SYLLABUS

(With effect from 2025 -26)

Bachelor Degree

In

Computer Science & Engineering

(Artificial Intelligence & Machine Learning)

III & IV Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

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VISION

"To develop skilled professionals in the field of Artificial Intelligence & Machine Learning contributing globally to the benefit of industry and society."

MISSION

- *To impart knowledge in cutting edge Artificial Intelligence technologies that meets industry standards.*
- *Tocollaborate with industry to uplift innovative research and development in Artificial Intelligence & Machine Learning and related domains to meet societal demands.*
- *To produce successful Computer Science and Engineering graduates with a specialization in Artificial Intelligence & Machine Learning with personal and professional responsibilities, and a commitment to lifelong learning.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Computer Science and Engineering (AI & ML)

The Vision of the department is:

"To develop skilled professionals in the field of Artificial Intelligence & Machine Learning contributing globally to the benefit of industry and society".

The mission of the department is:

DM1: To impart knowledge in cutting edge Artificial Intelligence technologies that meets industry standards.

{Required to create professionally competent engineers}

DM2: To collaborate with industry to uplift innovative research and development in Artificial Intelligence & Machine Learning and related domains to meet societal demands.
{Required to create professionally competent engineers and socially responsible engineers}

DM3: To produce successful Computer Science and Engineering graduates with a specialization in Artificial Intelligence & Machine Learning with personal and professional responsibilities and a commitment to lifelong learning.
{Required to create professionally competent engineers}

Program Educational Objectives (PEOs)

PEO1: Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Artificial Intelligence and Machine Learning.

PEO2: Graduates will be able to pursue higher education in reputed institutions with AI Specialization.

PEO3: Graduates will have the ability to explore research areas and produce outstanding contribution in various areas of Artificial Intelligence and Machine Learning.

PEO4: Graduates will be ethically and socially responsible solution providers and entrepreneurs in the field of Computer Science and Engineering with AI/ML Specialization.

The National Board of Accreditation (NBA) has defined twelve Program Outcomes for Under Graduate (UG) engineering programs as listed below.

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problem.
2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess Societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The Under Graduate (UG) of B.E Computer Science & Engineering Program has defined **Program Specific Outcomes (PSO**) which are listed below.

PSO1: Apply the knowledge of programming and designing algorithms to develop solutions for engineering problems pertaining to AI&ML

PSO2: Analyse and develop models in Machine Learning, Deep Learning using knowledge of AI and modern tools.

Bachelor of Engineering – Computer Science & Engineering [Artificial Intelligence & Machine Learning]
III Semester

Sl. No.	Course Code	Course Title	Teaching department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P24MA301C	Statistics and Probability	MA	2	2	-	3	50	50	100
2	P24CI302	Data Structures	AIML / CSE	3	-	-	3	50	50	100
3	P24CI303	Digital Design and Computer Organization	AIML / CSE	3	-	-	3	50	50	100
4	P24CI304	Operating Systems	AIML / CSE	3	-	-	3	50	50	100
5	P24CI305	Python Programming for Machine Learning	AIML / CSE	2	2	-	3	50	50	100
6	P24CI306	Artificial Intelligence	AIML / CSE	3	-	-	3	50	50	100
7	P24CIL307	Data Structures Laboratory	AIML / CSE	-	-	2	1	50	50	100
8	P24CIL308	Python Programming for Machine Learning Laboratory	AIML / CSE	-	-	2	1	50	50	100
9	P24CIL309	Artificial Intelligence Laboratory	AIML / CSE	-	-	2	1	50	50	100
10	P24HSMC310A	Employability Enhancement Skills - III	HSMC	-	2	-	1	50	50	100
11	P24NSS311	National Service Scheme	NSS	-	-	2	-	100	-	100
	P24PED311	Physical Education	PED							
	P24YOG311	Yoga	YOGA							
12		AICTE Activity Points								
Total							**22**			
13	P24MADIP301	Basic Engineering Mathematics - I	MA	2	2	-	0	100	-	100
14	P24HDIP310	Additional Communicative English - I	HSMC	-	2	-	0	100	-	100

Bachelor of Engineering – Computer Science & Engineering [Artificial Intelligence & Machine Learning]
IV Semester

Sl. No.	Course Code	Course Title	Teaching department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P24MA401C	Linear Algebra	MA	2	2	-	3	50	50	100
2	P24CI402	Java Programming	AIML / CSE	2	2	-	3	50	50	100
3	P24CI403	Design and Analysis of Algorithms	AIML / CSE	3	-	-	3	50	50	100
4	P24CI404	Computer Networks	AIML / CSE	3	-	-	3	50	50	100
5	P24CI405	Database Management System	AIML / CSE	3	-	-	3	50	50	100
6	P24CI406	Machine Learning	AIML / CSE	3	-	-	3	50	50	100
7	P24CIL407	Design and Analysis of Algorithms Laboratory	AIML / CSE	-	-	2	1	50	50	100
8	P24CIL408	Database Management System Laboratory	AIML / CSE	-	-	2	1	50	50	100
9	P24CIL409	Machine Learning Laboratory	AIML / CSE	-	-	2	1	50	50	100
10	P24HSMC410B	Employability Enhancement Skills - IV	HSMC	-	2	-	1	50	50	100
11	P24NSS411	National Service Scheme	NSS	-	-	2	-	100	-	100
	P24PED411	Physical Education	PED							
	P24YOG411	Yoga	YOGA							
12		AICTE Activity Points								
Total							**22**			
13	P24MADIP401	Basic Engineering Mathematics - II	MA	2	2	-	0	100	-	100
14	P24HDIP410	Additional Communicative English - II	HSMC	-	2	-	0	100	-	100

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: **STATISTICS AND PROBABILITY**		
Course Code: **P24MA301C**	CIE Marks: **50**	CIE Weightage: **50**
Teaching hours/week (L:T:P) 02:02:00	SEE Marks: **50**	SEE Weightage: **50**
Teaching hours of Pedagogy: 40	Exam Hours: 03	
Credits: 03		

Prerequisite:

Knowledge of Pre-University Mathematics

Course learning Objectives:

CLO1: Understand the basic concepts of Statistics and Probability.
CLO2: Categorize and analyse the given data using statistical tools.
CLO3: Identify and apply the appropriate statistical method to solve given problems

Unit 1: Introduction to Statistics	**Hrs: 08**

Introduction, frequency distributions, Measure of central tendency-mean, median and mode - for grouped and ungrouped data, illustrative examples. Measure of dispersion-quartile and mean deviation - for grouped and ungrouped data. Moments, method of moments. Fitting of the curves $y=ax+b$, $y=ax^2+bx+c$, $y=ab^x$, $y=ax^b$ by using the method of least squares.

Self-Study Content: Coefficients of Dispersion. Linear regression-angle between two lines of regression.

Unit 2: Probability distribution	**Hrs: 08**

Introduction to probability, Random Variables, Distribution function, Probability mass function and Probability density function. Discrete Probability Distributions-Introduction and Motivation, Binomial and Poisson's distribution. Continuous Probability Distributions-Exponential and Normal Distribution.

Self-Study Content: Geometric distribution and their properties

Unit 3: Joint Probability and Markov chain	**Hrs: 08**

Joint probability distribution - for two discrete random variables, expectation, covariance and correlation. Markov Chain: Introduction to Stochastic Process, Probability vector, Stochastic matrix, regular stochastic matrices, Markov chains, higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states.

Self-Study Content: Joint Probability distribution for two continuous random variables.

Unit4: Sampling theory	**Hrs: 08**

Sampling Theory – Introduction, Random sampling. Sampling from finite and infinite populations, Sampling distributions, Statistical hypotheses, Null Hypotheses, Tests of hypotheses and significance, Type-I and Type-II errors, level of significance, one tailed and two tailed tests, tests of significance for large and small samples- Students 't' test and Chi-square test.

Self-Study Content: F-test, Fisher's z-distribution.

Unit 5: Statistical Modelling	Hrs: 08
Basics of Time series analysis-semi average and moving average methods. Correlation and regression, Karl Pearson's coefficient, lines of regression, multiple regression, non-linear correlation. Introduction to R, Functions, Control flow and Loops, working with vectors and matrices, reading of data, writing data, working with data, manipulating data, simulation.	
Self-Study Content: Multiple Correlation and Regression.	

Suggested Learning Resources:

Textbooks:

	Title	Author	Year & Edition **(Latest)**	Publisher
1.	Fundamentals of Mathematical Statistics	V. K. Kapoor and S. C. Gupta	2020 & 12th Edition	Sultan Chand & Sons, New Delhi.
2.	Mathematical Statistics,	Kapur J. N. and Saxena H. C	2010 & 2nd Edition	Sultan Chand & Sons, New Delhi.
Reference Books:				
1.	Advanced Engineering Mathematics	E. Kreysizig	10th Ed. (Reprint) 2016.	John Wiley and sons
2.	Probability and Statistics for Engineers	R. Miller, J. E. Freund and R. Johnson	2017 & 9th Edition	PHI, New Delhi
3.	Fundamentals of Statistics	A. Goon, M. Gupta and B. Dasgupta,	Volume I & II	World Press

Web links and Video Lectures (e-resources)

1. https://nptel.ac.in/courses/110107114/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102160/
4. https://nptel.ac.in/courses/111106415/
5. https://nptel.ac.in/courses/111105090/
6. https://nptel.ac.in/courses/127101233/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

COURSE OUTCOMES: On completion of the course, student should be able to:

CO1: Understand the basic principles of statistics and probability.

CO2: Analyze the given data using statistical techniques.

CO3: Apply various statistical tests for solving the given problem.

CO4: Understand the basic concepts of R – programming to solve statistical problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2			2							
CO2	2	3			2							
CO3	3	2			1							
CO4	2	3			1							
Strength of correlation: Low-1, Medium-2, High-3												

DATA STRUCTURES

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER - III

Course Code:	**P24CI302**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2:2:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives:

- To become familiar with the concept of pointers and its usage in data structure.
- To study and understand the representation and implementation of linear & non-linear data structures.
- To identify the appropriate data structure while solving real-time applications.

UNIT – I	**8 Hours**

Basic Concepts: System Life Cycle, Algorithm Specification: Introduction, Performance Analysis
Pointers: Review of Pointers, Pointers and arrays, Arrays of Pointers.
Structures: Arrays of Structures, Structures and Functions-Passing Individual Members, Passing the Entire Structure, Passing Structures through Pointers, Self-referential Structures.
Introduction: Basic Terminology-Elementary Data Structure Organization, Classification of Data Structures.

Self-study component:	Pointers and Two-dimensional Arrays, Operations on Data Structures.

Textbook Map: Text Book 1: Chapter 1: 1.1, 1.2, 1.4 **Text Book 2:** Chapter 1: 1.11; Chapter 2: 2.1, 2.2; Chapter 3: 3.7, 3.8; Chapter 5: 5.3, 5.4, 5.5

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Stacks: Introduction to Stacks, Operations on Stack, Applications of Stacks: Implementing Parentheses Checker, Conversion of Expression: infix to postfix, Evaluation of Expressions: prefix expression, postfix expression.

Self-study component:	Conversion of Expressions: infix to prefix, Prefix to postfix, prefix to infix, Postfix to infix.

Textbook Map: Text Book 1: Chapter 3 Text Book 2: Chapter 7

Teaching-Learning Process	HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder.

UNIT – III	**8 Hours**

Recursion: Introduction, Factorial of a number, Fibonacci series, Tower of Hanoi, GCD of two numbers.
Queues: Introduction to Queues, Operations on Queue
Types of Queues: Circular Queues, Deques, Priority Queues, Multiple Queues

Self-study component:	Types of recursion with examples (Linear Search, Binary Search) Applications of Queues: Josephus Problem.

Textbook Map: Text Book 2: Chapter 7, Chapter 8

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	**8 Hours**

Linked Lists: Dynamic memory Allocation, Introduction, Operations on lists, Singly linked lists, Circular linked lists, Doubly Linked lists, Applications of linked lists-Polynomial Representation, Evaluation of polynomials.

Self-study component:	Doubly circular linked lists, Header linked list.

Textbook Map: Text Book 1: Chapter 4 Text Book 2: Chapter 6, Appendix A

Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	**8 Hours**

Trees: Introduction, Basic Terminology, Types of Trees, Traversing a Binary Tree, Huffman's tree. Applications of Trees, Binary Search Trees, Operations on Binary Search Trees, Threaded Binary Trees.

Self-study component:	Expression Trees

Textbook Map: Text Book 1: Chapter 5 Text Book 2: Chapter 9, 10

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** the concepts of pointers in data structures.	Apply	L3
CO2	**Analyze** and represent various data structures and its operations.	Analyze	L4
CO3	**Design** algorithms using different data structures like List, Stack, Queue and Trees.	Design	L5
CO4	**Develop** programs with suitable data structure based on the requirements of the real-time applications.	Develop	L5

Textbook:

1. Fundamentals of Data Structures in C, E. Horowitzand S. Sahani, S.A- Freed, 1993, University Press
2. Data Structures using C, Reema Thareja, 2nd Edition, 2018, Oxford University Press.

Reference Book(s):

- Data Structures using C, Aaron M Tenenbaum, Yedidyah Langsam and MosheJ Augenstein, 2014, low price edition, Pearson education
- Data Structures with C (Schaum's Outline Series), Seymour Lipschutz, July 2017, McGraw Hill Education

Web and Video link(s):

All the concepts of Data Structures is covered under these below links:

- https://nptel.ac.in/courses/106102064/
- https://www.nesoacademy.org/cs/01-data-structure
- https://www.youtube.com/playlist?list=PLBlnK6fEyqRj9lld8sWIUNwlKfdUoPd1Y

E-Books/Resources:

- **https://www.academia.edu/28758384/**

DIGITAL DESIGN AND COMPUTER ORGANIZATION

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P24CI303**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives:

This course will enable the students to:

- To demonstrate the functionalities of binary logic system
- To explain the working of combinational and sequential logic system
- To realize the basic structure of computer system
- To illustrate the working of I/O operations and processing unit

UNIT – I	**8 Hours**

Introduction to Digital Design:

Binary Logic, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation.

Textbook 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6

Self-study component:	Other Hardware Description Language – Verilog Model of a simple circuit.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Combinational Logic:

Introduction, Combinational Circuits, Design Procedure, Binary Adder - Subtractor, Decoders, Encoders, Multiplexers.

Synchronous Sequential Logic:

Introduction, Sequential Circuits.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 5.1, 5.2

Self-study component:	Thread.State in Java.
Teaching-Learning Process	HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder.

UNIT – III	**8 Hours**

Basic Structure of Computers: Basic operational Concepts, Performance.

Instruction Set Architecture: Memory Location and Addresses, Memory Operations, Instruction and Instruction Sequencing, Addressing Modes, Assembly Language.

Textbook 2: 1.2, 1.3, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5

Self-study component:	Number Representation and Arithmetic Operations, Character representation.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	**8 Hours**

Instruction Set Architecture:

Subroutines, Additional instructions

Basic Input/Output:

Accessing I/O Devices- I/O Device Interface, Program Controlled I/O, Interrupts-Enabling and Disabling Interrupts, Handling Multiple Devices, Exceptions.

Input/Output Organization:

Bus Structure, Bus Operation -Synchronous Bus, Asynchronous Bus, Arbitration.

Textbook 2: 2.7, 2.8, 3.1, 3.2, 7.1, 7.2, 7.3

Self-study component:	Stacks, Interface Circuits.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	**8 Hours**

Basic Processing Unit:

Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control

Textbook 2: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6

Self-study component:	CISC Style Processors.

Course Outcomes: On completion of this course, students are able to:

CO's	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Apply** the K–Map techniques to simplify various Boolean expressions.	**Apply**	L3
CO2	**Design** different types of digital logics.	**Design**	L5
CO3	**Understand** the operation and organization of a digital computer system.	**Understand**	L2
CO4	**Explain** the approaches involved in achieving communication between processor and I/O Devices.	**Explain**	L2
CO5	**Analyse** internal organization of memory and impact of cache / pipelining on processor performance.	**Analyse**	L4

Textbook:

1. M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5e, Pearson Education.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 6th Edition, Tata McGraw Hill

Web and Video link(s):

https://cse11-iiith.vlabs.ac.in/

OPERATING SYSTEMS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P24CI304**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives:

- To make aware of basics of Operating System and their services
- To learn different process scheduling algorithms and synchronization techniques
- To understand memory management concepts
- To explore features of various operating systems

UNIT – I	**8 Hours**

Introduction to operating systems: What Operating Systems do, Operating System structure, Operating System operations, Operating System services, System Calls, System Programs, Design and Implementation, Operating System structure– Simple, Layered, Microkernels and Modules. TextBook1: Ch. 1.1, 1.4, 1.5, 2.1 – 2.6, 2.7.1 - 2.7.4

Self-study component:	Types of system calls

UNIT – II	**8 Hours**

Processes and CPU Scheduling: Process concept, Process scheduling, Operations on processes, Inter process communication, Overview of Threads, Multithreaded models, Basic concepts of scheduling, Scheduling criteria and algorithms.

TextBook1: Ch. 3.1 - 3.4, 4.1, 4.3, 4.6, 5.1 - 5.3, 6.1 - 6.3

Self-study component:	Threading issues

UNIT – III	**8 Hours**

Process Synchronization: Synchronization Background, Critical section problem, Peterson's solution, Semaphores, Classic problems of synchronization.

Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention. Deadlock avoidance: Banker's algorithm, Deadlock detection, Recovery from Deadlock.

Textbook: Ch. 5.1 - 5.3, 5.6, 5.7, 7.1 - 7.7

Self-study component:	Monitors

UNIT – IV	**8 Hours**

Memory Management: Background, Swapping, Contiguous Memory allocation, Paging, Structure of page table, Segmentation.

Virtual memory: Background, Demand paging, copy on write, Basic Page replacement.

Textbook: Ch., 8.1 – 8.6, 9.1 - 9.4, 9.6

Self-study component:	Thrashing

UNIT – V	**8 Hours**

Virtual memory: Page replacement algorithms: FIFO, Optimal and LRU.

Secondary Storage Structures: Overview of Mass Storage Structure, Disk Scheduling.

Textbook: Ch. 9.4.1 – 9.4.4, 10.1, 10.4

Self-study component:	Disk Structure, Disk Attachment.		
Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the basics and functions of operating system.	Explain	L2
CO2	**Analyse** the process and CPU scheduling operations.	Apply	L3
CO3	**Analyze** the process synchronisation and deadlock.	Analyze	L4
CO4	**Apply** the concept of memory management policies	Design	L5
CO5	**Apply** the concept of virtual memory management and secondary storage structure**.**	Analyze	L4

Textbook:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 9th edition, Wiley, 2018

Reference Book(s):

1. Modern Operating Systems, Andrew S Tanenbaum and Herbert Bos, Fourth Edition, Pearson Education,2014
2. Thomas Anderson and Michael Dahlin, Operating Systems: Principles and Practice, Recursive Books, Second Edition, 2014
3. Stallings, Operating Systems internals and design Principles, 7th Edition, 2017

PYTHON PROGRAMMING FOR MACHINE LEARNING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER - III

Course Code:	**P24CI305**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives:

- To understand Python constructs and use them to build the programs.
- To analyze different conditional statements and their applications in programs.
- To learn and use basic data structures in python language.
- To learn and demonstrate array manipulations by reading data from files.
- To understand and use different data in a data analytics context.

UNIT – I	**8 Hours**

Introduction to python: Elements of python language, python block structure, variables and assignment statement, data types in python, operations, simple input/output print statements, formatting print statement.

Textbook 1: Chapter 3 (3.2, 3.3, 3.4, 3.6, 3.7, 3.9 and 3.10)

Self-study component:	Type Conversion.
Teaching-Learning Process	PPT and videos Hands-on sessions using Python

UNIT – II	**8 Hours**

Decision structure: forming conditions, if statement, the if-else and nested if-else, looping statements: introduction to looping, python built in functions for looping, loop statements, jump statement.

Text Book 1: Chapter 4 (4.2 to 4.6) , Chapter 5 (5.1 to 5.4)

Self-study component:	Recursive Functions.
Teaching-Learning Process	PPT and videos Hands-on sessions using Python

UNIT – III	**8 Hours**

Lists: lists, operation on list, Tuples: introduction, creating, indexing and slicing, operations on tuples.

Sets: creating, operation in sets, introduction dictionaries, creating, operations, nested dictionary, looping over dictionary.

Text Book 1: Chapter 7 (7.2 to 7.3) , Chapter 8 (8.1 to 8.4) and Chapter 9(9.1 to 9.3, 9.7 to 9.12)

Self-study component:	Advantages of Tuple over List
Teaching-Learning Process	PPT and videos Hands-on sessions using Python

UNIT – IV	8 Hours
NumPy Library: Ndarray: the heart of the library, Basic operations, indexing, slicing and iterating, conditions and boolean arrays, array manipulation, general concepts, reading and writing array data on files. The pandas Library: an introduction to Data structure, other functionalities on indexes, operations between data structures, function application and mapping. **Textbook 2:** Chapter 3 and Chapter 4.	
Self-study component:	Garbage Collection.
Teaching-Learning Process	PPT and videos Hands-on sessions using Python

UNIT – V	8 Hours
Pandas: Reading and Writing data: i/o API tools, CSV and textual files, reading data in CSV or text files, reading and writing HTML files, reading data from XML files, Microsoft excel files, JSON data, Pickle python object serialization. Pandas in Depth: data manipulation: data preparation, concatenating data transformation discretization binning, permutation, string manipulation, data aggregation group iteration. **Text Book 2:** Chapter 5 and Chapter 6	
Self-study component:	Built-in and User defined Exceptions.
Teaching-Learning Process	PPT and videos Hands-on sessions using Python

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Describe** the constructs of python programming	Understand	L2
CO2	**Apply** looping and conditional constructs to build programs.	Apply	L3
CO3	**Apply** the concept of data structure to solve the problem.	Apply	L3
CO4	**Apply** the NumPy constructs for matrix manipulations.	Apply	L3
CO5	**Apply** the Panda constructs for data analytics.	Apply	L3

Textbook:

- S. Sridhar, J. Indumathi, V.M. Hariharan "Python Programming" Pearson publishers, 1st edition 2023.
- Fabio Nelli, "Python Data Analytics", Apress, Publishing, 1st Edition, 2015.

Reference Book(s):

- Paul Deitel and Harvey deitel,"Intro to Python for Computer Science and Data science", 1st edition Pearson Publisher 2020.

Web and Video link(s):

- Nptel: Introduction to Python for Data Science https://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus5HX88ht7

ARTIFICIAL INTELLIGENCE

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P24CI306**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives:

- Familiarize with Artificial Intelligence principles and techniques.
- Introduce the facts of computational model and their applications.
- Explore problem-solving paradigms, search methodologies and learning algorithms.

UNIT – I	**8 Hours**

Introduction: Introduction to Artificial Intelligence, The Foundations of Artificial Intelligence, The State of the Art.

Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Self-study component:	The History of Artificial Intelligence

UNIT – II	**8 Hours**

Solving Problems by Searching: Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Search in Complex Environments: Local Search and Optimization Problems, Local Search in Continuous Spaces, Online Search Agents and Unknown Environments.

Self-study component:	Applications of Online Search Agents

UNIT – III	**8 Hours**

Adversarial Search and Games: Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search.

First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

Self-study component:	Applications of Adversarial Search and Games

UNIT – IV	**8 Hours**

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories.

Self-study component:	Reasoning with Default Information.

UNIT – V	**8 Hours**

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, Model Selection and Optimization, The Theory of Learning, Linear Regression and Classification, Nonparametric Models, Ensemble Learning.

Self-study component:	Application of different forms of Learning

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** and analyze AI concepts to design intelligent systems and evaluate the performance of their key components in different applications.	Analyze	L4
CO2	**Apply** appropriate uninformed and informed search algorithms and define suitable heuristic functions to solve specific search problems	Apply	L3
CO3	**Analyze** complex search environments, evaluate optimal decisions in adversarial games using techniques like Alpha-Beta search, and construct basic representations using First-Order Logic syntax	Analyze	L4
CO4	**Apply** advanced inference mechanisms, including Forward Chaining, Backward Chaining, and Resolution, to reason over knowledge bases and utilize ontological engineering principles for detailed knowledge representation	Apply	L3
CO5	**Understand** the different forms of supervised learning and model optimization, and apply techniques such as Decision Trees and Ensemble Learning to specific data sets	Understand	L2

Textbook:

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 4th Edition, Pearson Education, 2021,

Reference Book(s):

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill,2018, ISBN-13: 9780070087705.
2. Saroj Kaushik, Artificial Intelligence, 3rd Edition, Cengage learning, 2014, ISBN-13:978 8131510995.

Web and Video link(s):

1. https://nptel.ac.in/courses/106105077

DATA STRUCTURES LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P24CIL307**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**20 Hours Practical**	**SEE Marks:**	**50**

Note: All programs are to be implemented using C Language

Experiments

1.	In a travel management system, distances between various travel checkpoints are recorded. Create a structure DISTANCE with members kms and meters to store these values. Write a C program that calculates the total and remaining distance between two points by performing addition and subtraction of distances using functions that accept pointers to the structure.
2.	Design a basic task management system that uses a stack (implemented using an array with a fixed maximum size MAX) to manage tasks based on their arrival time following a Last-In-First-Out (LIFO) strategy. Each task is represented by an integer (e.g., task ID or priority code). Develop a menu-driven C program to support the following operations: (i) Add (push) a new task onto the stack. If the stack is full, display an appropriate overflow message. (ii) Remove (pop) the most recent task from the stack. If the stack is empty, display an underflow warning. (iii) Display the current status of the stack, showing all tasks waiting to be processed.
3.	Develop a module for a compiler or expression evaluator that converts standard mathematical expressions from **infix notation** (e.g., A + B * C) to **postfix notation** (also known as Reverse Polish Notation, e.g., A B C * +). This conversion is essential for efficient expression evaluation using stacks. Implement a C program to perform the following: (i) Accept a valid infix expression containing operands and operators (+, -, *, /, ^, and parentheses). (ii) Convert the expression into its corresponding postfix form using stack operations. (iii) Display the resulting postfix expression suitable for evaluation by machines or interpreters.
4.	Design a recursive solution module for solving classic computational problems that frequently arise in mathematical modeling and system simulations. Implement the following operations using recursion in C: (i) **Disk Movement in Automation Systems (Tower of Hanoi):** Simulate the process of moving disks between pegs in an automated robotic arm system using the Tower of Hanoi logic. The objective is to move n disks from the source peg to the destination peg following the recursive strategy. (ii) **Fault Detection in Signal Processing (GCD of Two Numbers):** Determine the Greatest Common Divisor (GCD) of two frequency values to identify synchronization intervals or signal overlaps using the Euclidean algorithm implemented recursively. (iii) **Recursive Evaluation in Data Streams (Find Largest of 'n' Numbers):** Implement a recursive approach to find the largest value in a dynamic dataset, such as real-time sensor data or test scores, without using loops or built-in sort mechanisms.

5.	Develop a hospital emergency management system using a priority queue where each patient is assigned a priority value - the lower the number, the more critical the case. Implement a C program to: (i) Add a patient to the emergency queue with name and priority. (ii) Attend to the most critical patient by removing the one with the highest priority. (iii) Display the list of waiting patients along with their priority levels.
6.	Implement an order tracking system using a Singly Linked List (SLL) where each order is represented by an order ID (integer). Develop a C program to: • Insert n new orders either at the front (VIP orders) or at the rear (regular orders). • Delete a specific order ID after serving it, with a proper message if the ID is not found. • Display the list of all pending orders.
7.	Build a ticket booking system for a theatre or event using a queue where each booking request is stored as a string (e.g., user name or booking code). The system must ensure bookings are handled in the order they arrive. Using a linked list implementation in C, perform the following operations: (i) Insert a new booking request into the queue. (ii) Remove the front request once it's processed. (iii) Display all pending booking requests in the queue.
8.	Develop a patient record management system for a hospital using a Doubly Linked List (DLL). Each patient record should include the following details: PATIENT_ID, NAME, DIAGNOSIS, and ADMISSION_DATE. Implement a menu-driven C program to perform the following operations: (i) Create an ordered list of N patient records sorted by PATIENT_ID. (ii) Count and display the total number of patients currently admitted. (iii) Delete the patient record at a specified position (e.g., patient discharge). (iv) Display all patient records in order, showing full details.
9.	Design a module of a computer algebra system that adds two polynomial expressions. Each polynomial is represented using a linked list, where each node contains a coefficient and exponent. Implement a C program to: (i) Add two polynomials by traversing their terms in descending order of exponents and combining like terms. (ii) Display the resulting polynomial in standard mathematical format.
10	Write a C program to simulate an inventory tracking system using a Binary Search Tree (BST). Each node represents a product, uniquely identified by an integer product_id. Through a menu-driven interface, perform the following operations: • Create the BST by inserting N product IDs. • Traverse the BST in: o Inorder (for sorted view of products), o Preorder (for serialization or storage), o Postorder (for safe deletion or restocking sequence).

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Design** algorithms using different data structures like List, Stack, Queue and Trees.	Design	L5
CO2	**Develop** programs with suitable data structure based on the requirements of the real time applications.	Develop	L5

Textbook:

1. Fundamentals of Data Structures in C, E. Horowitzand S. Sahani, S.A- Freed, 1993, University Press
2. Data Structures using C, Reema Thareja, 2nd Edition, 2018, Oxford University Press.

Reference Book(s):

1. Data Structures using C, Aaron M Tenenbaum, Yedidyah Langsam and MosheJ Augenstein, 2014, low price edition, Pearson education
2. Data Structures with C (Schaum's Outline Series), Seymour Lipschutz, July 2017, McGraw Hill Education

PYTHON PROGRAMMING LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER - III

Course Code:	**P24CIL308**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**20 Hours Practical**	**SEE Marks:**	**50**

Note: All programs are to be implemented using C Language

Experiments		**8 Hours**
1	Develop a python program to perform slice operation on strings.	
2	Simulation of a Simple calculator.	
3	Write a program to calculate the bill amount for an item given its quantity sold, value, discount and tax.	
4	Develop a python program to accept 4 numbers and display them in sorted order using a minimum number of if else statements.	
5	Develop python program to Calculate salary of an employee given his basic pay(to be entered by the user),HRA = 10 per cent of basic pay, TA =5 per cent of basic pay. Define HRA and TA as constants and use them to calculate the salary of the employee.	
6	Develop a program for checking if a given n digit number is palindrome or not. [Hint: input 1221 output: palindrome, use //and % operator with loop statement]	
7	Develop a python program to capitalize a given list of strings. [Hint: [hello, good, how, simple] output: [Hello, Good, How, Simple]	
8	Develop a python script to rotate right about a given position in that list and display them. [Hint: input [1,4,5,-10] position: 2, output: [-10,5,4,1]]	
9	Using a dictionary, develop a python program to determine and print the number of duplicate words in a sentence.	
10	Develop python program to perform addition and subtraction of Matrices using Numpy.	
11	Develop python program to read Numpy array and print row (sum,mean std) and column (sum, mean, std)	
12	Develop a python program to read and print in the console CSV file.	
13	Develop a python program to read a HTML file with basic tags and construct a dictionary and display the same in the console.	

CO's	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Apply** the constructs of python programming	Apply	L3
CO2	**Apply** looping and conditional constructs to build programs.	Apply	L3
CO3	**Apply** the concept of data structure to solve the problem.	Apply	L3
CO4	**Apply** the NumPy constructs for matrix manipulations.	Apply	L3
CO5	**Apply** the Panda constructs for data analytics.	Apply	L3

Textbook:

- S. Sridhar, J. Indumathi, V.M. Hariharan "Python Programming" Pearson publishers, 1st edition 2023.
- Fabio Nelli, "Python Data Analytics", Apress, Publishing, 1st Edition, 2015.

Reference Book(s):

- Paul Deitel and Harvey deitel,"Intro to Python for Computer Science and Data science", 1st edition Pearson Publisher 2020.

Web and Video link(s):

- Nptel: Introduction to Python for Data Science https://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus5HX88ht7

ARTIFICIAL INTELLIGENCE LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – III

Course Code:	**P24CIL309**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**20 Hours Practical**	**SEE Marks:**	**50**

Course Learning Objectives:

- Familiarize with Artificial Intelligence principles and techniques.
- Introduce the facts of computational model and their applications.
- Explore problem-solving paradigms, search methodologies and learning algorithms

UNIT – I

1. Write a Program to Implement vacuum cleaner world example.
2. Write a Program to Implement Water-Jug problem using Python

UNIT – II

3. Write a program to implement DFS using Python.
4. Write a program to implement BFS using Python.
5. Write a program to implement A* Algorithm using Python.

UNIT – III

6. Write a Python program to implement the Tic-Tac-Toe game using any adversarial searching algorithm.
7. Write a Program to Implement Alpha-Beta Pruning using Python.

UNIT – IV

8. Write a Python program that demonstrates the inference engine by checking whether Socrates is mortal and whether Aristotle is human based on the provided knowledge base.

UNIT – V

9. Write a Python program that demonstrates supervised learning using the Iris dataset and train a classifier to predict the species of iris flowers based on their features.
10. Write a Python program that demonstrates supervised learning through Linear Regression using a simple dataset of house prices based on their sizes to predict house prices

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Apply** knowledge of agent architecture, searching and reasoning techniques for different applications.	Apply	L3
CO2	**Apply** the key components of intelligent agents and evaluate their performance.	Apply	L3
CO3	**Apply** Search Algorithm techniques to a wide range of real-world problems.	Apply	L3
CO4	**Apply** First-Order Logic in problem solving and knowledge representation.	Apply	L3
CO5	**Apply** of machine learning principles, concepts, and techniques, focusing on learning	Apply	L3

Textbook:

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 4th Edition, Pearson Education, 2021,

Reference Book(s):

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill,2018, ISBN-13: 9780070087705.
2. Saroj Kaushik, Artificial Intelligence, 3rd Edition, Cengage learning, 2014, ISBN-13:978 8131510995.

Web and Video link(s):

1. https://nptel.ac.in/courses/106105077

Academic Year: 2025-26	Semester: III	Scheme: CBCS & OBE
Course Title : **EMPLOYABILITY ENHANCEMENT SKILLS – III**		
Course Code: P24HSMC310A	CIE Marks:	50
Teaching hours/week (L:T:P): 0:2:0	SEE Marks:	50
Teaching hours of Pedagogy:42 Hours	Exam Hours:	
Credits:01		

Course learning Objectives:

- **CLO1:** Calculations involving percentages, profit & loss and discounts.
- **CLO2 :** Explain concepts behind logical reasoning modules of direction sense and blood relations.
- **CLO3 :** Prepare students for Job recruitment process and competitive exams.
- **CLO4 :** Develop Problem Solving Skills.
- **CLO5 :** Apply programming constructs of C language to solve the real-world problem.

Unit 1:	**Hrs:8**
Quantitative Aptitude: Number System – Divisibility & Remainder, Multiples & Factors, Integers, HCF & LCM, Decimal Fractions, Surds & Indices, Simplification.	
Self-Study Content: Linear equations.	
Unit 2:	**Hrs:8**
Quantitative Aptitude: Percentages, Profits, Loss and Discounts. Logical Reasoning: Blood Relations.	
Self-Study Content: Inferred meaning, Chain rule.	
Unit 3:	**Hrs:8**
Logical Reasoning: Direction Sense Test. Verbal Ability: Change of Speech and Voice, Sentence Correction.	
Self-Study Content: Height & distance.	
Unit4:	**Hrs:10**
C-PROGRAMMING – I **Introduction:** Keywords and Identifier, Variables and Constants, Data Types, Input/Output, Operators, Simple Programs. **Flow Control:** If…else, for Loop, while Loop, break and continue, switch…case, goto, Control Flow Examples, Simple Programs. **Functions:** Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs **Arrays:** Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs	
Self-Study Content: Evaluation of Expression.	
Unit 5:	**Hrs:8**
C-PROGRAMMING - II **Pointers:** Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples. **Strings:** String Functions, String Examples, Programs. **Structure and Union:** Structure, Struct & Pointers, Struct & Function, Unions, Programs. **Programming Files:** Files Input/output	
Self-Study Content: Error handling during I/O operations.	

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Exhibit amplified level of confidence to express themselves in English.	Applying	L3
CO2	Solve the problems based on Number systems, percentages, profit & loss and discounts.	Analyzing	L4
CO3	Solve logical reasoning problems based on direction sense and blood relations.	Analyzing	L4
CO4	Apply suitable programming constructs of C language and / or suitable data structures to solve the given problem.	Applying	L3

Suggested Learning Resources:

Textbooks :

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Books:

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.
2. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web links and Video Lectures (e-resources)

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Practice expressive communication through role-play and interview activities.
2. Apply profit, loss, and discount concepts in a mini market simulation.
3. Solve logic-based treasure hunts and code real-world problems using C.

Course Outcomes		Program Outcomes										
		1	2	3	4	5	6	7	8	9	10	11
CO1	Exhibit amplified level of confidence to express themselves in English.	1								2	3	1
CO2	Solve problems based on number systems, percentages, profit & loss and discounts.	3	3		2	1					2	1
CO3	Solve logical reasoning problems based on direction sense and blood relations.	2	3	2	2	1				1	2	
CO4	Apply suitable programming constructs of C language and / or suitable data structures to solve the given problem.	3	3	3	2	3				1	2	2

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: National Service Scheme		
Course Code: P24NSS311	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:0:2	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy: 20-24 Hrs	Exam Hours: -	
Credits: 00		

Course Outcomes (COs):

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

CO1: Analyze Indian agriculture and organic farming: Assess historical and current trends in Indian agriculture, focusing on organic farming's potential for sustainability and market access.

CO2: Design waste management systems: Apply the 5 R's to design and evaluate waste management solutions considering technical, economic, and environmental factors.

CO3: Develop women's empowerment strategies: Create plans for information-sharing platforms to address women's social and economic needs and promote community participation.

CO4: Apply engineering to sustainable development: Integrate engineering knowledge to develop practical solutions for organic farming, waste management, and community development.

CO5: Evaluate sustainable development impacts: Assess the social, economic, and environmental impacts of sustainable development initiatives.

Course Description: This course explores critical aspects of sustainable development, focusing on organic farming practices, effective waste management strategies, and initiatives for empowering women in social and economic spheres. It emphasizes practical application, problem-solving, and community engagement.

Course Content:

- Organic farming and its role in Indian agriculture (historical context, current practices, and future trends). Emphasis on connectivity for marketing organic produce.
- Waste management strategies across public, private, and governmental organizations, with a focus on the 5 R's (Reduce, Reuse, Recycle, Recover, Refuse).
- Establishing information-sharing platforms for women to address social and economic challenges.

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: Physical Education		
Course Code: P24PED311	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:0:2	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy: 20-24 Hrs	Exam Hours: -	
Credits: 00		

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

1. Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
2. Familiarization of health-related Exercises, Sports for overall growth and development
3. Create a foundation for the professionals in Physical Education and Sports
4. Participate in the competition at regional/state / national / international levels.
5. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.
6. Understand and practice of Traditional Games

Module I: Orientation 4 Hours

1. Lifestyle
2. Health & Wellness \
3. Pre-Fitness test.

Module II: General Fitness & Components of Fitness 4 Hours

1. Warming up (Free Hand exercises)
2. Strength – Push-up / Pull-ups
3. Speed – 30 Mtr Dash

Module III: Specific games (Any one to be selected by the student) 16 Hours

1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.
2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: Yoga		
Course Code: P24YOG311	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:0:2	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy: 20-24 Hrs	Exam Hours: -	
Credits: 00		

Course Outcomes (COs):

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

CO1: Understand Yoga's principles and philosophy: Explain the meaning, history, schools, aims, and importance of prayer in Yoga.

CO2: Perform basic Yoga practices safely: Execute Suryanamaskar and selected Asanas with proper technique, breathing, and safety awareness.

CO3: Analyze Yoga's benefits and contraindications: Explain the physiological and Psychological benefits and identify contraindications and precautions for various practices.

CO4: Apply Yoga for stress management and well-being: Integrate Yoga into daily life for Stress reduction, focus enhancement, and improved well-being.

CO5: Evaluate Yoga misconceptions: Identify and debunk common myths, promoting a Scientifically informed understanding of Yoga.

Course Description: This course introduces students to the fundamental principles and practices of Yoga, emphasizing its holistic benefits for physical, mental, and emotional well-being. It explores the philosophical underpinnings of Yoga, various techniques, and their practical application in daily life. The course also addresses common misconceptions and provides guidelines for safe and effective practice.

Course Content:

- **Introduction to Yoga:**
  - Meaning and Definitions of Yoga
  - Historical Overview and Different Schools of Yoga (e.g., Hatha, Raja, Karma, Bhakti)
  - Aim and Objectives of Yoga: Physical health, mental clarity, spiritual growth, stress management.
  - Importance of Prayer and its role in Yoga
- **Yogic Practices for Common Man:**
  - Brief introduction to various yogic practices suitable for beginners.
  - Focus on promoting positive health and stress reduction.
- **Rules and Regulations for Yogic Practices:**
  - Guidelines for safe practice (e.g., appropriate time, place, clothing, empty stomach).
  - Contraindications and precautions for specific conditions.
- **Misconceptions of Yoga:**
  - Addressing common myths and misunderstandings about Yoga.
  - Clarifying the scientific basis of Yoga's benefits.
- **Suryanamaskar (Sun Salutation):**
  - Suryanamaskar prayer and its meaning.
  - Need, importance, and benefits of Suryanamaskar.
  - Detailed breakdown of the 12 counts with proper breathing and movement coordination.
  - Practice of 2 rounds.
- **Asanas (Postures):**

- Meaning and importance of Asanas.
- Detailed study of the following Asanas:
  - **Sitting:** Padmasana (Lotus Pose), Vajrasana (Thunderbolt Pose)
  - **Standing:** Vrikshasana (Tree Pose), Trikonasana (Triangle Pose)
  - **Prone:** Bhujangasana (Cobra Pose), Shalabhasana (Locust Pose)
  - **Supine:** Utthitadvipadasana (Raised Two-Legged Pose), Ardha Halasana (Half Plough Pose)
- For each Asana:
  - Meaning of the name.
  - Step-by-step technique.
  - Breathing pattern.
  - Benefits.
  - Precautionary measures and contraindications.

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: **BASIC ENGINEERING MATHEMATICS–I**		
Course Code: **P24MADIP301**	CIE Marks: **100**	CIE Weightage:100
Teaching hours/week (L:T:P:S) **04 (L:2, T:2)**	SEE Marks: --	SEE Weightage:--
Teaching hours of Pedagogy: 40	Exam Hours: 00	
Credits: 0		

Prerequisite:

Basic Mathematics

Course learning Objectives:

CLO1: To provide basic concepts of complex trigonometry, vector algebra, differential & integral calculus, vector differentiation and various methods of solving first order differential equations.

Unit 1	**Hrs: 8**

Complex Trigonometry: Complex Numbers: Definitions & properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).

Vector Algebra: Scalar and vectors. Vectors addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple products-simple problems

Self-Study Content: De-Moivre's theorem (without proof). Roots of complex number - Simple problems.

Unit 2	**Hrs: 8**

Differential Calculus: Polar curves –angle between the radius vector and the tangent pedal equation-Problems. Taylors series and Maclaurin's series expansions- Illustrative examples.

Partial Differentiation: Elementary problems. Euler's theorem for homogeneous functions of two variables. Total derivatives-differentiation of composite and implicit function.

Self-Study Content: Review of successive differentiation. Formulae for n^{th} derivatives of standard functions- Liebnitz's theorem (without proof). Application to Jacobians, errors & approximations.

Unit 3	**Hrs: 8**

Integral Calculus: reduction formulae for for $\sin^n x$, $\cos^n x$ and $\sin^m x \cos^n x$ and evaluation of these with standard limits-Examples. Applications of integration to area, length of a given curve, volume and surface area of solids of revolution.

Self-Study Content: Differentiation under integral sign (Integrals with constants limits)-Simple problems.

Unit4	**Hrs: 8**

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only).

Self-study components: Solenoidal and irrotational vector fields-Problems.

Unit 5	**Hrs: 8**

Ordinary differential equations (ODE's): Introduction-solutions of first order and first-degree differential equations: homogeneous, exact, linear differential equations of order one and equations reducible to above types.
Self-Study Content: Applications of first order and first-degree ODE's - Orthogonal trajectories of Cartesian and polar curves. Newton's law of cooling, R-L circuits- Simple illustrative examples from engineering field.

Suggested Learning Resources:

Textbooks:

	Title	Author	Year & Edition **(Latest)**	Publisher
1.	Higher Engineering Mathematics	B. S. Grewal	44th Edition 2018	Khanna Publishers, New Delhi
Reference Books:				
1.	Advanced Engineering Mathematics	E. Kreyszig	10th Ed., 2015	John Wiley & Sons
2.	Engineering Mathematics	N. P. Bali and Manish Goyal	7th Ed., 2007	Laxmi Publishers

Course Out comes: After completing the course,the students will be able to	
CO1	Demonstrate the fundamental concepts–in complex numbers and vector algebra to analyze the problems arising in related area of engineering field.
CO2	Identify–partial derivatives to calculate rate of change of multivariate functions
CO3	Apply-the acquired knowledge of integration and differentiation to evaluate double and triple integrals to compute length surface area and volume of solids of revolution and identify velocity, acceleration of a particle moving in a space
CO4	Find analytical solutions by solving first order ODE's which arising in different branches of engineering.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2										
CO2	2	3										
CO3	3	2										
CO4	2	3										
Strength of correlation: Low-1, Medium-2, High-3												

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: **Additional Communicative English – I**		
Course Code: P24HDIP310	CIE Marks: 100	CIE Weightage:100%
Teaching hours/week (L:T:P): 0:2:0	SEE Marks: -	SEE Weightage: -
Teaching hours of Pedagogy: 30 Hours	Exam Hours: 3 Hrs	
Credits: 00		

Module-1

Introduction to Communication Skills **6 Hours**

Introduction to communication, Meaning and process, Channels of communication, Elements of communication, Barriers to effective communication. Activities - Making introductions, Sharing personal information, Describing feelings and opinions.

Module-2

Listening Skills I **4 Hours**

Hearing vs. Listening, Types of listening, Determinants of good listening, Active listening process, Barriers to listening, Activities - Listening for pronunciation practice, Listening for personal communication, Listening for communication - language functions

Module-3

Speaking Skills I **6 Hours**

Basics of speaking, Elements and Functions of speaking, Structuring your speech, Focusing on fluency, Homographs and Signpost words. Activities – Free Speech and Pick and Speak

Module-4

Reading Skills I **4 Hours**

Developing reading as a habit, Building confidence in reading, improving reading skills, Techniques of reading - skimming and scanning. Activities - understanding students' attitudes towards reading, countering common errors in reading, developing efficiency in reading.

Writing Skills I **4 Hours**

Improving writing skills, Spellings and punctuation, Letter and Paragraph writing. Activity – Writing your personal story

Module-5

Body Language and Presentation Skills **6 Hours**

Elements of body language, Types, Adapting positive body language, Cultural differences in body language. 4 Ps in presentations, Overcoming the fear of public speaking, Effective use of verbal and nonverbal presentation techniques. Activity – Group presentations

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

CO 1: Understand the role of communication in personal and professional success

CO 2: Comprehend the types of technical literature to develop the competency of students to Apprehend the nature of formal communication requirements.

CO 3: Construct grammatically correct sentences to strengthen essential skills in speaking & writing and to develop critical thinking by emphasizing cohesion and coherence

CO 4: Demonstrate effective individual and teamwork to accomplish communication goals.

Textbooks and Reference Books:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press - 2015.
2. Everyday Dialogues in English by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.
3. Developing Communication Skills by Krishna Mohan& Meera Banerjee (Macmillan)
4. The Oxford Guide to Writing and Speaking, John Seely, Oxford.
5. English Language Communication Skills - Lab Manual cum Workbook by Rajesh Kumar Singh, Cengage learning India Pvt Limited – 2018

CO – PO – PSO Matrix

CO	PO											PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS O1	PS O2	PS O3
CO1				3	1			2						
CO2				3	1				1					
CO3				3					2	1				
CO4				2				3			1			

Academic Year: 2025-26	Semester: IV	Scheme: P24
Course Title: **LINEAR ALGEBRA**		
Course Code: **P24MA401C**	CIE Marks: **50**	CIE Weightage:**50**
Teaching hours/week (L:T:P) 02:02:00	SEE Marks: **50**	SEE Weightage:**50**
Teaching hours of Pedagogy: 40	Exam Hours: 03	
Credits: 03		

Prerequisite:

Knowledge of Pre-University Algebra

Course learning Objectives:

CLO1: To build up the knowledge of Matrices and Determinants
CLO2: Understand algebraic structures like Vector space, Inner product space and Fields.
CLO3: To gain the knowledge of interplay between matrices and linear transformations
CLO4: Apply Mathematical methods to solve system of linear equations and to decompose the given matrix using LU, QR and SVD methods.

Unit 1: Matrices and Linear Systems	**Hrs: 08**

Introduction to Matrices and Determinants; Special Matrices-Hermitian, Unitary and Orthogonal Matrices. LU Decomposition. Solution to Linear Equations by Gauss elimination method. Applications of linear systems - in Network analysis, Balancing Chemical equation, Polynomial interpolation. Solve System of equations using MATLAB.

Self-Study Content: Linear equations in Electrical Networks.

Unit 2: Vector spaces	**Hrs: 08**

Vector spaces (Axiomatic definition), Subspaces, examples. Linear Combinations, Linear Spans. Linear Dependence and Independence, Basis and Dimension. Problems. Row space, column space and null space of a Matrix-bases and dimension. The Rank theorem. Application to System of Equations – Illustrate using MATLAB.

Self-Study Content: Rank and Invertible Matrix Theorem

Unit 3: Linear Transformations	**Hrs: 08**

Linear Transformation, Geometric Linear Transformations of R^2, Kernel and Image of a linear transformation, Singular and Non-singular linear transformations. Rank-Nullity Theorem (No proof). Matrix representation of linear transformations. Change of basis-Problems. Visualize properties of Linear transformations through MATLAB.

Self-Study Content: Change of bases-applications to differential equations, signal processing.

Unit4: Probability and Distribution	**Hrs: 08**

Diagonalization and quadratic forms: Eigenvalues and Eigenvectors, Diagonalization of a matrix using eigen vectors. Inner products, inner product space, length and norm, Orthogonality. Quadratic forms and Nature of the Quadratic Forms, Positive definite matrices, Reduction of Quadratic form to canonical forms by Orthogonal Transformation. Determine the Eigen values and Eigen vectors using MATLAB.

Self-Study Content: Iterative estimate for Eigen values and eigen vectors-Power and Inverse power method.

Unit 5: Matrix Decomposition	Hrs: 08
Gram-Schmidt orthogonalization and QR decomposition. Singular value decomposition. Least Square solution of $AX = B$. Introduction to their applications in Image Processing and Machine Learning.	
Self-Study Content: Applications to Linear Models. Principal Component Analysis. Illustrate SVD through MATLAB.	

Suggested Learning Resources:

Textbooks:

	Title	Author	Year & Edition **(Latest)**	Publisher
1.	Higher Engineering Mathematics	B. S. Grewal	44th Edition2018	Khanna Publishers, New Delhi
2.	Linear Algebra	Seymour Lipschutz	Edition	McGraw-Hill Companies, Inc., New Delhi.
3.	Linear Algebra and its Applications	David C. Lay, Steven R. Lay, Judi J Mc. Donald	Edition, 2021	Pearson Education
Reference Books:				
1.	Applied Mathematics	P. N. Wartikar and J. N. Wartikar,	Vol I & II	Vidyarthi Prakashan
2.	Linear Algebra and its Applications	Gilbert Strang	4th edition, 2005	Brooks Cole.3
3.	Linear Algebra: An Introduction	Richard Bronson & Gabriel B. Costa	2nd edition	Academic Press

Web links and Video Lectures (e-resources)

1. https://archive.nptel.ac.in/courses/111/104/111104137
2. https://archive.nptel.ac.in/courses/111/106/111106135
3. https://archive.nptel.ac.in/courses/111/107/111107164
4. https://archive.nptel.ac.in/courses/111/105/111105165

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

COURSE OUT COMES: On completion of the course, student should be able to:

CO1: Understand and develop a demonstrate working knowledge of algebraic properties of matrices

CO2: Understand the concepts of Vector spaces, linear independence, bases, dimension and linear transformation

CO3: Analyze and apply techniques of matrix decomposition and theirapplications in data analysis.

CO4: Solve problems on linear equations, matrices using MATLAB.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2										
CO2	2	3										
CO3	3	2										
CO4	2	3										
Strength of correlation: Low-1, Medium-2, High-3												

JAVA PROGRAMMING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CI402**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2:2:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Demonstrate the OOP Concepts using Java.
- Illustrate the concept of Interfaces, Packages, Exception, Multithreading and Generics in Java.
- Understand the java applets and event handling.
- Development of Java Application using the concept of Abstract Window Toolkit and swings

UNIT – I	**8 Hours**

Getting Started with Java: Principles of Object-Oriented Languages, Java Virtual Machine.

Classes and Objects: Classes. Objects, Class Declaration in Java, Creating Objects, Methods, Constructors, Cleaning Up Unused Objects, Class Variable and Methods—Static Keyword, this Keyword.

Inheritance: Inheritance vs Aggregation, Overriding Method, super Keyword, final Keyword, Abstract Class

Text Book – 1: Chapter 1 (1.3), Chapter 2 (2.5 – 2.6), Chapter 4 (4.1 – 4.9), Chapter 5 (5.1 – 5.5)

Self-study component:	Java Features
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Interfaces and Packages: Interfaces, Packages.

Exception: Introduction, Exception Handling Techniques, User-Defined Exception.

Multithreading in Java: Introduction, Multithreading in Java, java.lang.Thread, Main Thread, Creation of New Threads.

Generics: Introduction, Generics.

Text Book – 1: Chapter 6 (6.1 – 6.2), Chapter 7 (7.1 – 7.3), Chapter 8 (8.1 – 8.6), Chapter 10 (10.1 – 10.2)

Self-study component:	Thread. State in Java.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**

Applets: Introduction, Applet Class, Applet Class, Applet Structure, Example Applet Program, Applet Life Cycle, Common Methods Used in Displaying the Output, paint(), update(), and repaint(),More About Applet Tag, getDocumentbase() and getCodebase() Methods, Appletcontext Interface, How To Use An Audio Clip?, Images in Applet, Graphics Class, Color, Font, Fontmetrics.

Event Handling in Java: Introduction, Event Delegation Model, java. awt.Event Description, Sources of Events, Event Listeners, How Does The Model Work?, Adapter Classes, Inner Classes in Event Handling

Text Book – 1: Chapter 12 (12.1 – 12.17), Chapter 13 (13.1 – 13.8)

Self-study component:	Practical Problem: Digital Clock
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	**8 Hours**

Abstract Window Toolkit: Introduction, Components and Containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Textfield and Textarea, Container Class, Layouts, Menu, Scrollbar

Text Book – 1: Chapter 14 (14.1 – 14.14)

Self-study component:	Practical Problem: City Map Applet
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	**8 Hours**

Swing: Introduction, JFrame, JApplet, JPanel, Components in Swings, Layout Managers, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, JFileChooser, JColorChooser, Pluggable Look and Feel, Inner Frames.

Text Book – 1: Chapter 15 (15.1 – 15.17)

Self-study component:	Practical Problem: Mini Editor

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Apply the knowledge of Java Programming to demonstrate the OOP Concepts.	Apply	L3
CO2	Demonstrate the concept of Interfaces, Packages, Exception, Multithreading and Generics in Java.	Analyze	L3
CO3	Develop Java Program for applets and event handling.	Create	L6
CO4	Apply Abstract Window Toolkit for the development of Java application.	Apply	L3
CO5	Apply Swing for the development of Java application.	Apply	L3

Textbook:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java" 2nd Edition, Oxford University Press, 2016

Reference book(s):

1. Herbert Schildt, "The Complete Reference Java" Seventh Edition, TataMcGraw-Hill,2007
2. H.M. Deitel, "Java –How to Program? ",PrenticeHall,2004.

DESIGN AND ANALYSIS OF ALGORITHMS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CI403**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Prerequisites: Students should have knowledge of Programming language and Data structures.

Course Learning Objectives: This course will enable students to:

- Explain various computational problem-solving techniques.
- Apply appropriate method to solve a given problem.
- Describe various methods of algorithm analysis.

UNIT – I	**8 Hours**

Introduction: Algorithm, Fundamentals of Algorithmic problem solving, Important Problem Types, Fundamental Data Structures – Graphs.

Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical analysis of Non-Recursive Algorithms with Examples [Max Element, Unique Elements]and Recursive Algorithms with Examples [Factorial, Tower of Hanoi].

Self-study component:	Additional Examples of Mathematical analysis of Non-Recursive& Recursive Algorithms.
Textbook Map : Textbook1:Chapter 1 ; Chapter 2:2.1,2.2,2.3,2.4	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Brute Force and Exhaustive Search: Selection Sort, Brute-Force String Matching, Exhaustive Search [Travelling Salesman Problem and Knapsack Problem],Depth First Search, Breadth First Search

Decrease and Conquer: Introduction, Insertion Sort, Topological Sorting , Algorithms for generating Combinatorial objects

Self-study component:	Bubble Sort and Sequential Search.
Textbook Map : Textbook1: Chapter 3: 3.1,.3.2,3.4,3.5 Chapter 4: 4.1,4.2,4.3	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**

Divide and Conquer: General Method, Merge sort, Quick Sort, Binary Search, Strassen's Matrix Multiplication.

Transform and Conquer: Presorting, Balanced Search Trees, Heaps and Heap sort.

Self-study component:	Binary Tree Traversals and Related Properties.
Text Book 1: Chapter 6: 6.1,6.3,6.4 **Text Book 2:**Chapter 3: 3.1,3.3,3.5,3.6,3.8	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	8 Hours
Space and Time Tradeoffs: Sorting by counting (comparison counting sort), Input Enhancement in String Matching (Horspool's), Hashing. **Greedy Technique:** General Method, Job Sequencing with Deadlines, Prim's Algorithm, Kruskal's Algorithm, Single Source Shortest path (Dijikstra's Algorithm),Huffman Trees and codes	
Self-study component:	B-Trees, Optimal Binary Search Trees.
Text Book 1: Chapter 7: 7.1,7.2,7.3 Chapter 9: 9.1,9.2,9.3,9.4 **Text Book 2:** Chapter 4: 4.1,4.5	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning
UNIT – V	**8 Hours**
Dynamic Programming: General Method, The Knapsack Problem, Warshall's and Floyd's Algorithms. **Limitations of Algorithm Power:** P, NP and NP- Complete Problems. **Coping with the Limitations of Algorithm Power:** **Backtracking:** n-Queens Problem, Subset-Sum Problem, **Branch and Bound:** Knapsack Problem. **Approximation Algorithms for NP –Hard Problems :**Travelling Salesperson Problem	
Self-study component:	Lower Bound Arguments, Decision trees.
Text Book 1: Chapter 8: 8.1,8.2,8.4,11.3,12.1,12.2,12.3 **Text Book 2:** Chapter 5: 5.1	

Course Outcomes: On completion of this course, students are able to:

CO's	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	**Understand** the basic concepts of various algorithmic techniques	Understand	L2
CO2	**Design** Algorithm/solutions for the given problem using algorithmic technique..	Design	L5
CO3	**Analyze** the asymptotic performance of algorithms	Analyze	L4

Textbook:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, 3rd Edition, 2011. Pearson.

Reference book(s):

1. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.

Web and Video link(s):

1. Algorithms: Design and Analysis, Part 1 (Coursera) | MOOC List (mooc-list.com)
2. https://onlinecourses.nptel.ac.in/noc15 _cs02/preview

COMPUTER NETWORKS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CI404**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Prerequisites: Basic knowledge of problem-solving skills, Computer hardware are required to learn the course.

Course Learning Objectives: This course will enable the students to:

- Study the TCP/IP protocol suite, switching criteria and Medium Access Control protocols for reliable and noisy channels.
- Study network layer services and IP versions
- Discuss transport layer services and understand UDP and TCP protocols.
- Demonstrate the working of different concepts of networking layers and protocols.

UNIT – I	**8 Hours**

Introduction: Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: Transmission media, Guided Media, Unguided Media: Wireless.

Textbook: Ch. 1.1 - 1.3, 2.1 - 2.3, 7.1 – 7.3, 8.3.

Self-study component:	Switching: Packet Switching and its types.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Data Link Layer: Error Detection and Correction: Introduction, Block Coding, Cyclic Codes.

Data link control: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control.

Media Access Control: Random Access, Controlled Access.

Textbook: Ch. 10.1-10.4, 11.1 -11.3, 12.1 - 12.2

Self-study component:	Check Sum and Point to Point Protocol.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**

Network Layer: Network layer Services, Packet Switching, IPv4 Address, IPv4 Datagram, IPv6 Datagram, Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR, Unicast Routing protocols: RIP, OSPF, BGP.

Textbook 1: Ch. 18.1, 18.2, 18.4, 22.2,20.1-20.3, 21.3.2

Self-study component:	Multicasting Routing-MOSPF
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	8 Hours
Introduction to Transport Layer: Introduction, **Transport-Layer Protocols:** Introduction, User Datagram Protocol, Transmission Control Protocol: services, features, segments, TCP connections, flow control, Error control, Congestion control. **Textbook 1:** Ch. 23.1- 23.2, 24.1-24.3.4, 24.3.6-24.3.9	
Self-study component:	Transport Layer Protocols
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	8 Hours
Introduction to Application Layer: Introduction, Client-Server Programming, **Standard Client-Server Protocols:** World Wide Web and HTTP, FTP, Electronic Mail, Domain Name System (DNS). **Textbook 1:** Ch. 25.1-25.2, 26.1-26.6	
Self-study component:	TELNET, Secure Shell (SSH)

Course Outcomes: On completion of this course, students are able to:

CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Explain** the fundamentals of computer networks.	Explain	L2
CO2	**Apply** the concepts of computer networks to demonstrate the working of various layers and protocols in communication network.	Apply	L3
CO3	**Analyze** the principles of protocol layering in modern communication systems.	Analyze	L4
CO4	**Simulate/Design & Demonstrate** various Routing protocols and their services using tools such as Cisco packet tracer, Wireshark and so on	Simulate/Design	L5

Textbook:

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, Tata McGraw-Hill,2013.

Reference book(s):

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019.
2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education, 2015.
3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc., 2014.

DATABASE MANAGEMENT SYSTEMS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CI405**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours of Theory**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Understand the basic concepts of different models to design a relational database.
- Formulate SQL queries on data and improve the database design by Normalization.
- Describe the basic issues of transaction processing and concurrency control.
- Understand the advanced databases and database security.

UNIT – I	**8 Hours**

Introduction to Database, Database system concepts and architecture: Databases Introduction, Characteristics of the database approach, Advantages of DBMS, Schemas, and Instances, Three Schema Architecture and Data Independence. ER model: Entity Types, Entity Sets, attributes and keys, Relation Types, Relationship Sets, roles, and structural constraints, Weak Entity Types, ER Diagrams.

Text Book Mapping: chapter 1: 1.1,1.3,1.6, Chapter 2: 2.1,2.2, Chapter 7: 7.3,7.4,7.5,7.6,7.7

Self-study component:	Network model, Object-Oriented data models.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Relational Model Concepts, Relational Model Constraints, update operations dealing with constraint violations, Relational Database Design using ER-to-Relational mapping.

Relational Algebra: Unary and Binary relational operations, Examples of simple queries in relational algebra.

Creation of table in SQL: SQL Data Definition and Data types.

Text Book Mapping: chapter 3: 3.1,3.2,3.3, Chapter 4: 4.1, Chapter 6: 6.1,6.3,6.5, Chapter 9: 9.1

Self-study component:	Constraint violation problems.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**

SQL: Specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, More Complex SQL Retrieval Queries, Specifying Constraints as Assertions and Triggers, Views in SQL.

Text Book Mapping: chapter 4: 4.2,4.3,4.4 Chapter 5: 5.1,5.2,5.3

Self-study component:	EXPLAIN command in SQL.
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	**8 Hours**

Basics of Functional Dependencies and Normalization for Relational Databases: Informal design guidelines for relation schema, Functional Dependencies: Inference rules, Normal Forms based on Primary Keys: First, Second and Third Normal Forms, Boyce–Coded Normal Form.

Transaction processing: Introduction to Transaction processing, Transaction and System concepts, ACID property.

Text Book Mapping: chapter 15: 15.1,15.2,15.3,15.4,15.5 Chapter 21: 21.1,21.2,21.3		
Self-study component:	Dependency preservation.	
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning	
UNIT – V		**8 Hours**
Transaction processing (cont.): characterizing schedules based on Serializability: Serial, Non-serial and conflict-Serializable, Testing for conflict serializability of a schedule. **Concurrency Control:** Two –phase locking techniques, Control based on time stamp ordering. **Database Recovery:** Techniques based on Update, Shadow paging. **Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection. **Text Book Mapping:** Chapter 21: 21.5, Chapter 22: 22.1,22.2, Chapter 23: 23.3,23.4 **Database security: https://WWW.slideshare.net/slideshow/dbms-unit-8-database security/239193734**		
Self-study component:	Logical databases, Web databases, SQL injection.	

Course Outcomes: On completion of this course, students are able to:

CO's	Course Outcomes with *Action verbs* for the Course topics
CO1	**Understand database** concepts to design relational database model.
CO2	**Design** ER diagram for given scenario and transforms it into a relational model.
CO3	**Implement** basic and complex queries for the given context using relational algebra and SQL.
CO4	**Apply** suitable normalization techniques to improve relational database design.
CO5	**Analyze** the knowledge of concurrency control and recovery techniques to maintain database consistency and integrity.

Textbook:

1. Fundamentals of Database Systems, Elmasri and Navathe, 7th Edition, 2011, Addison-Wesley.

Reference book(s):

1. Data Base System Concepts, Silberschatz, Korth and Sudharshan, 5th Edition, 2006, Mc-Graw Hill.
2. An Introduction to Database Systems, C.J. Date, A. Kannan, S. Swamynatham, 8th Edition, 2006, Pearson Education.

MACHINE LEARNING

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CI406**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

CLO 1. Define machine learning and understand the basic theory underlying machine learning.

CLO 2. Demonstrate the basic concepts of learning.

CLO 3. Explore the basics concept of decision tree and rule based learning.

CLO 4. Illustrate Bayesian techniques and Probabilistic Graphical Models for problems appear in machine learning

UNIT – I	**8 Hours**

Introduction to Machine Learning: Need for Machine Learning, Machine Learning Explained, Machine Learning in relation to other fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process.

Understanding Data: Data, Big data analytics and types of analytics, Big data Analysis framework, Descriptive statistics, Univariate data analysis and visualization, Bivariate data and multivariate data, Multivariate statistics, Essential mathematics for multivariate data.

Text book 1: Chapter 1, Chapter 2 (2.1 to 2.8)

Self-study component:	Machine Learning Applications
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – II	**8 Hours**

Understanding Data: Overview of Hypothesis, Featured Engineering and Dimensionality Reduction Techniques.

Basics of Learning Theory: Introduction to Learning and its types, Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning, Induction Biases, Modelling in Machine Learning, Learning Frameworks.

Text book 1: Chapter 2 (2.9 to 2.10), Chapter 3

Self-study component:	Learning Frameworks – Vapnik – Chervonenkis Dimension
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – III	**8 Hours**

Similarity – Based Learning: Introduction to similarity or Instance based Learning, Nearest Neighbor Learning, Weighted K – Nearest Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis:**

Introduction to Regression, Introduction to Linearity, Correlation and Causation, Introduction to Linear Regression, Validation of Regression Methods, Multiple Linear Regression, Polynomial Regression, Logistic Regression, Reidge and Lasso Regression

Text book 1: Chapter 4 and Chapter 5

Self-study component:	Elastic Net Regression
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – IV	8 Hours

Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Validation and Pruning of Decision Trees.

Rule – based Learning: Introduction, Sequential Covering Algorithm, First Order Rule Learning, Induction as Inverted Deduction, Inverting Resolution, Analytical Learning or Explanation based Learning, Association Rule Mining

Text book 1: Chapter 6, Chapter 7

Self-study component:	Active Learning
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

UNIT – V	8 Hours

Bayesian Learning: Introduction to probability based learning, Fundamentals of Bayes Theorem, Classification using Bayes Model, Naïve Bayes Algorithm for continuous attributes.

Probabilistic Graphical Models: Introduction, Bayesian Belief Network, Markov Chain, Problems solved with HMM

Text book 1: Chapter 8 and Chapter 9

Self-study component:	Other popular types of naïve Bayes classifiers
Teaching-Learning Process	Chalk and board, Active Learning, Problem based learning

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Understand the basic concept of Machine Learning and data	Understanding	L2
CO2	Apply the basic concept of Learning.	Apply	L3
CO3	Analyse various similarity – based learning and regression algorithms.	Analyse	L4
CO4	Analyse various decision tree and rule based learning	Analyse	L4
CO5	Apply the basics of Bayesian Model and discuss the probabilistic graphical models.	Apply	L3

Text Book(s):

1. S Sridhar and M Vijayalakshmi, Machine Learning, Oxford Higher Education, 2021

Reference Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CIL407**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**24 Hours Practical**	**SEE Marks:**	**50**

Note: Implement the following programs using C Language

Experiments

1.	Develop a graph traversal module that uses the Breadth-First Search (BFS) algorithm to identify and list all nodes reachable from a specified starting node within a directed graph.
2.	Implement Depth-First Search (DFS) based algorithm to compute the topological ordering of vertices in a directed acyclic graph (DAG) .
3.	Implement Merge sort algorithm to sort the given ‘n’ unordered elements. Determine the time taken to sort the elements for different values of ‘n’ and plot a graph of the time taken versus ‘n’.
4.	Implement Quick sort algorithm to sort the given ‘n’ unordered elements. Determine the time taken to sort the elements for different values of ‘n’ and plot a graph of the time taken versus ‘n’.
5.	Develop a text search module using Horspool’s String Matching Algorithm to locate a specific pattern within a larger text.
6.	Implement Heap Sort algorithm to sort a list of unordered elements.
7.	Implement a dynamic programming algorithm for 0/1 Knapsack problem and determine the objects that are part of optimal solution.
8.	Implement Dijikstra’s algorithm to find shortest paths from a given vertex to all other vertices in a weighted connected graph.
9.	Implement Kruskal’s Algorithm to find the minimum cost spanning tree for a given undirected graph.
10.	Implement Travelling Salesperson Problem (TSP) using approximation algorithms, aiming to compute near optimal tour paths for visiting all cities with minimal total travel cost.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Implement the algorithms based on various algorithm design techniques.	Implement	L5
CO2	Analyze the efficiency of various algorithms.	Analyze	L4

Textbook:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, 3rd Edition, 2011. Pearson.

Reference book(s):

1. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.

DATABASE MANAGEMENT SYSTEMS LABORATORY

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – IV

Course Code:	**P24CIL408**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**20 Hours of Practical**	**SEE Marks:**	**50**

Note: Implement the following programs using C Language

Experiments

1.	Consider the following Company Database EMPLOYEE (Fname: String, MINIT: STRING, LNAME: string, SSN: int, Bdate: date, Address: string, Sex: string, Salary: int, super_ssn: int, DNO: int) DEPARTMENT (Dname: string, Dnumber:int, mgr_ssn:int, mgr_strat_date:date) DEPT_LOCATION (Dnumber: int, Dlocation: string) PROJECT (Pname: string, Pnumber: int,Plocation:string, Dnum:int) WORKS_ON (ESSN: int, Pno:int, hours:int) DEPENDENT (essn:int, Dependent_name: string, sex: string, Bdate:date, Relationship: string) Write the SQL Queries of the following: 1. Retrieve the name and address of all employees who work for the 'Research' department 2. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate. 3. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
2.	Consider the following Company Database EMPLOYEE (Fname: String, MINIT: STRING, LNAME: string, SSN: int, Bdate: date, Address: string, Sex: string, Salary: int, super_ssn: int, DNO: int) DEPARTMENT (Dname: string, Dnumber:int, mgr_ssn:int, mgr_strat_date:date) DEPT_LOCATION (Dnumber: int, Dlocation: string) PROJECT (Pname: string, Pnumber: int, Plocation:string, Dnum:int) WORKS_ON (ESSN: int, Pno:int, hours:int) DEPENDENT (essn:int, Dependent_name: string, sex: string, Bdate:date, Relationship: string) Write the SQL Queries of the following: 1. Retrieve the name of each employee who has a dependent with the same first name and same sex as the employee 2. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford 3. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings

3.	Consider the following schema for a Library Database: BOOK(Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS(Book_id, Author_Name) PUBLISHER(Name, Address, Phone) BOOK_COPIES(Book_id, Programme_id, No-of_Copies) BOOK_LENDING(Book_id, Programme_id, Card_No, Date_Out, Due_Date) LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies ineach Programme, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. 3. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.
4.	Consider the following database for a Banking enterprise: BRANCH (branch-name: string,branch-city: string,assets: real) ACCOUNT (accno:int,branch-name: string,balance: real) DEPOSITOR (customer-name: string,accno:int) CUSTOMER (customer-name: string,customer-street: string,city:string) LOAN (loan-number:int,branch-name: string,loan- number-int) BORROWER (customer-name: string,customer-street: string,city: string) Write SQL queries to 1. Create the above tables by properly specifying the primary and foreign keys 2. Enter 5 tuples for each relation 3. Find all the customers who have atleast two accounts at the main branch 4. Demonstrate how you delete all account tuples at every branch located in a specified city.
5.	Consider the following database for a Sports League Management System: TEAMS (team_id: int, team_name: string, city: string) PLAYERS (player_id: int, player_name: string, age: int, position: string, team_id: int) MATCHES (match_id: int, match_date: date, home_team_id: int, away_team_id: int, home_score: int, away_score: int) STATS (stat_id: int, player_id: int, match_id: int, goals: int, assists: int, yellow_cards: int, red_cards: int) COACHES (coach_id: int, coach_name: string, team_id: int, experience_years: int) Write SQL queries to Create the above tables by properly specifying the primary and foreign keys. 1. List all players in a specific team (e.g., team_id = 1) 2. Get the result of all matches where a specific team (e.g., team_id = 2) 3. played Find top 5 players with the most goals

Course Outcomes: On completion of this course, students are able to:			
CO's	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Design** ER diagrams for given scenario using draw.io tool and transforms it to a relational model.	Design	L5
CO2	**Implement** simple and complex queries for the given context using SQL.	Implement	L5

Textbook:

1. Fundamentals of Database Systems, Elmasri and Navathe, 6th Edition, 2011, Addison-Wesley.

Reference book(s):

1. Data Base System Concepts, Silberschatz, Korth and Sudharshan, 5th Edition, 2006, Mc-Graw Hill.
2. An Introduction to Database Systems, C.J. Date, A. Kannan, S. Swamynatham, 8th Edition, 2006, Pearson Education.

MACHINE LEARNING LABORATORY
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER – IV

Course Code:	**P24CIL409**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**24**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:
CLO 1. Define machine learning and understand the basic theory underlying machine learning.
CLO 2. Understand the basic concepts of learning and decision trees.
CLO 3. Understand the basics concept of decision tree and rule based learning.
CLO 4. Understand Bayesian techniques and Probabilistic Graphical Models for problems appear in machine learning

1. Descriptive Statistics

Implement and demonstrate dataset exploration using **Pandas** for statistical analysis. Read the dataset from a `.csv` file and perform the following operations:

1. Apply statistical operations on the dataset.
2. Use the describe() command to summarize the dataset.
3. Perform descriptive statistics for univariate and bivariate analysis.
   Finally, generate the summary of the dataset based on your observations.

2. Data Preprocessing

Implement and demonstrate dataset preprocessing using **Scikit-learn**. Read the dataset from a `.csv` file and perform the following preprocessing tasks:

1. Apply **Label Encoding** on categorical attributes.
2. Use **scaling techniques** from Scikit-learn preprocessing routines.
3. Apply **binarization** using Scikit-learn preprocessing routines.
   Finally, generate the preprocessed dataset and summarize the transformations performed.

3. Graphics Plots
Implement and demonstrate data visualization techniques for **Univariate and Bivariate analysis**. Generate appropriate graphs using Python libraries (such as Matplotlib/Seaborn) to explore the dataset visually.

4. Data Visualization using Seaborn
To write python program using Seaborn for data visualization. The data visualization is done for both synthetic data as well as for preloaded Iris dataset.

5. Statistical Tests Using SCIPY
To write python program for finding Chi-square test and t-tests using SciPy module

6. Principal Component Analysis
To write python program for finding principal component analysis (PCA) for the given problem and to a randomly generated dataset.

7. Find – S Algorithm

Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file and generate the final specific hypothesis.

8. k-Nearest Neighbor Algorithm

Implement and demonstrate k-Nearest Neighbor algorithm. Read the training data from a .CSV file and build the model to classify a test sample. Print both correct and wrong predictions.

9. Linear Regression

To write Python program for finding linear regression.

10. Logistic Regression

Implement and demonstrate the **Logistic Regression** model using **Scikit-learn**. Perform the following tasks:

1. Generate a random dataset suitable for logistic regression.
2. Apply the logistic regression model in Python on the generated dataset. Finally, evaluate the model and display the results.

11. Decision Tree Classifier – CART

Implement and demonstrate the working of the decision tree based CART algorithm using a sample data set. Build the decision tree and use this model to classify a test sample.

12. Decision Tree Classifier – ID3

Implement and demonstrate the working of the decision tree based ID3 algorithm using a sample data set. Build the decision tree and use this model to classify a test sample.

13. Naive Bayes Classifier

Implement and demonstrate the working of Naive Bayesian classifier using a sample data set. Build the model to classify a test sample.

14. Hidden Markov Model

Implement and demonstrate Hidden Markov Model (HMM) to decode the hidden states given a sequence of observation states using Viterbi algorithm.

Course Outcomes: On completion of this course, students are able to:			
COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO3	Implement various similarity – based learning and regression algorithms.	Apply	L3
CO4	Implement various decision tree and rule based learning	Apply	L3
CO5	Implement the basics of Bayesian Model and discuss the probabilistic graphical models.	Apply	L3

Text Book(s):

1. S Sridhar and M Vijayalakshmi, Machine Learning, Oxford Higher Education, 2021

Reference Book(s):

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn & TensorFlow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019

Academic Year: 2025-26	Semester: IV	Scheme: CBCS & OBE
Course Title: **EMPLOYABILITY ENHANCEMENT SKILLS – IV**		
Course Code: **P24HSMC410A**	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:2:0	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy:48 Hours	Exam Hours:	
Credits:01		

Course learning Objectives: This course will enable the students to:

- **CLO1:** Calculations involving simple and compound interest, averages, alligations & mixtures, proportions, variations and partnership.
- **CLO2 :** Explain concepts behind logical reasoning modules of series, coding & decoding, seating and data arrangements.
- **CLO3 :** Develop problem solving skills through Data structures.

Unit 1:	**Hrs:8**

Quantitative Aptitude: Simple and Compound Interest, Averages.

Logical Reasoning: Series, Coding & Decoding.

Self-Study Content: Mensuration

Unit 2:	**Hrs:8**

Quantitative Aptitude: Alligations and Mixtures, Ratios, Proportions and Variations.

Logical Reasoning: Seating Arrangement, Data Arrangement.

Self-Study Content: Types of cryptarithm

Unit 3:	**Hrs:8**

Quantitative Aptitude: Partnership.

Verbal Ability: Sentence Completion, Ordering of Sentences

Self-Study Content: Game based assessments

Unit4:	**Hrs:12**

DATA STRUCTURES I - Problem Solving Techniques and Object-Oriented Programming

Recursion: Introduction to recursion, Principle of mathematical induction, Fibonacci numbers, Recursion using arrays, Recursion using strings, Recursion using 2D arrays.

Time and Space Complexity: Order complexity analysis, Theoretical complexity analysis, Time complexity analysis of searching and recursive algorithms, Theoretical space complexity, Space complexity analysis of merge sort.

Backtracking: Introduction to Backtracking, Rat In a Maze, N-queen, Word Search.

Basics of OOP: Introduction to oops, Creating objects, Getters, and setters, Constructors and related concepts, Inbuilt constructor and destructor, Example classes.

Advance Concepts of OOP: Static members, Function overloading and related concepts, Abstraction, Encapsulation, Inheritance, Polymorphism, Virtual functions, Abstract classes, Exception handling.

Self-Study Content: Examples of Abstract Data Type

Unit 5:	**Hrs:12**

DATA STRUCTURES II – Linear Data Structures and Tress

Linked Lists: Introduction to linked list, Inserting node in linked list, Deleting node from linked list,

Midpoint of linked list, Merge two sorted linked lists, merge sort of a linked list, Reversing a linked list. **Stacks and Queues:** Introduction to stacks, Stack using arrays, Dynamic Stack class, Stack using linked list, Inbuilt stack, Queue using arrays, Dynamic queue class, Queue using linked list, Inbuilt queue. **Generic Trees:** Introduction to Trees, Making a tree node class, Taking a tree as input and printing, Tree traversals, Destructor for tree node class. **Binary Trees**: Introduction to Binary Trees, Taking a binary tree as input and printing, Binary Tree traversals, Diameter of binary tree. **Binary Search Trees**: Introduction to Binary Search Trees, Searching a node in BST, BST class, Inserting and Deleting nodes in BST, Types of balanced BSTs.
Self-Study Content: Huffman tree, Expression Trees.

Course Outcomes: On completion of this course, students are able to:

Cos	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on simple and compound interests, averages, alligations & mixtures, ratios, proportions, variations and partnerships.	Applying	L3
CO2	Solve logical reasoning problems based on seating arrangements, data arrangement and verbal ability skills of sentence corrections and ordering of sentences.	Applying	L3
CO3	Analyze and represent various data structures and its operations.	Analyzing	L4
CO4	Develop programs with suitable data structure based on the requirements of the real-time applications	Applying	L3

Text Book(s):

1. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
2. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava
3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Aaron M Tenenbaum, Yedidyah Langsam and Moshe J Augenstein, "Data Structures using C", 2014, low price edition ,Pearson education.
2. Seymour Lipschutz ,"Data Structures with C (Schaum's Outline Series)" , July 2017, McGraw Hill Education.
3. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning

1. Engage in group reasoning and verbal skill exercises.
2. Perform hands-on analysis of data using different structures.
3. Create and implement mini coding projects based on real-world scenarios.

Course Outcomes		Program Outcomes										
		1	2	3	4	5	6	7	8	9	10	11
CO1	Solve problems on simple & compound interest, averages, alligations & mixtures, ratios, proportions, variations, partnerships.	3	3		2	1					1	2
CO2	Solve logical reasoning & verbal ability problems (arrangements, sentence ordering).	2	3	1	1					1	3	1
CO3	Analyze & represent various data structures and their operations.	3	3	3	3	3					1	1
C04	Develop programs with suitable data structures for real-time applications.	3	3	3	2	3				1	1	2

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: National Service Scheme		
Course Code: P24NSS411	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:0:2	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy: 20-24 Hrs	Exam Hours: -	
Credits: 00		

Course Outcomes (COs):

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

CO1: Analyze and propose water conservation: Assess water resource issues and recommend conservation strategies considering stakeholder roles.

CO2: Develop rural business proposals: Create actionable business proposals for increasing village income, including market analysis and implementation plans.

CO3: Enhance educational outcomes and access: Design and implement initiatives to improve school performance and promote higher/technical/vocational education enrolment.

CO4: Apply engineering to community development: Integrate engineering knowledge to develop solutions for water conservation, business development, and educational initiatives.

CO5: Evaluate community development impacts: Assess the social, economic, and environmental impacts of community development projects.

Course Description: This course focuses on practical strategies for community development, covering water conservation techniques, business development in rural areas, and educational enhancement initiatives. It emphasizes stakeholder engagement, project planning, and implementation.

Course Content:

- Water conservation techniques, the role of different stakeholders (e.g., government, communities, NGOs), and implementation strategies.
- Developing actionable business proposals to increase village income and outlining implementation approaches.
- Supporting local schools to improve academic results and increase enrolment in higher/technical/vocational education.

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: Physical Education		
Course Code: P24PED411	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:0:2	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy: 20-24 Hrs	Exam Hours: -	
Credits: 00		

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

1. Understand the ethics and moral values in sports and athletics
2. Perform in the selected sports or athletics of student's choice.
3. Understand the roles and responsibilities of organisation and administration of sports and games.

Module I: Ethics and Moral Values 4 Hours

1. Ethics in Sports
2. Moral Values in Sports and Games

Module II: Specific Games (Any one to be selected by the student) 16 Hours

1. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass.
2. Athletics (Track Events) – Any event as per availability of Ground

Module III: Role of Organization and administration 4 Hours

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: Yoga		
Course Code: P24YOG411	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 0:0:2	SEE Marks:50	SEE Weightage:50%
Teaching hours of Pedagogy: 20-24 Hrs	Exam Hours: -	
Credits: 00		

Course Outcomes (COs):

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

CO1: Understand Yoga's ethics and philosophy: Explain Patanjali's Ashtanga Yoga (Yamas and Niyamas) and their relevance to personal and professional life.

CO2: Perform Yoga practices safely: Execute Suryanamaskar, selected Asanas, Kapalabhati, and Pranayama techniques with correct technique, breathing, and safety awareness.

CO3: Analyze Yoga's effects: Describe the benefits and contraindications of practiced techniques, explaining their impact on body and mind.

CO4: Apply Yoga for well-being: Integrate Yoga for stress management, focus, mindfulness, and overall well-being.

CO5: Understand Yoga's interconnectedness: Articulate the relationship between physical practices, mental states, and ethical principles in Yoga.

Course Description: This course introduces students to the ancient practice of Yoga, focusing on its physical, mental, and ethical dimensions. It covers key components of Patanjali's Ashtanga Yoga, including Yamas and Niyamas, along with practical training in Asanas, Suryanamaskar, Pranayama, and Shatkarmas like Kapalabhati. The course aims to equip students with tools for stress management, improved focus, and overall well-being.

Course Content:

- **Patanjali's Ashtanga Yoga:** Yama (Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha), Niyama (Shaucha, Santosha, Tapas, Svadhyaya, Ishvarapranidhana)
- **Suryanamaskar:** 12 counts, 4 rounds
- **Asanas:**
  - Sitting: Sukhasana, Paschimottanasana
  - Standing: Ardhakati Chakrasana, Parshva Chakrasana
  - Prone: Dhanurasana
  - Supine: Halasana, Karna Peedasana
- **Kapalabhati:** 40 strokes/min, 3 rounds
- **Pranayama:** Suryanuloma-Viloma, Chandranuloma-Viloma, Suryabhedana, Chandra Bhedana, Nadishodhana

Meaning, Need, importance of Pranayama. Di fferent types. Meaning by name, technique, precautionary measures and benefits of each Pranayama

Academic Year: 2025-26	Semester: IV	Scheme: P24
Course Title: **BASIC ENGINEERING MATHEMATICS–II**		
Course Code: **P24MADIP401**	CIE Marks: **100**	CIE Weightage:**100**
Teaching hours/week (L:T:P:S) **04 (L:2, T:2)**	SEE Marks: --	SEE Weightage:--
Teaching hours of Pedagogy: 40	Exam Hours: 00	
Credits:0		
Prerequisite:		
Basic Mathematics		
Course learning Objectives:		
CLO1: To provide essential concepts of linear algebra, introductory concepts of second & higher order differential equations along with various techniques/methods to solve them, Laplace & inverse Laplace transforms and elementary probability theory.		
Unit 1		**Hrs: 08**
Linear Algebra: Introduction - Rank of matrix by elementary row operations - Echelon form of a matrix. Consistency of system of linear equations - Gauss elimination method. Gauss-Jordan and LU decomposition methods. Eigen values and Eigen vectors of a square matrix.		
Self-Study Content: Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples.		
Unit 2		**Hrs: 08**
Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators and variation of parameters. Solution of Cauchy's homogeneous linear equation and Legendre's linear differential equation.		
Self-Study Content: Method of undetermined coefficients		
Unit 3		**Hrs: 08**
Multiple Integrals: Double and triple integrals-region of integration. Evaluation of double integrals by change of order of integration. Vector Integration: Vector Integration: Integration of vector functions. Concept of a line integrals, surface and volume integrals. Green's, Stokes's and Gauss theorems (without proof) problems.		
Self-Study Content: Orthogonal curvilinear coordinates.		
Unit 4		**Hrs: 08**
Laplace transforms: Laplace transforms of elementary functions. Transforms of derivatives and integrals, transforms of periodic function and unit step function-Problems only. Inverse Laplace transforms: Definition of inverse Laplace transforms. Evaluation of Inverse transforms by standard methods.		
Self-Study Content: Application to solutions of linear differential equations and simultaneous differential equations.		
Unit 5		**Hrs: 08**
Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability – illustrative examples.		
Self-Study Content: State and prove Bayes's theorem.		
Suggested Learning Resources:		

Textbooks:				
Sl. No.	**Title**	**Author**	**Year & Edition**	**Publisher**
1.	Higher Engineering Mathematics	B. S. Grewal	44th Edition 2018	Khanna Publishers, New Delhi
Reference Books:				
1.	Advanced Engineering Mathematics	E. Kreyszig	10th Ed., 2015	John Wiley & Sons
2.	Engineering Mathematics	P. Bali and Manish Goyal	7th Ed., 2022	Laxmi Publishers

Course Out comes: After completing the course, the students will be able to	
CO1	Apply matrix theory for solving systems of linear equations in the different areas of linear algebra.
CO2	Solve second and higher order differential equations occurring in electrical circuits, damped/un-damped vibrations.
CO3	Identify-the technique of integration evaluates double and triple integrals by change of variables, and vector integration technique to compute line integral
CO4	Explore the basic concepts of elementary probability theory and apply the same to the problems of decision theory,

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3										
CO2	3	3										
CO3	3	2										
CO4	2	3										
Strength of correlation: Low-1, Medium-2, High-3												

Academic Year: 2025-26	Semester: III	Scheme: P24
Course Title: **Additional Communicative English – II**		
Course Code: P24HDIP410	CIE Marks: 100	CIE Weightage:100%
Teaching hours/week (L:T:P): 0:2:0	SEE Marks: -	SEE Weightage: -
Teaching hours of Pedagogy: 30 Hours	Exam Hours: 3 Hrs	
Credits: 00		

Module-1 **Listening Skills II**	**2 Hours**
Levels of listening, Active listening, Techniques of listening. Activity: Listening for main ideas and Listening for specific information	
Speaking Skills II	**6 Hours**
Language of discussion – Giving opinion, agreeing / disagreeing, asking questions, making suggestions. Sentence stress – content and structure words, Speaking situations, Intonations and Summarizing skills	
Module-2 **Reading Skills II**	**2 Hours**
Guessing meaning from the context, Understanding graphical information, Summarizing. Activity: Book review	
Writing Skills II	**4 Hours**
Linkers and connectives, Sentence and paragraph transformation, Mind mapping techniques, Letter writing, Essay writing	
Module-3 **Email Etiquette**	**4 Hours**
Parts of an email, Writing an effective subject line, email language and tone. Activity: Email writing practice - Scenario based emails	
Group Presentations	**2 Hours**
Group presentations by the students	
Module-4 **Goal Setting**	**2 Hours**
Defining goals, types of goals, Establishing SMART goals, Steps in setting goals, Goal setting activity	
Individual Presentations	**4 Hours**
Individual presentation by the students	
Module-5 **Teamwork**	**4 Hours**
Defining teams, Team vs. Group, Benefits and challenges of working in teams, Stages of team building, Building effective teams, Case studies on teamwork	

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

CO 1: Understand the role of communication in personal and professional success

CO 2: Comprehend the types of technical literature to develop the competency of students to apprehend the nature of formal communication requirements.

CO 3: Construct grammatically correct sentences to strengthen essential skills in speaking & writing and to develop critical thinking by emphasizing cohesion and coherence

CO 4: Demonstrate effective individual and teamwork to accomplish communication goals.

Textbooks and Reference Books:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press - 2015.
2. Everyday Dialogues in English by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.

3. Developing Communication Skills by Krishna Mohan& Meera Banerjee (Macmillan)
4. The Oxford Guide to Writing and Speaking, John Seely, Oxford.
5. English Language Communication Skills - Lab Manual cum Workbook by Rajesh Kumar Singh, Cengage learning India Pvt Limited – 2018
6. The 7 Habits of Highly Effective People by Stephen R Covey, Simon & Schuster – 2020
7. You Are the Team: 6 Simple Ways Teammates Can Go from Good to Great by Michael G. Rogers

CO – PO – PSO Matrix

CO	PO											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PS O1**	**PS O2**	**PS O3**
CO1				3	1			2						
CO2				3				2	1					
CO3				3	2						1			
CO4				1				3			1			