SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

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]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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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.*
- *To collaborate 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 (III–Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching department**	**Hrs / Week**			**Credits**	**Examination Marks**		
				L	**T**	**P**		**CIE**	**SEE**	**Total**
1	P22MAAI301	Probability and Statistics	MA	2	2	-	3	50	50	100
2	P22AI302	Data Structures	AIML / CSE	3	-	-	3	50	50	100
3	P22AI303	Digital Systems and Computer Organization	AIML / CSE	3	-	-	3	50	50	100
4	P22AI304	Operating System (Integrated)	AIML / CSE	3	-	2	4	50	50	100
5	P22AI305	Python Programming (Integrated)	AIML / CSE	3	-	2	4	50	50	100
6	P22AIL306	Data Structures Laboratory	AIML / CSE	-	-	2	1	50	50	100
7	P22HSMC307	Employability Enhancement Skills – III	HSMC	-	2	-	1	50	50	100
8	P22BFE308	Biology for Engineers	AIML / CSE	2	-	-	2	50	50	100
9	P22NSS309	National Service Scheme (NSS)	NSS Coordination	-	-	2	0	100	-	100
	P22PED309	Physical Education (PE) (Sports and Athletics)	PED							
	P22YOG309	Yoga	YOGA							
Total							**21**			
10	P22MDIP301	Additional Mathematics - I	MA	2	2	-	0	100	-	100
11	P22HDIP307	Additional Communicative English - I	HSMC	-	2	-	0	100	-	100

Bachelor of Engineering(IV–Semester)										
Sl. No.	**Course Code**	**Course Title**	**Teaching department**	**Hrs / Week**			**Credits**	**Examination Marks**		
				L	**T**	**P**		**CIE**	**SEE**	**Total**
1	P22MAAI401	Linear Algebra	MA	2	2	-	3	50	50	100
2	P22AI402	Design and Analysis of Algorithms	AIML / CSE	3	-	-	3	50	50	100
3	P22AI403	Computer Networks	AIML / CSE	3	-	-	3	50	50	100
4	P22AI404	Introduction to Artificial Intelligence (Integrated)	AIML / CSE	3	-	2	4	50	50	100
5	P22AI405	Database Management System (Integrated)	AIML / CSE	3	-	2	4	50	50	100
6	P22AIL406	Design and Analysis of Algorithms Laboratory	AIML / CSE	-	-	2	1	50	50	100
7	P22HSMC407B	Employability Enhancement Skills - IV	HSMC	-	2	-	1	50	50	100
8	P22INT408	Internship – I	AIML / CSE	-	-	-	2	-	100	100
9	P22NSS409	National Service Scheme (NSS)	NSS Coordination	-	-	2	0	100	-	100
	P22PED409	Physical Education (PE) (Sports and Athletics)	PED							
	P22YOG409	Yoga	YOGA							
Total							**21**			
10	P22MDIP401	Additional Mathematics – II	MA	2	2	-	0	100	-	100
11	P22HDIP407	Additional Communicative English - II	HSMC	-	2	-	0	100	-	100

PROBABILITY AND STATISTICS

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

SEMESTER – IV

Course Code:	**P22MAAI301**	**Credits:**	**03**
Teaching Hours/Week (L: T: P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
- Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
- Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

UNIT – I	**Statistics**	**8 Hours**

Introduction, variables, frequency distributions, measures of central tendency – illustrative examples, measures of dispersion, 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, method of moments.

(RBT Levels: L1, L2 and L3).

UNIT – II	**Probability**	**8 Hours**

Probability distributions: Random variables, probability mass and density functions. Mathematical expectation, mean and variance. Discrete Random variables, Binomial, Poisson - Illustrative examples. Normal distributions, exponential distributions, Mean and standard deviation, standard normal distributions and normal probability curve visualization using R programming.

(RBT Levels: L1, L2 and L3)

UNIT – III	**Joint Probability and Markov chain**	**8 Hours**

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation using R programming.

Markov Chain: Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states.

(RBT Levels: L1, L2 and L3)

UNIT – IV	**Statistical Inference I**	**8 Hours**

Correlation and regression, Karl Pearson's coefficient, lines of regression, multiple regression, non-linear correlation. Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance,test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples.

(RBT Levels: L1, L2 and L3)

UNIT – V	**Statistical Inference II**	**8 Hours**

Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two large and small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution.

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

COs	Course Outcomes with *Action verbs* for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Apply suitable probability distributions and statistical methods in Computer science and allied Engineering Sciences.	Apply	L3
CO2	Analyze the computer science and allied engineering Sciences applications using statistical methods.	Analyze	L4
CO3	Compute the confidence intervals for the mean of the population and apply the ANOVA test related to engineering problems.	Apply	L3

Suggested Learning Resources:

Textbooks:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition **2020**.

Reference Books:

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
4. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
5. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
6. **Jim Pitman**. Probability, Springer-Verlag, 1993.
7. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
8. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1983.
9. **P. G. Hoel, S. C. Port and C. J. Stone**, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
10. **S. Ross**, "A First Course in Probability", Pearson Education India, 6th Ed., 2002.
11. **N.P. Bali and Manish Goyal**, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
12. **Veerarajan T**, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- http://www.bookstreet.in.
- VTU EDUSAT PROGRAMME – 20
- VTU e-Shikshana Program

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Programming Assignment
- Seminars

DATA STRUCTURES

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

Course Code:	**P22AI302**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**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**

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, Operations on Data Structures, Abstract Data Type.
Dynamic memory Allocation

Self-study component:	Examples of Abstract Data Type Static v/s Dynamic memory allocation Pointers and Two-dimensional Arrays

UNIT – II	**8 Hours**

Linked Lists: 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

UNIT – III	**8 Hours**

Stacks: Introduction to Stacks, Operations on a Stack (Using Arrays & Linked list), Applications of Stacks: Implementing Parentheses Checker, Conversion of Expression: infix to postfix, Postfix to Prefix, Evaluation of Expressions: prefix expression, postfix expression.

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

UNIT – IV	**8 Hours**

Recursion: Introduction, Factorial of a number, Fibonacci series, Tower of Hanoi, GCD of two numbers.
Queues: Introduction to Queues, Operations on Queue (Using Arrays & Linked list).
Types of Queues: Circular queue, DeQues , Priority Queue, Multiple Queues

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

UNIT – V	**8 Hours**

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

Self-study component:	Huffman tree, Expression Trees.

COs	**Course Outcomes** with ***Action verb*** for the Course topics
CO1	**Apply** the concepts of pointers in data structures.
CO2	**Analyze** and represent various data structures and its operations.
CO3	**Design** algorithms using different data structures like List, Stack, Queue and Trees.
CO4	**Develop** programs with suitable data structure based on the requirements of the real-time applications.

Text Book(s):

- ReemaThareja, "Data Structures using C", 2nd Edition,2018, Oxford University Press

Reference Book(s):

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

Web and Video link(s):

- Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/

E-Books/Resources:

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

DIGITAL DESIGN AND COMPUTER ORGANIZATION

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

Computer Science & Engineering (AI & ML)

SEMESTER – III

Course Code:	**P22AI303**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**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.

UNIT – II	**8 Hours**

Combinational Logic:

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

Sequential Logic:

Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 5.1, 5.2, 5.3, 5.4.

Self-study component:	HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder.

UNIT – III	**8 Hours**

Basic Structure of Computers:

Functional Units of Computer, 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.

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.
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.

Text Book(s):

1. M. Morris Mano & Michael D. Ciletti, Digital Design with an Introduction to Verilog Design, 5th Edition, 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/

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

COs	**Course Outcomes** with ***Action verbs*** for the Course topics
CO 1	**Apply** the K–Map techniques to simplify various Boolean expressions.
CO 2	**Design** different types of combinational and sequential circuits.
CO 3	**Understand** the operation and organization of a digital computer system.
CO 4	**Analyze** the given assembly language code snippet.
CO 5	**Apply** the knowledge of assembly language to solve the given problem.

OPERATING SYSTEM [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22AI304**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives:

- To familiarize the operations performed by OS as a resource Manager.
- To impart various scheduling policies of OS.
- To teach different memory management techniques..

UNIT – I	**8 Hours**

Introduction: Purpose of Operating System, Computer System Architecture, Operating System Structure, Operating System Operations
System Structures: Operating System Services, User and Operating system interface, System Calls, Types of System calls, System programs.
Processes: Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication.

Self-study component:	Computer system Organization, Computing Environments, Operating System Structure(chapter 2)
Practical Topics:	1. Program to implement the Process system calls. 2. Program to create a Process using API.

UNIT – II	**8 Hours**

Threads: Overview, Multicore Programming, Multithreading Models.

File-system Implementation: File-System Structure, File-System Implementation, Directory Implementation, Allocation methods.

Self-study component:	Threading Issues, Free Space Management
Practical Topics:	1. Program to implement Sequential file allocation method. 2. Program to simulate Single level directory file organization technique.

UNIT – III	**8 Hours**

Process Synchronization: Critical Section Problem, Peterson's solution, Mutex locks, Semaphores, Classic Problems of Synchronization.

CPU Scheduling: Basic concepts, Scheduling Criteria, Scheduling Algorithms-FCFS, SJF, RR, priority.

Self-study component:	Synchronization Hardware ,Multiple-Processor Scheduling

Practical Topics:	1. Program to simulate the concept of Dining-Philosopher's problem. 2. Program to implement CPU scheduling algorithm for Shortest Job First CPU Scheduling algorithm.

UNIT – IV	**8 Hours**

Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock Detection.

Main Memory: Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging.

Self-study component:	Recovery from deadlock, Structure of Page Table
Practical Topics:	1. Simulate Banker's algorithm for Dead Lock Avoidance. 2. Program to implement and simulate the MFT algorithm.

UNIT – V	**8 Hours**

Virtual Memory: Background, Demand paging, Copy on write, Page replacement algorithms-. FIFO page replacement, Optimal page replacement, LRU page replacement

Mass-storage structure: Disk Structure, Disk Scheduling.

Self-study component:	Thrashing, Disk Attachment.
Practical Topics:	1. Program to implement FIFO page replacement technique. 2. Program to simulate FCFS Disk scheduling algorithm.

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

COs	**Course Outcomes** with ***Action verbs*** for the Course topics.
CO1	**Apply** Various Process Scheduling Algorithms, Disk Scheduling algorithms, Page replacement algorithms and Deadlock detection and avoidance techniques for providing Operating System functionalities.
CO2	**Analyze** and interpret operating system concepts to acquire a detailed understanding of the course.
CO3	**Understand** and explore the fundamental concepts of various operating system services.
CO4	**Conduct** experiments using Programming Language to demonstrate the Basic features of Operating System.

Text Book(s):

1. Operating System Concepts Abraham Silberschatz, Peter Baer Galvin and Greg Gagn, 9th edition, John Wiley &Sons, Inc.

Reference Book(s):

1. Ann McHoes Ida M Flynn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI (EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Web and Video link(s):

1. https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O.
2. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f

E-Books/Resources:

1 **https://www.researchgate.net/publication/354665053_Operating_System_Concepts_9th201212.**

CO-PO Mapping

CO	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	**Apply** Various Process Scheduling Algorithms, Disk Scheduling algorithms, Page replacement algorithms and Deadlock detection and avoidance techniques for providing Operating System functionalities.	2	2	1									2	
CO2	**Analyze** and interpret operating system concepts to acquire a detailed understanding of the course.	2	2										2	
CO3	**Understand** and explore the fundamental concepts of various operating system services.	2	1										2	
CO4	**Conduct** experiments using Programming Language to demonstrate the Basic features of Operating System.	2	2	1	1								2	

PYTHON PROGRAMMING FOR DATA SCIENCE

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

SEMESTER – III

Course Code:	**P22AI305**	**Credits:**	**04**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory + 20 Hours Practical**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students:

- 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	**Introduction to python**	**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)

Practical Topics:	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.

UNIT – II	**Decision structure**	**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)

Practical Topics:	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]

UNIT – III	Lists	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)		
Practical Topics:	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.	
UNIT – IV	**NumPy Library**	**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.		
Practical Topics:	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)	
UNIT – V	**Pandas**	**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		
Practical Topics:	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.	

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	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

Text Book(s):

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

Reference Book(s):

1. 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

Data Structures Laboratory [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III			
Course Code:	**P22AIL306**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Lab Hours:	**24**	**SEE Marks:**	**50**

Note: All programs are to be implemented using C Language

1.	Create a structure **DISTANCE** with data members ***kms*** and ***meters*** of type integer. Implement a program to perform addition and subtraction on two distances by passing pointer to a structure to function.
2.	Implement a menu driven program to perform the following operations on Singly Linked List. (i) Create SLL of 'n' nodes of integers (insert front/rear) (ii) Delete the node with specified integer from the list with appropriate message. (iii) Display the contents of the SLL.
3.	Implement a menu driven Program for the following operations on Doubly Linked List (DLL) of Library Data with the fields: BOOK_ID, BOOK_TITLE, AUTHOR, EDITION (i) Create a DLL of 'N' books (Insert front/rear). (ii) Count the number of nodes in the DLL. (iii) Delete the node at front/rear. (iv) Display the contents of DLL.
4.	Implement a menu driven Program for the following operations on Circular Linked List. (i) Create CLL of 'n' nodes of string. (insert front/rear) (ii) Count the number of nodes in the CLL. (iii) Delete the node at front/rear. (iv) Display the contents of CLL.
5.	Implement a menu driven Program for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) (i) Push an Element on to Stack (Handle the situation of overflow) (ii) Pop an Element from Stack (Handle the situation of underflow) (iii) Display the contents of Stack
6.	Implement a Program to convert an infix expression to its equivalent postfix expression.
7.	Implement the following using recursion: (i) Tower_of_Hanoi (ii) GCD of two numbers (iii) Largest of 'n' numbers
8.	Implement a menu driven Program for the following operations on QUEUES of Strings using Linked list (i) Insert an Element into Queue (ii) Delete an Element from Queue (iii) Display the contents of Queue

9.	Implement a menu driven program to perform the following operations on priority queue using linked list. (i) Insert a node based on priority. (ii) Delete a node from the queue (iii) Display the contents of the queue
10.	Implement a menu driven Program for the following operations on Binary Search Tree (BST) of Integers (i) Create a BST of N Integers (ii) Traverse the BST in Inorder, Preorder and Postorder

EMPLOYABILITY ENHANCEMENT SKILLS - III [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III			
Course Code:	**P22HSMC307**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

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

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

UNIT – I		**06 Hours**

Quantitative Aptitude: Number System – Divisibility & Remainder, Multiples & Factors, Integers, HCF & LCM, Decimal Fractions, Surds & Indices, Simplification.

Self-study component:	Linear equations.

UNIT – II		**06 Hours**

Quantitative Aptitude: Percentages, Profits, Loss and Discounts.

Logical Reasoning: Blood Relations.

Self-study component:	Inferred meaning, Chain rule.

UNIT – III		**06 Hours**

Logical Reasoning: Direction Sense Test.

Verbal Ability: Change of Speech and Voice, Sentence Correction.

Self-study component:	Height & distance.

UNIT – IV	**C-PROGRAMMING - I**	**06 Hours**

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 component:	Evaluation of Expression.

UNIT – V	C-PROGRAMMING - II	06 Hours

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 component:	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

Text Book(s):

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 Book(s):

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 and Video link(s):

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

COURSE ARTICULATION MATRIX (EMPLOYABILITY ENHANCEMENT SKILLS - III – P22HSMC307)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2	3		2
CO2	2	2										
CO3	2	2										
CO4	2	2								2		1

BIOLOGY FOR ENGINEERS

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

SEMESTER – III

Course Code:	**P22BFE308**	**Credits:**	**02**
Teaching Hours/Week (L:T:P)	**2:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**25**	**SEE Marks:**	**50**

Course Learning Objectives:

The objectives of this course are to,

- Familiarize the students with the basic biological concepts and their engineering applications.
- Enable the students with an understanding of bio-design principles to create novel devices and structures.
- Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- Motivate the students to develop the interdisciplinary vision of biological engineering.

Course Content

Biomolecules And Their Applications (Qualitative): Carbohydrates (cellulose-based water filters, PHA and PLA as bio-plastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (bio-diesel, cleaning agents/detergents), Enzymes (glucose-oxidase in bio-sensors, lingolytic enzyme in bio-bleaching). **5Hrs**

UNIT-II

Human Organ Systems And Bio-Designs-1 (Qualitative): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics, Engineering solutions for Parkinson's disease), Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **5Hrs**

UNIT-III

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS-2 (QUALITATIVE): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine), Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). **5Hrs**

UNIT-IV

Nature Bio Inspired Materials And Mechanisms (Qualitative): Echolocation (ultra sonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts). **5Hrs**

UNIT-V

Trends In Bio- Engineering (Qualitative): DNA origami and Bio-computing, Bio-imaging and Artificial Intelligence for disease diagnosis, Self healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes), Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). **5Hrs**

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook, 16thEdition, 2022.
- Biology for Engineers, Thyagarajan S, SelvamuruganN, Rajesh M. P, Nazeer R. A, Thilagaraj W, Barathi. S and Jaganthan M.K, Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T.Johnson, CRC Press, Taylor and Francis, 2011.
- Bio-medical Instrumentation, Leslie Cromwell, Prentice Hall, 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen,Vayu Education of India, New Delhi, 2014.
- Bio-mimetics: Nature Based Innovation,Yoseph Bar-Cohen,1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bio-remediation of heavy metals: bacterial participation, C R Sunil Kumar, N Geetha, A C Udayashankar, Lambert Academic Publishing, 2019.
- 3D Bio-printing: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016.

Web links and Video Lectures (e-Resources):

- VTUEDUSAT/SWAYAM/NPTEL/MOOCS/Coursera/MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes

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

1. **Understand** the bio-design principles involved in building novel devices and structures.
2. **Elucidate** the basic biological concepts through relevant industrial/Engineering application.
3. **Apply** innovative bio based solutions solving socially relevant problems.

Course Articulation Matrix

Course Outcomes		Program Outcomes											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**Understand** the bio-design principles involved in building novel devices and structures.	2	1				1	1	1				1
CO2	**Elucidate** the basic biological concepts through relevant industrial application.	2	1				1	1	1				1
CO3	**Apply** innovative bio based solutions solving socially relevant problems.	2	2				2	2	1				2

Blooms Level	Marks Weightage	Maps Course Outcome to the Corresponding Blooms Level
Understand/Elucidate	50-60%	
Apply	35-50%	

NATIONAL SERVICE SCHEME [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - III			
Course Code:	**P22NSS309/409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Pre-requisites to take this Course:

1. Students should have a service oriented mind set and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service oriented targets on time.

Corse Objectives :National Service Scheme (NSS) will enable the students to:

1. Understand the community in which they work
2. Identify the needs and problems of the community and involve them in problem-solving
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems
4. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes
5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony

Content

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5 R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stakeholders– Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.
7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath,Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural outreach programs.(minimum5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).
13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

AND

ONENSS – CAMP @ College /University /Stateor Central GovtLevel /NGO's /General Social Camps

Students have to take up anyone activity on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same. Compulsorily students have to attend one camp.

CIE will be evaluated based on their presentation, approach and implementation strategies.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the importance of his / her responsibilities towards society.
CO2:	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO3:	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4:	Implement government or self-driven projects effectively in the field.

<table>
<tr><td colspan="4">PHYSICAL EDUCATION
[As per Choice Based Credit System (CBCS) & OBE Scheme]
SEMESTER - III</td></tr>
<tr><td>Course Code:</td><td>P22PED309</td><td>Credits:</td><td>00</td></tr>
<tr><td>Teaching Hours/Week (L:T:P):</td><td>0:0:2</td><td>CIE Marks:</td><td>100</td></tr>
<tr><td>Total Number of Teaching Hours:</td><td></td><td>SEE Marks:</td><td>-</td></tr>
<tr><td>Fitness Components

Speed
Strength
Endurance
Agility
Flexibility</td><td colspan="3">Meaning and Importance, Fit India Movement, Definition of fitness, Components of
fitness, Benefits of fitness, Types of fitness and Fitness tips.
Practical Components: Speed, Strength, Endurance, Flexibility, and Agility
KABADDI
A. Fundamental skills
1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.
2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.
3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.
4. Game practice with application of Rules and Regulations.
B. Rules and their interpretations and duties of the officials.</td></tr>
<tr><td>Kho kho</td><td colspan="3">A. Fundamental skills
1. Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul.
2. Skills in running: Chain Play, Ring play and Chain & Ring mixed play.
3. Game practice with application of Rules and Regulations.
B. Rules and their interpretations and duties of the officials.</td></tr>
<tr><td>Kabaddi</td><td colspan="3">A. Fundamental skills
1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.
2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.
3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.
4. Game practice with application of Rules and Regulations.
B. Rules and their interpretations and duties of the officials</td></tr>
</table>

YOGA [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - III			
Course Code:	**P22YOG309**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:		**SEE Marks:**	**-**

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance
abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical

1. Improved body flexibility and balance
2. Improved cardiovascular endurance (stronger heart)
3. Improved digestion
4. Improved abdominal strength
5. Enhanced overall muscular strength
6. Relaxation of muscular strains
7. Weight control
8. Increased energy levels

9. Enhanced immune system

- Mental

1. Relief of stress resulting from the control of emotions
2. Prevention and relief from stress-related disorders
3. Intellectual enhancement, leading to improved decision-making skills

- Spiritual

1. Life with meaning, purpose, and direction
2. Inner peace and tranquility
3. Contentment

Yoga, its origin, history and development. Yoga, its meaning, definitions.
Different schools of yoga, Aim and Objectives of yoga, importance of prayer
Yogic practices for common man to promote positive health
Rules to be followed during yogic practices by practitioner
Yoga its misconceptions,
Difference between yogic and non yogic practices
Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12
count, 2 rounds
Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana
Different types of Asanas
a. Sitting 1. Padmasana
2. Vajrasana
b. Standing 1. Vrikshana
2. Trikonasana
c. Prone line 1. Bhujangasana
2. Shalabhasana
d. Supine line 1. Utthitadvipadasana
2. Ardhahalasana

Additional Mathematics - I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III (Lateral Entry: Common to all branches)			
Course Code:	**P22MDIP301**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Course Learning Objectives: The mandatory learning course P21MATDIP31 viz., Additiona Mathematics-I aims to provide basic concepts of complex trigonometry, vector algebra, differentia & integral calculus, vector differentiation and various methods of solving first order differentia equations.

UNIT-I	
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 components:** De-Moivre's theorem (without proof). Roots of complex number - Simple problems.	**12Hrs**
UNIT-II	
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: Elimentary problems. Euler's theorem for homogeneous functions of two variables. Total derivatives-differentiation of composite and implicit function **Self-study components**: Review of successive differentiation. Formulae for n^{th} derivatives of standard functions- Liebnitz's theorem (without proof). Application to Jacobians, errors & approximations.	**10Hrs**
UNIT-III	
Integral Calculus: reduction formulae for $sin^n x$, $cos^n x$, and $sin^m x cos^m x$ 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 components**: Differentiation under integral sign (Integrals with constants limits)-Simple problems.	**10Hrs**
UNIT-IV	
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.	**10Hrs**
UNIT - V	
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 components:** 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.	**10Hrs**

Course Outcomes: 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 indentify 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.

Text Book:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.

Additional Communicative English – I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – III			
Course Code:	**P22HDIP307**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

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	PO12	PSO1	PSO2	PSO3
CO1												2			
CO2										2					
CO3										2					
CO4									2						
CO									**2**	**2**		**2**			

LINEAR ALGEBRA [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22MAAI401**	**Credits:**	**03**
Teaching Hours/Week (L: T: P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Understand the importance of linear algebra in computer and allied engineering science.
- Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

UNIT – I	Matrices and Linear systems	8 Hours

Special Matrices (real and complex), Linear system and invertible Matrices, Gauss Jordon elimination method, solution of linear equations using A^{-1}, solving two linear systems at once, Applications of linear systems in network analysis. Polynomial interpolation by Gauss – Jordon elimination method.

UNIT – II	Vector Spaces	8 Hours

Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, coordinates.

UNIT – III	Linear Transformations	8 Hours

Functions, Linear Mappings, geometric linear transformation of i^2, Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof), Operations on linear transformations, Composition of linear transformations. Matrix representation of linear transformations.

UNIT – IV	Matrix of linear transformations	8 Hours

Singular and Nonsingular linear transformations, Invertible linear transformations. Inner products, inner product space, length and norm, orthogonal sets, Gram – Schmidt orthogonalization process. QR factorization.

UNIT – V	Optimization Techniques	8 Hours

Eigen values and Eigen vectors – Properties, involutory and orthogonal matrices, normal form and rank. Eigen spaces. similarity and diagonalization, Quadratic form. Positive definite matrices, the singular value decomposition, LU decomposition – Problems.

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	**Apply** the concepts of linear algebra in Computer and allied Engineering Sciences.	Apply	L3
CO2	Analyze the computer science and allied engineering Sciences applications using Linear algebra.	Analyze	L4
CO3	Demonstrate the applications of computer science and allied engineering Science applications using Linear algebra tools.	Apply	L3

Text Book(s):

1. Linear Algebra and its applications, David C. Lay, Steven R. Lay, Judi J Mc. Donald, 6th Edition, 2021, Pearson Education.
2. Linear Algebra and its applications, Gilbert Strang, 4th edition, 2005, Brooks Cole.
3. Linear Algebra: An Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition.

Reference Book(s):

1. Schaum's outline series -Theory and problems of linear algebra, Seymour Lipschutz, Marc Lipson, 6th edition, 2017, McGraw-Hill Education.
2. Elementary Linear Algebra, Howard Anton, Chris Rorres, Eleventh edition, wiley india pvt ltd.
3. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.

Web and Video link(s):

1. https://www.coursera.org/learn/linear-algebra-machine-learning
2. https://nptel.ac.in/syllabus/111106051/

E-Books/Resources:

1. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebrafall-2011/index.htm
2. https://www.math.ucdavis.edu/~linear/linear.pdf

DESIGN AND ANALYSIS OF ALGORITHMS

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

SEMESTER – IV

Course Code:	**P22AI402**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**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.

UNIT - II	**8 Hours**

Brute Force and Exhaustive Search: Selection Sort, Brute-Force String Matching, Exhaustive Search [Travelling Salesman Problem and Knapsack Problem].**Decrease and Conquer**: Introduction, Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.

Self-study component:	Bubble Sort and Sequential Search.

UNIT - III	**8 Hours**

Divide and Conquer: Merge sort, Quick Sort, Multiplication of Large integers and Strassen' Matrix Multiplication. **Transform and Conquer**: Pre sorting, Balanced Search Trees, Heaps and Heap sort.

Self-study component:	Binary Tree Traversals and Related Properties.

UNIT - IV	**8 Hours**

Space and Time Tradeoffs: Sorting by counting, Input Enhancement in String Matching, Hashing. **Dynamic Programming**: Three Basic Examples, the Knapsack Problem, Warshall's and Floyd's Algorithms.

Self-study component:	B-Trees, Optimal Binary Search Trees.

UNIT - V		8 Hours
Greedy Technique: Kruskal's Algorithm, Prim's Algorithm, Dijikstra's Algorithm. 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.		
Self-study component:	Lower Bound Arguments, Decision trees.	
Course Outcomes: On completion of this course, students are able to:		
Course Outcomes with ***Action verbs*** for the Course topics		
CO1	.Understand the basic concepts of various algorithmic techniques	
CO2	Analyze the asymptotic performance of algorithms	
CO3	Design solutions for the given problem using algorithmic technique.	

Text Book(s):

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

Reference Book(s):

1. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni 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 – V**			
Course Code:	**P22AI403**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

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

- Understand the fundamentals concepts of computer networks.
- Familiarize with the standard models for the layered approach to set the communication between machines in a network using protocols of the various layers.
- Get prepare for advanced courses in computer networking.

UNIT – I	**INTRODUCTION AND PHYSICAL LAYER**	**8 Hours**
Data communication—Networks — Network Types — Protocol Layering — TCP/IP Protocol suite — OSI Model — Physical Layer: Signals—Signal impairment— Multiplexing—Transmission media : guided		
Self-study component:	Transmission media : unguided	

UNIT – II	**DATA-LINK LAYER & MEDIA ACCESS**	**8 Hours**
Introduction — Data-Link Control—Media Access Control —Layer Addressing — Ethernet—Cellular telephony—Satellite Network—Connecting devices.		
Self-study component:	Wired LAN: Ethernet Protocol, Standard Ethernet-Characteristics, addressing	

UNIT – III	**NETWORK LAYER**	**8 Hours**
Network Layer Services — Packet switching —IPV4 Addresses — Next generation IP (IPV6) — Transition from IPv4 to IPv6—Routing algorithms—Unicasting routing protocols—Multicasting Protocol: PIM— IGMP		
Self-study component:	Multicasting protocol: DVMRP, MOSPF	

UNIT – IV	**TRANSPORT LAYER**	**8 Hours**
Transport Layer services— Transport Layer Protocols — User Datagram Protocol — Transmission Control Protocol: TCP services, TCP features, Segment, TCP connection, Windows in TCP, Flow control, Error control, TCP congestion control— SCTP.		
Self-study component:	Transport layer services: Connectionless and connection oriented protocols	

UNIT – V	**APPLICATION LAYER**	**8 Hours**
Client /Server Paradigm—Standard Applications—Socket interface programming		
Self-study component:	Network management: Introduction	

Course Outcomes: On completion of this course, students are able to:			
COs	**Student should be able to**	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Understand** the basic taxonomy and terminology of computer networks.	Knowledge	L1
CO2	**Comprehend** services, basic protocols of various layers and how they can be used to assist in network design.	Understand	L2
CO3	**Articulate** various techniques involved in data transmission with examples.	Apply	L3

Text Book(s): Behrouz A. Forouzan "Data Communications and Networking with TCP/IP protocol suite" 6th Edition Published by McGraw Hill LLC, 2022.

Reference Book(s):- Computer networks, Andrew S. Tanenbaum, David J. Wetherall. -- 5th ed, Pearson Education, Inc, 2011.

Web and Video link(s):

- https://www.youtube.com/watch?v=bR3l1L1oCb0&list=PL9P1J9q3_9fNXTTpJ1TM0gJDdjM9HBGxN
- https://www.youtube.com/watch?v=VwN91x5i25g&list=PLBlnK6fEyqRgMCUAG0XRw78UA8qnv6jEx

E-Books/Resources

:https://drive.google.com/file/d/1BXjlY59ka2gYkxGLVPnSmH8Ew0IBqBLi/view?usp=drive_link

INTRODUCTION TO ARTIFICIAL INTELLIGENCE (INTEGRATED)

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

SEMESTER – III

Course Code:	**P22AI404**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Hours of Pedagogy:	**40 Hours Theory + 20 Hours Practical**	**SEE Marks:**	**50**

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

- 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 History 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.

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

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.

Practical Topics:	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	**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.

Practical Topics:	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 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, Reasoning with Default Information.	
Practical Topics:	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	**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.	
Practical Topics:	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:

COs	**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	**Analyze** the key components of intelligent agents and evaluate their performance.	Analyze	L4
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	**Understand** of machine learning principles, concepts, and techniques, focusing on learning	Understand	L2

Text Book(s):

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

Reference Book(s):

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

Web and Video link(s):

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

DATABASE MANAGEMENT SYSTEM (Integrated) [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22AI405**	**Credits:**	**04**
Teaching Hours/Week (L: T:P):	**3:0:2**	**CIE Marks:**	**50**
Total Theory Teaching Hours: **Total Laboratory Hours:**	**40** **24**	**SEE Marks:**	**50**

Course Learning Objectives:

1. To learn the basic knowledge of Database Management System and various types of data models.
2. To learn the concept and syntax of ER Diagram, relational data model and relational algebra.
3. To learn and write various SQL queries.
4. To learn the concept of Normalization.
5. To learn the various issues in Transaction processing.

UNIT – I		**8 Hours**

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

Self-study component:	Actors on the scene, Workers behind the scene, Database Languages and Interfaces, Relationship Types of Degree Higher Than Two
Practical Topics: **(6 Hours)**	1. Introduction to ER diagram tool. (Draw.io) 2. Create an ER diagrams Company Database system and Banking database System using tool.

UNIT – II		**8 Hours**

Relational Model: 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.

Self-study component:	Additional relational operations,
Practical Topics:	1. **Consider the company database and create the below tables by properly specifying the primary keys and the foreign keys**

(6 Hours)	**Employee** (Fname: varchar, Minit: Char, Lname: varchar, ssn:int, Bdate: Date, Address: varchar, Sex: char, salary: decimal, Super_ssn:int, DNO:int) **Department** (Dname: varchar, Dnumber: int, mgr_ssn: int, mgr_start_date: date) **Dept_location** (Dnumber: int, Dlocation: varchar) **Project** (pname: varchar, pnumber: int, plocation: varchar, dnum:int) **Works_on** (Essn: int, pno:int, hours: decimal) **Dependent** (Essn: char, dependent_name: varchar, sex: char, Bdate: date, relationship: varchar) 2. Insert at least five tuples in each relation.

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.

Self-study component:	Schema change statements in SQL.
Practical Topics: **(4 Hours)**	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 birth date. 3. For each employee, retrieve the employee's first and last name and the first and last name of his or her immediate supervisor. 4. Make a list of all project numbers for projects that involve an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project. 5. Retrieve all employees whose address is in Houston, Texas 6. Retrieve all employees in department 5 whose salary is between $30,000 and $40,000. Execute above quires for the Company database defined in Unit-II.

UNIT – IV	**8 Hours**

Specifying Constraints as Assertions and Triggers**,** Views in SQL.
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–Codd Normal Form.

Self-study component:	Nested Queries
Practical Topics: **(4 Hours)**	1. Retrieve the names of all employees who do not have supervisors. 2. Retrieve the name of each employee who has a dependent with the same first name and is the same gender as the employee 3. Retrieve the names of employees who have no dependents. 4. List the names of managers who have at least one dependent. 5. Retrieve the Social Security numbers of all employees who work on project numbers 1, 2, or 3. 6. Find the sum of the salaries of all employees of the 'Research' department, as well as the maximum salary, the minimum salary, and the average salary in this department. 7. For each department, retrieve the department number, the number of employees in the department, and their average salary. Execute above quires for the Company database defined in Unit-II.

UNIT – V	**8 Hours**

Database Design: Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Transaction Processing : Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing schedules based on Serializability: Serial, Non-serial and conflict-serializable, Testing for conflict serializability of a schedule.

Self-study component:	Characterizing schedules based on recoverability
Practical Topics: **(4 Hours)**	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) 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) Find all the customers who have an account at all the branches located in a specified city

	5) Demonstrate how you delete all account tuples at every branch located in a specified city

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

COs	Course Outcomes with *Action verbs* for the Course topics.
CO1	**Apply** the database concepts to create the relations by specifying various constraints.
CO2	**Desi**gn ER diagrams for given scenario.
CO3	**Apply** suitablenormalization technique to improve database design.
CO4	Conduct experiments on given database using modern tools: Draw io,MySQL.

Text Book(s):

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

Reference Book(s):

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

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs91/
2. https://youtu.be/c5HAwKX-suM

NPTEL Web Course:

1. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
2. http://nptel.ac.in/courses/106106093/
3. http://nptel.ac.in/courses/106106095/

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY [As per Choice Based Credit System (CBCS) & OBE Scheme] **SEMESTER – IV**			
Course Code:	**P22AIL406**	**Credits:**	**01**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**50**
Total Number of Lab Hours:	**24**	**SEE Marks:**	**50**

Note: Implement the following programs using *C* Language

Experiments

1.	Print all the nodes reachable from a given starting node in a digraph using BFS method.
2.	Obtain the Topological ordering of vertices in a given digraph (DFS Based).
3.	Sort a given set of elements using Merge sort method and determine the time taken to sort the elements. Repeat the experiment for different values of *n*, the number of elements in the list to be sorted and plot a graph of the time taken versus *n*.
4.	Sort a given set of elements using Quick sort method and determine the time taken to sort the elements. Repeat the experiment for different values of *n*, the number of elements in the list to be sorted and plot a graph of the time taken versus *n*.
5.	Find the Pattern string in a given Text string using Horspool's String Matching Algorithm.
6.	Sort a given set of elements using Heap Sort algorithm.
7.	Implement 0/1 Knapsack problem using Dynamic Programming.
8.	From a given vertex in a weighted connected graph, find shortest paths to other Vertices using Dijikstra's algorithm.
9.	Find minimum cost spanning tree of a given undirected graph using Kruskal's Algorithm.
10.	Implement Sum-of-Subset problem of a given set S = {s1, s2, ..., sn} of 'n' Positive integers whose sum is equal to a given positive integer'd'.

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

COs	**Course Outcomes** with ***Action verbs*** for the Course topics
CO1	Implement the algorithms based on various algorithm design techniques.
CO2	Analyze the efficiency of various algorithms.

EMPLOYABILITY ENHANCEMENT SKILLS - IV

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

SEMESTER – IV for CSE, ISE, ECE, CSE(AIML), CSBS & CSE(DS) Branches only

Course Code:	**P22HSMC407B**	**Credits:**	**01**
Teaching Hours/Week (L:T:P)	**0:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**50**

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

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

UNIT – I		**06 Hours**

Quantitative Aptitude: Simple and Compound Interest, Averages.

Logical Reasoning: Series, Coding & Decoding.

Self-study component:	Mensuration

UNIT – II		**06 Hours**

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

Logical Reasoning: Seating Arrangement, Data Arrangement.

Self-study component:	Types of cryptarithm

UNIT – III		**06 Hours**

Quantitative Aptitude: Partnership.

Verbal Ability: Sentence Completion, Ordering of Sentences.

Self-study component:	Game based assessments

UNIT – IV	**DATA STRUCTURES I - Problem Solving Techniques and Object-Oriented Programming**	**06 Hours**

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 component:	Examples of Abstract Data Type	
UNIT – V	**DATA STRUCTURES II – Linear Data Structures and Tress**	**06 Hours**

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 component:	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.

Web and Video link(s):

1. Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/

COURSE ARTICULATION MATRIX
(EMPLOYABILITY ENHANCEMENT SKILLS - IV – P22HSMC407)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2										
CO4	1	1	2									1

Internship - I [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22INT409**	**Credits:**	**02**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**-**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**100**

All the students registered to II year of BE shall have to undergo a mandatory internship of 02 weeks during the intervening vacation of II and III semesters or III and IV semester. Internship shall include Inter / Intra Institutional activities. A Semester End Examination (Presentation followed by question-answer session) shall be conducted during IV semester and the prescribed credit shall be included in IV semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

PHYSICAL EDUCATION [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - IV			
Course Code:	**P22PED409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Fitness Components	**Track Events**
Athletics Track- Sprints Jumps- Long Jump Throws- Shot Put	1.1. Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. 1.2. Acceleration with proper running techniques. 1.3. Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. **Long Jump**: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing **Shot put**: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique.
Kho kho	A. **Fundamental skills** 1. Service: Under arm service, Side arm service, Tennis service, Floating service. 2. Pass: Under arm pass, Over head pass. 3. Spiking and Blocking. 4. Game practice with application of Rules and Regulations B. **Rules and their interpretation and duties of officials**.
Throw ball Athletics Track- 110 &400 Mtrs Hurdles Jumps- High Jump Throws- Discuss Throw	A. **Fundamental skills:** Overhand service, Side arm service, two hand catching, one hand overhead return,side arm return. B. **Rules and their interpretations and duties of officials** **110 Mtrs and 400Mtrs**: Hurdling Technique :Lead leg Technique, Trail leg Technique ,Side Hurdling, Over the Hurdles Crouch start (its variations) use of Starting Block. Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. **High jump**: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. **Discus Throw**: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).

YOGA [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER - IV			
Course Code:	**P22YOG409**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:0:2**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**-**	**SEE Marks:**	**-**

Course objectives:

6) To enable the student to have good health.
7) To practice mental hygiene.
8) To possess emotional stability.
9) To integrate moral values.
10) To attain higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical

10. Improved body flexibility and balance
11. Improved cardiovascular endurance (stronger heart)
12. Improved digestion
13. Improved abdominal strength
14. Enhanced overall muscular strength
15. Relaxation of muscular strains
16. Weight control
17. Increased energy levels
18. Enhanced immune system

- Mental
4. Relief of stress resulting from the control of emotions
5. Prevention and relief from stress-related disorders
6. Intellectual enhancement, leading to improved decision-making skills
- Spiritual
4. Life with meaning, purpose, and direction
5. Inner peace and tranquility
6. Contentment

Patanjali's Ashtanga Yoga, its need and importance.
Yama :Ahimsa, satya, asteya, brahmacarya, aparigraha
Niyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan
Suryanamaskar12 count- 4 rounds of practice
Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana
Different types of Asanas
a. Sitting 1. Sukhasana
2. Paschimottanasana
b. Standing 1. Ardhakati Chakrasana
2. Parshva Chakrasana
c. Prone line 1. Dhanurasana
d. Supine line 1. Halasana
2. Karna Peedasana
Meaning, importance and benefits of Kapalabhati.
40 strokes/min 3 rounds
Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama
Pranayama – 1. Suryanuloma –Viloma 2. Chandranuloma-Viloma 3. Suryabhedana
4. Chandra Bhedana 5. Nadishodhana

Additional Mathematics - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV (Lateral Entry: Common to all branches)			
Course Code:	**P22MDIP401**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**2-2-0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**-**

Course Objectives: The mandatory learning course**:** **P21MATDIP401** viz., **Additional Mathematics-II** aims 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-I	
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 Components**: Application of Cayley-Hamilton theorem (without proof) to compute the inverse of a matrix-Examples.	**10 Hrs**
UNIT-II	
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 Components**: Method of undetermined coefficients	**12 Hrs**
UNIT-III	
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 Components**: Orthogonal curvilinear coordinates.	**10 Hrs**
UNIT-IV	
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 Components**: Application to solutions of linear differential equations and simultaneous differential equations..	**12Hrs**
UNIT-V	
Probability: Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability – illustrative examples. **Self-study Components**: State and prove Bayes's theorem	**06Hrs**

Course Outcomes: 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 of electrical circuits, damped/un-damped vibrations.
CO3:	Identify - the technique of integration evaluate 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,

Text Book:

- B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Ed., 2015.

Reference books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
2. N.P.Bali and Manish Goyal: Engineering Mathematics, Laxmi Publishers,7th Ed., 2007.

Additional Communicative English - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – IV			
Course Code:	**P22HDIP407**	**Credits:**	**00**
Teaching Hours/Week (L:T:P):	**0:2:0**	**CIE Marks:**	**100**
Total Number of Teaching Hours:	**30**	**SEE Marks:**	**-**

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		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO 1												2			
CO 2										2					
CO 3										2					
CO 4									2						
CO									**2**	**2**		**2**			