AI & ML

SEMESTER –III

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	BS	MA23303	Discrete Mathematics	3	1	0	4
2	PC	CL23301	Object Oriented Programming	3	0	0	3
3	PC	CL23302	Data Structures	3	0	0	3
4	PC	CL23303	Computer Architecture	3	0	0	3
5	PC	CL23304	Foundations of Artificial Intelligence	3	0	0	3
6	MC	MC23302	Human Values and Gender Equality	2	0	0	0
Theory with Practical							
7	ES	EC23306	Digital Principles and System Design	3	0	2	4
Practical							
8	PC	CL23305	Data Structures Laboratory	0	0	4	2
9	PC	CL23306	Object Oriented Programming Laboratory	0	0	4	2
10	EE	GE23301	Professional Development I	0	0	2	1
			TOTAL	**20**	**01**	**12**	**25**

SEMESTER –IV

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	BS	MA23404	Probability and Statistics	3	1	0	4
2	PC	CL23401	Introduction to Data Science	3	0	0	3
3	PC	CL23402	Database Management System	3	0	0	3
4	PC	CL23403	Operating Systems	3	0	0	3
5	MC	MC23401	Environmental Sciences and Sustainability	2	0	0	0
Practical with theory							
6	PC	CL23404	Computer Networks	3	0	2	4
Practical							
7	PC	CL23405	Database Management System Laboratory	0	0	4	2
8	PC	CL23406	Operating Systems Laboratory	0	0	4	2
9	EE	GE23401	Professional Development II	0	0	2	1
			TOTAL	**17**	**01**	**12**	**22**

PAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BE CSE (AI & ML)
27/5/24
AUTONOMOUS

SEMESTER - III

MA23303	DISCRETE MATHEMATICS	3	1	0	4
(Common to CSE, CSE(IOT), CSE(AI&ML), Cyber, AI&DS, IT)					

COURSE OBJECTIVES	
To enable the students to	
1.	interpret the introductory concepts of Logic, which will enable them to model and analyze the physical phenomena involving arguments.
2.	implement the definitions of relevant vocabulary from quantifiers and inference and be able to perform related calculations.
3.	apply the methodologies involved in solving problems related to fundamental principles of sets and implement the mathematical ideas for relations.
4.	understand the concepts of functions and its types.
5.	acquire knowledge and understand the concepts of graphs and its models.

UNIT I	PROPOSITIONAL CALCULUS	12
Propositions - Logical connectives, Compound propositions, Conditional and bi-conditional propositions, Truth tables; Tautologies and contradictions; Contrapositive; Logical equivalences and implications – De Morgan's Laws, Normal forms, Principal conjunctive and disjunctive normal forms; Rules of inference; Arguments - Validity of arguments.		

UNIT II	PREDICATE CALCULUS	12
Predicates - Statement function, Variables, Free and bound variables; Quantifiers; Universe of discourse; Logical equivalences and implications for quantified statements; Theory of inference - The rules of universal specification and generalization; Validity of arguments.		

UNIT III	SET THEORY	12
Basic concepts - Notations, Subset, Algebra of sets, the power set; Ordered pairs and Cartesian product; Relations on sets - Types of relations and their properties, Relational matrix and the graph of relation; Partitions; Equivalence relations. Partial ordering - Posets, Lattices as Posets, Properties of lattices.		

UNIT IV	FUNCTIONS	12
Definitions of functions, Classification of functions, Type of functions, Examples, Composition of functions, Inverse functions; Binary and n-ary operations; Characteristic function of a set; Hashing functions; Recursive functions; Permutation functions.		

UNIT V	GRAPHS	12
Graphs and graph models; Graph terminology and special types of graphs; Matrix representation of graphs and graph isomorphism; Connectivity - Euler and Hamilton paths.		
	TOTAL PERIODS	60

COURSE OUTCOMES		
At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	apply propositional logic to validate the arguments.	Applying (K3)
CO2	apply the rules of inference and methods of proof in predicate calculus to verify the validity of arguments.	Applying (K3)
CO3	explain the knowledge of various set theoretic concepts.	Applying (K3)
CO4	characterize different types of functions and solve recurrence relations.	Understanding (K2)

CO5	apply the concepts of discrete structures such as Euler and Hamilton paths.	Applying (K3)

TEXT BOOKS

1. Trembly, J.P. and Manohar, R., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw-Hill, 35th Reprint, 2008.
2. Veerarajan T., "Discrete Mathematics with Graph Theory and Combinatorics", Reprint Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.

REFERENCES

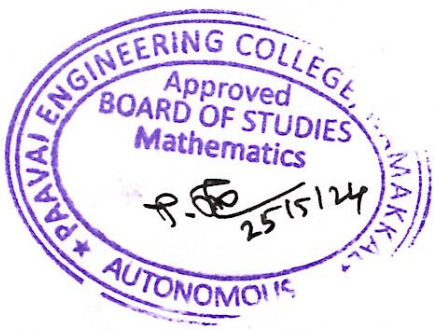
1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 8th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2012.
2. Tamilarasi, A., and Natarajan, A. M., "Discrete Mathematics and its Applications", 3rd Edition, Khanna Publishers, 2008.
3. Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
4. Ralph.P.Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education, 2002.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	3	-	-	-	-	-	-	-	3	2	2
CO2	3	2	3	3	-	-	-	-	-	-	-	3	2	2
CO3	2	3	3	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	-	-	-	-	-	-	-	3	2	2



CL23301	OBJECT ORIENTED PROGRAMMING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand OOP concepts and basics of Java programming language.
2.	know the principles of inheritance, packages, and interfaces.
3.	develop a java application with threads and generics classes.
4.	define exceptions and use I/O streams.
5.	understand Graphical User Interface Application using JavaFX.

UNIT I	INTRODUCTION TO OOP AND JAVA	9

Overview of OOP – Object oriented programming paradigms – Features of Object-Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods - Access specifiers - Static members- Java Doc comments.

UNIT II	INHERITANCE, PACKAGES AND INTERFACES	9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

UNIT III	EXCEPTION HANDLING AND MULTITHREADING	9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV	I/O, GENERICS, STRING HANDLING	9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. – Streams – Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT V	JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS	9

JavaFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, Toggle Button – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – Scroll Pane. Layouts – Flow Pane – HBox and VBox – Border Pane – Stack Pane – Grid Pane. Menus – Basics – Menu – Menu bars – Menu Item.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	explain the basic OOP and Java concepts.	Understanding (K2)
CO2	demonstrate programs using inheritance, packages and interfaces.	Applying (K3)
CO3	assign exception handling mechanisms and multithreading concepts to solve real-world problems.	Applying (K3)
CO4	customize Java applications with I/O packages, string classes, collections and generics concepts.	Applying (K3)

CO5	apply the concepts of event handling, JavaFX components and controls for developing GUI based applications.	Applying (K3)

TEXT BOOKS

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019.
2. Herbert Schildt, "Introducing JavaFX 8 Programming", 1st Edition, McGraw Hill Education, New Delhi, 2015.

REFERENCES

1. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018.
2. Deitel & Deitel, "Java: How to Program", Prentice Hall of India, 2010.
3. Allen B. Downey and Chris Mayfield, "Think Java: How to Think Like a Computer Scientist", O'Reilly, California, First Edition, 2016.
4. Joshua Bloch, "Effective Java: A Programming Language Guide", Addison-Wesley Professional, US, Third Edition, 2018.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

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CO's	PO's												PSO's	
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CO2	2	2	3	3	2	-	-	-	-	-	-	2	2	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2	2	2
CO4	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	3	2	2	-	-	-	-	-	-	2	2	2

CL23302	DATA STRUCTURES	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the concepts of ADTs.
2.	learn linear data structures like lists, stacks.
3.	apply linear data structures for queues.
4.	apply Non-linear data structures for various application.
5.	acquire different types of sorting, searching and hashing algorithms.

UNIT I	ABSTRACT DATA TYPES (ADT)	9

Introduction to Data Structures - Definition, Need of Data Structures, Types of Data Structures; Abstract Data Types (ADT) - List ADT, Operations (Insertion, Deletion), Array Based Implementation, Linked List Implementation, Singly Linked List, Doubly Linked List, Circularly Linked List; Applications of Linked List - Polynomial ADT.

UNIT II	LINEAR DATA STRUCTURES – STACKS	9

Stack ADT – Definition of Stack, Operations, Array based Implementations, Linked List Implementation; Applications of Stack - Conversion of Infix to prefix expression, Conversion of Infix to postfix expression.

UNIT III	LINEAR DATA STRUCTURES – QUEUES	9

Queue ADT – Definition of Queue, Operations, Array based Implementations, Linked List Implementation; Circular Queue; Priority Queue; Applications of Queue.

UNIT IV	NON-LINEAR DATA STRUCTURES – TREES, GRAPHS	9

Tree ADT - Basic Tree Terminologies, Binary Tree ADT, Expression Trees, Tree Traversals, Applications of Trees, Binary Search Tree ADT, AVL Trees; Graph – Definitions, Representation of Graphs, Types of Graphs, Depth-first traversal, Breadth-first traversal, Topological Sort.

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	9

Searching - Linear Search, Binary Search; Sorting - Bubble Sort, Insertion Sort, Shell Sort, Radix Sort, Heap Sort; Hashing - Hash Functions, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	understand the different data structures for representation.	Understanding (K2)
CO2	select various linear data structures for problem-solving using stack.	Analyzing (K4)
CO3	solve the computational problems using queue.	Applying (K3)
CO4	examine of various concepts of trees and graphs with real time application.	Applying (K3)
CO5	demonstrate the concept of sorting, searching and hashing techniques.	Analyzing (K4)

TEXT BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2020.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2018.

REFERENCES

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", An Indian Adaptation, John Wiley & Sons Inc., 2021.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, "Fundamentals of Data Structures in C", 2nd Edition,Universities Press, Hyderabad, 2018.
3. R.Venkatesan, S.Lovelyn Rose, "Data Structures", 1st Edition, Wiley, 2019.
4. Seymour Lipschutz, "Data Structures with C", 4th Edition, MCGraw Hill Education, 2017.

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CO's	PO's												PSO's	
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CO1	2	2	2	3	3	-	-	-	-	-	1	3	3	2
CO2	3	3	3	-	3	-	-	-	-	-	1	3	3	2
CO3	3	3	3	-	3	-	-	-	-	-	1	3	3	2
CO4	3	3	3	-	3	-	-	-	-	-	1	3	3	2
CO5	3	3	3	-	3	-	-	-	-	-	1	3	3	2

CL23303	COMPUTER ARCHITECTURE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	learn basics structure and operations of computer.
2.	study the operations of arithmetic and logic unit
3.	acquire knowledge about pipelining and parallel processing. .
4.	understand the concept of virtual and cache memory.
5.	know the different ways of communicating with I/O devices and I/O interfaces.

UNIT I	BASIC STRUCTURE OF COMPUTER SYSTEM	9

Functional Units; Basic Operational Concepts; Bus Structure; Performance; Memory Locations and Addresses; Memory Operations; Instruction and Instruction Sequencing; Introduction to Microprocessors and Microcontrollers - 8085 Microprocessor, 8051 architectures; Addressing Modes.

UNIT II	ARITHMETIC AND LOGIC UNIT	9

Addition and Subtraction of signed numbers; Design of Fast adders; Multiplication of positive numbers; Signed operand Multiplication, Fast multiplication; Integer Division; Floating Point numbers and operations - IEEE standard for floating point numbers, Arithmetic operations on floating point numbers, Guard bits and truncation, Implementing floating point operations.

UNIT III	PIPELINING AND PARALLEL PROCESSING	9

Pipelining - Basic concepts; Data hazards; Instruction hazards; Influence oninstruction sets; Data path and control considerations; Super Scalar Operations; Performance considerations; Parallel Processing Challenges - SISD, MIMD, SIMD, SPMD; Hardware multithreading.

UNIT IV	MEMORY SYSTEM	9

Basic concepts; Semiconductor RAM; ROM; Speed, Size and cost; Cache memories - Mapping Functions, Replacement Algorithms, Example of Mapping Techniques, Example of Cache Commercial Processors; Performance Considerations; Virtual memories; Memory management requirements; Secondary storage devices.

UNIT V	I/O ORGANIZATION	9

Accessing I/O devices; Interrupts - Interrupt Hardware, Enabling and Disabling Interrupts, handling multiple devices, Controlling Device Request, Exceptions; Direct Memory Access; Buses; Interface circuits; Standard I/O Interfaces (PCI, SCSI, and USB).

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	illustrate the working of a digital computer using different addressing modes.	Applying (K3)
CO2	apply algorithms for performing different arithmetic operations.	Applying (K3)
CO3	demonstrate the execution of instruction in the data path of a processor using pipelining	Applying (K3)
CO4	analyze the cache and virtual memory for efficient use of memory	Applying (K3)
CO5	demonstrate the need for and types of interrupts in I/O transfer.	Applying (K3)

TEXT BOOKS

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGrawHill, 2015.
2. David A. Petterson and John L. Hennessey, "Computer organization and design", Morgan Kauffman / Elsevier, Fifth edition, 2014.

REFERENCES

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Eighth Edition,Pearson Education, 2010.
2. John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 2012.
3. Jim Ledin, "Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-V architectures and the design of smartphones, PCs, and cloud servers", Second Edition, 2022.
4. Krishna Kant "Microprocessors and Microcontrollers Architecture, Programming and System Design Using 8085,8086, 8051 and 8096", Prentice Hall of India, 2013.

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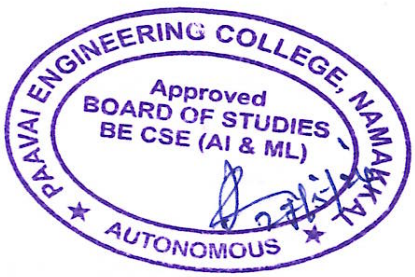
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	2	1	-	-	-	-	-	-	-	1	1
CO4	3	2	2	1	-	-	-	-	-	-	-	-	1	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	1



CL23304	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

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

UNIT I	INTRODUCTION	9

Introduction – Definition, Foundation of Artificial Intelligence, History of Artificial Intelligence, Future of Artificial Intelligence - Characteristics of Intelligent Agents, Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

UNIT II	PROBLEM SOLVING METHODS	9

Problem Solving Methods – Search Strategies, Uniformed, Informed, Heuristics, Local Search Algorithm and Optimization Problems, Searching with Partial Observations- Constraint Satisfaction Problems - Constraint Propagation, Backtracking Search, Game playing, Optimal Decision in Games – Alpha, Beta Pruning, Stochastic Game.

UNIT III	REPRESENTATION OF KNOWLEDGE	9

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining - Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering, Categories and Object - Events - Mental Events and Mental Objects - Reasoning System for Categories - Reasoning with Default Information.

UNIT IV	SOFTWARE AGENTS	9

Architecture for Intelligent Agents - Agent Communication - Negotiation and Bargaining - Argumentation among Agents – Trust and Reputation in a Multi-agent system.

UNIT V	APPLICATIONS	9

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

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	classify a problem and build intelligent agents.	Understanding (K2)
CO2	employ appropriate search algorithms for any AI problem.	Applying (K3)
CO3	illustrate the strategy to solve a given problem.	Applying (K3)

CO4	demonstrate software agents to solve a problem.	Applying (K3)
CO5	make use of some of the AI applications for solving real-time applications.	Applying (K3)

TEXT BOOKS

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson Education, 2022. ISBN-13: 978-9356063570.
2. S.Russel, P.Norvig, "Artificial Intelligence - A Modern Approach", Pearson Education, New Delhi, 4th Edition, 2020. E-Book ISBN-13: 978-0134610993.

REFERENCES

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers Inc., 1st Edition, 2008.
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.
4. I. Bratko, "Prolog: Programming for Artificial Intelligence", Addison-Wesley Educational Publishers Inc., 4th Edition, 2011.

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CO1	2	2	1	2	1	1	-	1	-	-	-	1	2	1
CO2	2	2	3	2	2	1	-	1	-	-	-	1	2	2
CO3	2	2	2	2	3	1	-	1	-	-	-	1	2	2
CO4	2	3	2	2	1	1	-	1	-	-	-	1	3	1
CO5	2	3	3	2	1	1	-	1	-	-	-	1	2	1

MC23302	HUMAN VALUES AND GENDER EQUALITY	2	0	0	0

COURSE OBJECTIVES

To enable the students to

1.	define different types of human values and their impact on individual behaviour and societal norms.
2.	apply principles of personal development such as self-confidence, self-discipline, and resilience to navigate modern challenges effectively.
3.	evaluate the role of values in shaping professional ethics, civic sense and global citizenship.
4.	examine the socio-economic factors influencing gender inequality and explore avenues for empowerment and advocacy.
5.	critically analyse prevalent issues and challenges faced by women, including gender-based violence, discrimination, and cultural biases, and propose measures for their eradication.

UNIT I	HUMAN VALUES	6

Value Education - Definition, Types of values; Human values - Acceptance, Consideration. Appreciation, Listening. Empathy, Sympathy, Honesty, Integrity, Wisdom, Decision making, Self-actualization, Character formation towards positive personality, Contentment; - Religious Values - Humility, Compassion, Gratitude. Peace, Justice, Freedom, Equality.

UNIT II	PERSONALITY DEVELOPMENT	6

Personal Development - Introspection, Self-confidence, Self-discipline; Flexibility - Peer pressure - Sensitization towards Gender Equality; Reliability; Unity; Modern Challenges of Adolescent Emotions and behavior - Comparison and Competition, Positive and Negative attitudes; Family values; Self-improvement - Physical exercises, Meditation, Yoga.

UNIT III	VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT	6

Professional Values -. Integrity, Responsibility, Punctuality, Dedication - Perseverance - Competence; Civic sense and Responsibility; Global Values - Computer Ethics, Moral Leadership, Code of Conduct; Corporate Social Responsibility; Aesthetic values; National Integration and International understanding of Religious Values – Spirituality, thought process.

UNIT IV	GENDER EQUALITY	6

Gender Equality - Definition, Empowerment, Economic Equality; Condition of Women in India-Education, Healthcare, Political Representation, Gender-based Violence; Challenging Stereotypes: Parental and Caregiving Responsibilities; Legal and Policy Reform; Cultural Shifts; Global Perspective; Male Chauvinism; Sustainable Development.

UNIT V	WOMEN ISSUES AND CHALLENGES	6

Women Issues and Challenges - female feticide, violence against women; Domestic violence- dowry related abuse and deaths, Physical violence, Emotional abuse; Sexual assault; Honour killing; Eve-teasing- Stalking, e-stalking (cyber-crime).

	TOTAL PERIODS	30

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the concept of human values and their significance in personal and societal development.	Understanding (K2)
CO2	demonstrate introspective skills to enhance personal growth and self-awareness.	Applying (K3)
CO3	recognize the importance of gender equality in promoting a just and equitable society.	Understanding (K2)
CO4	cultivate a sense of social responsibility and ethical conduct towards achieving national and global development.	Analyzing (K4)
CO5	analyse the challenges faced by women in various spheres and identify strategies for addressing them.	Analyzing (K4)

TEXT BOOKS

1. A Foundation Course in Human Values and Professional Ethics: Presenting a Universal Approach to Value Education - Through Self-exploration. New Delhi, 2016.
2. Aurther, John. Personality Development. Lotus Press, 2018.

REFERENCES

1. Joshi, Dhananjay. Value Education in Global Perspective. Lotus Press, 2014.
2. Mahrotra, Mamta. Gender Inequality in India: Challenging Social Norms. Prabhat Books, 2015.

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CO2	-	1	-	1	1	1	3	3	2	2	1	1	2	2
CO3	-	1	-	1	1	1	2	3	1	1	1	3	2	2
CO4	-	1	-	1	1	1	2	3	2	2	1	2	2	2
CO5	-	1	-	1	1	1	1	3	2	2	1	3	2	2

EC23306	DIGITAL PRINCIPLES AND SYSTEM DESIGN	3	0	2	4

Common to CSE, IT, CSE(AIML) and CSE(AIDS)

COURSE OBJECTIVES

To enable the students to

1.	understand the fundamentals of Boolean algebra and digital logic gates.
2.	know the concepts of various combinational circuits.
3.	gain knowledge about different synchronous sequential circuits.
4.	be familiar with the operation of asynchronous sequential circuits.
5.	acquire basic knowledge about Memory and Programmable Logic Devices.

UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES	9

Boolean laws and Theorem, Boolean functions - Canonical and Standard forms - Sum of Products, Product of Sums; Simplifications of Boolean functions - Karnaugh map, Quine McCluskey method, Don't care Conditions; Implementations of Boolean Functions using logic gates, NAND, NOR.

UNIT II	COMBINATIONAL CIRCUITS	9

Design procedure of Combinational circuits - Adders, Subtractors, 4-bit Parallel adder / Subtractor, Carry look ahead adder, BCD adder, Multiplexer, Demultiplexer, Encoder, Decoder, 2-bit Magnitude Comparator; Code converters, Parity generator and checker.

UNIT III	SEQUENTIAL CIRCUITS	9

Latches, Flip flops - SR, JK, D, T Flip-flops, Realization of flip flop using other flip flops; Classification of sequential circuits - Asynchronous and Synchronous counters; Moore and Mealy; Design of Synchronous counters - Modulo - N counter; Shift registers - SISO, SIPO, PISO, PIPO.

UNIT IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS	9

Design of fundamental mode and pulse mode circuits - Primitive flow table, Minimization of Primitive flow table, State assignment, Excitation table; Cycles - Race Free State assignment; Hazards - Static, Dynamic, Essential Hazards, Elimination of Hazards.

UNIT V	MEMORY AND PROGRAMMABLE LOGIC DEVICES	9

Classification of memories - ROM organization, types; RAM organization, types - Static RAM Cell, Dynamic RAM cell; Memory Expansion; Programmable Logic Devices - PLA, PAL, Basics of FPGA.

LIST OF EXPERIMENTS

1. Design and implementation of Adders and Subtractors using logic gates.
2. Design and implementation of Binary to Gray code and Gray to Binary code Code converters using logic gates.
3. Design and implementation of Multiplexer, Demultiplexer.

4. Design and implementation of Encoder and decoder.	
5. Design and implementation of 4-bit Ripple counter / 3-bit synchronous Up/Down counter.	
6. Implementation of 4-bit shift registers using Flip flops. (SISO/ SIPO/PISO/PIPO).	
TOTAL PERIODS	**75**

COURSE OUTCOMES At the end of this course, the students will be able to		**BT MAPPED** (Highest Level)
CO1	apply Boolean functions in digital design.	Applying (K3)
CO2	design and implement combinational circuits.	Applying (K3)
CO3	design and implement synchronous sequential circuits.	Applying (K3)
CO4	analyze the types of asynchronous sequential circuits.	Analyzing (K4)
CO5	classify memory devices and PLDs.	Understanding (K2)

TEXT BOOKS

1. M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 6th Edition, 2018.
2. H. Charles Roth Jr, "Digital System Design using VHDL", Thomson / Brooks cole, 2015.

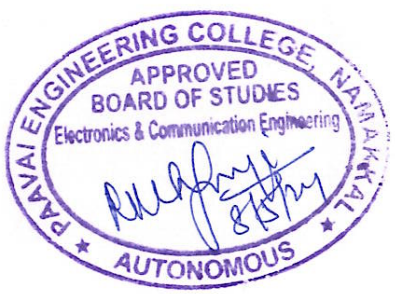
REFERENCES

1. S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design", 4th Edition, Vikas Publishing House Pvt.Ltd, New Delhi, 2012.
2. John .M Yarbrough, "Digital Logic Applications and Design", Thomson Publications, New Delhi, 2007.
3. Charles H.Roth, "Fundamentals of Logic Design", 6th Edition, Thomson Publication Company, 2010.
4. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 5th edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

CO-PO MAPPING :

Mapping of Course Outcomes (CO's) with Programme Outcomes (PO's) and Program Specific Outcomes (PSO's) (1/2/3 indicates the strength of correlation) 3 – Strong , 2 – Medium , 1 – Weak

COs	PO's												PSO's	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	-	1	-	-	-	1	1	-	2	2	2
CO2	3	2	2	-	1	-	-	-	1	1	-	2	2	2
CO3	3	2	2	-	1	-	-	-	1	1	-	2	2	2
CO4	3	2	2	-	1	-	-	-	1	1	-	2	2	2
CO5	3	1	2	-	1	-	-	-	1	1	-	2	2	2



CL23305	DATA STRUCTURES LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1.	implement basic data structure using an array.
2.	implement linear data structures.
3.	apply various operations on non-linear data structures.
4.	get familiarized to sorting and searching algorithms.

LIST OF EXPERIMENTS

1. Array implementation of List ADT.
2. Linked List Implementation of Singly and Doubly Linked List.
3. Array Implementation of Stack ADTs.
4. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion.
5. Array Implementation of Queue ADTs.
6. Applications of Queue ADTs.
7. Implementation of Binary Search Trees.
8. Implementation of AVL Trees.
9. Implementation of Graph Traversal algorithms.
10. Implementation of Linear Search and Binary Search.
11. Implementation of Insertion Sort and Bubble Sort.
12. Implementation of Hashing. (Any one collision technique).

TOTAL PERIODS	**60**

COURSE OUTCOMES

At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	develop a basic data structure using an array.	Applying (K3)
CO2	perform various operations in stacks, queues, linked list.	Applying (K3)
CO3	implement various operations on non-linear data structures.	Applying (K3)
CO4	apply searching and sorting techniques for given data.	Applying (K3)

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	3	-	-	-	2	-	1	3	3	1
CO2	3	3	3	-	3	-	-	-	2	-	1	3	3	1
CO3	3	3	3	-	3	-	-	-	2	-	1	3	3	1
CO4	3	3	3	-	3	-	-	-	2	-	1	3	3	1

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BE CSE (Ai & ML)
AUTONOMOUS

CL23306	OBJECT ORIENTED PROGRAMMING LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1.	build software development skills using java programming for real-world applications.
2.	understand and apply the concepts of classes, packages, and interfaces.
3.	implement exception handling and perform file processing.
4.	develop applications using generic programming and event handling.

LIST OF EXPERIMENTS

1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion).
2. Develop stack and queue data structures using classes and objects.
3. Write a Java program to demonstrate the concept of package.
4. Solve the above problem using an interface.
5. Implement exception handling and creation of user defined exceptions.
6. Write a Java program that implements a multi-thread application.
7. Write a program to perform file operations.
8. Write a Java program to handle all mouse events and key events using Adapter classes.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.
11. Create a Java application for Student Information System. It is used to store, administer and manage all aspects of student information such as student details, subjects, semesters, enrollment details, grades of students, etc.
12. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for digits and for the + - * / % operations. Add a text field to display the result.

TOTAL PERIODS	**60**

COURSE OUTCOMES

At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	analyze software development skills for real-world applications.	Analyzing (K4)
CO2	investigate different methodologies to create application using classes, packages, and interfaces.	Analyzing (K4)
CO3	explore exception handling and perform file processing.	Analyzing (K4)
CO4	create applications using generic programming & event handling.	Applying (K3)

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CO's	PO's												PSO's	
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CO1	3	2	2	1	2	-	-	1	-	-	-	1	2	2
CO2	3	2	1	2	2	-	-	1	-	-	-	1	2	2
CO3	3	3	2	1	2	-	-	1	-	-	-	1	2	3
CO4	3	1	1		2	-	-	1	-	-	-	1	3	2

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27/5/22
AUTONOMOUS

GE23301	PROFESSIONAL DEVELOPMENT I	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1.	enhance and evaluate the student's professional skills and introduce the function of corporate world.
2.	enhance and develop the students behavioral, speaking and listening skills to face the interview.
3.	solve advance level verbal aptitude tests to get placed in Tier I companies.
4.	improve their reasoning skills to get placed in reputed companies.

UNIT I	SELF – UNDERSTANDING AND PERSONALITY ENHANCEMENT SKILLS	7

Introduction self-exploration; SWOT analysis – Types and barriers; Effective communication in workplace; Leadership skills; Decision making – Problem solving; Goal setting – Critical, strategic and lateral thinking; JAM level- I; Basic resume building level- I.

UNIT II	BEHAVIOURAL SKILLS, LISTENING AND SPEAKING SKILLS	7

Behavioural skills; Time management; Emotional intelligence; Analytical thinking- Listening; Listening and hearing; Self-introduction; Group discussion – Types and importance, evaluation criteria, do's and don'ts of GD; GD Level-1.

UNIT III	QUANTITATIVE APTITUDE	8

Number System; LCM and HCF; Simple interest and compound interest; Average; Pipes and cisterns; Area; Profit and loss.

UNIT IV	LOGICAL REASONING	8

Logical sequence; Analogy; Classification; Causes and effect; Making judgment; Directions.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	define and analyze soft skills to improve the leadership skills.	Analyzing (K4)
CO2	demonstrate the behavioral skills through various activities.	Applying (K3)
CO3	develop the problem-solving skills through quantitative aptitude.	Applying (K3)
CO4	illustrate the logical reasoning Skills to solve real world problems.	Analyzing (K4)

TEXT BOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2021.
2. Agarwal, R.S. "Quantitative Aptitude", S.Chand & Co.2021.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill, 2023.
2. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi.2021.
3. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications, 2021.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	3	3	2	3	-	3	1	1
CO2	-	-	-	-	-	-	2	3	2	3	-	3	1	1
CO3	3	2	2	2	-	1	-	-	-	-	2	-	2	2
CO4	2	1	3	2	-	3	3	1	-	1	2	-	2	2

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SEMESTER - IV

MA23404	PROBABILITY AND STATISTICS	3	1	0	4

(Common to Agri, Biotech, Cyber, CSE, CSE(IOT), CSE(AI&ML), AI&DS, IT, Food, Pharma)

COURSE OBJECTIVES

To enable the students to

1.	analyse the concept of random variables and probability distribution in designing processes.
2.	differentiate the discrete and continuous two-dimensional random variables.
3.	determine the concepts of hypotheses testing, its need and applications.
4.	equip with statistical techniques for designing experiments, analysing, interpreting and presenting research data.
5.	emphasize the aspects of control charts in quality control.

UNIT I	RANDOM VARIABLES	12

Discrete and continuous random variables – Moments, Moment generating functions; Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions; Functions of random variables.

UNIT II	TWO - DIMENSIONAL RANDOM VARIABLES	12

Joint distributions; Marginal and conditional distributions; Covariance, Correlation and Linear regression; Transformation of random variables; Applications of Central limit theorem (for independent and identically distributed random variables).

UNIT III	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters; Statistical hypothesis; Large sample test for single mean and difference of means; Small samples - Tests based on t, Chi-square and F distributions for mean, variance and proportion; Contingency table (test for independent), Goodness of fit.

UNIT IV	DESIGN OF EXPERIMENTS	12

Completely randomized design; Randomized block design; One way and two-way classifications- Latin square design - 2^2 factorial design.

UNIT V	STATISTICAL QUALITY CONTROL	12

Control charts for measurements (X and R charts) - Control charts for attributes (P, C and NP charts), Tolerance limits, Acceptance sampling - U-test and Sign test.

	TOTAL PERIODS	60

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	assign suitable probability distributions in engineering problems.	Applying (K3)
CO2	apply the concept of discrete and continuous two-dimensional random variables.	Applying (K3)
CO3	apply the concept of testing of hypothesis for small and large samples in real life problems.	Applying (K3)
CO4	analyse the principles to be adopted for designing the experiments.	Analyzing (K4)
CO5	examine statistical data using control chart in quality control.	Applying (K3)

TEXT BOOKS

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

2. Johnson. R.A. and Gupta. C.B., Miller and Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 7thEdition, 2007.

REFERENCES

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8thEdition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education Asia, 8thEdition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

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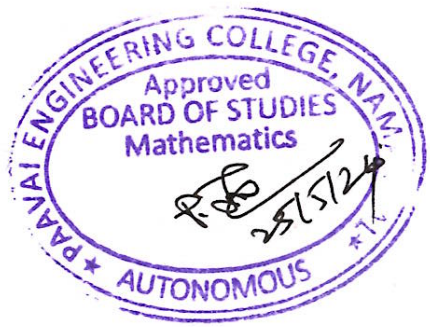
CO2	3	2	3	3	-	-	-	-	-	-	-	3	1	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2	1	2
CO4	3	3	2	2	-	-	-	-	-	-	-	2	1	2
CO5	3	3	2	3	-	-	-	-	-	-	-	2	1	2



CL23401	INTRODUCTION TO DATA SCIENCE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the fundamentals of data science and its processes.
2.	learn and describe the data for the data science process.
3.	know the relationship between data.
4.	provide the Python libraries for Data Wrangling.
5.	present and interpret data using visualization libraries in Python.

UNIT I	INTRODUCTION	9

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model – presenting findings and building applications – Data Mining – Data Warehousing - Basic Statistical descriptions of Data.

UNIT II	DESCRIBING DATA	9

Types of Data – Types of Variables _ Describing Data with Tables and Graphs – Describing Data with Averages- Describing Variability – Normal Distributions and Standard (z) Scores.

UNIT III	DESCRIBING RELATIONSHIPS	9

Correlation – Scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – Regression – regression line – least squares regression line – Standard error of estimate – interpretation of r2 – multiple regression equations – regression towards the mean.

UNIT IV	PYTHON LIBRARIES FOR DATA WRANGLING	9

Basics of NumPy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables.

UNIT V	DATA VISUALIZATION	9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	describe the fundamentals of data science and its processes.	Understanding (K2)
CO2	assign different types of data description for the data science process.	Applying (K3)
CO3	construct relationships between data using Correlation and Regression techniques.	Applying (K3)
CO4	explore the Python Libraries for Data Wrangling.	Applying (K3)
CO5	apply visualization libraries in Python to interpret and explore data.	Applying (K3)

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.

REFERENCES

1. Igual, L Seghi, "Introduction to Data Science a Python approach to Concepts, Techniques and Applications", Springer, 1st Edition, 2017. ISBN:978-3-319-50016-4.
2. David Taieb, "Data Analysis with Python: A Modern Approach", Packt Publishing, 2018. ISBN-978-1789950069.
3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC, 2013.
4. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

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CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	2	2	-	-	1	-	-	-	3	2	2
CO2	2	1	1	1	1	-	-	1	-	-	-	3	2	3
CO3	2	2	1	2	2	-	-	1	-	-	-	3	2	2
CO4	3	2	2	1	2	-	-	1	-	-	-	3	3	3
CO5	2	2	1	2	2	-	-	1	-	-	-	3	2	2

CL23402	DATABASE MANAGEMENT SYSTEM	3	0	0	3

COURSE OBJECTIVES	
To enable the students to	
1.	explore the fundamentals of DBMS and Relational Model.
2.	acquire the knowledge about basic, intermediate and advanced SQL.
3.	design the database with Query Languages and E-R model.
4.	apply the normalization and understand the storage and File structure.
5.	implement the query processing, optimization and Transaction.

UNIT I	INTRODUCTION	9

Introduction- Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators; Relational Model - Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages- Relational Operations.

UNIT II	INTRODUCTION TO SQL AND INTERMEDIATE AND ADVANCED SQL	9

Introduction to SQL- Overview of the SQL Query Language, Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Aggregate Functions, Nested Sub queries; Intermediate & Advanced SQL - Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization, Functions and Procedures, Triggers.

UNIT III	DATABASE DESIGN	9

Relational Query Languages - The Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus; E-R Model - The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Entity-Relationship Design Issues.

UNIT IV	RELATIONAL DATABASE DESIGN AND STORAGE AND FILE STRUCTURE	9

Relational Database Design - Features of good relational designs, Functional dependency, Decomposition using functional dependencies, Normal Forms, 1NF, 2NF, 3NF, BCNF, 4NF, 5NF; Storage and File Structure - Physical Storage Media, Magnetic Disk and Flash Storage, RAID, Tertiary Storage, File Organization, Organization of Records in Files, Data-Dictionary Storage.

UNIT V	QUERY PROCESSING, QUERY OPTIMIZATION AND TRANSACTIONS	9

Query Processing and Query Optimization - Selection Operation, Sorting, Join Operation, Heuristic optimization, Cost based optimization; Transaction - Transaction concept, Transaction Atomicity and Durability, Transaction Isolation Serializability, Transaction Isolation and Atomicity, Transaction Isolation levels, Implementation of Isolation Levels.

	TOTAL PERIODS	45

COURSE OUTCOMES		
At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	describe the database architecture and schema diagrams.	Understanding (K2)
CO2	explore Structured Query Language for creating databases.	Applying (K3)

CO3	design a database using Relational Query Languages and E-R model	Applying (K3)
CO4	choose the appropriate normal form for the given database.	Analyzing (K4)
CO5	make use of query processing, optimization and Transaction for finding best performance.	Analyzing (K4)

TEXT BOOKS

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017.

REFERENCES

1. Ramakrishna R. & Gehrke J, "Database Management Systems", Third Edition, Mc-Graw Hill, 2022.
2. Elmasri Ramez and Navathe Shamkant B., "Fundamental Database Systems", 7th Edition, Pearson Education, New Delhi, 2017.
3. Majumdar, A. K., Bhattacharyya, P, "Database Management Systems", McGraw-Hill, 2017.
4. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, New Delhi, 2013.

CO-PO MAPPING:

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CO's	PO's												PSO's	
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CO1	3	2	2	1	2	-	-	-	-	-	-	-	2	1
CO2	3	3	2	1	2	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	3	-	-	-	-	-	2	2	3	3
CO4	3	3	2	3	2	-	-	-	-	-	1	-	3	2
CO5	3	3	3	3	3	-	-	-	-	-	2	2	3	3

CL23403	OPERATING SYSTEMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the basic concepts and functions of operating systems.
2.	acquire knowledge about processes, threads, scheduling algorithms and concept of deadlocks.
3.	analyze various memory management schemes.
4.	learn file system interfaces and implementation process.
5.	be familiar with virtual machines, clouds and IOT Operating Systems.

UNIT I	INTRODUCTION TO OPERATING SYSTEMS	9

Introduction - Computer system organization, Operating Systems and types, Operating system structures, Services, System calls, System programs; Processes - Process concept, Process scheduling, Operations on Processes, cooperating processes, Inter process communication; Threads - Overview, Multi-threading models - Threading issues.

UNIT II	PROCESS MANAGEMENT AND DEADLOCK	9

CPU Scheduling - Concepts-scheduling criteria, Scheduling algorithms, Algorithm Evaluation; Process Synchronization - The critical-section problem, Synchronization hardware; Semaphores, Classic problems of synchronization - Monitors; Deadlock-System model - Deadlock Characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III	MEMORY MANAGEMENT	9

Main Memory – Background, Swapping, Contiguous memory allocation, Paging Segmentation, Segmentation with paging; Virtual Memory – Background, Demand paging, Page replacement, Allocation of frames, Thrashing.

UNIT IV	FILE SYSTEMS	9

File-System Interface - File concept, Access methods, Directory structure, File system mounting, File sharing, Protection; File-System Implementation - Directory implementation, Allocation methods, Free-space management, efficiency and performance, recovery, Network file systems.

UNIT V	I/O SYSTEMS	9

I/O Systems - I/O Hardware - Application I/O interface - kernel I/O subsystem - streams – Performance - Disk attachment - Disk scheduling - Disk management - Storage Device Management - Swap-space management - RAID - stable storage.

	TOTAL PERIODS	45

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	identify appropriate system calls for a given service using various OS services and structure.	Understanding (K2)
CO2	apply different methods for process synchronization and handling deadlock.	Applying (K3)
CO3	make use of memory management strategies and page replacement policies to address demand paging.	Analyzing (K4)
CO4	apply various file system concepts for memory management.	Applying (K3)

CO5	make use of memory management strategies for storing data.	Understanding (K2)

TEXT BOOKS

1. Silberschatz, Galvin, and Gagne, "Operating System Concepts", Tenth Edition, Wiley India Pvt Ltd, 2018.
2. William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition Prentice Hall of India, 2018.

REFERENCES

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson Education, 2014.
2. Harvey M. Deital, "Operating Systems", Third Edition, Pearson Education, 2007.
3. Andrew S. Tannenbaum & Albert S. Woodhull, "Operating System Design and Implementation", Prentice Hall, 3rd Edition, 2006.
4. Gary J.Nutt, "Operating Systems", Pearson/Addison Wesley, 3rd Edition, 2004.

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CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	-	-	-	-	-	-	1	-	-	-	2	1
CO2	3	3	3	-	3	-	-	-	1	-	-	1	2	1
CO3	2	3	3	-	3	-	-	-	1	-	1	2	2	1
CO4	2	3	3	-	3	-	-	-	1	-	2	3	2	1
CO5	3	3	-	-	-	-	-	-	3	3	2	3	1	3

MC23401	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	2	0	0	0

COURSE OBJECTIVES

To enable the students to

1.	establish the knowledge of precious resources of the environment and their various impacts.
2.	create awareness on ecosystem and biodiversity preserve.
3.	learn scientific and technological solutions to current day pollution issues.
4.	analyze climate changes, concept of carbon credit and the challenges of environmental management.
5.	understand green materials, energy cycles and the role of sustainable urbanization.

UNIT I	ENVIRONMENT AND NATURAL RESOURCES	6

Definition, scope and importance of Environment. Forest resources: Use and over-exploitation, deforestation, - mining, dams and their effects on forests and tribal people. Water resources: Use and over- utilization of surface and ground water, dams-benefits and problems. Food resources: effects of modern agriculture, fertilizer-pesticide problems. Role of an individual in conservation of natural resources.

UNIT II	ECOSYSTEMS AND BIODIVERSITY	6

Concept of an ecosystem: Structure and function of an ecosystem - ecological succession - food chains and food webs. Ecosystems- Types of ecosystems: Introduction - forest ecosystem and lake ecosystems. Biodiversity: Introduction - definition (genetic - species - ecosystem). Diversity - Value of biodiversity - Hotspots of biodiversity - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III	ENVIRONMENTAL POLLUTION	6

Pollution : Définition - air pollution - water pollution - marine pollution - noise pollution. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - Electronic waste -Sources-Causes and its effects- Pollution case studies-Field study of local polluted site – Industrial/Agricultural

UNIT IV	SUSTAINABILITY AND ENVIRONMENT	6

Sustainability - from unsustainability to sustainability-millennium development goals, and protocols. Sustainable development goals-targets, indicators and intervention areas. Climate change— acid rain - ozone layer depletion. Regional and local environmental issues and possible solutions-case studies. Concept of carbon credit, carbon footprint. Environmental management in industry-A case study.

UNIT V	SUSTAINABILITY PRACTICES	6

Zero waste and R concept, Circular economy, ISO 14000 Series, Environmental Impact Assessment - Sustainable energy: Non-conventional Sources, Green materials, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization - Socio economical and technological change.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	find the method of conservation of natural resources	Understanding (K2)
CO2	understand ecosystem and the conservation of biodiversity.	Understanding (K2)
CO3	aware of environmental pollution and interpret its effects.	Understanding (K2)

CO4	apply sustainable development for technological advancement and societal development.	Applying (K3)
CO5	measure the sustainability practices for green energy cycles.	Analyzing (K4)

TEXT BOOKS

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, 1st edition, 2017.
2. Gilbert M. Masters, Wendell P. Ela, "Introduction to Environmental Engineering and Science", 3rd edition, Pearson, 2022.

REFERENCES

1. William P. Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern", McGraw Hill, 16th edition, 2023.
2. C.S. Rao, "Environmental Pollution and Control Engineering", New Age International (P) ltd Publication, New Delhi, 4th edition, 2021.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., Hyderabad, 3rd edition, 2020.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 4th Edition, 2015.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	1	-	-	-	2	-	-	1	1	-	-	2	2
CO2	-	2	-	-	1	1	-	1	-	-	-	-	2	2
CO3	2	-	1	1	-	-	-	2	-	-	-	2	2	2
CO4	-	2	-	-	1	-	3	1	1	-	1	1	2	2
CO5	2	2	-	1	-	-	2	1	-	-	-	1	2	2

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CL23404	COMPUTER NETWORKS	3	0	2	4

COURSE OBJECTIVES

To enable the students to

1.	understand the function of different layers of OSI model.
2.	know about the components required to build different types of networks.
3.	study the various routing protocols operation.
4.	learn the flow control and congestion control algorithms.
5.	acquire knowledge of application layer and its working principles.

UNIT I	FUNDAMENTALS & PHYSICAL LAYER	9

Introduction - Data communications, Networks, Network Types - Protocol Layering - The OSI Model, TCP/IP protocol suit - Physical Layer: Overview of Data and signals - Transmission media - Switching.

UNIT II	DATA LINK LAYER	9

Data link control - Framing, Flow Control, Error Control, HDLC; Media Access Control - Wired LANs - Standard Ethernet, Fast Ethernet, Gigabit Ethernet - Wireless LANs - IEEE 802.11, Bluetooth - Connecting Devices.

UNIT III	NETWORK LAYER	9

Logical addressing - IPv4 Addresses, IPv6Addresses - Internet protocol - Internetworking (IPv4, IPv6), Transitions from IP4 to IP6 – ICMP – IGMP – Forwarding - Unicasting routing protocol - Multi casting routing protocol.

UNIT IV	TRANSPORT LAYER	9

Duties of Transport Layer - User datagram protocol (UDP) - Transmission control protocol (TCP) - Connection establishment, Connection release - Congestion control - Congestion avoidance (DECbit, RED) - Quality of Service - Techniques to Improve QoS.

UNIT V	APPLICATION LAYER	9

Application Layer protocols: DNS – Email protocols (SMTP - POP3 - IMAP - MIME) – FTP – WWW (HTTP, HTTPS) – SNMP.

	TOTAL PERIODS	45

LIST OF EXPERIMENTS

1. Simulate the network topologies (Bus, Ring, Star and Mesh) using Cisco Packet Tracer.
2. There are 20 PC's in your network. Five PC's are connected to one Ethernet hub, and five PC's are connected to another hub. Each hub is connected to separate switch and both the switches are connected to a separate router. The routers are connected via an Ethernet bridge. The remaining 10 PC's are connected directly to one of the two switches. How many Ethernet segments are there? Implement this scenario using cisco packet tracer.
3. Simulation of error correction code (like CRC).
4. Implement bit stuffing and byte stuffing using C program.
5. Write a code to implement distance vector routing algorithm.
6. Write a code to implement border gateway protocol (BGP).
7. Applications using TCP sockets like:
    a. Echo client and Echo server
    b. Chat
8. Write a HTTP web client program to download a web page using TCP sockets.

9. Configure a Web server, DHCP server and a DNS server all together in a single simulation through which IP have to be allocated for the host through DHCP server, Conversion of Canonical Name to IP address to be done by DNS server and Access to the webpage has to be given by web server using Cisco Packet Tracer.

	TOTAL PERIODS	75

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	explain the basic layers and its functions in computer networks.	Applying (K3)
CO2	demonstrate the knowledge of flow control algorithms at data link layer.	Analyzing (K4)
CO3	apply the suitable routing algorithms for the given network.	Applying (K3)
CO4	develop a client/server application using TCP/UDP and design algorithms for end-end communication.	Applying (K3)
CO5	implement the various application layer protocols.	Analyzing (K4)

TEXT BOOKS

1. Behrouz A. Forouzan, "Data Communications and Networking with TCP/IP Protocol Suite", Sixth Edition TMH, 2022.
2. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Eighth Edition, Pearson Education, 2021.

REFERENCES

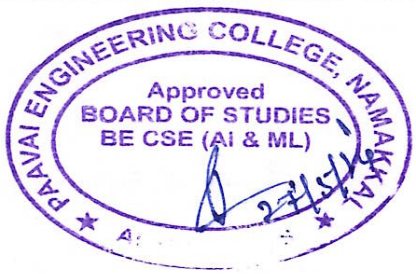
1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Sixth Edition, Morgan Kaufmann Publishers Inc., 2019.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2014.
3. Nader F. Mir, "Computer and Communication Networks", Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open-Source Approach", McGraw Hill, 2012.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	1	1	2	-	-	-	-	-	3	1	3	-	3
CO2	2	3	3	2	-	-	-	-	1	3	1	3	2	3
CO3	3	3	2	2	-	-	-	1	1	3	1	3	2	3
CO4	3	3	3	2	-	-	-	1	1	3	1	3	2	3
CO5	3	3	3	2	3	2	-	2	1	3	1	3	3	3



CL23405	DATABASE MANAGEMENT SYSTEM LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1.	explore and implement important commands in SQL with key and constraints.
2.	learn the usage of nested and joint queries.
3.	acquire the knowledge of Triggers, Views and Cursor.
4.	familiar with the use of a database Connectivity

LIST OF EXPERIMENTS

1. Create a database table, add constraints (primary key, unique, check, not NULL), insert rows, update and delete rows using SQL DDL and DML commands.
2. Create a set of tables, add foreign key constraints and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions and also implement aggregate functions.
4. Query the database tables and explore sub queries.
5. Query the database tables and explore natural, equi and outer joins.
6. Write user defined functions and stored procedures in SQL.
7. Execute complex transactions and realize DCL and TCL commands.
8. Write SQL Triggers for insert, delete, and update operations in a database table.
9. Create View and index for database tables with a large number of records.
10. Database Programming: Implicit and Explicit Cursors.
11. Database Connectivity with Front End Tools.

TOTAL PERIODS	**60**

COURSE OUTCOMES

At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	create SQL databases table with various key constraints.	Applying (K3)
CO2	construct simple and advanced Query Techniques and Join operations.	Applying (K3)
CO3	implement the Transaction Management and Trigger Implementation.	Applying (K3)
CO4	develop program with Integration and Database Programming.	Applying (K3)

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	2	-	-	-	-	-	-	-	3	2
CO2	3	3	2	2	3	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	1	1	-	-	3	2
CO4	3	3	3	3	3	2	-	-	2	2	1	2	3	3

CL23406	OPERATING SYSTEMS LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1.	execute shell programming and the use of filters in the UNIX environment.
2.	perform programming in c using system calls and to process creation and inter process communication, demonstrate scheduling algorithms.
3.	implement file system related system calls.
4.	be familiar with implementation of CPU scheduling algorithms, page replacement algorithms and deadlock avoidance.

LIST OF EXPERIMENTS

1. Basics of UNIX commands.
2. Shell Programming.
3. Implement the following CPU scheduling algorithms.
   a) FCFS b) SJF c) Priority d) Round Robin
4. Implement the following file allocation strategies.
   b) Sequential b) Indexed c) Linked
5. Implement Semaphores.
6. Implement Bankers Algorithm for Dead Lock Avoidance and Deadlock Detection.
7. Implement the following page replacement algorithms.
   c) FIFO b) LRU c) Optimal
8. Implement Paging Technique of memory management.
9. Implement Shared memory and IPC.
10. Implement Thread and Synchronization

TOTAL PERIODS	**60**

COURSE OUTCOMES

At the end of this course, students will be able to		**BT Mapped (Highest Level)**
CO1	compare the performance of various CPU scheduling algorithms for a given applications.	Applying (K3)
CO2	implement the file allocation strategy.	Applying (K3)
CO3	implement deadlock avoidance and detection algorithms.	Applying (K3)
CO4	analyse different paging techniques for efficient memory allocation.	Applying (K3)

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes (PSO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	3	-	-	-	-	2	1	3	2	1
CO2	3	3	3	1	2	-	-	-	-	2	2	3	2	1
CO3	3	2	3	2	3	-	-	2	2	2	2	3	2	1
CO4	3	3	3	1	2	-	-	-	-	2	2	3	2	1

GE23401	PROFESSIONAL DEVELOPMENT II	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1. enhance their own behavioral skills to survive in corporate world.
2. evaluate their listening and speaking skills to face the interviews in a successful way.
3. solve advance level verbal aptitude tests to get placed in Tier I companies.
4. improve their reasoning skills to get placed in reputed companies.

UNIT I	WRITING SKILLS	7

Email writing; Fixing and cancelling appointments; Paper submission for seminars and conferences; Business communication; Stress management; Body language; Dress code; Self-introduction II; Update resume building II; JAM level -3.

UNIT II	PRESENTATION SKILLS	7

Presentation skills - Types and methods of delivering presentation, ways and methods to improve presentation skills; Mini presentation in smaller groups; Situational role play; Face to face interview; Group discussion level IL; JAM Level-4.

UNIT III	QUANTITATIVE APTITUDE - I	8

Simplification; Time, speed and distance; Trains; Boats and streams; Ratio and proportion; Partnership; Percentage.

UNIT IV	LOGICAL REASONING	8

Seating arrangement; Arithmetic reasoning; Character puzzle; Syllogisms; Matching definitions; Statements and arguments.

	TOTAL PERIODS	30

COURSE OUTCOMES

At the end of this course, students will be able to		BT Mapped (Highest Level)
CO1	interpret the personality development through various activities.	Understanding (K2)
CO2	examine speaking and listening skills to excel in their jobs.	Analyzing (K4)
CO3	develop the quantitative skills and analytical skills to face the interview.	Applying (K3)
CO4	extend the reasoning abilities by scoring exceeded percentage to get placed in reputed companies.	Understanding (K2)

TEXT BOOKS

1. Agarwal, R.S. "Objective General English", S.Chand & Co.2021.
2. Agarwal, R. S, "Quantitative Aptitude", S.Chand & Co.2021.

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude", Tata-Mcgraw Hill, 2023.
2. Agarwal R. S, "A Modern Approach to Verbal & Non Verbal Reasoning", S.Chand & Co Ltd, New Delhi.2021.

3. "Word Power Made Easy By Norman Lewis", Wr.Goyal Publications, 2021.

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CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	3	3	2	3	-	3	1	2
CO2	-	-	-	-	-	-	2	3	2	3	-	3	1	2
CO3	3	2	2	-	-	1	-	-	-	-	2	-	2	2
CO4	2	3	3	2	-	3	3	1	-	1	2	-	2	2

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