrate by examples the basic terminology of sets, relations, functions and algebraic structures along with their associated operations.
3. Demonstrate basics of counting, principles of permutations, combinations, applying inclusion/exclusion principle and the pigeonhole methodology in solving counting problems.
4. Demonstrate Generating functions, write recurrence relations and apply various techniques solving recurrence relations.
5. Transform a problem in computer science and engineering as a graph to solve it efficiently using concepts of graph theory.

UNIT-I

Mathematical Logic: Statements and notations, Connectives, Well-formed formulas, Truth Tables, tautology, equivalence implication, Normal forms, Quantifiers, universal quantifiers.Predicates: Predicative logic, Free & Bound variables, Rules of inference, Consistency, proof of contradiction, Automatic Theorem Proving.

UNIT-II

Relations: Properties of Binary Relations, equivalence, transitive closure, compatibility and partial ordering relations, Lattices, Hasse diagram. Functions: Inverse Function Composition of functions,recursive Functions, Lattice and its Properties.

UNIT-III

Elementary Combinatorics: Basis of counting, Combinations & Permutations, with repetitions,Constrained repetitions, Binomial Coefficients, Binomial Multinomial theorems, the principles of Inclusion – Exclusion. Pigeon hole principles and its application.

UNIT-IV

Recurrence Relation: Generating Functions, Function of Sequences Calculating Coefficient of generating function, Recurrence relations, Solving recurrence relation by substitution and Generating funds. Characteristics solution of inhomogeneous Recurrence Relation.

UNIT-V

Graph Theory: Basic Concepts, Representation of Graph, Isomorphism, Sub graphs, Spanning Trees, Planar Graphs, Multi graphs, Euler circuits, Hamiltonian graphs, Chromatic Numbers. Graph Theory and Applications.

Suggested Readings:

1. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay, R. Manohar, McGraw Hill education (India) Private Limited. (UNITS - I , II)
2. Discrete Mathematics for Computer Scientists & Mathematicians, Joe L. Mott, Abraham Kandel, Theodore P. Baker, Pearson, 2nd ed. (Units - III, IV, V)
3. Elements of Discrete Mathematics- A Computer Oriented Approach- C L Liu, D P Mohapatra Third Edition, Tata Mc Graw Hill.
4. Discrete Mathematics for Computer Scientists & Mathematicians, J.L. Mott, A.Kandel, T.P. Baker, PHI.
5. Discrete Mathematics and its Applications, Kenneth H. Rosen, Fifth Edition.TMH.
6. Discrete Mathematical Structures Theory and Application-Malik & Sen, Cengage.

Course Code	Course Title						Core/Elective
U23CD508	FUNDAMENTALS OF DATA SCIENCE						OEC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	40	60	3

Course Objectives

1. To identify the scope and essentiality of Data warehousing and Data Mining.
2. To develop research interest towards advances in data mining.
3. To analyze the data, data science lifecycle, data collection and cleaning, exploratory data analysis and visualization, statistical inference and prediction, and decision-making algorithms for respective applications.

Course Outcomes

1. Understand the basic concepts in data science, including real world applications
2. Understand fundamentals of data and Data Mining Principles.
3. To Understand importance of qualitative data, terminologies related to Data Science.
4. Understand and Extract knowledge using data preprocessing concepts in data science.
5. Understand the basics of R Programming environment: R language, R- studio and R packages

UNIT-I

Introduction to Data Science: Data Science Definition - The Data Science Venn Diagram Terminology Types of Data: - Flavors of Data- Structured and Unstructured Data-Quantitative versus qualitative DataFour Levels of Data- Case study

UNIT-II

Evolutionary of (Five Steps) of Data Science: - Overview of Evolutionary (Five Steps)- Explore theData Dataset 1 - Dataset2 – Titanic Communication Data: Communication matter- Identifying effective and ineffective visualizations- graphs and statistics Be- Verbal Communication

Unit III :

Basics of Data Mining: importance of Data Mining, moving toward the Information Age Data Mining as the Evolution of Information Technology, What Is Data Mining, What Kinds of Data Can Be Mined, Database Data, Data Warehouses, Transactional Data, Other Kinds of Data, OLTP & Online Analytical Processing (OLAP), Graphs Database

Unit IV:

Identification of data: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity: Euclidean, Jaccard's Index & Cosine Similarity

Data Pre-processing: Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization (ETL Operations)

Unit V :

Introduction to R Programming, getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

Suggested Readings:

1. Fundamentals of Data Science , Jugal K.Kalitha Swarup Roy, Elseiver 2023
2. Han, Jiawei, MichelineKamber, and Jian Pei. "Data mining concepts and techniques third edition."The Morgan Kaufmann Series in Data Management Systems 5.4 (2011).
3. Nina Zumel, Practical Data Science with R, Manning Publications, 2014

Course Code	**Course Title**						Core/Elective
U23CD5L1	**SOFTWARE ENGINEERING LAB**						**Core**
Prerequisite	**Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
OS	**-**	**–**	**–**	**3**	**25**	**50**	**1.5**

Course Objectives:

1. To identify Project Scope, Objectives and infrastructure
2. To understand software engineering methodologies for project development.
3. To capture the requirements specification for an intended software system
4. To draw the UML diagrams for the given specification
5. To map the design properly to code

Course Outcomes:

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

1. Recall the basic principles of Software Engineering and UML modeling.
2. Interpret and explain use-case diagrams, class diagrams, and activity diagrams for software requirements.
3. Construct various UML diagrams (use case, class, sequence, collaboration, activity, state, component, deployment).
4. Analyze software requirements to select appropriate modeling techniques and tools.
5. Evaluate the consistency and correctness of UML diagrams with respect to given requirements.

List of Experiments

1. Understanding UML diagrams
2. Understanding the software to implement UML diagrams
3. Design the **Use Case Diagram** highlighting student and librarian interactions.
4. Draw the **Class and Object Diagrams** for the system structure and a sample book issue transaction.
5. Create the **Sequence Diagram** and **Collaboration Diagram** for the book issue scenario.
6. Create **State chart** and **Activity Diagrams** showing workflows for ATM transaction and LMS book issue process.
7. Develop the **Component and Deployment Diagram** indicating physical deployment on hardware infrastructure.
8. Design an UML diagrams for Exam Registration Process
9. Design an UML diagrams for credit card Processing

Suggested Readings:

1. The Unified Modeling Language User Guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education.
2. UML Distilled Third Edition, Martin Fowler.

Course Code	Course Title						Core/Elective
U23CD5L2	**Full Stack Web Development Lab**						**Core**
	Hours Per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
C & C++			**–**	**2**	**40**	**60**	

Course Objectives:

1. To understand the structure and syntax of HTML and CSS for designing static web pages.
2. To apply styling using CSS properties such as layout, positioning, typography, and responsiveness.
3. To gain knowledge of JavaScript and jQuery for adding interactivity and client-side logic to web pages.
4. To explore form handling and validation techniques using JavaScript.
5. To practice full-stack web application development and deployment using modern tools and frameworks.

Course Outcomes:

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

1. Develop well-structured HTML web pages with embedded CSS styles.
2. Apply various CSS properties to create visually appealing and responsive layouts.
3. Write JavaScript programs to add dynamic behavior to web pages.
4. Validate forms using client-side JavaScript and handle user input efficiently.
5. Deploy web applications and demonstrate the ability to build full-stack web solutions.

LAB EXPERIMENT

1. Create a basic HTML page with a title, headings, paragraphs, a horizontal line, and a line break. Use <html>, <head>, <body>, <h1> to <h6>, <p>, <hr>, and
 tags. This experiment helps in understanding the structure of an HTML page.
2. Design an HTML form using various input types such as text boxes, radio buttons, checkboxes, submit and reset buttons. Implement labels and organize the form layout using tables or divs for better structure.
3. Create an HTML table with appropriate headings and data. Use rowspan and colspan to merge cells. Apply CSS styling to enhance table appearance like border, background-color, and text alignment.
4. Use internal or external CSS to apply properties such as font size, font family, background color, border thickness, margin, padding, and text alignment to a basic HTML page with content elements.
5. Style an HTML page using Inline CSS, Internal CSS, and External CSS.
6. Write a JavaScript program that uses variables, arithmetic operators, comparison operators, and logical operators.
7. Implement JavaScript control structures such as if-else and switch-case. Also, include looping structures like for, while, and do-while to print series or patterns based on conditions.
8. Create a registration or login form and apply JavaScript form validation to check email format, password strength, phone number length, and required fields before submission.
9. Show date and time using the Date object.
10. Perform pattern matching using RegExp class.
11. Use jQuery to show, hide, and toggle visibility of elements such as paragraphs, divs, and images on button click. Use $(selector).hide(), show(), and toggle() methods.

12. Implement slide animations using jQuery on different elements. Use slideDown(), slideUp(), and slideToggle() to demonstrate UI effects like drop-down menus or slide panels.
13. Install Node.js and write a basic Node.js program using console.log() and process object. Execute it using the command line and display output.

Suggested Readings:

1. Mayur Ramgir, “Full Stack Java Development with Spring MVC, Hibernate, jQuery, and Bootstrap”, Packt Publishing, 2020.
2. Ketan Agnihotri, Pranali Dahale, " React Development using Typescript: Modern web app development using advanced React techniques ", English Edition, 2024.
3. Nabendu Biswas, “Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS”, 1st Edition, 2023.

Course Code	Course Title						Core/Elective
U23CM5L2	Artificial Intelligence Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	3	25	50	1.5

Course Objectives:

The objective of this lab is to get an overview of the various Artificial Intelligence techniques and can able to demonstrate those using python.

1. To introduce students to the basic concepts of AI Searching techniques
2. To develop skills for solving practical problems.
3. To gain experience neural networks.

Course Outcomes:

After the completion of the course the student can able to:

1. After learning the AI concepts the student must be able to design and implement AI solutions searching techniques using AI.
2. Able to know about facts of querying.
3. Be capable of confidently applying tree mechanism using AI with Neural Network
4. Be capable of performing experiments in Machine Learning using real-world data.·
5. Be capable to implement classifiers and Regression algorithm

List of Experiments:

1. Write a Program to Implement Breadth First Search
2. Write a Program to Implement Depth First Search
3. Write a Program to Implement Tic-Tac-Toe game
4. Write a Program to Implement 8-Puzzle problem
5. Write a Program to Implement Water-Jug problem
6. Write a Program to Implement Travelling Salesman Problem
7. Write a Program to Implement Tower of Hanoi
8. Write a Program to Implement Monkey Banana Problem
9. Write a Program to Implement Missionaries-Cannibals Problems
10. Write a Program to Implement N-Queens Problem using Python.
11. Write a program to train and validate the following classifiers for given data (scikit-learn):

a) Decision Tree
b) Multi-layer Feed Forward neural network
c) Implementation of Gaussian Naive Bayes classifier using scikit-learn (Any two classifiers).

12. Write a program to Implementation of Linear Regression using python(Any Two Algorithm).

Suggested Readings:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008

Course Code	Course Title						Core/Elective
U23CD5P1	INTERNSHIP						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	3	50	-	1.5

Course Objectives:

This course enable students to:

1. Produce an accurate record of work performed during the Internship/Co-op
2. Apply engineering knowledge to a problem in industry
3. Produce a technical report
4. Discuss work in a team environment, if relevant to the project
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment

Course Outcomes:

After completing the course, the student will be able to:

1. Design/develop a small and simple product in hardware or software.
2. Complete the task or realize a pre specified target, with limited scope, rather than taking up a complex task and leave it.
3. Learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to pre specified criteria.
4. Implement the selected solution and document the same.

Guidelines:

Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organizations /Computer Industry/Software Companies/R&D Organization for a period of 4 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co- ordinate (person from industry). The course schedule will depend on the specific internship/training experience.

The typical time per topic will vary depending on the internship

Documents to be submitted:

1. Overview of company/project
2. Safety training
3. Discussions with project teams
4. Background research, review of documents, white papers, and scientific papers
5. Planning, designing, and reviewing the planned work
6. Executing the plans
7. Documenting progress, experiments, and other technical documentation
8. Further team discussions to discuss results
9. Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Note:

Students have to undergo summer internship of 4 weeks at the end of semester IV and credits will be awarded after evaluation in V semester.

LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF CSE-DATA SCIENCESCHEME OF INSTRUCTION & EXAMINATION [LR-23]
(W.E.F Academic Year 2025-26)
B.E. VI-Semester (Tentative)

S. No.	Course Code	Course Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	CIE	SEE	Duration in Hours	
Theory Course											
1	U23CD601	PCC	Data Engineering	3	-	-	3	40	60	3	3
2	U23CM602	PCC	Machine Learning	3	-	-	3	40	60	3	3
3	U23MB601	HSMC	Business Economics and Financial Analysis	3	-	-	3	40	60	3	3
4	-	PEC	Professional Elective-II	3	-	-	3	40	60	3	3
5	-	OEC	Open Elective-II	3	-	-	3	40	60	3	3
Practical / Laboratory Course											
6	U23CD6L1	PCC	Data Engineering Lab	-	-	3	3	25	50	3	1.5
7	U23CM6L2	PCC	Machine Learning Lab	-	-	3	3	25	50	3	1.5
Project											
8	U23CD6P1	PROJ	Mini Project	-	-	6	6	50	50	-	2
Skill Development Course											
9	U23MA6L1	BSC	Aptitude and Reasoning Skills Lab	-	-	2	2	25	50	2	1
Total				**15**	**-**	**14**	**29**	**325**	**500**	**-**	**21**

L: Lecture *(Hrs/Wk/Sem)* **T**: Tutorial *(Hrs/Wk/Sem)* ***P*:** Practical **D**: Drawing *(Hrs/Wk/Sem)*
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination **BSC**: Basic Science Course
ESC: Engineering Science Course **PCC:** Program core course **MA**: Mathematics **MB:** Management Studies
HSMC: Humanities & Social Sciences Including Management Course **PEC:** Professional Elective Course
CM: CSE-AIML **CD:** CSE-Data Science **OEC:** Open Elective Course **PROJ:** Project

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

PEC 2	U23CD603	Network Security and Cryptography
	U23CD604	Natural Language Processing
	U23CD605	Automata Theory & Language Computation
	U23CD606	Agile Methodology and DevOps

- Any NPTEL course of 12 weeks is equivalent to 3 credits of Professional electives

Course Code	**Course Title**						Core/Elective
U23CD601	**Data Engineering**						**Core**
Prerequisite	**Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
Basic programming knowledge	**3**	**_**	**_**	**_**	**40**	**60**	**3**

Course Objectives:

1. To understand the fundamental concepts of data engineering and its lifecycle.
2. To leverage Python for ingesting, transforming, and managing structured and unstructured data.
3. To work with databases and data warehouses using Python.
4. To implement data pipelines using modern data engineering tools.
5. To develop skills to manage, monitor, and optimize data workflows in real-world scenarios.

Course Outcomes:

At the end of the course, student would be able to:

1. Understand the data engineering lifecycle and ecosystem.
2. Use Python libraries and tools to perform ETL processes.
3. Work with different data storage and retrieval systems (SQL, NoSQL, file formats).
4. Build and deploy end-to-end data pipelines using Python.
5. Optimize, monitor, and debug data pipelines effectively.

UNIT I:

Introduction to Data Engineering and Python Basics: Introduction to Data Engineering, Data vs Software Engineering, Data Engineering lifecycle: Ingestion, Storage, Processing, Orchestration, Python for Data Engineering: File handling, Exception handling, OOP Basics, Pandas, NumPy, OS, Logging

UNIT II:

Data Ingestion and Transformation: File formats: CSV, JSON, XML, Parquet, Avro, Reading/Writing structured and semi-structured data using Python, APIs and Web scraping for data ingestion, Data cleaning with Pandas, Data transformation techniques, Data validation methods

UNIT III:

Working with Databases and Data Warehousing: SQL and Python: sqlite3, SQLAlchemy, working with MySQL, PostgreSQL, NoSQL using MongoDB and PyMongo, Introduction to Data Warehousing, Dimensional Modeling concepts, Connecting Python to data warehouses: BigQuery, Redshift

UNIT IV:

Building Data Pipelines: ETL vs ELT, Modular and reusable pipeline design, Apache Airflow basics: DAGs, Task scheduling, Airflow Python operators, Custom operators, Batch data processing, Introduction to Kafka, Streaming data concepts

UNIT V:

Data Workflow Management and Deployment: Pipeline testing strategies, Logging best practices, Monitoring and alerting using Airflow UI and retries, Performance optimization techniques, Introduction to Docker for deployment, Case Study: Building and deploying a complete data pipeline.

Suggested Readings:

1. **Data Engineering with Python** by Paul Crickard — Covers Python tools and techniques for building data pipelines, ETL, and data workflows.
2. **Designing Data-Intensive Applications** by Martin Kleppmann — Provides deep insights into scalable data systems, storage, processing, and architectures.

Course Code	Course Title						Core/Elective
U23CM602	MACHINE LEARNING						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Artificial Intelligence	3	1	-	-	40	60	3

Course Objectives:

This course will enable students to

1. To introduce students to the basic concepts of Data Science and techniques of Machine Learning.
2. To develop skills of using recent machine learning software for solving practical problems.
3. To gain experience of doing independent study and research.
4. To develop an understanding of the role of machine learning in massive scale automation.
5. To design and implement various machine learning algorithms in the range of real world applications

Course Outcomes:

On completion of this course, the students are able to :

1. Design and implement machine learning solutions of classification, regression problems.
2. Evaluate and interpret the results of the machine learning algorithms.
3. Evaluate exploratory data analysis and Data preparation and preprocessing on different datasets.
4. Calculate Statistical measurements of the given data.
5. Analyze and identify the best algorithm matches for a given dataset.

UNIT – I

Introduction: What is Machine Learning, Use Machine Learning, and Types of Machine Learning Systems: supervised, unsupervised, semi-supervised, Reinforcement Learning, Batch and Online Learning, Main Challenges of Machine Learning.

UNIT – II

Descriptive Statistics: Data representation, types of data- nominal, ordinal, interval and continuous, central tendency- calculating mean mode median, mean vs median, variability, variance, standard deviation, Mean Absolute Deviation using sample dataset, finding the percentile, interquartile range, Box Plot, Outlier, whisker, calculating correlation, covariance, causation. Exploratory data analysis, Data preparation and preprocessing, Data visualization.

UNIT – III

Regression: Introduction to Regression analysis, measure of linear relationship, Regression with stats models, Determining coefficient, meaning and significance of coefficients, coefficient calculation with least square method, Types of regression, Simple Linear Regression, Using Multiple features, Polynomial Regression, Metrics for Regression: MSE, RMSE, MAE.

UNIT – IV

Classification: Classification problem, Probability based approach, Logistic Regression- log-odd, sigmoid transformation, Metrics: Confusion Matrix, Accuracy, Error Rate, Precision, Recall, ROC curve, F1 score, and introduction to gradient descent.

UNIT – V

Non Parametric & SVM classification: About Non parametric classification, Decision Trees: Entropy, Gain ratio, Information Gain, Splitting criteria.

Ensemble Method: Introduction to Random Forest, Accuracy measure & performance

Instance based learning- Introduction, KNN algorithm, Distance measures, model building, locally weighted regression, radial basis functions, SVM classifier, hyper-plane, slack variables, geometric transformation kernel trick, kernel transformation.

Suggested Readings:

1. Machine Learning in Action, Peter Harrington, Dreamtech Press India Pvt. Ltd, 1st Edition,2012.
2. The Field Guide to Data Science ,Booz, Allen, Hamilton, Manning Publications 2nd Edition,2018.

3. Hands-On Machine Learning with Scikit-Learn and TensorFlow Aurelian Géron, ,O'Reilly Media, 3rd Edition,2017.

4. Pattern Recognition and Machine Learning, A foundational book providing a deep theoretical understanding of machine learning models using statistical techniques, Christopher M. Bishop, Springer, 1st Edition, 2006.

5. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, A practical guide focusing on machine learning techniques using Python, Scikit-learn, Keras, and TensorFlow., Packt Publishing, 3rd Edition, 2019

Course Code	Course Title						Core/Elective
U23MB601	BUSINESS ECONOMICS AND FINANCIAL ANALYSIS						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basic Economics	3	-	-	-	40	60	3

Course Objectives:

This course will enable students to

1. Understand the concepts of Business and Economics
2. Comprehend the concepts of market dynamics namely elasticity of demand and pricing in different market structures.
3. Gain the knowledge on the production theories and cost analysis while dealing with the production and the concept of breakeven analysis.
4. To acquire the in depth knowledge on Financial Accounting concepts and principles and preparation of final accounts.
5. To understand the financial statements through ration analysis and cash flow techniques.

Course Outcomes:

On completion of this course, the students are able to

1. Apply the concepts of business and economics during his/her professional and personal life.
2. Understand the elasticity of the demand of the product, different types, and measurement of elasticity of demand and factors influencing on elasticity of demand.
3. Recognize the Production function, features of Iso-Quants and Iso-Costs, different types of internal economies, external economies and law of returns with appropriate examples.
4. Prepare the financial statements of the firm.
5. Analyze the financial statements using ratio analysis and cash flow techniques.

UNIT – I

Introduction to Business and Economics: Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance. Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II

Demand and Supply Analysis: Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting. Supply Analysis: Determinants of Supply, Supply Function & Law of Supply.

UNIT- III

Production, Cost, and Market Structures & Pricing: Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions. Cost analysis: Types of Costs, Short run and Long run Cost Functions. Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, & Cost Volume Profit Analysis.

UNIT – IV

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, and Preparation of Final Accounts.

UNIT - V

Financial Analysis through Ratios: Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems), Introduction to Cash Flow Analysis (simple problems).

Suggested Reading:

1. "Managerial Economics and Financial Analysis",A.R. Aryasri, , TMH Publications, 3rd Edition, 2007.
2. "Managerial Economics", D.N. Dwivedi, Vikas Publication House Pvt. Ltd, 2nd Edition, 2012.
3. "Financial Accounting", S.N. Maheshwari & S.K.Maheshwari, , Vikas Publication House Pvt.Ltd, 4th Edition, 2012.

4. "Financial Accounting- A managerial Perspective", R. Narayana Swamy,Pearson publications, 1st Indian Reprint Edition, 2012.
5. "Managerial Economics & Financial Analysis", J.V. Prabhakar Rao & P.V. Rao, Maruthi Publishers, 1st Revised Edition, 2011.
6. "Managerial Economics and Financial Analysis", M.Kasi Reddy & Saraswathi, PHI Publications, New Delhi, 10th Revised Edition, 2012.

CourseCode	Course Title						Core/Elective
U23CD603	NETWORK SECURITY AND CRYPTOGRAPHY						Professional Elective
Prerequisite	Contact Hours per Week				CI E	SEE	Credits
	L	T	D	P			
ComputerNetworks	3	-	-	-	40	60	3

Course Objectives

1. To learn legal and technical issues in building secure information systems
2. To provide an understanding of network security
3. To expose the students to security standards and practices
4. To understand the various protocols for network security to protect against the threats in the network.
5. To learn about how to maintain the confidentiality, integrity, and availability of a data.

Course Outcomes

After completing this course, the student will be able to

1. Describe the steps in Security Systems development life cycle (SDLC)
2. Understand the common threats and attack to information systems
3. Understand the legal and ethical issues of information technology
4. Identify security needs using risk management and choose the appropriate risk control strategy based on business needs
5. Use the basic knowledge of security frameworks in preparing security blue print for the organization

UNIT – I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT – II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

UNIT – III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), **Message authentication codes:** Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure

UNIT – IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPSecure Shell (SSH)

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11Wireless LAN Security

UNIT – V

E-Mail Security: Pretty Good Privacy, S/MIME **IP Security:** IP Security overview, IP Security architecture Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

Suggested Reading:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
3. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

Course Code	Course Title						Core/ Elective
U23CD604	**NATURAL LANGUAGE PROCESSING**						**ELECTIVE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Python, Machine Learning	3	-	-	-	40	60	3

Course Objectives

This course will introduce students to:

1. Teach students the leading trends and systems in natural language processing.
2. Make them understand the concepts of morphology, syntax and semantics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
3. Teach them to recognize the significance of pragmatics for natural language understanding.
4. Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic and semantic processing.
5. How to evaluate the strengths and weaknesses of various NLP technologies and frameworks as they gain practical experience in the NLP toolkits available.

Course Outcomes

1. To tag a given text with basic Language features
2. To design an innovative application using NLP components
3. To implement a rule based system to tackle morphology/syntax of a language
4. To design a tag set to be used for statistical processing for real-time applications
5. To compare and contrast the use of different statistical approaches for different types of NLP applications and Perform various language phonetic analysis

UNIT I

Introduction of NLP: Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Automata , Morphology and Finite State Transducers, Tokenization, stemming, Normalization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II

WORD LEVEL ANALYSIS: N-grams, Evaluating N-grams, Smoothing,Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Entropy, Hidden Markov and Maximum Entropy models, ; Named Entities

UNIT-III

SYNTACTIC ANALYSIS: Context free rules and trees – The noun Phrase – Co-ordination – Verb phrase – context free grammars – Parsing with context free grammars, Shallow parsing – Probabilistic CFG , Dependency Grammar , Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion- Reference Resolution- Discourse Coherence and Structure.

UNIT_IV

Speech Fundamentals: Phonetics – speech sounds and phonetic transcription – articulatory phonetics – phonological categories and pronunciation variation – acoustic phonetics and signals –phonetic resources – articulatory and gestural phonology

UNIT-V

Speech synthesis – text normalization – phonetic analysis – prosodic analysis – diphone waveform synthesis – unit selection waveform synthesis – evaluation.

Suggested reading:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.

Course Code	Course Title						Core/Elective
U23CD605	AUTOMATA THEORY, LANGUAGES AND COMPUTATION						PEC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Discrete Mathematics	3	-	-	-	40	60	3

Course Objectives

This course will enable students to

1. Develop a formal notation for strings, languages and machines.
2. Understand Regular Expression and algebraic laws.
3. Design context free grammars and PDA, to generate strings from a context free language and Convert them into normal forms.
4. Identify the hierarchy of formal languages, grammars and machines.
5. Distinguish between computability and non-computability and Decidability and undecidability.

Course Outcomes

On completion of this course, the students are able to :

1. Gain knowledge of the various abstract machines
2. Use regular languages and regular expression for constructing different finite state machines
3. Understand and design different types of grammars
4. Construct Push down Automata
5. Construct Turing Machine.

UNIT-I

Introduction to Finite Automata: Structural Representations, Basic Concepts of Automata Theory – Symbol, Alphabets, Strings, Languages, Kleene Closure, Positive Closure

Finite Automata without Output: Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with Epsilon-Transitions, Conversion of NFA to DFA

UNIT-II

Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of regular sets, Conversion of Finite Automata to Regular Expressions.

Pumping Lemma for Regular Languages, Statement of the pumping lemma, Applications of the Pumping Lemma.

Closure Properties of Regular Languages: Closure properties of Regular languages, Decision Properties of Regular Languages, Minimization of Automata- Equivalence, Myhill - Nerode Theorem

UNIT-III

Context-Free Grammars: Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Trees, Ambiguity in Grammars.

Push down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Acceptance by final state & empty stack, Deterministic PDA Conversion of CFG to PDA, Conversion of PDA to CFG

UNIT-IV

Normal Forms for Context- Free Grammars: Grammar Simplification, Chomsky Normal form, Greibach Normal form.

Context-Free Languages: Statement of pumping lemma, Applications pumping lemma

Properties of Context-Free Languages: Closure properties of CFL's, Decision Properties of CFL's.

UNIT-V

Turing Machines: Introduction, Techniques for construction of Turing machines, Modifications of TM, TM as enumerator, Restricted TM.

Undecidability: Recursive and Recursively enumerable languages, Halting problem, Rice Theorem, Post's correspondence problem, P,NP,NP-Complete, NP-Hard Problems, Chomsky's Hierarchy–Regular grammars, Unrestricted grammar, CSL

Suggested Reading:

1. Introduction to Automata Theory, languages, and Computation, John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Pearson Education India, 3rd Edition,2008.
2. Automata and Computability, Undergraduate Texts in Computer Science,Dexter C. Kozen, Springer, 2007.
3. Introduction to the Theory of Computation, Michael Sipser, PWS Publishing 3rd Edition,2014.
4. Introduction to Languages and the Theory of Computation, John Martin, Tata McGraw Hill, 3rd Edition,2002.

Course Code	Course Title						Core/Elective
U23CD606	**AGILE METHODOLOGY AND DEVOPS**						**Core**
Prerequisite	**Hours Per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
SE	**3**	**–**	**–**	**–**	**40**	**60**	**3**

Course Objectives:

1. To introduce the fundamental concepts of Agile and DevOps methodologies.
2. To understand the Agile Manifesto and its principles for software development.
3. To explore various Agile frameworks including XP, Scrum, FDD, Kanban, and Crystal.
4. To study the DevOps process lifecycle, continuous delivery, testing, and architecture.
5. To develop understanding of tools and practices like Git, Jenkins, Docker, and test automation in Agile and DevOps.

Course Outcomes:

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

1. Discuss the evolution and significance of Agile and DevOps methodologies in the context of contemporary software development practices.
2. Interpret the core principles of the Agile Manifesto and apply Agile frameworks such as Scrum, XP, and Kanban to real-world scenarios.
3. Examine the DevOps lifecycle and analyze the impact of continuous integration and continuous delivery on achieving business agility.
4. Illustrate the practical use of modern DevOps tools including Git, Jenkins, Docker, and Ansible within Agile/DevOps pipelines.
5. evaluate quality assurance practices and testing tools for ensuring successful project execution.

UNIT – I

Agile Software Development: History and Value, Agile Manifesto Principles, Agile Development Model, Organizational Culture Considerations. **Introduction to DevOps:** Philosophy, Goals, Agile-DevOps Relationship.

UNIT – II

DevOps Process and Continuous Delivery: DevOps Lifecycle, Release Management, Continuous Testing. **DevOps and Architecture:** Influence of DevOps on software and system architecture.

UNIT – III

Agile Frameworks: Extreme Programming (XP), Scrum, Feature-Driven Development (FDD), Kanban Method, Crystal Family., **Agile Roles:** Product Owner, Scrum Master, Agile Team; Agile Requirements Gathering and Documentation.

UNIT – IV

Source Code Management: Git Basics, Git Servers, Gerrit, GitLab., **Build Systems and CI/CD:** Jenkins, Managing Build Dependencies, Infrastructure as Code (IaC) with Docker, Puppet, Ansible.

UNIT – V

Agile Quality Assurance: Principles, Practices. **Test-Driven Development (TDD):** Concept, Implementation.**Automation in Agile:** Testing Tools – Selenium, Continuous Testing, Agile Learning Environments.**Abstraction in Agile:** Importance and Application. **Global Software Development:** Agile in distributed teams.

Suggested Books:

1. "The DevOps Handbook" by Gene Kim, Patrick Debois, John Willis, and Jez Humble.
2. "Agile Software Development: Principles, Patterns, and Practices" by Robert C. Martin.
3. "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley.
4. "Scrum: The Art of Doing Twice the Work in Half the Time" by Jeff Sutherland.

Course Code	Course Title						core/ Elective
U23CD607	DATA ETHICS						Open Elective
Prerequisite	Contact Hours per week				CIE	SEE	credits
	L	T	D	P			
Basics of Data Science	3	-	-	-	40	60	3

Course Objectives

1. Understand the importance of data ethics in modern society and its role in shaping competitive advantages for businesses.
2. Analyze the ethical challenges associated with the collection, processing, and use of personal data by businesses and organizations.
3. Develop critical thinking skills to evaluate ethical implications of data collection and usage in various contexts.
4. Understand the legal frameworks and regulations related to data ethics and privacy.
5. Learn ethical decision-making frameworks to address complex data ethical issues in the work place and society.

Course Outcomes:

1. Students will be able to identify and evaluate ethical issues related to the collection and use of data in various contexts.
2. Students will understand the legal frameworks and regulations related to data ethics and privacy and applythem to real-world scenarios.
3. Students will develop critical thinking and problem-solving skills to address complex data ethical issues in the workplace and society.
4. Students will be able to apply ethical decision-making frameworks to make informed and responsible decisions regarding data ethics.
5. Students will be able to communicate effectively about data ethics to a variety of audiences, including businesses, policymakers, and the general public.

Unit-I

INTRODUCTION: What is data ethics, The fourth industrial revolution, Global standards for data ethics, Fairer mark conditions, Privacy for the elite. Digital hangovers, Oops, we're all public , Personal data becomes commercially valuable, Big data religion, Surveillance revelations

Unit-II

The data driven business model, Data as payment, good data, Data at risk, Data brokers in a grey area, A need for ne business models. What customers want, General concern for digital surveillance, who do internet users trust, Targeted ads and price Teens want privacy, Demand for data control, Consumers are beginning to act, blocking cookies and using vpn, Fal data on the rise, Obfuscation, from lack of knowledge to resignation, Pay for privacy.

Unit-III

Data ethics facilitates trust, Digital trust, The Snowden effect, The sharing economy, Trust is achieved in various ways, Made in Europe, Privacy branding, Privacy charlatans, Social privacy, Which is which?, More (perceived)security, More sharing

Unit-IV

A new market for privacy tech, User friendliness, Privacy products arenot new, Anonymity tech , Privacy is a commitment Privacy embedded in innovation, Surveillance capitalism, Declarations of independence, Anti-surveillance social revolutionaries, Privacy by design, A business philosophy

Unit-V

Investments in data ethical businesses, Investor Storytime, Privacy ascsr criteria, Investors ask for privacy practices. Data on the political agenda, Data protection in europe, Eu general data protection regulation 2016, Beyond compliance, Human rights, Global guidelines for businesses, The data industry lobby

Suggested Readings:

1. Data ETHICS: The New Competitive Advantages 1. Edition 2016 by Gry Hasselbalch &Pernille Tranber Ethics of Big Data: Balancing Risk and Innovation" by Kord Davis and Doug Patterson.

Course Code	Course Title						Core/Elective
U23CD6L1	Data Engineering Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Python	-	-	-	3	25	50	1.5

Course Objectives

1. To understand the fundamental concepts of data engineering and its lifecycle.
2. To leverage Python for ingesting, transforming, and managing structured and unstructured data.
3. To work with databases and data warehouses using Python.
4. To implement data pipelines using modern data engineering tools.
5. To develop skills to manage, monitor, and optimize data workflows in real-world scenarios.

Course Outcomes:

At the end of the course, student would be able to:

1. Understand the data engineering lifecycle and ecosystem.
2. Use Python libraries and tools to perform ETL processes.
3. Work with different data storage and retrieval systems (SQL, NoSQL, file formats).
4. Build and deploy end-to-end data pipelines using Python.
5. Optimize, monitor, and debug data pipelines effectively.

1. Write programs to parse text files, CSV, HTML, XML and JSON documents and extract relevant data. After retrieving data check any anomalies in the data, missing values etc.

2. Write programs for reading and writing binary files

3. Write programs for searching, splitting, and replacing strings based on pattern matching using regular expressions

4. Design a relational database for a small application and populate the database. Using SQL do the CRUD (create, read, update and delete) operations.

5. Create a Python MongoDB client using the Python module pymongo. Using a collection object practice functions for inserting, searching, removing, updating, replacing, and aggregating documents, as well as for creating indexes

6. Write programs to create numpy arrays of different shapes and from different sources, reshape and slice arrays, add array indexes, and apply arithmetic, logic, and aggregation functions to some or all array elements

7. Write programs to use the pandas data structures: Frames and series as storage containers and for a variety of data-wrangling operations, such as:

- Single-level and hierarchical indexing
- Handling missing data
- Arithmetic and Boolean operations on entire columns and tables
- Database-type operations (such as merging and aggregation)
- Plotting individual columns and whole tables
- Reading data from files and writing data to files

Course Code	Course Title						Core/Elective
U23CM6L2	MACHINE LEARNING LAB						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Python Programming	-	-	3	3	25	50	1.5

Course Objectives:

This course enables students to:

1. To introduce students to the basic concepts of Data Science and techniques of Machine Learning.
2. To develop skills of using recent machine learning software for solving practical problems.
3. To gain experience of doing independent study and research.
4. Be capable of confidently applying common Machine Learning algorithms in practice and implementing their own
5. Be capable of performing experiments in Machine Learning using real-world data.

Course Outcomes:

On completion of this course, the students are able to:

1. The student must be able to design and implement machine learning solutions to classification, regression problems.
2. Understand complexity of Machine Learning algorithms and their limitations
3. Able to evaluate and interpret the results of the algorithms.
4. Implement Decision trees and various algorithms
5. Implement and analyze various random forest techniques.

1. Implement a program to demonstrate the following
   a) Operation of data types in Python.
   b) Different Arithmetic Operations on numbers in Python.
   c) Create, concatenate and print a string and access substring from a given string.
   d) Append, and remove lists in python.
   e) Demonstrate working with tuples in python.
   f) Demonstrate working with dictionaries in python.

2. Using python write a NumPy program to compute the
   a) Expected Value
   b) Mean
   c) Standard deviation
   d) Variance
   e) Covariance
   f) Covariance Matrix of two given arrays.

3. For a given set of training data examples stored in a .CSV file, demonstrate Data Preprocessing in Machine learning with the following steps
   a) Getting the dataset.
   b) Importing libraries.
   c) Importing datasets.
   d) Finding Missing Data.
   e) Encoding Categorical Data.
   f) Splitting dataset into training and test set.
   g) Feature scaling.

4. Build a linear regression model using python for a particular data set by
   a) Splitting Training data and Test data.
   b) Evaluate the model (intercept and slope).
   c) Visualize the training set and testing set
   d) predicting the test set result
   e) compare actual output values with predicted value
   f) The dataset contains information of users from a company's database. It contains information about UserID, Gender, Age, EstimatedSalary, and Purchased. Use this dataset for predicting that a user will purchase the company's newly launched product or not by Logistic Regression model.

5. Implement a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Implement k-nearest neighbor's classification to classify the iris data set using python.

User ID	Gender	Age	EstimatedSalary	Purchased
15624510	Male	19	19000	0
15810944	Male	35	20000	0
15668575	Female	26	43000	0
15603246	Female	27	57000	0
15804002	Male	19	76000	0
15728773	Male	27	58000	0
15598044	Female	27	84000	0
15694829	Female	32	150000	1
15600575	Male	25	33000	0
15727311	Female	35	65000	0
15570769	Female	26	80000	0
15606274	Female	26	52000	0
15746139	Male	20	86000	0
15704987	Male	32	18000	0
15628972	Male	18	82000	0
15697686	Male	29	80000	0
15733883	Male	47	25000	1
15617482	Male	45	26000	1
15704583	Male	46	28000	1

7. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	**VAR2**	**CLASS**
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

8. Evaluate the metrics for all types of machine learning algorithms using sample data.

9. Implement an algorithm to demonstrate the significance of SVM.

Suggested Readings:

1. The Field Guide to Data Science ,Booz, Allen, Hamilton,Manning Publications 2nd Edition,2018.
2. Hands-On Machine Learning with Scikit-Learn and TensorFlow,Aurélien Géron, O'Reilly Media, 1st Edition,2017.
3. Machine Learning in Action, Peter Harrington, Manning Publications.2012.

Course Code	Course Title						Core/Elective
U23CD6P1	MINI PROJECT						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	6	6	50		2

Course Objectives:

The objective of the course is to:

1. Enhance practical and professional skills.
2. Familiarize tools and techniques of systematic literature survey and documentation
3. Expose the students to industry practices and team work.
4. Encourage students to work with innovative and entrepreneurial ideas.
5. Make students evaluate different solutions based on economic and technical feasibility

Course Outcomes:

After completing the course, the student will be able to:

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

1. As part of the curriculum in the VI- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Four students will be allotted to one faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter-disciplinary/ industry relevance.
5. The students can select a mathematical modelling based/Experimental investigations or Numerical modelling
6. All the investigations should be clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference.
8. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
9. The preliminary results (if available) of the problem may also be discussed in the report.
10. The work has to be presented in front of the PRC committee which consists of one Supervisor and a minimum of two faculty members from the respective Department of the Institute.

Course Code	Course Title						Core/Elective
U23MA6L1	APTITUDE AND REASONING SKILLS LAB						Core
	Contact Hours per Week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
-	-	-	2	2	25	50	1

Course Objectives

This course enables students to:

1. Acquire the concepts of mathematical aptitude and reasoning.
2. Develop the innovative and creative thinking through basic mathematical concepts.
3. Improve analytical and problems solving skills.
4. Enhance logical thinking and mathematical ability.
5. Empower with the basic tools of mathematical aptitude.

Course Outcomes

After completing this course, the student will be able to:

1. Build proficiency in quantitative reasoning
2. Improve critical thinking skills
3. Enhance analytical skills
4. Demonstrate quantitative aptitude concepts
5. Adapt principles of quantitative aptitude to achieve qualitative results.

Guidelines

1) **Basic concepts**: combined mean, average principles, wrong values taken, number added or deleted, average speed.

2) **Percentages** -Basic Concepts, conversions, finding percentages from given numbers, quantity increases or decreases by given percentage, population increase by given percentage, comparisons, consumption when a commodity price increase or decrease and applications.

3) **Data Interpretation** - Introduction to Data Interpretation, quantitative and qualitative data, Tabular Data, Line Graphs, Bar Chart, Pie Charts, X-Y Charts.

4) Number Series, Letter Series, Series completion and correction, Coding and Decoding. Word analogy-Applied analogy, Classifications, verbal classification.

5) **Reasoning Logical Diagrams** - Simple diagrammatic relationship, Multi diagrammatic relationship, Venn-diagrams, Analytical reasoning., Reasoning Ability - Blood Relations, Seating arrangements, Directions, Decision making. Number Systems: Basic Concepts,

6) **Number Systems**: Natural numbers, whole numbers, integers, fractions, Rational Numbers, Irrational Numbers, Real Numbers, Divisibility Rules, Logic Equations, Remainder theorem, Unit digit calculation. Progressions & Inequalities: Basic Concepts, Types: arithmetic, geometric, harmonic progression and applications.

7) **Profit and Loss**: Basic Concepts, discounts, marked price and list price, dishonest shopkeeper with manipulated weights, successive discounts etc. Interest (Simple and Compound): Basic Concepts, Yearly, Half-yearly, and quarterly calculations, multiples, differences between simple and compound interest.

8) **Ratio and Proportion**: Basic Concepts of ratio and proportion, continued or equal proportions, mean proportions, invest proportion, alternative proportion, division proportion, compound proportion, duplication of ratio, finding values, coins and currencies, etc.

9) **Speed, Time and Distance**: Basic Concepts, Single train problems, two train problems: some point same side, some point opposite sides, relative speed, different points meeting at common points, different points same side (different timings vs. same timings), ratios, number of stoppages, average speed, etc.

10) **Time and Work**: Basic Concepts, comparative work, mixed work, alternative work, middle leave and middle join, ratio efficiency.

11) **Permutations and combinations**: Basic Concepts, differences between permutations and combinations, alternative arrangement, fixed positions, items drawing from a single group, items drawing from a multiple group, total ways of arrangement with repetitions and without repetitions, handshakes or line joining between two points or number of matches, sides and diagonals, etc.

12) **Clocks and Calendars**: Basic Concepts, Angle between minute hand and hour hand, reflex angle, hours hand angle, time gap between minute hand and hour hand, relative time: coincide, opposite sides and right angle, mirror images, faulty clock (slow/fast), miscellaneous, calendar.

13) **Geometry and Mensuration**: Basic concepts, types of angles.

Plane figures: rectangles, squares, triangles, quadrilateral, areas, perimeters, etc.

Solid figures: cubes, cuboids, cylinders-area (total surface area and lateral surface area), volumes, perimeters.

Others: Parallelogram, Rhombus, Trapezium, Circle, Sector, Segment, Cone, Sphere, Hemisphere, etc.

Suggested Readings:

1. Aptitude and reasoning skills lab Manual, LIET, HYD.