CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2025-26)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1.	22MTC07	Mathematical and Statistical Foundations	3	-	3	40	60	3
2.	22ITC05N	Discrete Mathematics	3	-	3	40	60	3
3.	22ADC31N	Exploratory Data Analysis and Visualization	2	-	3	40	60	2
4.	22ITC02N	Java Programming	3	-	3	40	60	3
5.	22ITC01N	Digital Logic and Computer Architecture	3	-	3	40	60	3
6.	22CSC14N	Design and Analysis of Algorithms	3	-	3	40	60	3
7.	22EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	Non-Credit
PRACTICAL								
8.	22ADC32N	Exploratory Data Analysis and Visualization Lab	-	2	3	50	50	1
9.	22ITC03N	Java Programming Lab	-	3	3	50	50	1.5
10.	22ADC33N	Competitive Programming	-	2	-	50	-	1
11.	22ADI01	MOOCs/Training/Internship	3-4 Weeks/ 90 Hours		-	50	-	2
TOTAL			**19**	**7**		**440**	**510**	**22.5**
Clock Hours per week: 26								

L: Lecture **D: Drawing** **CIE - Continuous Internal Evaluation**

T: Tutorial **P: Practical** **SEE: Semester End Examination**

22MTC07

MATHEMATICAL AND STATISTICAL FOUNDATIONS

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3
Prerequisites:	

Course Objectives:

1. Able to learn and Analysing data in using statistical tools.
2. Able to fit the hypothetical data using probability distribution.
3. Able to fit the random data using distribution function.
4. Able to understand the data using the testing of Hypothesis.
5. Able to understand the basic concepts of the Number Theory for data security.
6.

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

1. Apply the statistical averages for identifying behaviour of the data.
2. Analyse the data using probabilistic models.
3. Apply the probability function to characterise the random phenomenon.
4. Analyse data using different methods of hypothesis testing.
5. Apply the number theory concept to cryptography domain.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	2	2	2	3
CO2	3	3	2	2	-	-	-	-	-	-	2	2	2	2
CO3	3	3	2	2	-	-	-	-	-	-	2	2	2	2
CO4	3	3	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	3	2	2	-	-	-	-	-	-	2	1	2	1

UNIT-I: Basic Statistics

Measures of Central Tendency, Measures of Dispersion, Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Correlation, linear regression, properties of regression coefficient.

UNIT-II: Mathematical Expectation (One Dimensional Random variables)

Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, Variance and co-variance. Moments (Moments about the mean and moments about a point).

UNIT-III: Probability Distributions

Poisson distribution, Mean, Variance, MGF and CGF, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution). Normal distribution, Characteristics of normal distribution, Mean, Variance, MGF and CGF, Areas under normal curve. Uniform distribution, Mean, Variance and MGF, Exponential distribution, Mean, Variance, MGF and CGF.

UNIT-IV: Testing of Hypothesis

Large and Small Sample Tests: Tests of significance for large samples, for Single Proportion, difference of Proportions, Single mean and difference of means. Small sample test: t-test for single mean and differences of means. F-test for equality of two population variances.

UNIT-V: Number Theory

Greatest common divisors, The Euclidean algorithm, the fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers. Introduction to Congruence, Linear congruence, The Chinese Remainder Theorem, System of linear congruences.

Textbooks:

1. 1.S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. Kenneth H. Rosen, Elementary number theory & its applications, Sixth edition, Addison-wesley, ISBN978 0-321-50031-1.

Suggested Reading:

1. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.
3. S.C.Gupta, V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, 2014.

Online Resources:

Course Code	Course Name		Resource Links
22MTC07	Mathematical and Statistical Foundation	1.	2. https://archive.nptel.ac.in/courses/110/107/110107114/ 3. https://archive.nptel.ac.in/courses/111/101/111101137/ (Week 1,2,4,5 &7)

22ITC05N

DISCRETE MATHEMATICS

(Common to CSE-AIML, AIML, CET and IT branches)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

This course aims to

1. Introduce Propositional, Predicate Logic and various proof techniques for validation of arguments.
2. Develop an understanding of counting, functions and relations.
3. Familiarize with fundamental notions and applicability of graph theory and algebraic systems

COURSE OUTCOMES:

After completion of this course, students will be able to

1. Describe rules of inference for Propositional and Predicate logic.
2. Demonstrate use of Set Theory, Venn Diagrams, and relations in Real-world scenarios.
3. Model solutions using Generating Functions and Recurrence Relations.
4. Determine the properties of graphs and trees to solve problems arising in computer science applications.
5. Distinguish between groups, semi groups and monoids in algebraic systems

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	-	-	-	2	-	-	-	-	-
CO2	3	3	1	3	-	-	-	-	-	-	1	1	2	3
CO3	2	3	1	3	1	-	-	-	-	-	-	-	-	-
CO4	3	3	2	3	1	-	-	-	-	-	1	2	2	2
CO5	3	3	1	1	-	-	-	-	-	-	-	-	-	-

UNIT-I

Introduction to Propositional Calculus: Basic Connectives and Truth tables, Logical Equivalence: Laws of Logic, Logical Implication; Rules of Inference. **Predicates**: The Use of Quantifiers, Definitions and the Proofs of Theorems

UNIT-II

Sets: Sets and Subsets, Operations on sets and the Laws of Set Theory, Counting and Venn Diagrams. **Relations**: Cartesian Products and Relations. Partial ordering relations, POSET, Hasse diagrams, Lattices as Partially Ordered Sets, Equivalence relations. Pigeonhole principle.

UNIT-III

Generating Functions: Generating Functions, Calculating Coefficient of generating functions.

Recurrence Relations: The First Order Linear Recurrence Relation, Second Order Linear. Homogeneous Recurrence relations with constant coefficients, Non-Homogeneous Recurrence relations.

UNIT-IV

Introduction to Graphs: Graphs and their basic properties- degree, path, cycle, Sub graphs, Complements and Graph Isomorphism, Euler trails and circuits, Hamiltonian paths and cycles, planar graphs, Euler formula, Graph Coloring.

Trees: Definitions, Properties, Spanning Trees, **Minimum Spanning trees**: The Algorithms of Kruskal and Prim

UNIT-V

Algebraic Structures: Algebraic Systems, Examples and General Properties, Semi groups and Monoids.

Groups: Definitions and Examples, Subgroups, Homomorphisms and cyclic groups

TEXTBOOKS:

1. Rosen, K. H. (2019). Discrete Mathematics and Its Applications. (8th Edition) ISBN10: 125967651X ISBN13: 9781259676512(latest edition)
2. Oscar Levin Discrete Mathematics An Open Introduction (4th Edition) ISBN 9781032966168 2025**,** CRC Press.
3. J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", TATA Mc Graw-Hill Edition, 1995.

SUGGESTED READING:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", An Applied Introduction, 5th edition, Pearson Education, 2016. (latest edition)
2. Singh, S.B., Discrete Mathematics, Khanna Book Publishing Company, New Delhi. SBN: 9789382609407, 9789382609407 Edition: 3, 2019 (latest edition)
3. David D. Railey, Kenny A. Hunt, "Computational Thinking for the Modern Problem Solving", CRC Press, 2014
4. Joe L. Mott, Abraham Kandel, Theodore P. Baker, "Discrete Mathematics for Computer Scientists & Mathematicians", 8th Edition, PHI, 1986.

WEB RESOURCES:

1. https://nptel.ac.in/courses/111107058/
2. https://nptel-discrete-mathematics-5217

22ADC31N

EXPLORATORY DATA ANALYSIS AND VISUALIZATION

Instruction	2L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

PREREQUISITE: Python Programming

Course Objectives: This course aims to:

1. Introduce the fundamentals of NumPy, including array creation, manipulation, and mathematical operations, to build a strong foundation for numerical computing in Python.
2. Familiarize students with core Pandas data structures and operations for loading, manipulating, and summarizing structured datasets.
3. Teach essential data preprocessing techniques such as handling missing values, transforming data, and combining datasets using Pandas for real-world data analysis.
4. Explain methods for data aggregation and grouping along with time series handling to manage, analyze, and interpret time-dependent data effectively.
5. Develop skills in data visualization using Matplotlib and Seaborn to present analytical results clearly through various types of charts and plots.

Course Outcomes:

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

1. Apply NumPy operations such as array creation, indexing, arithmetic computations, transposition, and random number generation to efficiently perform numerical and data manipulation tasks.
2. Perform data manipulation, analysis, and summarization on structured data by utilizing Pandas data structures and functionalities.
3. Apply data cleaning and wrangling techniques using Pandas to handle missing data, transform and categorize values, perform hierarchical indexing, merge and reshape datasets, and prepare data for meaningful analysis.
4. Summarize and analyze data using group operations, and handle time series data by converting dates, selecting time-based data, and performing resampling and frequency changes with Pandas.
5. Create and customize a variety of visualizations using Matplotlib and Seaborn, including line plots, bar charts, histograms, scatter plots, and categorical plots, to effectively communicate data insights.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	-	-	-	-	-	2	1	1	2
CO2	3	2	-	1	2	-	-	-	1	-	2	2	1	3
CO3	3	2	-	1	2	-	-	-	1	-	2	2	1	2
CO4	3	2	-	2	2	-	-	-	1	-	2	1	1	2
CO5	1	1	-	1	2	-	-	-	2	-	2	1	1	2

UNIT - I

NumPy Basics: Creating ND arrays, Data Types for ND arrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes, Pseudo Random Number Generation, Universal Functions.

UNIT - II

Getting Started with Pandas: Series, Data Frame and Index Objects, Reindexing, Dropping Entries from an Axis, Indexing, Selection and Filtering, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels, Summarizing and Computing Descriptive Statistics.
Data Loading, Storage and File Formats: Reading Text Files in Pieces, Writing Data to Text Format.

UNIT - III

Data Cleaning and Preparation: Filtering out Missing Data, Filling in Missing Data, Transforming Data using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering, Categorical Extension Type in Pandas, Computations with Categoricals.

Data Wrangling: Hierarchical Indexing-Reordering and Sorting Levels, Summary Statistics by Level, Indexing with a Data Frame's Columns, Database-Style Data Frame Joins, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap, Reshaping with Hierarchical Indexing.

UNIT - IV

Data Aggregation and Group Operations: Column-Wise and Multiple Function Application, Returning Aggregated Data without Row Indexes, General Split-apply-combine.
Time Series: Date and Time Data Types and Tools, Converting between String and Date time, Time Series Basics-Indexing, Selection, Subsetting, Time Series with Duplicate Indices, Generating Date ranges, Frequencies and Dateoffsets, Resampling and Frequency Conversion-Down Sampling, Up sampling and Interpolation.

UNIT - V

Plotting and Visualization: Figures and Subplots, Colors, Markers and Line styles, Ticks, Labels and Legends, Saving Plots to File, Seaborne - Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots, Facet Grids and Categorical Data.

TEXTBOOKS:

1. Wes McKinney, "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", 3rd Edition, 2022

SUGGESTED READING:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition, 2023.

WEB RESOURCES:

1. https://numpy.org/doc/stable/user/index.html
2. https://pandas.pydata.org/
3. https://matplotlib.org/
4. https://seaborn.pydata.org/tutorial.html
5. https://www.coursera.org/learn/data-analysis-with-python

22ITC02N

JAVA PROGRAMMING

(Common to CSE, IT, AI&DS, CET and allied branches)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CI E	40 Marks
Credits	3

Course Objectives

The course aims to:

1. Introduce the fundamental concepts of Object-Oriented Programming (OOP).
2. Guide students through the process of creating and managing classes and objects.
3. Explain and demonstrate the use of inheritance and polymorphism.
4. Teach effective handling of runtime exceptions and the basics of multithreading.
5. Provide hands-on experience with Java's IO package for application development.

Course Outcomes

By the end of this course, students will be able to:

1. Apply OOP concepts to develop structured Java applications.
2. Utilize inheritance and interfaces to enhance code reusability and flexibility.
3. Implement exception handling and multithreading to manage complex program flows.
4. Build applications using the Java Collection Framework.
5. Develop programs that handle input and output operations using the IO package.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	-	1	2	1	2	2	2	2
CO2	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO5	2	2	3	2	3	1	-	1	2	1	2	2	3	3

UNIT-I

Introduction to Java: Procedural and object-oriented programming paradigms, Principles, Features, Basic structure a java program, Java Primitive Data Types, Basic Operators, Flow-control statements. Defining Classes, Adding Instance Fields and Methods, Object Creation, Constructors, Access Modifiers, Method Overloading and Constructor Overloading, Use of static and final keyword, Arrays, Strings and String Tokenizer, Scanner.

UNIT-II

Inheritances and Packages: Types of Inheritance, super keyword, preventing inheritance, the Object class, method overriding and dynamic method dispatch, abstract classes and methods. Interfaces, Interfaces vs. Abstract classes, Inner classes and types, Packages, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

UNIT-III

Exception Handling and Threading: What are exceptions, Error vs. Exception, usage of try, catch, throw,

throws and finally clauses, Multithreading in Java, Life cycle of Thread, how to create threads, Thread class in java, Thread priorities, Thread Synchronization. Introduction to Generics, Advantages of Generics, Generic class, Type Parameters, Generic Methods.

UNIT-IV

Collections: Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Collection classes – Array List, Linked List, Hash Set, Tree Set, Hash Map, Tree Map, Iteration over Collections – Iterator and List Iterator, Comparable and Comparator interface, Introduction to Java 8 Features, Lambda Expressions, Functional Interfaces.

UNIT-V

Java I/O and NIO: Input Stream, Output Stream, Reader, Writer, File Reader, File Writer, Buffered Reader, Buffered Writer, Object Serialization and Deserialization, Java NIO: Non-blocking I/O, Path, Files, Selectors, Channels, Buffers, Asynchronous I/O, NIO vs. IO

Textbooks:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram "Advanced Programming in Java2" Jaico Publishing House, 2008.

Suggested Reading:

1. E Balaguruswamy "Programming with Java", Tata McGraw-Hill, 6th Edition, 2019.
2. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects", 11th Edition. 2018.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

22ITC01N DIGITAL LOGIC AND COMPUTER ARCHITECTURE

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with Data representation, Number system and Logic gates.
2. To provide understanding of Combinational and Sequential logic circuits, Digital Registers and Counters.
3. To present the operation of the Central Processing Unit.
4. To facilitate the techniques that computers use to communicate with input and output devices.
5. To introduce the concept of memory hierarchy and memory management.

Course Outcomes: Upon completing this course, students will be able to:

1. Apply Boolean algebra for simplification and learn representation of data using numbers.
2. Understand fundamentals of Combinational & Sequential logic gates, registers and counters.
3. Infer the architecture and functionality of the central processing unit.
4. Explore the techniques that computers use to communicate with I/O devices for data transfer.
5. Comprehend memory hierarchy, cache memory and virtual memory.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	0	1	0	0	0	1	0	0	2	0	2
CO2	2	2	1	0	1	0	0	0	0	0	0	1	0	2
CO3	2	2	1	0	0	0	0	0	0	0	2	0	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	0	2
CO5	2	2	1	0	0	0	1	0	1	0	2	1	0	2

UNIT–I

Data Representation: Number Systems, Octal, binary, Hexadecimal and Decimal Representation, Complements: (r-1)'s Complement, r's Complement, Subtraction of Unsigned Numbers.

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean algebra, Map simplification, Sum-of-Products and Product-of-sums Simplification, Don't -Care Conditions.

UNIT–II

Combinational Circuits: Decoders, Encoders, Multiplexers, Half-Adder, Full-Adders.

Flip-Flops: SR, D, JK, T Flip- Flops, Edge triggered Flip-Flops, Excitation Tables.

Registers: Register with Parallel load, Bidirectional Shift Register with Parallel load, 4-bit Synchronous Binary Counter.

UNIT-III

Central Processing Unit: Computer Registers, General register Organization, Instruction Cycle and Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions, Zero-Address Instructions, RISC Instructions, Addressing Modes, Data Transfer and Manipulation, Program Control.

UNIT-IV

Input-Output Organization: Input-output Interface: I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface, Modes of Transfer, Interrupt-

Initiated I/O, Priority Interrupt: Daisy Chaining Priority, Parallel Priority Interrupt, Priority Encoder, Direct Memory Access(DMA): DMA Controller.

UNIT- V

Memory Organization: Memory Hierarchy, Main Memory: RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary memory: Magnetic Disks, Associative Memory: Hardware Organization, Match Logic, Cache Memory: Associative Mapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space.

Textbook:

1 M.Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Education. 2016.

References:

1. Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design", 2nd Edition, McGraw Hill, 2009.
2. ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, Tata McGraw Hill, 1995.
3. William Stallings, "Computer Organization and Architecture", 8th Edition,PHI.2010
4. Carl Hamachar, Vranesic, Zaky, "Computer Organization", 5th Edition, McGraw Hill.2002.

Web Resources:

1. https://nptel.ac.in/courses/117106114Week1%20Slides1.1Introduction.pdf
2. http://www.nptelvideos.in/2012/11/computer-organization.html
3. Z. Honghong, J. Yi, W. Zhehe, P. Junjie and Z. Honghong, "Research on a New Computer Architecture," 2018 IEEE 3rd International Conference on Communication and Information Systems (ICCIS), Singapore, 2018, pp. 203-207, doi: 10.1109/ICOMIS.2018.8644796.
4. M. Špoljarić, M. Hajba and i. M. Pecimotika, "Interactive approach to Digital Logic," 2020 43rd International Convention on Information, Communication and Electronic Technology (MIPRO),Opatija,Croatia, 2020, pp. 1601-1606, doi: 10.23919/MIPRO48935.2020.9245362.

22CSC14N

DESIGN AND ANALYSIS OF ALGORITHMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basics of Data structures and algorithms.

Course Objectives:

This course aims to:

1. Provide an introduction to formalisms to understand, analyse and denote time complexities of algorithms.
2. Introduce the different algorithmic approaches for problem solving through numerous example problems.
3. Provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness.

Course Outcomes:

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

1. Identify and apply asymptotic notations and recurrence-solving techniques to analyse the performance of recursive algorithms
2. Apply greedy and dynamic programming strategies to solve optimization problems and identify the most suitable design approach based on problem characteristics.
3. Implement backtracking and branch-and-bound techniques to solve combinatorial and decision problems and evaluate their efficiency.
4. Solve and evaluate the performance of graph traversal and shortest path algorithms.
5. Demonstrate NP-completeness through problem reductions and complexity classes.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	-	-	-	-	-	-	2	3	2
CO2	3	3	2	-	2	-	-	-	-	-	-	3	3	2
CO3	3	3	2	-	2	-	-	-	-	-	-	3	3	2
CO4	3	3	-	-	2	-	-	-	-	-	-	3	3	2
CO5	2	3	-	-	2	-	-	-	-	-	-	2	2	3

UNIT - I

Introduction: Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds – best, average and worst-case behaviour. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method, Minimum and Maximum Problem **Analysis of recursive algorithms through recurrence relations:** Iterative/Expansion method, Recursion tree method and Masters' theorem.

UNIT - II

Greedy Algorithms: The general method, Knapsack Problem, Huffman Codes, Job scheduling with deadlines. **Dynamic Programming**: The general method, 0/1 Knapsack, Travelling Salesman Problem, Matrix chain multiplication, Longest Common subsequence.

UNIT - III

Backtracking: The general Method, 8-Queens Problem, Graph Coloring, Hamiltonian Cycle. **Branch-and-Bound**: The general method, FIFO branch and bound, LC branch and bound, 0/1 Knapsack Problem using FIFO branch and bound, Travelling Salesperson problem using LC branch and bound.

UNIT - IV

Graph Algorithms: Applications of DFS: Bi-Connected components, strongly connected components, topological sorting. **Shortest Path Algorithms**: Dijkstra's, Bellman-Ford, Floyd-Warshall

UNIT - V

Theory of NP-Completeness: Polynomial time, Polynomial time verification, P, NP, NP-hard and NP-Complete classes, NP-Completeness and Reducibility. **Standard NP-Complete Problems and Reduction Techniques:** The Clique Problem, Vertex-Cover Problem.

Textbooks:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press/McGraw-Hill, 4th Edition, 2022.
2. E. Horowitz, sartaj sahni and sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2008.

Suggested Reading:

1. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis", and Internet Examples, Wiley Second Edition.

Online Resources:

1. https://nptel.ac.in/courses/106101060/

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/BTech III/IV/VI/VII Semester - Common to all branches)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	----
Credits	0

Prerequisite: Basic awareness of Indian Constitution and Government.

Course Objectives

The course will introduce the students to:

1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

Course Outcomes

After successful completion of the course the students will be able to:

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	1	1	1	-	-	-	1	-	-
CO2	-	-	2	-	-	3	2	1	-	-	-	2	-	-
CO3	-	-	1	-	-	1	-	-	-	-	-	-	-	-
CO4	-	-	1	-	-	1	-	-	-	-	-	1	-	-
CO5	-	-	2	-	-	3	1	1	-	-	-	2	-	-

Unit-I

Constitutional History and Framing of Indian Constitution

East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

Unit-II

Fundamental Rights, Duties and Directive Principles of State Policy

The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

Unit-III

Union Government and its Administration

Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

Unit-IV

Union Legislature and Judiciary

Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

Unit-V

Local Self Governments

Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

Textbooks:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Academy, 2nd edition, 2018.
2. "Indian Constitution at Work", NCERT, First edition 2006, reprinted in 2022.

Suggested Reading:

1. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. Granville Austin, "The Indian Constitution: The Cornerstone of a Nation", OUP, 2nd Edition, 1999.
4. M.V. Pylee, "India's Constitution", S. Chand Publishing, 16th Edition, 2017.
5. Rajeev Bhargava (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.

22ADC32N

EXPLORATORY DATA ANALYSIS AND VISUALIZATION LAB

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Python Programming

Course Objectives:

The course is designed to enable students to:

1. Develop foundational skills in performing numerical operations and array manipulations using NumPy.
2. Understand and apply data handling, transformation, and preprocessing techniques using Pandas.
3. Analyze structured datasets to identify trends, summarize information, and prepare data for analysis.
4. Create effective and customized data visualizations using Matplotlib and Seaborn to communicate insights.
5. Integrate EDA techniques in a real-world case study to perform a comprehensive analysis from data loading to visualization.

COURSE OUTCOMES:

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

1. Apply NumPy functionalities such as array creation, indexing, broadcasting, and matrix operations for efficient data computation.
2. Utilize Pandas for creating, cleaning, transforming, and analysing structured data.
3. Perform complex data operations like merging, hierarchical indexing, grouping, and time series analysis using Pandas.
4. Generate various types of data visualizations using Matplotlib and Seaborn to reveal patterns and insights.
5. Execute an end-to-end exploratory data analysis on a domain-specific dataset, integrating all learned skills in a structured workflow.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	2	2	-	-	-	-	-	-	2	2	3
CO2	3	1	-	2	2	-	-	-	-	-	-	2	2	3
CO3	3	2	-	2	2	-	-	-	-	-	-	2	2	3
CO4	2	1	1	2	2	-	-	-	1	-	-	1	1	2
CO5	3	3	2	3	3	-	-	-	2	-	3	3	3	3

LIST OF PROGRAMS:

1. **NumPy Fundamentals:** Array creation: 1D, 2D, 3D arrays, Indexing, slicing, broadcasting, Arithmetic operations and matrix computations
2. **Advanced NumPy Operations:** Transposition and reshaping arrays, Random number generation, Aggregate functions and axis operations
3. **Pandas:** Series and Data Frame creation, Data Frame indexing, slicing, and selection, Basic operations and attributes
4. **Data Cleaning and Preprocessing:** Handling missing data (dropna, fillna), Replacing values and data type conversion, Detecting and removing duplicates

5. **Data Transformation and Categorization:** Mapping and renaming values, Binnand categorization, Sorting, ranking, and filtering data
6. **Hierarchical Indexing and Merging:** Multi-level indexing, Concatenating and merging DataFrames, reshaping with stack, unstack, and pivot
7. **GroupBy and Time Series Analysis:** Grouping and aggregation, Time series conversion and indexing, Resampling, frequency conversion, and date-based selection
8. **Data Visualization with Matplotlib and Seaborn**: Line plots, bar charts, histograms, scatter plots, Customizing plots (labels, legends, styles)
9. **Advanced Visualizations with Seaborn:** Categorical plots (box, violin), Heatmaps and pairplots, Styling themes and color palettes
10. **Case Study: End-to-End EDA**
    - Dataset: Choose from domains like healthcare, e-commerce, finance, or social media etc.
    - Data loading and preprocessing, Cleaning and wrangling, Grouping and time series (if applicable), Data visualization and insights
    - Deliverables: Jupyter notebook/ Colab notebool

TEXT BOOKS:

1. Wes McKinney, "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", 3rd Edition, 2022

SUGGESTED READING:

2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition, 2023.

WEB RESOURCES:

1. https://numpy.org/doc/stable/user/index.html
2. https://pandas.pydata.org/
3. https://matplotlib.org/
4. https://seaborn.pydata.org/tutorial.html
5. https://www.coursera.org/learn/data-analysis-with-python

DATASETS:

1. https://www.kaggle.com/datasets?search=Exploratory+data+analysis
2. https://archive.ics.uci.edu/

22ITC03N

JAVA PROGRAMMING LAB

(Common to CSE, IT, AI&DS, CET and allied branches)

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims to:

1. Introduce the core principles of Object-Oriented Programming (OOP).
2. Explain the object-oriented approach to designing and implementing classes and objects.
3. Demonstrate the use of inheritance and polymorphism in Java.
4. Illustrate exception handling and multithreading techniques for managing runtime behavior.
5. Explore Java's IO package for developing basic input/output functionalities in applications.

Course Outcomes:

Upon successful completion of this course, student will be able to:

1. Apply OOP principles to design and develop Java applications.
2. Implement inheritance and interfaces to build modular and reusable code.
3. Use exception handling and multithreading to manage multiple execution paths efficiently.
4. Develop robust applications utilizing the Java Collection Framework.
5. Integrate Java IO concepts for effective data input and output operations in applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	-	1	2	1	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	2	2	2	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO5	3	3	3	2	3	1	-	1	2	2	2	2	3	3

LIST OF EXPERIMENTS

1. Implement the program(s) to handle the various data types, operators, expressions, control-flow, and strings.
2. Develop a java program(s) for constructors.
3. Develop a java program to demonstrate the method overloading and riding.
4. Develop a java program(s) to deal with different types of inheritances and interfaces.
5. Implement the program(s) to demonstrate the packages.
6. Develop a java program(s) to handle user defined exceptions with multiple catch blocks.
7. Implement program(s) to demonstrate Multithreading and thread synchronization.
8. Implement program(s) to demonstrate generics.
9. Implement the collection framework classes with Iterator/List Iterator.

10. Develop a java program(s) to implement the features of JDK8.

Textbooks:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram "Advanced Programming in Java2" Jaico Publishing House, 2008.

Suggested Reading:

1. E Balaguruswamy "Programming with Java", Tata McGraw-Hill, 6th Edition, 2019.
2. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects", 11th Edition. 2018.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

22ADC33N

COMPETITIVE PROGRAMMING

Instruction	2P Hours per week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1

COURSE OBJECTIVES:

1. Introduce the fundamentals of competitive programming and online coding platforms.
2. Equip students with skills for efficient input/output operations and core programming constructs.
3. Provide a strong foundation in data structures and algorithmic problem-solving techniques.
4. Enable application of advanced algorithms such as divide and conquer, backtracking, dynamic Programming, and greedy methods.
5. Develop the ability to solve real-time programming challenges using optimal and efficient code.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Identify suitable algorithms and data structures for solving computational problems.
2. Apply basic and advanced problem-solving strategies in programming.
3. Develop code using programming best practices to enhance readability, efficiency, and performance.
4. Analyze different algorithmic techniques like divide and conquer, dynamic programming, and greedy methods.
5. Solve real-world problems by writing optimized and error-free code.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	-	1	-	-	-	-	-	-	2	2	2
CO2	3	3	3	-	1	-	-	-	-	-	-	2	2	2
CO3	2	3	2	-	1	-	-	-	-	-	-	2	2	2
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	-	-	-	2	2	2

PRE-REQUISITES/CO-REQUISITES:

Problem Solving and Programming, Problem Solving and Programming Lab, Data Structures, Data Structures Lab, Design and Analysis of Algorithms.

Week 1: Introduction and Basics

- Overview of Competitive Programming
- Setting up IDEs (Code Chef, Hacker Rank, LeetCode, etc.)
- Input/Output optimization (Fast I/O in C++/Python/Java)
- Basic Syntax, Loops, and Conditionals

Week 2: Searching and sorting

- Introduction to searching and sorting.
- Practice problems on sorting
- Practice problem on Searching algorithms

Week 3: Data Structures (Linear)

- Introduction to Linked List, Stack and Queues.
- Practice problems on applications of Linked List, Stack and Queues.

Week 4: Data Structures (Non - Linear)

- Introduction to Trees and Graphs.
- Practice problems on applications of Trees and Graphs.

Week 5: Advanced Data Structures

- Heaps and priority queues
- Hashing

Week 6: Bit Manipulation

- Practicing problem on Bit Manipulation

Week 7: Divide and conquer

- Introduction to Divide and Conquer Algorithms
- Practice Problems on Divide and Conquer

Week 8: Backtracking

- Introduction to Backtracking
- Practice problems on Backtracking

Week 9: Dynamic Programming

- Introduction to Dynamic Programming
- Practice Problem on Dynamic Programming

Week 10: Greedy Algorithms

- Introduction to Greedy Algorithms
- Practice Problems on Greedy Algorithms

PRACTICE PLATFORMS:

Regularly practice problems on online coding platforms like Code forces, Hacker Rank, Code Chef, and LeetCode.

TEXT BOOKS:

1. "Competitive Programming" by Steven Halim and Felix Halim
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
3. Leetcode 50 Common Interview Questions – Leetcode Clean Code Handbook, 2014

WEB RESOURCES:

1. https://www.topcoder.com/
2. https://www.geeksforgeeks.org/data-structures/?ref=shm
3. https://takeuforward.org/interviews/strivers-sde-sheet-top-coding-interview-problems/
4. https://www.geeksforgeeks.org/dsa-sheet-by-love-babbar/
5. https://neetcode.io/practice
6. https://docs.google.com/spreadsheets/d/1MGVBJ8HkRbCnU6EQASjJKCqQE8BWng4qgL0n3vCVOxE/ed it#gid=0
7. https://docs.google.com/spreadsheets/d/1kyHfGGaLTzWspcqMUUS5Httmip7t8LJB0P-uPrRLGos/edit#gid=0

NOTE: Incorporate Standard Template Library (STL) in C++, Java Collections Framework (JCF) in Java, and Python's built-in data structures like list, set, dict, tuple, along with modules such as heapq, collections, and itertools for efficient problem-solving and implementation.

22ADI01

MOOCS / TRAINING / INTERNSHIP

Instruction / Demonstration / Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	--
SEE	--
CIE	50 Marks
Credits	2

Course Objectives:

This course aims to:

1. Exposing the students to the industrial environment and technologies
2. Provide possible opportunities to learn, make them understand and sharpen them to the real time technical/ managerial skills required at the job
3. Expose with the current technological developments relevant to program domain
4. Understand Engineer's responsibilities and ethics and provide opportunity to interact with the people of industry/society to understand the real conditions.

Course Outcomes:

After the completion of this course, the student will be able to:

1. Learn new technologies and apply them to solve real-time projects.
2. Address and analyze problems in industrial environments using relevant technologies.
3. Acquire in-depth knowledge of contemporary technologies and meet industrial requirements.
4. Identify, design, and develop innovative solutions for real-world problems.
5. Communicate their ideas and learning experiences through detailed reports and presentations.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	3	2	3	3	2	3
CO2	2	2	2	1	1	2	2	1	3	2	3	3	2	3
CO3	3	2	1	1	1	2	2	1	2	2	3	3	2	2
CO4	2	3	3	3	1	2	1	-	3	3	3	3	2	3
CO5	1	1	1	1	1	1	-	-	2	3	3	2	2	3

Process to Be Followed for Carrying Out Instructions to Students:

1. Students may apply for internships through the AICTE Portal or through CDC of the institute by filling in the application form IAP-101.
2. Industry shall scrutinize the students based on their criteria and communicate a provisional offer or confirmation letter to the student.
3. If students apply through CDC, then CDC shall nominate the students for various opportunities accordingly by issuing NOC (IAP-104).
4. The respective head of the department shall assign a faculty mentor.
5. Student shall undergo internship/industrial training at the concerned Industry/Organization by submitting the form, IAP-103.
6. During the internship, Faculty Mentor will evaluate the performance of students twice either by visiting the Industry/Organization or through obtaining periodic reports from students.
7. Student shall submit internship report to the industry/organization at the end of internship program.

8. On successful completion of the Internship, Industry/Organization shall issue Internship Certificate to the students
9. All the students should maintain discipline, professional ethics and follow the health and safety precautions during internship
10. Students should get approval for MOOCS and Training Programs and same evaluation process will be followed.

Student shall maintain diary during the internship and submit the internship report at the end of the internship. The report will be evaluated by the supervisor on the basis of the following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

Evaluation of Internship: The internship of the students will be evaluated in three stages:

a. Evaluation by the Industry (in the scale of 1 to **10** where 1-Unsatisfactory; 10-Excellent)
b. Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (**15** marks)
c. Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (**25 marks**)

For further details regarding templates, assessment guidelines please refer to the document from page number 16 onwards available at: https://www.cbit.ac.in/wp-content/uploads/2019/04/R22-Rules-with-internship-guidelines-10-11-2022..pdf

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from A.Y. 2025-26)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
		THEORY						
1.	22MTC16	Stochastic Process and Queueing Theory	3	-	3	40	60	3
2.	22ITC08N	Enterprise Application Development	3	-	3	40	60	3
3.	22ADC41N	Fundamentals of Machine Learning	3	-	3	40	60	3
4.	22CSC11N	Data Base Management Systems	3	-	3	40	60	3
5.	22MBC01	Engineering Economics and Accountancy	3	-	3	40	60	3
6.		Professional Elective – I	3	-	3	40	60	3
7.	22CEM01	Environmental Science	2	-	2	-	50	Non- Credit
		PRACTICAL						
8.	22ITC09N	Enterprise Application Development lab	-	3	3	50	50	1.5
9.	22CSC13N	Database Management Systems Lab	-	3	3	50	50	1.5
10.	22ADC42N	Fundamentals of Machine Learning Lab	-	3	3	50	50	1.5
12.	22ADU01	Upskill Certification Course-I	60 Hours			-	-	0.5
TOTAL			**20**	**9**		**410**	**560**	**23**
Clock Hours per week: 29								

L: Lecture **D: Drawing** **CIE – Continuous Internal Evaluation**
T: Tutorial **P: Practical** **SEE - Semester End Examination**

Professional Elective #1	Digital Image Processing (22ADE43N)	Modern Mobile Application Development (22ITE04)	Formal Language Theory and Compiler Design (22ADE44N)	Data Warehousing (22ADE45N)	Principles of Programming Languages (22ADE46N)

22MTC16

STOCHASTIC PROCESS AND QUEUEING THEORY
(For AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Able to learn methods to solve bivariate probability functions.
2. Able to know characterizing the random process.
3. Able to identify the tools for interpretating the random process.
4. Able to know the statistical techniques for random process.
5. Able to analyses the queuing models.

Course Outcomes: On successful completion of this course the students shall be able to

1. Estimate the marginal probabilities of statistical averages.
2. Distinguish the random process of auto correlation and cross correlation.
3. Characterize the random process of ensemble averages.
4. Analyze the effect the thermal noise in the system.
5. Analyze the queuing behavior of different queuing models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO2	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO3	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO4	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO5	3	2	3	1	-	-	-	-	-	-	2	2	3	2

UNIT-I: Two-Dimensional Random Variables

Two-dimensional or Joint Probability Mass Function, Two-dimensional Distribution Function, Marginal Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence, Generalization of n dimensional random variable, transformation of One-dimensional Random variable, transformation of Two-dimensional random variable.

UNIT-II: Random Processes

Classification of Random Processes, Methods of Description of a Random Process, Special classes of Random Processes, Average values of Random Process, Stationarity, Strict Strong Stationary process, Analytical Representation of a Random process, Autocorrelation Function and Its properties of R(t), Cross-Correlation Function and its Properties wide sense stationary process.

UNIT-III: Discrete Time Process

Ergodicity, Mean-Ergodic Process, Mean Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process, Power Spectral density function, Properties of power spectral Density function, Properties of Power Spectral Density Function, System in the Form of Convolution, Unit Impulse Response of the System, Properties.

UNIT-IV: Applications of Random Process

Definition of Gaussian process, Properties, Band Pass Process, Narrow-Band Gaussian process, Property, Noise, Thermal noise, Filters, Poisson process, Probability law of Poisson process, Mean and Autocorrelation of the Poisson process, Properties of Poisson process, Markov process, Definition of a Markov chain and Transition Probabilities

UNIT-V: Queuing Theory

Introduction-Queueing system-The arrival pattern-The service pattern-The queue discipline, Symbolic Representation of a Queueing Model –Characteristics of Infinite Capacity, Single server Poisson Queue Model Queueing problem-Pure Birth and Death Process-Probability Distribution of Departures(pure death process)-Basic queueing Models-Measures of the (M/M/1):$(\infty/FIFO)$ $model$-Characteristic of Finite Capacity, Single Server Poisson Queue Model III (M/M/1):$(N/FCFS)$ Model.

Text Books

1. "Probability Statistics and Random Processes" by T Veerarajan,2nd Edition Tata McGraw-Hill.
2. "Fundamentals of Mathematical Statistics" by V.K.Kapoor & S.C.Gupta 11th revised Edition Sultan Chand & Sons.

Reference Books:

1. "Stochastic Process and Queueing Theory" by Randolph Nelson 1995,Ist edition, Springer- verlag Newyork.

Online Resources:

Course Code	Course Name	Resource Link
22MTC16	Stochastic Process and Queueing Theory	https://nptel.ac.in/courses/111102111

22ITC08N

ENTERPRISE APPLICATION DEVELOPMENT

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

This course aims to:

1. Provide knowledge about web pages design and development.
2. Understand how the HTML, CSS and JavaScript components of Bootstrap work.
3. Explore the basic architecture of a React application and develop applications in agile mode.
4. Gain the basics of frond-end and back-end application development using Nodejs.
5. Understand the basics of MongoDB and its Data Model.

COURSE OUTCOMES:

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

1. Create web pages with good aesthetic sense of design using HTML and CSS.
2. Create real-world React web applications and related tools.
3. Become an agile practitioner with the ability to quickly complete projects.
4. Build an end-to-end application from scratch using NODE JS.
5. Understand and build logical relationships between documents using MongoDB.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	0	0	0	0	0	0	0	0	0	3
CO2	2	2	3	3	3	2	2	0	1	0	2	3	0	3
CO3	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO4	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO5	2	2	2	3	3	0	0	0	0	0	1	2	0	3

UNIT-I

Introduction to full stack: MVC pattern**,** Web Fundamentals. **HTML 5.0:** Basic tags, HTML DOM**,** Images, Tables, Lists, Forms, Layout, Graphics, span and div tags.

Introduction to Cascading Style Sheets: Types of CSS**,** CSS Selectors, CSS BOX Model, Text and Font, Color, CSS Positioning and CSS floating, CSS Grid layout Module, CSS Media Queries.

UNIT-II

Java Script: Data Types & Type Conversion, JSON, Events, String and Date Functions, Local Storage, Object Oriented Programming (OOP) in JS, JavaScript Regular Expressions.

Bootstrap: Introduction of Bootstrap, Container and Container-fluid, Bootstrap Carousel.

Bootstrap Component: Button, Grid, Table, Form, Alert, Image, Tabs/Pill, Navbar, Modals.

UNIT-III

React JS: Introduction to React, react with JSX, Actual DOM vs React VDOM, Components, Lifecycle, State, Props, Fragments, Events, Router, Forms, Pagination, Tables, Portals, Hook, Signals. React 18 New features.

Redux and MUI: Introduction to Redux, State, Actions, Reducers, Colour Reducer, Sort Reducer, Store, Action Creators, Middleware. React Material UI Introduction and Installation, MUI Input Components.

Integration of Google MAP API and GPS Location Tracking: Incorporating Google MAP API and GPS Location Tracking for location-based services.

UNIT-IV

Node JS: Modules, Node Package Manager(npm), Creating Web Server, Sending Requests and Handling HTTP requests, Handling User authentication with NodeJS, File System, Writing a file asynchronously and Other I/O Operations.

Events: Event Emitter class, Inheriting Events and Returning event emitter.

Express JS: Introduction to the Express framework- Server-side rendering with Templating Engines, Routing, Middleware, Custom Middleware, static files.

UNIT-V

Mongo DB: Introduction, Importance of NoSQL databases, JSON Vs BSON, Data types and examples. CRUD Operations, Data Modelling & Schema Design, Indexing and Aggregation, MongoDB Replication and Shading.

TEXT BOOKS:

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", Second Edition, Apress Publications, 2019.
2. David How's, Peter Membrey, EelcoPlugge – "MongoDB Basics", Apress, 2014.

SUGGESTED READING:

1. Ethan Brown, "Web Development with Node and Express", Oreilly Publishers, First Edition, 2014.

WEB RESOURCES:

1 https://web.stanford.edu/class/cs142/index.html
2 https://nodejs.org/en/docs/
3 https://www.mongodb.com/
4 https://reactjs.org/
5 https://getbootstrap.com/docs/5.0/utilities/api/
6 https://edu.anarcho-copy.org/Programming%20Languages/Node/

22ADC41N

FUNDAMENTALS OF MACHINE LEARNING

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:
1. Impart knowledge on the basic concepts of machine learning.
2. Familiarize different machine learning techniques.
3. Learn various Classification and Regression algorithms.
4. Familiarize various Kernels, SVMs and Ensemble methods.
5. Facilitate Dimensionality Reduction and Clustering.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Explain the types of machine learning and handle the challenges of machine learning.
2. Construct Decision Trees, Measure performance of classifiers.
3. Apply Regression, Logistic Regression and gradient descent to solve problems.
4. Design solutions using Bayesian classifier, SVMs and Ensemble methods.
5. Perform Dimensionality reduction and clustering of data.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	1	-	2	-	-	-	-	-	-	1	2	2	3
CO2	1	1	1	1	-	-	-	-	-	-	1	2	3	3
CO3	2	2	1	2	1	-	-	-	-	1	1	2	3	3
CO4	2	2	1	2	1	-	-	-	-	1	1	2	3	3
CO5	2	2	1	2	1	-	-	-	-	1	1	2	3	3

UNIT - I

The Machine Learning Landscape: What Is Machine Learning, Why Use Machine Learning, Examples of Applications, **Types of Machine Learning Systems:** Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning, **Main Challenges of Machine Learning:** Insufficient Quantity of Training Data, Non representative Training Data, Poor-Quality Data, Irrelevant Features, Overfitting the Training Data, Under fitting the Training Data, Stepping Back, **Testing and Validation:** Hyper parameters Tuning and Model Selection , Data Mismatch.

UNIT - II

Classification: Training a Classifier, **Performance Measures:** Measuring Accuracy Using Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall Trade-off, the ROC Curve, Multiclass Classification. **Decision Trees:** Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy? Regularization Hyper parameters, Regression, Instability.

UNIT - III

Support Vector Machines: Linear SVM Classification, Soft Margin Classification, **Nonlinear SVM Classification:** Polynomial Kernel, Similarity Features, Gaussian RBF Kernel, Computational Complexity, SVM Regression, **Under the Hood:** Decision Function and Predictions, Training Objective, Kernelized SVMs. **Bayes Classification:** Maximum Posteriori, Bayes Belief Networks.

UNIT - IV

Regression: Linear Regression: The Normal Equation, Computational Complexity, **Gradient Descent:** Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Learning Curves, **Regularized Linear Models:** Ridge Regression, Lasso Regression, Elastic Net, Early Stopping, **Logistic Regression:** Estimating Probabilities, Training and Cost Function, Decision Boundaries, Softmax Regression.

UNIT - V

Dimensionality Reduction: The Curse of Dimensionality, PCA, Randomized PCA, Incremental PCA, Kernel PCA, LLE. **Unsupervised Learning Techniques: Clustering:** K-Means, Limits of K-Means, Using Clustering for Image Segmentation, DBSCAN, Other Clustering Algorithms, Gaussian Mixtures. **Ensemble Learning and Random Forests:** Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting.

TEXT BOOKS:

1. Aurelian Geron, "Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow"- Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd edition, O'Reilly, 2019.

SUGGESTED READING:

1.Tom Mitchel, "Machine Learning", Tata McGraW Hill, 2017.
2.Stephen Marshland, "Machine Learning: An Algorithmic Perspective", CRC Press Taylor & Francis, 2nd Edition, 2015

WEB RESOURCES:

https://www.coursera.org/specializations/machine-learning

22CSC11N

DATA BASE MANAGEMENT SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Programming and Data Structures.

Course Objectives:

This course aims to:

1. Familiarize students with fundamental concepts of database management. These concepts include aspects of database design, database languages and database-system implementation.
2. Understand about data storage techniques and indexing.
3. Impart knowledge in transaction management, concurrency control techniques and recovery procedures.

Course Outcomes:

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

1. Understand fundamental concepts of database and design database schema for an application.
2. Write relational algebra expression and SQL queries for various tasks.
3. Apply the principles of functional dependency and normalization to ensure data integrity
4. Understand indexing and transaction processing
5. Analyze transaction processing, concurrency control and recovery mechanisms.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	-	-	-	-	1	3	2	2
CO2	2	3	2	2	3	-	-	-	-	-	1	3	3	1
CO3	2	1	2	1	3	-	-	-	-	-	-	3	2	2
CO4	2	1	1	-	-	-	-	-	-	-	-	2	3	2
CO5	2	1	-	1	-	-	-	-	-	-	-	2	3	2

UNIT-I

Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators, Database System Architecture, Data Models, **E-R Model**: Introduction, Constraints, E-R Diagrams, E-R Design Issues, Mapping from ER to relational model, Extended E-R Features.

UNIT-II

Relational Algebra: Introduction to relational algebra operations, Basic relational algebra operators, Natural join, Assignment operator. **SQL:** Data Types, Basic Structure of SQL Queries, Modification of the Database, Set Operations, Aggregate Functions, Data-Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Simple Queries (select/project/join/ aggregate queries), Complex queries (With Clause, Nested Sub queries, Views)

UNIT-III

Functional Dependency: Trivial and Nontrivial Dependencies, Closure of Set of Functional Dependencies, Attribute closure, Irreducible Set of Functional Dependencies, lossless decomposition, **Normalization**–1NF,

2NF, 3NF and BCNF, Dependency preserved decomposition, Comparison of BCNF and 3NF.

UNIT–IV

Indexing: Basic Concepts, Primary Index, Dense and Sparse Indices, Secondary Indices, Tree-Structured Indexing, Indexed Sequential Access Method (ISAM), B+Tree Index Files, Hash indices, Bitmap indices. **Transaction Processing:** Concept of transactions and schedules, ACID properties, Conflict-serializability

UNIT-V

Concurrency control: Lock-Based Protocols, Dead lock handling, Timestamp-Based Protocols, Validation-Based Protocols. **Recovery system:** Failure classification, Log based recovery, recovery algorithm, ARIES.

Text Books:

1. Silberschatz, Korth and Sudarshan, “Database System Concepts”, 7th Edition, McGraw-Hill, 2021.
2. C.J. Date, "An Introduction to Database Systems", 8th edition, Pearson, 2020,

Suggested Reading:

1. Raghu Ramakrishna, Johnnes Gehrke, “Database Management Systems”, 3rd Edition, McGraw Hill, 2014.
2. Elmasri and Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson Pubs, 2017.
3. Lemahieu, Broucke and Baesens, “Principles of Database Management”, Cambridge University Press, 2018.
4. Krishnan, “Database Management Systems”, McGraw Hill.

Online Resources:

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html.

22MBC01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

COURSE OUTCOMES: After Completion of the Course, Student will be able to:

1. Apply fundamental knowledge of Managerial Economics Concepts and Tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make the best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	3	1	1	1	-	1	1	1	-	2	1	2
CO2	2	2	2	2	-	1	-	1	-	1	-	2	1	2
CO3	1	2	1	2	2	1	-	1	-	1	-	2	1	2
CO4	2	2	1	2	2	1	-	3	-	1	-	2	2	1
CO5	1	3	1	2	1	1	-	-	-	1	2	2	2	2

UNIT-I

Introduction to Managerial Economics

Introduction to Economics and Its Evolution - Managerial Economics - Its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic Concepts of Managerial Economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equi-Marginal Principle, Contribution, Negotiation Principle.

UNIT-II

Demand and Supply Analysis

Demand Analysis - Concept of Demand, Determinants, Law of Demand – Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple Numerical Problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT-III

Production and Cost Analysis

Theory of Production - Production function - Isoquants and Iso-costs, MRTS, Input - Output Relations; Laws of Returns. Cost Analysis: Cost Concepts – Types of Costs, Cost - Output Relationship – Short Run and Long Run; Market Structures – Types of Competition, Features of Perfect Competition, Price Output Determination under Perfect Competition, Features of Monopoly Competition, Price Output Determination under Monopoly Competition. Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV

Accountancy

Book-keeping, Principles and Significance of Double Entry Bookkeeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Ledger Accounts, Trial Balance Concept and preparation of Final Accounts with Simple Adjustments.

UNIT-V

Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and Sources of raising Finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical Problems.

TEXT BOOKS:

1. Mehta P.L., "Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 12th Edition, 2018.

SUGGESTED READINGS:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2016.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018

22CEM01

ENVIRONMENTAL SCIENCE

Instruction	2L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives: To enable the students to

1. Identify environmental problems arising due to engineering and technological activities and the Science behind those problems.
2. Become aware about the importance of eco system and biodiversity for maintaining ecological balance.
3. To identify the importance of interlinking of food chain.
4. Learn about various attributes of pollution management and waste management practices.
5. To make the students contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes: At the end of the course, student is able to

1. Identify various natural resources and effects of their over utilization.
2. Outline the working mechanism of ecosystem.
3. Illustrate the importance of bio-diversity conservation.
4. Identify remediation measures for environmental pollution through legislations.
5. Explain environmental issues and possible sustainable solutions.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	2	-	-	-	1	-	-	-
CO2	3	1	-	-	-	1	1	-	-	-	1	-	-	-
CO3	3	1	-	-	-	2	2	-	-	-	1	-	-	-
CO4	3	1	-	-	-	2	2	2	-	-	1	-	-	-
CO5	3	1	-	-	-	2	3	-	-		1	-	-	-

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wildlife Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards.

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006

E Resources:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://archive.nptel.ac.in/courses/120/108/120108004/

22ADE43N

DIGITAL IMAGE PROCESSING

(Professional Elective #1)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITE: Matrices and Vectors

COURSE OBJECTIVES: This course aims to:

1. Understand the Fundamentals of Image Processing
2. Learn Image Enhancement Techniques
3. Study Color Image Processing
4. Understand Image Segmentation and Edge Detection.
5. Explore Image Compression Techniques

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

1. Describe image formation, sensing techniques, and image representation formats used in imaging systems.
2. Apply spatial and transform domain filters for basic image analysis and processing.
3. Explain image enhancement techniques in both spatial and frequency domains.
4. Apply restoration techniques to reconstruct degraded images using noise and degradation models
5. Compare geometric restoration and image compression methods for efficient image representation.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO2	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO3	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO4	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO5	3	2	1	-	-	-	-	-	-	-	2	2	1	3

UNIT - I

Digital Image Processing and Analysis, Image Processing and Human Vision, Digital Imaging Systems, Digital Imaging Systems, Image Formation and Sensing, Visible Light Imaging, Imaging Outside the Visible Range of the EM Spectrum, Acoustic Imaging, Electron Imaging, Laser Imaging, Computer-Generated Images, Image Representation, Binary Images, Gray-Scale Images, Color Images, Multispectral and Multiband Images, Digital Image File Formats.

UNIT - II

Transform Filters, Spatial Filters and the Wavelet: Low pass Filters, High pass Filters, Bandpass, Band reject and Notch Filters, Spatial Filtering via Convolution, Lowpass Filtering in the Spatial Domain, High pass Filtering in the Spatial Domain, Bandpass and Band reject Filtering in the Spatial Domain, Discrete Wavelet Transform,

UNIT - III

Image Enhancement: Gray-Scale Modification, Mapping Equations, Histogram Modification, Adaptive

Contrast Enhancement, Color Image, Sharpening, High pass Filtering, High-Frequency Emphasis (HFE), Directional Difference Filters, Homomorphic Filtering, Unsharp Masking, Edge Detector–Based Sharpening Algorithms, Image Smoothing, Frequency Domain Smoothing, Spatial Domain Smoothing, Smoothing with Nonlinear Filters.

UNIT – IV

Image Restoration and Reconstruction: System Model, Noise Models, Noise Histograms, Periodic Noise, Estimation of Noise, Noise Removal Using Spatial Filters, Order Filters, Mean Filters, Adaptive Filters, The Degradation Function, The Spatial Domain – The Point Spread Function, The Frequency Domain – The Modulation/Optical Transfer Function, Estimation of the Degradation Function, Frequency Domain Restoration Filters, Inverse Filter, Wiener Filter, Constrained Least Squares Filter, Geometric Mean Filters Adaptive Filtering, Bandpass, Band reject and Notch Filters, Practical Considerations, Geometric Transforms,

UNIT - V

Spatial Transforms, Gray-Level Interpolation, The Geometric Restoration Procedure, Geometric Restoration with CVIPtools, Image Reconstruction, and Reconstruction Using Back projections, The Radon Transform, The Fourier-Slice Theorem and Direct Fourier Reconstruction. **Image Compression:** Compression System Model, Lossless Compression Methods, Huffman Coding, Golomb-Rice Coding, Run-Length Coding, Lempel–Ziv–Welch Coding, Arithmetic Coding, Lossy Compression Methods, Gray-Level Run-Length Coding, Block Truncation Coding, Vector Quantization, Differential Predictive Coding, Model-Based and Fractal Compression, Transform Coding, Hybrid and Wavelet Methods.

TEXT BOOK:

1. Scott E Umbaugh , Digital Image Processing and Analysis, Fourth Edition, Tayler and Frances, 2023

SUGGESTED READING:

1. Wilhelm Burger Mark J. Burge , Digital Image Processing An Algorithmic Introduction, Third edition, 2022
2. Guillermo Guillen, Sensor Projects with Raspberry Pi: Internet of Things and Digital Image Processing, Second Edition, 2024

Web Resources:

1. https://www.mathworks.com/solutions/image-video-processing/resources.html
2. https://archive.nptel.ac.in/courses/117/105/117105135/

22ITE04

MODERN MOBILE APPLICATION DEVELOPMENT

(Professional Elective #1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Introduce Flutter and Dart programming for cross-platform mobile application development.
2. Enable the design, development, and deployment of interactive and data-driven mobile applications.
3. Explore advanced concepts such as state management, animations, API integration, and database connectivity.

Course Outcomes:

Upon completing this course, learners will be able to:

1. Develop mobile applications using Flutter widgets, layouts, and animations.
2. Apply state management techniques for efficient app performance.
3. Integrate APIs and databases for real-time data processing.
4. Utilize Dart packages to enhance app functionality and performance.
5. Deploy and optimize Flutter applications on Android and iOS platforms.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	-	-	1	1	1	1	2	3	1
CO2	3	3	3	2	3	-	-	1	1	1	1	2	3	1
CO3	3	3	3	2	3	-	-	1	1	-	-	3	3	2
CO4	3	3	3	3	3	-	-	1	1	1	1	2	3	2
CO5	3	3	3	3	3	-	-	1	1	1	1	2	3	2

UNIT I: Introduction to Flutter

Features of Flutter, Advantages of Flutter, Disadvantages of Flutter, Architecture of Flutter Applications, Core Principles of Flutter Development, and Comparison with Other Cross-Platform Frameworks, Real-World Applications of Flutter, and Flutter's Role in Modern UI/UX Design

UNIT II: Flutter Basics & Dart Programming

Widgets, Gestures, Introduction to Dart Programming, Variables and Data Types, Decision Making and Loops, Functions, Object-Oriented Programming, Introduction to Widgets, Widget Build Visualization, Basic Programming, OOP Concepts, Exception Handling, Debugging, Asynchronous Programming – Futures, Async, Await, Streams.

UNIT III: UI Development & Layouts

Types of Layout Widgets, Single Child Widgets, Multiple Child Widgets, Advanced Layout Application, Introduction to Gestures, State Management in Flutter, Ephemeral State Management, Application State, Scoped Model, Navigation and Routing, Styles and Assets, Fonts, Model API, Media Query.

UNIT IV: Animations & API Integration
Introduction to Animation-Based Classes, Workflow of Flutter Animation, Working Application, Android-Specific Code on Flutter, Introduction to Packages, Types of Packages, Using a Dart Package, Developing a Flutter Plugin Package, Accessing REST API, Basic Concepts, Accessing Product Service API.

UNIT V: Database & Deployment
SQLite, Cloud Fire store, Internationalization on Flutter, Using intl Package, Testing on Flutter, Types of Testing, Widget Testing, Steps Involved, Working Example, Deployment, Android Application, iOS Application, Development Tools, Widget Sets, Flutter Development with Visual Studio Code, Dart DevTools, Flutter SDK.

Textbook:

1. Marco L. Napoli, Beginning Flutter: A Hands-On Guide to App Development, Apress, 2019.

Suggested Reading:

1. Alessandro Biessek, “Flutter for Beginners: An Introductory Guide to App Development”, Packet Publishing, 2020.
2. Rap Payne, “Flutter & Dart: The Complete Guide to Build Cross-Platform Apps”, 2019.
3. David Griffiths & Dawn Griffiths, “Head First Android Development”, O'Reilly Media, 2017.

Web Resources:

1. Flutter Official Documentation – https://flutter.dev/docs
2. Dart Language Guide – https://dart.dev/guides
3. Google Codelabs (Flutter Tutorials) – https://codelabs.developers.google.com/?cat=Flutter
4. Flutter & Dart API Reference – https://api.flutter.dev

22ADE44N

FORMAL LANGUAGE THEORY AND COMPILER DESIGN

(Professional Elective #1)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: NIL

Course Objectives:

1. Understand the foundational concepts of formal languages, finite automata, and Chomsky hierarchy
2. Explore regular languages, context-free grammars, and their representation using various normal forms.
3. Analyze and construct Pushdown Automata and Turing Machines for the recognition of context- free and recursively enumerable languages.
4. Apply the phases of compiler design, especially lexical and syntax analysis techniques using tools like LEX and YACC.
5. Develop syntax-directed definitions and generate intermediate code using translation schemes and intermediate representations.

Course Outcomes: At the end of the Course the student shall be able to

1. Explain the concepts of formal languages, automata theory, and Chomsky hierarchy. (BL2)
2. Analyze and apply regular expressions and finite automata for language recognition (BL3)
3. Construct PDA and Turing machines for the given set of languages (BL3)
4. Build the lexical and Syntax analyzer phases of compiler (BL3)
5. Model SDD's using Intermediate Representations (BL3)

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	3	3
CO2	1	1	-	-	2	-	-	-	-	-	-	1	3	3
CO3	-	1	1	1	1	-	-	-	-	-	-	-	3	3
CO4	-	1	1	-	1	2	-	1	-	-	-	1	3	3
CO5	-	1	-	1	1	1	-	1	-	-	-	1	3	3

UNIT-I

Fundamentals: Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages. Finite Automata: Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA – Equivalence of NDFAs with and without €-moves, Minimization of finite automata, Equivalence between two DFA's, Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore

UNIT-II

Regular Languages: Regular expressions, Identity rules, Conversion of a given regular expression into a finite automaton, Conversion of finite automata into a regular expression, Pumping lemma for regular sets, Closure properties of regular sets (proofs not required). Context Free Grammars: Context free grammars and languages, Derivation trees, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion

and left factoring in context free grammars, Minimization of context free grammars, Normal forms for context free grammars, Chomsky normal form, Greibach normal form, Pumping Lemma for Context free Languages, Closure and decision properties of context free languages.

UNIT-III

Pushdown Automata: Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence, Equivalence of context free grammars and pushdown automata, Inter-conversion (Proofs not required). Turing Machine: Introduction to Turing Machine, Design of Turing machines, Types of Turing machines

UNIT-IV

Introduction To Compiling: Overview of Compilers, Phases of a Compiler. Lexical Analysis: The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A language for specifying Lexical Analyzers(LEX). Syntax Analysis: The role of the Parser, First and Follow, Predictive Parsing, LR Parsers-SLR, Canonical LR, LALR, Parser Generator(YACC).

UNIT-V

Syntax-Directed Translation: Syntax-Directed Definition, S-Attributed SDD, L-Attributed SDD, Translation Schemes. Intermediate Code Generation: Intermediate Languages- Graphical Representations, Three address code, Implementations.

TEXT BOOKS:

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Compilers: Principles, Techniques & Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman,2nd Edition, Pearson.

SUGGESTED READING:

1. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
2. Kenneth C Louden, Thomson, “Compiler Construction Principles and Practice”, PWS Publishing 1st edition.

NPTEL RESOURCES:

1. Theory of Automata and Formal Languages, IIT Guwahati https://nptel.ac.in/courses/106103070
2. Theory of Automata, Formal Languages and Computation, IIT Madras https://nptel.ac.in/courses/106106049
3. Formal Languages and Automata Theory, IIT Guwahati https://nptel.ac.in/courses/111103016
4. NOC: Introduction to Automata, Languages and Computation, IIT Kharagpur https://nptel.ac.in/courses/106105196
5. Principles of Compiler Design, IISc Bangalore https://nptel.ac.in/courses/106108113
6. Compiler Design, IISc Bangalore https://nptel.ac.in/courses/106108052

22ADE45N

DATA WAREHOUSING

(Professional Elective #1)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: NIL

Course Objectives:

1. To understand the fundamental concepts, architecture, and need for Data Warehousing in modern business environments.
2. To impart knowledge on planning, gathering requirements, and designing a robust Data Warehouse system.
3. To equip students with dimensional modelling techniques using star and snowflake schemas.
4. To explore the ETL process and strategies for maintaining high data quality.
5. To introduce OLAP systems, operations, and implementation practices for effective information delivery.

Course Outcomes: At the end of the Course the student shall be able to

1. Explain the basic concepts, architecture, and evolution of data warehousing systems. (BL2)
2. Design dimensional models using star, snowflake schemas, and define fact/dimension tables.
3. Demonstrate understanding of the ETL process and techniques to ensure data quality and integrity. (BL3)
4. Apply OLAP operations and evaluate data delivery mechanisms for strategic decision-making. (BL3)
5. Evaluate the implementation, deployment, and maintenance strategies of a data warehouse, and identify emerging trends and technologies in modern data warehousing. (BL3)

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	-	-	-	-	2	2	2	3
CO2	2	2	2	2	2	-	-	-	-	-	-	2	2	3
CO3	1	1	-	2	2	-	-	-	-	-	-	3	1	3
CO4	-	1	1	-	2	2	-	-	2	-	-	2	2	3
CO5	-	-	-	-	2	-	-	-	-	3	3	2	2	3

UNIT-I

Data warehouse: Introduction to Data warehouse, Difference between operational database systems and data warehouses, Data warehouse Characteristics, Data warehouse Architecture and its Components, Data Marts: Dependent vs Independent, Role of Metadata in Data Warehousing, Data Warehousing Process Overview, Challenges in Data Warehousing.

UNIT-II

Data Warehouse Design and Modeling: Dimensional modeling, Star schema, Snowflake schema, and Fact constellation, Fact and dimension tables, Measures: additive, semi-additive, and non-additive, slowly Changing Dimensions (SCDs), Granularity in fact tables.

UNIT-III

ETL Process and Data Quality: ETL tools and their architecture, Data extraction methods, Data cleaning and transformation techniques, Handling missing values and duplicates, Data integration issues, Data profiling and quality management

UNIT-IV

Data warehouse OLAP: Information Delivery, Information Delivery tools, Data Warehouse and OLAP, Major Features and Functions, OLAP Models, OLAP Implementation Considerations.

UNIT-V

Data Warehouse Deployment and Future Trends: Data Warehouse Implementation Phases, Deployment and Roll-out Strategies, Performance Tuning and Optimization, Maintenance and Growth of the Data Warehouse, Future Trends in Data Warehousing: Real-time Data Warehousing, Data Warehousing in the Cloud, Integration with Big Data and NoSQL, Self-service BI and Visualization Tools.

TEXT BOOKS:

1. Data Warehousing Fundamentals for IT Professionals 2e by Paulraj Ponniah, Wiley-Interscience
2. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Ralph Kimball and Margy Ross, Wiley

SUGGESTED READING:

1. Data Warehousing, Data Mining, and OLAP, Alex Berson and Stephen J. Smith, McGraw-Hill.
2. Building the Data Warehouse, W.H. Inmon, Wiley.

WEB RESOURCES:

1. https://www.coursera.org/specializations/data-warehousing
2. https://www.nptelvideos.com/lecture.php?id=5934
3. https://www.coursera.org/learn/data-warehousing

22ADE46N

PRINCIPLES OF PROGRAMMING LANGUAGES

(Professional Elective #1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. To provide a concise overview of different programming paradigms.
2. To develop a conceptual understanding of the design and implementation of high-level programming languages.
3. To explore the capabilities and advantages of scripting languages.

Outcomes:

1. Describe different programming paradigms, language categories, and syntax description techniques using formal methods like BNF and parse trees.
2. *Analyze* the design and implementation issues of data types, variable bindings, and control structures in high-level programming languages.
3. Compare various subprogram design strategies including parameter passing, scoping, and overloading in procedural languages.
4. Evaluate abstraction mechanisms, concurrency constructs, and exception handling techniques across multiple programming paradigms including logic programming.
5. Differentiate between functional and imperative languages and demonstrate scripting language features using Python.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	1	1	-	2	1	1
CO2	3	3	3	2	3	-	-	-	1	1	-	2	1	1
CO3	3	3	3	2	2	-	-	-	1	-	-	2	2	1
CO4	3	3	3	3	3	-	-	1	1	1	1	2	1	1
CO5	3	3	3	3	3	-	-	-	1	1	1	2	2	1

UNIT I:

Preliminary Concepts: Reasons for studying, concepts of programming languages, Programming domains, Language Evaluation Criteria, influences on Language design, Language categories, Programming Paradigms – Imperative, Object Oriented, functional Programming , Logic Programming. Programming Language Implementation – Compilation and Virtual Machines, programming environments. **Syntax and Semantics:** general Problem of describing Syntax and Semantics, formal methods of describing syntax - BNF, EBNF for common programming languages features, parse trees, ambiguous grammars, attribute grammars, denotational semantics and axiomatic semantics for common programming language features.

UNIT II:

Data types: Introduction, primitive, character, user defined, array, associative, record, union, pointer and reference types, design and implementation uses related to these types. Names, Variable, concept of binding, type checking, strong typing, type compatibility, named constants, variable initialization. **Expressions and Statements:** Arithmetic relational and Boolean expressions, Short circuit evaluation mixed mode assignment, Assignment Statements, Control Structures – Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, and guarded commands.

UNIT III :

Subprograms and Blocks: Fundamentals of sub-programs, Scope of life time of varaibles, static and dynamic scope, design issues of subprograms and operations, local referencing environments, parameter passing methods, overloaded sub-programs, generic sub-programs, parameters that are sub-program names, design issues for functions user defined overloaded operators, co routines.

UNIT IV :

Abstract Data types: Abstractions and encapsulation, introductions to data abstraction, design issues, language examples, C++ parameterized ADT, object oriented programming in small talk, C++, Java, C#, Ada 95

Concurrency: Subprogram level concurrency, semaphores, monitors, massage passing, Java threads, C# threads.

Exception handling: Exceptions, exception Propagation, Exception handler in Ada, C++ and Java.

Logic Programming Language: Introduction and overview of logic programming, basic elements of prolog, application of logic programming.

UNIT V:

Functional Programming Languages: Introduction, fundamentals of FPL, LISP, ML, Haskell, application of Functional Programming Languages and comparison of functional and imperative Languages.

Scripting Language: Pragmatics, Key Concepts, Case Study: Python- Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Separate Compilation, Module Library.

TEXT BOOKS:

1. Concepts of Programming Languages Robert .W. Sebesta 8/e, Pearson Education, 2008.
2. Programming Language Design Concepts, D. A. Watt, Wiley dreamtech, rp-2007.

REFERENCE BOOKS:

1. Programming Languages, 2nd Edition, A. B. Tucker, R. E. Noonan, TMH.
2. Programming Languages, K. C. Louden, 2nd Edition, Thomson, 2003.
3. LISP Patric Henry Winston and Paul Horn Pearson Education.
4. Programming in Prolog, W. F. Clocksin & C. S. Mellish, 5th Edition, Springer.
5. Programming Python, M. Lutz, 3rd Edition, O'reilly, SPD, rp-2007.
6. Core Python Programming, Chun, II Edition, Pearson Education, 2007.
7. Guide to Programming with Python, Michel Dawson, Thomson, 2008

22ITC09N

ENTERPRISE APPLICATION DEVELOPMENT LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES

This course aims to:

1. Understand and practice HTML5 and CSS.
2. Introduce the fundamental concepts of JavaScript and Bootstrap.
3. Understand the concepts of Client-side JS Framework.
4. Work with the concepts of Server-side JS Framework.
5. Be familiar with real time database.

COURSE OUTCOMES:

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

1. Apply HTML and CSS effectively to create dynamic websites.
2. Describe and utilize JavaScript concepts in real-world applications.
3. Develop single page applications in React Framework.
4. Use Node.js for server-side application development.
5. Design the Realtime database applications based on the requirements.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	0	2	0	1	0	2	3	0	3
CO2	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO3	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO4	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO5	2	3	2	3	3	0	2	0	1	0	2	3	0	3

LIST OF EXPERIMENTS:

1. Design a Login Page using HTML, CSS (Media Query) and JavaScript.
2. Design a chessboard pattern using HTML and CSS.
3. Design a calculator application using JavaScript.
4. Create responsive web page of your class time table by using bootstrap grid system.
5. Create a timer component to start, pause and reset using ReactJS.
6. Create a React component that checks the strength of a password and displays the result to the user. The component will take user input and use a set of rules to determine the strength of the password.
7. Design the authorized end points using JWT (JSON Web Token)
8. Develop a backend application with REST API to perform CRUD operations on student data. (Use Postman Tool)
9. Design replica set of student database and insert records in primary node and display the records in secondary nodes.
10. Create Real-Time Chat Features in a Web Application Using React, Node.js, Socket.io, and MongoDB.

TEXT BOOKS:

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", second Edition, Apress Publications, 2019.
2. David Hows, Peter Membrey, EelcoPlugge – "MongoDB Basics", Apress, 2014.

SUGGESTED READING:

1. Ethan Brown, "Web Development with Node and Express", Oreilly Publishers, First Edition, 2014.

WEB RESOURCES:

1. https://web.stanford.edu/class/cs142/index.html
2. https://nodejs.org/en/docs/
3. https://www.mongodb.com/
4. https://reactjs.org/
5. https://getbootstrap.com/docs/5.0/utilities/api/
6. https://edu.anarcho-copy.org/Programming%20Languages/Node/

22CSC13N

DATABASE MANAGEMENT SYSTEMS LAB

Instruction	3 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims to:

1. Become familiar with the concepts of structured query language.
2. Understand about Programming Language / Structured Query Language (PL/SQL).
3. Learn database constraints, DCL, TCL and advanced SQL commands.
4. Familiarize with cursors, triggers, exceptions, procedures and functions in PL/SQL.

Course Outcomes:

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

1. Outline the built-in functions of SQL and Create, Alter and Drop table.
2. Demonstrate Queries to retrieve and Change Data using Select, Insert, Delete and Update. Construct Queries using Group By, Order By and Having Clauses.
3. Demonstrate Commit, Rollback, save point commands and formulate the Queries for Creating Views and constraints.
4. Develop queries using Joins, Sub-Queries.
5. Develop PL/SQL code to create stored procedures, functions, cursors and exceptions.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	-	1	2	3	1
CO 2	3	2	2	2	3	-	-	-	-	-	1	2	3	1
CO 3	3	1	2	1	3	-	-	-	-	-	-	2	3	2
CO 4	3	-		2	-	-	-	-	-	-	-	2	3	2
CO 5	3	1	2	1	-	-	-	-	-	-	-	3	3	2

List of Experiments:

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
2. Queries using DDL and DML statements.
3. Queries using Group By, Order By, Having Clauses and set operations.
4. Queries on Controlling Data: Commit, Rollback and Save point.
5. Queries for Creating, Dropping and Altering Tables, Views and Constraints.
6. Queries using Joins, views and Sub-Queries.
7. Write PL/SQL code using Basic Variables, bind and substitution variables.
8. Write PL/SQL code using Control Structures.
9. Write PL/SQL code using Procedures, Functions.
10. Write PL/SQL code using Cursors, Triggers and Exceptions.

Text Books:

1. "Oracle: The complete Reference", Oracle Press.
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007.

Suggested Reading:

1. Rick FVander Lans, "Introduction to SQL", 4th Edition, Pearson Education, 2007.
2. "The Language of SQL (Learning)" by Larry Rockoff.
3. Steven Feuerstein, "Oracle PL/SQL Programming", 6th Edition, O'reilly publications, 2014.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview

22ADC42N

FUNDAMENTALS OF MACHINE LEARNING LAB

Instruction	3 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives: This course aims to:

1. Impart knowledge of dimensionality reduction and clustering techniques.
2. Introduce the concept of decision tree for supervised learning.
3. Familiarize with Bayesian decision theory and probabilistic methods.
4. Introduce the concept of SVM.
5. Familiarize with ensemble methods.

Course Outcomes: After the completion of this course, the student will be able to

1. Perform dimensionality reduction of a dataset.
2. Build decision trees for classification.
3. Design solutions using SVM, KNN, Regression algorithms.
4. Perform clustering of data.
5. Use Principal Component Analysis for feature Extraction.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	2	2	-	-	-	-	-	1	2	2	3
CO 2	3	2	1	1	-	-	-	-	-	-	2	1	1	3
CO 3	2	1	1	1	-	-	-	-	-	-	2	2	1	3
CO 4	2	2	1	1	-	-	-	-	-	-	2	1	1	3
CO 5	2	1	1	1	-	-	-	-	-	-	2	1	1	3

LIST OF PROGRAMS

1. Vectors, Matrices, and Arrays representation, loading of different types of data.
2. Data Wrangling, Handling Numerical, Categorical and Image Data.
3. Decision Trees and Support Vector Machines.
4. Implement Logistic Regression and K-Nearest Neighbor classifiers.
5. Random Forest and Naive Bayes classifier for continuous and discrete datasets.
6. Linear Regression, Nonlinear Regression, and Dependent Regression.
7. Ridge Regression and Lasso Regression.
8. Data Reduction using Feature Extraction, Feature Selection, PCA.
9. Clustering using K-Means, DBSCAN and Hierarchal Clustering.

10. Model Selection, Saving and Loading Trained Models.

TEXT BOOKS:

1. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow", O'Reilly Media, 2nd Edition, 2019.
2. Chris Albon, "Python Machine Learning Cook Book". Orielly, Ist Edition, 2018

SUGGESTED READING:

1. Tom Mitchel, "Machine Learning", Tata McGraW Hill, 2017.
2. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", CRC Press Taylor & Francis, 2nd Edition, 2015

DATASETS:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

WEB RESOURCE:

1. https://www.coursera.org/specializations/machine-learning