MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belgaum)

Autonomous Programme

Bachelor of Engineering

DEPARTMENT OF

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

SYLLABUS

III & IV Semester (2022 Admitted Batch)

(2^{nd}Year)

Academic Year 2023-24

COLLEGE VISION

To be an institute of excellence in engineering education and research, producing socially responsible professionals

COLLEGE MISSION

1. Create conducive environment for learning and research
2. Establish industry and academia collaborations
3. Ensure professional and ethical values in all institutional endeavors

DEPARTMENT VISION

To be a Center of Excellence for innovative teaching, learning and research to produce socially responsible professionals in the field of Artificial Intelligence and Machine Learning to address real-world problems.

DEPARTMENT MISSION

1. Fostering innovation through cutting-edge teaching, transformative learning, and innovative research in field of artificial intelligence and machine learning with foundations of Computer Science and Engineering.
2. Impart latest technology through industry-academia collaboration.
3. Maintain high standards of ethical values involved in AI and ML applications with transparency of operations for moral concerns of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Acquire the fundamentals and expertise in basic science, Computer Science and Engineering, Artificial Intelligence and Machine Learning principles and excel as an IT professional or an entrepreneur.

PEO2: Pursue Higher Studies and Research

PEO3: Adapt to the technological advancements by engaging in lifelong learning and exhibit professional ethics, teamwork and leadership qualities

ROGRAM OUTCOMES (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze 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 the public health and safety, and the 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 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 ofthe 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon graduation, students with a degree B.E. in Computer Science and Engineering (Artificial Intelligence and Machine Learning) will be able to:

1. **Analytical Thinking:** Apply the principles of analytical and programming skills to solve the engineering problems.

2. **Data Engineering and Intelligent Systems:** Utilize cognitive computing, artificial intelligence, and machine learning skills within the realm of data engineering to create intelligent systems.

Scheme of Evaluation (Theory Courses)

Assessment	Marks
Three CIE's conducted for 20 marks each and reduced to 10 –Total of 30 marks	30
Activities as decided by course faculty	20
SEE	50
Total	**100**

Scheme of Evaluation (Lab Integrated Courses)

Assessment	Marks
Three CIE's conducted for 20 marks each and reduced to 10 –Total of 30 marks	30
Activities – 20 Marks 1. Continues Evaluation in every lab session by the course faculty – 5 Marks 2. Record Writing – 5 Marks 3. Lab CIE (Conducted for 50 marks and reduced to 10 marks) – 10 Marks	20
SEE	50
Total	**100**

Scheme of Evaluation (Laboratory Courses)

Assessment	Marks
Continuous Evaluation in every lab session by the course coordinator	20
Record writing	10
Laboratory CIE conducted by the course coordinator	20
SEE	50
Total	**100**

Examination	Maximum Marks	Minimum marks to qualify
CIE	50	20 (12 in CIE + 8 in activity)
SEE	50 (Conducted for 100 and reduced to 50)	20

Scheme & Syllabus for II year

B.E. in Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Academic Year 2023-2024

Semester -III					
Course Category	**Course Code**	**Course Title**	**L-T-P in hours**	**Credit**	**Contact Hours**
BSC	22AI301	Computational Statistics	2-2-0	3	4
PCC	22AI302	Digital Design and Computer Organization	2-2-0	3	4
PCC	22AI303	Operating Systems	3-0-0	3	3
IPCC	22AI304	Data Structures	3-0-2	4	5
PCC	22AI305	Introduction to Artificial Intelligence	3-0-0	3	3
PCCL	22AIL306	UNIX and Shell Programming Laboratory	0-0-2	1	2
ESC	22AI307x	ESC/ETC/PLC	2-2-0	3	3
UHV	22AI308	Social Connect and Responsibility	0-0-2	1	2
AEC/SEC	22AI309x	Ability Enhancement Course/Skill Enhancement Course–III	0-0-2	1	2
Total				22	28

Engineering Science Course (ESC/ETC/PLC)			
22AI307A	Object Oriented Programming	22AI307C	Python for Data Science
22AI307B	Quantum Computing	22AI307D	Discrete Mathematical Structures
Ability Enhancement Course - III			
22AI309A	Data analytics with Excel	22AI309C	Technical writing using LATEX
22AI309B	Ethics and Public Policy for AI	22AI309D	UI/UX(Lab)

Scheme & Syllabus for II year

B.E. in Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Academic Year 2023-2024

Semester - IV					
Course Category	**Course Code**	**Course Title**	**L-T-P in hours**	**Credit**	**Contact Hours**
BSC	22AI401	Linear Algebra	2-2-0	3	4
IPCC	22AI402	Design and Analysis of Algorithms	3-0-2	4	5
IPCC	22AI403	Database Management Systems	3-0-2	4	5
PCC	22AI404	Machine Learning	2-2-0	3	4
PCCL	22AI405	Web Application Development Lab	0-0-2	1	2
BSC	BBOK406	Biology for Engineers	2-0-0	1	2
ESC	22AI407x	ESC/ETC/PLC	2-2-0	3	4
UHV	BUHK408	Universal human values course	1-0-0	1	1
AEC/SEC	22AI409x	Ability Enhancement Course/Skill Enhancement Course–III	0-0-2	1	2
Total				21	29

Engineering Science Course (ESC/ETC/PLC)			
AI407A	Object Oriented Programming	AI407C	Quantum Algorithms
AI407B	Python for Data Science	AI407D	Discrete Mathematical Structures
Ability Enhancement Course - III			
AI409A	Data analytics with Excel	AI409C	Ethics and Public Policy for AI
AI409B	Technical writing using LATEX	AI409D	UI/UX(Lab)

Course Title	COMPUTATIONAL STATISTICS		
Course Code	22AI301	L-T-P-C	(2-2-0)3
Exam Hrs.	3 Hours	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: To equip students with a solid foundation in computational statistics, enabling them to analyze and interpret data, make informed decisions based on statistical evidence, and effectively communicate statistical findings.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate the fundamental statistical concepts, descriptive statistics, probability theory, hypothesis testing, regression techniques	1	-
2.	Apply a range of statistical techniques including hypothesis testing, regression analysis, analysis of variance, and categorical data analysis to solve problems	1, 5	1
3.	Analyze the given real-world datasets using the appropriate statistical methods	2,5	1
4.	Interpret statistical output, draw meaningful conclusions, and effectively communicate the results of their analyses	3, 5, 9, 10	-

Course Contents:

Module 1	10 Hours

Introduction to Statistical Concepts

Introduction to Statistics, Definition and importance of statistics, Types of data and variables, Descriptive Statistics, Measures of central tendency (mean, median, and mode) Measures of variability (range, variance, and standard deviation), Data visualization techniques (histograms, box plots).

Probability Basics, Probability theory and terminology, Probability rules and laws, Probability distributions (discrete and continuous), Sampling and Estimation, Sampling methods and techniques, Point estimation and confidence intervals, Sample size determination.

Module 2	10 Hours

Statistical Inference

Hypothesis Testing, Introduction to hypothesis testing, Null and alternative hypotheses, Type I and Type II errors, significance level, and p-values, Parametric Tests, One-sample and two-sample t-tests, Analysis of variance (ANOVA), Chi-square test for independence. Non-parametric Tests.

Statistical Models and Analysis

Introduction to Regression Analysis, Simple linear regression, Assumptions and interpretation Coefficient of determination (R-squared), Multiple Regression Analysis, Multiple linear regression.

Module 3	10 Hours

Statistical Models and Analysis (contd..)

Model assumptions and diagnostics, Variable selection techniques (stepwise, backward, forward), Analysis of Categorical Data.

Logistic regression, Odds ratio and interpretation, Goodness-of-fit tests (chi-square, Hosmer-Lemeshow), Analysis of Variance (ANOVA)

One-way and two-way ANOVA, Post hoc tests (Tukey's HSD, Bonferroni), Introduction to Experimental Design.

Module 4	10 Hours

Introduction to Statistical Software

Overview of popular statistical software, Exploratory Data Analysis, Data visualization techniques (scatter plots, bar charts),Data cleaning and pre-processing, Statistical Analysis with Software, Conducting descriptive statistics and hypothesis tests, Implementing regression

analysis and ANOVA, Interpreting output and generating reports, Practical Data Analysis Project, Applying statistical concepts and techniques to a real-world dataset, Exploratory analysis, hypothesis testing, and model building.

Text Books:

1. Statistics for Business: Decision Making and Analysis (2nd Edition), Robert Stine, Pearson ISBN: 9780136759102, 2017.

Reference Books:

1. "Introduction to Statistical Learning with Applications in R" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani.
2. "Statistical Computing with R" by Maria L. Rizzo. 2nd edition, Chapman and Hall/CRC, Tailor and Francis Group, 2019.
3. 3."Bayesian Data Analysis" by Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and Donald B. Rubin.
4. "Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery.

MOOCs:

1. Introduction to Computational Statistics for Data Scientists Specialization**https://www.coursera.org/specializations/compstats**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2	2				2								2	
CO3		2			2								2	
CO4			2		2				2	2				

Course Title	Digital Design and Computer Organization		
Course Code	22AI302	L-T-P-C	(2-2-0) 3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: To understand the basic circuit design and basic structure of a computer.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge of Boolean algebra and digital logic to simplify logical expressions. Comprehend the basic structure and working principles of computers	1	1
2.	Analyze and solve problems related to digital circuits and computer organization using appropriate techniques and tools.	2	1
3.	Design and implement digital circuits to solve complex logic expressions and contribute to the basic structure of computer systems	3	1
4.	Work collaboratively and demonstrate the components and operation of digital design concepts and computer organization principles through clear documentation and presentation	5, 8,9,10,12	-

Course Contents:

Module 1	10 Hours

Number Systems and Codes: Binary Number system, Binary to decimal, decimal to binary, hexa decimal, ASCII code, Excess,3 Code, Gray code. Digital Logic: The Basic Gates, NOT, OR, AND, Universal Logic Gates, NOR, NAND.
Combinatorial Logic Circuits: Boolean Laws and Theorems, Sum of Products method, Truth table to Karnaugh Map – Pairs, Quads, Octets – Don't Care Conditions Product of sums method, Product of sums Simplifications
Combinational Circuits – Karnaugh Map, Analysis and Design Procedures, Binary Adder, Subtract or, Decimal Adder, Magnitude Comparator, Decoder, Encoder, Multiplexers, Demultiplexers

Module 2	10 Hours

Data Processing Circuits: Multiplexers, Demultiplexers,1of,16 Decoder, BDCto decimal Decoders, Seven segment Decoders, Encoders, ExclusiveOR Gates, Parity Generators and Checkers.
Arithmetic Circuits: Binary Addition, Binary Subtraction, 2'S Complement Representation, 2'S Complement Arithmetic, Arithmetic Building Blocks.
Introduction to Sequential Circuits – Flip Flops, operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits, Design

Module 3	10 Hours

Basic Structure of Computers: Basic Operational Concepts**,** Numbers, Arithmetic Operations and Characters. Memory Location and Addresses**.**
Input/Output Organization: Accessing I/O Devices, Interrupts, Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Buses, Standard I/O Interfaces – PCI Bus, USB.

Module 4	10 Hours

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories Mapping Functions.
Arithmetic: Signed Operand Multiplication, Fast multiplication**,** Integer Division, Floating-point Numbers and Operations , IEEE standard for floating point numbers.
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard,wired Control.

Text Books:

1. Digital Principles and Applications – Donald P Leach, Albert Paul Malvino, GoutamSaha, 8th edition ,McGrawHill Education, 3rd reprint 2015.
2. Computer Organization - Carl Hamacher, Zvonko Vranesic, SafwatZaky, 5th Edition,

Tata McGraw Hill.

Reference Books:

1. Digital design, R.AnanthaNatarajan, PHI Learning, 2015.
2. Computer Organization and Architecture, V.Rajaraman and T.Radhakrishnan, PHI learning, 5th Print, 2015.

MOOCs:

1. https://nptel.ac.in/courses/117105080/
2. Switching circuits and logic design https://nptel.ac.in/courses/106/105/106105185/
3. Digital Circuits and Systems SWAYAM IIT-Madras,https://swayam.gov.in/ndl_noc19_ee51

Activity: Students must conduct the following activities

Simulation using LTspice/Multisim

1. **Arithmetic Circuits**
2. **Logic Circuits**
3. **Combinational circuits**
4. **Data Processing circuits**
5. **Sequential Circuits**

Conduct the below experiments

1. **know the components of a Computer and its peripherals**
2. **Assemble and disassemble the computer**
3. **Formatting a partitioning of HDD**
4. **Configuring a bootable device**
5. **Installation of Operating System, Virtual Machines and Network and Internet configuration**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2												2	
CO2		2											2	
CO3			2										2	
CO4					2			1	2	2		2		

Course Title	Operating Systems		
Course Code	22AI303	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to understand the working of operating system.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Comprehend the fundamentals of operating systems components, functions, and their interactions within computer systems	-	-
2.	Apply the process scheduling, disk Scheduling and memory management algorithms for processes, disk and memory management	1	-
3.	Analyze the given scenario and identify the appropriate algorithm and solve the problems	2	1
4.	Design solutions for process synchronization and deadlock prevention using synchronization techniques and apply concepts of memory management strategies in various scenarios	3	1

Course Contents:

Module 1	10 Hours

Introduction to Operating Systems, System Structures: What Operating Systems Do? Computer System Architecture; Operating System Structure; Operating System Operations; Operating System Services; System Calls; Types of System Calls; System Programs, **Process Management:** Process Concept; Operations on Processes; Inter-Process Communication. Multi-Threaded Programming: Overview; Multithreading Models.

Module 2	10 Hours

Process Management (contd..): Process Scheduling: Basic Concepts; Scheduling Criteria; Scheduling Algorithms; **Process Synchronization**: The Critical Section Problem; Peterson's Solution; Synchronization Hardware; Semaphores; Classic problems of Synchronization, Monitors- Usage, Dining-Philosophers solution using monitors.

Module 3	10 Hours

Deadlocks: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from Deadlock. **Memory Management:** Memory Management Strategies: Background; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation.

Module 4	10 Hours

Virtual Memory Management: Background; Demand Paging; Page Replacement. **Storage Management:** Secondary Storage Structures, Protection: Mass Storage Structures; Disk Structure; Disk Scheduling; Swap Space Management. **Protection:** Goals of Protection, Principles of Protection, Domain of Protection- Domain Structure, Access Matrix, Implementation of Access Matrix.

Text Books:

1. Operating System Concepts - Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 9th Edition, 2018, John Wiley & Sons, ISBN 978-1-265-5427-0

Reference Books:

1. Modern Operating Systems - A Concept Based Approach -Andrew.S.Tanenbaum, 4th Edition, Addison Wesley, 2015. ISBN: 978-0133591620.
2. Introduction to Operating Systems: Concepts and Practice - P.C.P. Bhatt, 2nd Edition, PHI, 2008.
3. Operating Systems Internals and Design Principles, William Stallings: 8th Edition, Tata McGraw-Hill Education , 2007, ISBN - 978-0070611948.

MOOCs:

1. Fundamentals of Operating Systemhttps://nptel.ac.in/courses/106/105/106105214/

Activity:

Write a program to implement the below experiments

(Note: processes creation can be done using fork () or vfork () system call ()

1. Printing processes attributes
2. Program to demonstrate multi-tasking (Create multiple processes and perform multi-tasking)
3. Parent and child synchronization ex: making parent to wait for specific child to perform, a task)
4. data sharing mechanism between parent and child
5. data sharing between parent and child through regular files
6. data sharing between Related Process
7. data sharing between Related Process using FIFO
8. Data sharing mechanism through message Queue with the following operation
    1. Creation of multiple messages queue and allow process to
    2. Send message to a particular message queue
    3. Receiving message from a specific message queue
    4. Delete/access/modify message queue attributes
9. Data sharing mechanism through shared memory
    1. Creation of shared MEMORY SEGMENT
    2. Attaching to a shared memory segment and perform read and write operation
10. demonstrate synchronization mechanism through semaphores
11. program to demonstrate signal handling mechanism
12. program to demonstrate multi-threading using POSIX

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2	2													
CO3		2											2	
CO4			2										2	

Course Title	Data Structures		
Course Code	22AI304	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	50

Course Objective: Students will be able to use appropriate data structures for solving problems.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply principles of Data Structures for solving problems	1	-
2.	Analyze and develop operations on linear and non-linear data structures	2	-
3.	Design and develop solutions using the operations of linear and nonlinear data structure for a given problem.	3	1
4.	Conduct practical experiments for demonstrating the operations of different data structures.	3, 5, 9,10	-

Course Contents:

Module 1	10 Hours

Introduction to Data Structures: Definition, Classification of Data Structures, Dynamic Memory Allocation – Introduction, Dynamic memory allocation, malloc, calloc, free and realloc. The Stack - Definition and examples: Primitive operations, Example. Representing stacks in C: Implementing the pop operation, testing for exceptional conditions, implementing the push operation.
Infix, postfix and prefix: Basic definitions and examples, evaluating a postfix expression, Program to evaluate a postfix expression, converting an expression from infix to postfix, Program to convert an expression from infix to postfix.

Module 2	10 Hours

Recursion: Recursive definition and processes: Factorial function, Multiplication of natural numbers, Fibonacci sequence, Binary search, Properties of recursive definition or algorithm.
Recursion in C: Factorial of a number, generation of Fibonacci numbers, Binary searching, Concept of Recursive chains, Towers of Hanoi problem,
Queues and lists: The queue and its sequential representation: C implementation of queues, Insert operation, Priority queue, Array implementation of a priority queue.
Linked lists: Inserting and removing nodes from a list, Linked implementation of stacks. Getnode and freenode operations.

Module 3	10 Hours

Lists in C: Array implementation of lists, Limitations of array implementation, allocating and freeing dynamic variables, linked lists using dynamic variable, Queues as lists in C, Examples of list operations in C, Non integer and non-homogeneous lists.
Other list structures: Circular lists, Stack as a circular list, Queue as a circular list.

Module 4	10 Hours

Trees -Binary trees: Operations on binary trees, Applications of binary trees. Binary tree representation: Node representation of binary tree, Internal and external node, Implicit array representation of binary trees, choosing a binary tree representation, Binary tree traversals in C, Threaded binary trees.

Text Books:

1. Data structures using C and C++,YedidyahLangsam and Moshe J. Augenstein and Aaron M.Tenanbaum, PHI, 2008 Chapters 2, 3, 4, 5

Reference Books:

1. Data Structures: A Pseudo-code approach with C –Gilberg and Forouzan, 2nd edition, Cengage Learning, 2014.
2. An Introduction to Data Structures with Applications- Jean-Paul Tremblay & Paul G. Sorenson, 2ndEdition, McGraw Hill, 2013.

MOOCs:

1. Data Structures and algorithms https://nptel.ac.in/courses/106/102/106102064/

Activity:

1. Design and Implement a menu driven Program in C for the following Array operations:
   a. Creating an Array of N Integer Elements
   b. Display of Array Elements with Suitable Headings
   c. Inserting an Element (ELEM) at a given valid Position (POS)
   d. deleting an Element at a given valid Position (POS)

2. Write a C Program to create a Sequential file with at least 5 records, each record having the structure shown below:

USN	Name	Marks1	Marks2	Marks3
Non-zero positive integer	25 characters	Positive integer	Positive integer	Positive integer

   Write necessary functions
   a. To display all the records in the file.
   b. To search for a specific record based on the USN.

3. Write a menu driven C Program to arrange a pile of dinner plates that you encounter when you eat at the local cafeteria: When you remove a plate from the pile, you take the plate on the top of the pile. This is exactly the plate that was added most recently to the pile by the dishwasher. If you want the plate at the bottom of the pile, you must remove all the plates on top of it to reach it (use integers to number dinner plates).

4. Write recursive C Programs for
   a. Searching an element in a given list of integers using the Binary search method.
   b. Solving the Towers of Hanoi problem.

5. Write a C Program to evaluate a valid suffix/postfix expression using stack. Assume that the suffix/ postfix expression is read as a single line consisting of non-negative single digit operands and binary arithmetic operators. The arithmetic operators are + (add), - (subtract), * (multiply) and / (divide).

6. Write a menu driven C Program to simulate the working of a queue of vehicles on toll-tax bridge: The vehicle that comes first to the toll tax booth leaves the booth first. The vehicle that comes last leaves last. Therefore, it follows first-in-first-out (FIFO) strategy of queue (use integers to represent vehicles).

7. Write a menu driven C Program to simulate the working of a Circular Queue of integers using an array. Provide the following operations:
   a. Insert b. Delete c. Display

8. Write a menu driven C Program using dynamic variables and pointers, to construct a Singly linked list of integers and perform insertion and deletion operations.

9. Write a menu driven C Program using dynamic variables and pointers to construct a Stack of integers using Singly linked list and to perform the following operations:
   a. Push b. Pop c. Display

10. Write a menu driven C Program
    a. To construct a binary search tree of integers.
    b. To traverse the tree using all the methods i.e., In-order, Pre-order and Post-order.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2		2												
CO3			2										3	
CO4			2		2				2	2				

Course Title	Artificial Intelligence		
Course Code	22AI305	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: Students will be able to apply the concepts of Artificial Intelligence to construct knowledge based systems.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply AI techniques to construct intelligent agents towards problem	1	-
2.	Analyze the problem and identify an appropriate AI method to provide efficient solution	2	-
3.	Design and develop intelligent agents and knowledge based systems using search algorithms and First-Order Logic to solve a complex AI problems	3,5	2
4.	Collaborate effectively in teams and identify the societal implications, potential environmental impact and ethical considerations related to AI applications and communicate the same	6,7, 8, 9,10,12	-

Course Contents:

Module 1	10 Hours

Introduction: What is AI? **Intelligent Agents**: Agents and environment; Good behavior: The Concept of Rationality; the nature of environment; the structure of agents.

Solving Problems by Searching: Problem-solving agents, Example problems; Searching for solution; Uninformed search strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search.

Module 2	10 Hours

Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Optimality of A*, Memory-bounded heuristic search;

Local Search Algorithms and Optimization Problems: Hill-climbing search, Simulated annealing, Local beam search, Genetic algorithms;

Logical Agents: Knowledge-based agents; The Wumpus world, Logic, propositional logic, Propositional Theorem proving.

Module 3	10 Hours

First-Order Logic: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic, Knowledge engineering in first-order logic.

Inference in first-order logic: propositional versus first-order inference, uniform and lifting, forward chaining, backward chaining, resolution

Module 4	10 Hours

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, Ensemble Learning. Reinforcement Learning: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning

Natural Language Processing: Language models, Text Classification, Information Retrieval. **Robotics**: Introduction, Robotics Hardware Robotic perception.

Text Books:

1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.

Reference Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015.
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015

MOOCs:

1. https://www.edx.org/course/artificial-intelligence-uc-berkeleyx-cs188-1x
2. https://www.udacity.com/course/intro-to-artificial-intelligence--cs271
3. https://www.class-central.com/subject/ai

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2		2												
CO3			2		2									2
CO4						2	2	1	2	2		2		

Course Title	UNIX Laboratory		
Course Code	22AIL306	L-T-P-C	(0-0-2) 1
Exam Hrs.	3Hrs.	Hours / Week	2
SEE	50 Marks	Total Hours	24

Course Objective: The course provides a comprehensive introduction to UNIX commands and utilities, students will develop Shell Programming and Vi editing skills.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply critical thinking and problem-solving skills to design efficient and effective shell scripts that accomplish specific tasks using UNIX commands and utilities	1,3,5	1
2.	Exhibit the ethics in lab and communicate the results through report and presentation.	8,10,12	-

Course Contents:

Execution following basic UNIX commands

ls, ls –l, cat, grep, sed, cd, od, mkdir, echo, date, mv.

Design and Develop a shell scripts for following statements

1. Write a shell script that takes a valid directory name as an argument and recursively descend all the sub-directories, finds the maximum length of any file in that hierarchy and writes this Maximum value to the standard output.
2. Write a shell script that accepts a path name and creates all the components in that path name as directories. For example, if the script is named mpc, then the command mpc a/b/c/d should create directories a, a/b, a/b/c, a/b/c/d.
3. Write a shell script that accepts two file names as arguments, checks if the permissions for these files are identical and if the permissions are identical, output common permissions and otherwise output each file name followed by its permissions.
4. Create a script file called file-properties that reads a file name entered and outputs it properties.
5. Write a shell script that accept one or more filenames as argument and convert all of them to uppercase, provided they exist in current directory
6. Write a shell script that accepts as filename as argument and display its creation time if file exist and if it does not send output error message.
7. Write a shell script that gets executed displays the message either “Good Morning” or “Good Afternoon” or “Good Evening” depending upon time at which the user logs in.
8. Write a shell script that accept the file name, starting and ending line number as an argument and display all the lines between the given line number.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2		2								3	
CO2								2		2		2		

Engineering Science Courses/Emerging Technology Courses/ Programming Language Courses – III

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	22AI307A	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: Design and develop java application programs using object-oriented concepts.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the concepts of OOP and Java constructs for the development of applications	1	-
2.	Analyze the given java program to make suitable changes and write the output	2	1
3.	Design and develop a java program, user interface to solve the given problem.	3	1
4.	Conduct practical experiments for demonstrating object oriented concepts through java.	3,5,9,10	-

Course Contents:

Module 1	10 Hours

Introduction to OOPand Java: Overview of OOP, Object oriented programming paradigms, Features of Object Oriented Programming, Java Buzzwords, Overview of Java, Data Types, Variables and Arrays, Operators, Control Statements, Programming Structures in Java, Defining classes in Java, Constructors, Methods, Access specifiers, Static members, Java Doc comments
Inheritance, Packages and Interfaces: Overloading Methods, Objects as Parameters, Returning Objects, Static, Nested and Inner Classes. Inheritance: Basics, Types of Inheritance, Super keyword, Method Overriding, Dynamic Method Dispatch, Abstract Classes, final with Inheritance. Packages and Interfaces: Packages, Packages and Member Access, Importing Packages Interfaces.

Module 2	10 Hours

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

Module 3	10 Hours

I/O, Generics, String Handling: I/O Basics, Reading and Writing Console I/O, Reading and Writing Files. Generics: Generic Programming, Generic classes, Generic Methods, Bounded Types, Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.
Files, Streams- Byte streams, Character streams, Text input/output, Binary input/output, File management using File class

Module 4	10 Hours

GUI Programming with Swing: The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – Jbutton, JLabel, JTextField, JTextArea, simple Swing applications, Layout management – Layout manager types – border, grid and flow
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, Examples: Handling Mouse and Key events, Adapter classes.

Text Books:

1. Java Fundamentals, A comprehensive Introduction by Herbert Schildt, Dale Skrien.TataMcGraw Hill Edition 2013 (Chapters 1,2,3,4,5,6,7,8,9,10,12)
2. Java –The complete Reference, by Herbert Schildt Eight Edition Tata Mcgraw Hill Education (Chapter 19).

Reference Books:

1. Programming in JAVA2 by Dr K Somasundaram, Jaico publications
2. Java Programming by Hari Mohan Pandey, Pearson Education, 2012

MOOCs:

1. http://nptel.ac.in/courses/106106147/
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. https://www.coursera.org/specializations/object-oriented-programming

Activity:

Write and execute the following programs in java

1. Get acquainted with java environment. Print different patterns of asterisk (*) using loops (e.g. triangle of *). Compare syntactical similarities and dissimilarities between Java and C++
2. Create a class Employee and encapsulate the data members. Create demo applications to illustrate different types of inheritance.
3. Create an Array of Employee class and initialize array elements with different employee objects. Understand the No. of objects on heap memory when any array is created.
4. Create a demo application to understand the role of access modifiers. Implement multilevel, multiple and hybrid inheritance using different packages.
5. Access/invoke protected members/methods of a class outside the package. Override finalize method to understand the behaviour of JVM garbage collector.
6. Create sample classes to understand boxing & unboxing.
7. Use different methods of java defined wrapper classes.
8. Create StringDemo class and perform different string manipulation methods.
9. Understand the difference between String / StringBuffer / StringBuilder.
10. Development of applications using AWT components

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2		2											3	
CO3			2										3	
CO4			2		2				2	2				

Course Title	QUANTUM COMPUTING		
Course Code	22AI307B	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40

Course Objective: The primary course objective is to equip students with a strong foundation in the mathematical prerequisites for quantum computation, including proficiency in linear algebra and complex numbers, wave functions, quantum superposition, and entanglement, essential for quantum computing applications.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Discus the fundamental principles of quantum mechanics, including wave functions, eigenvalues, and quantum superposition, as well as the mathematical tools of linear algebra and complex numbers used in quantum computation.	-	-
2.	Apply the fundamental principles of quantum mechanics and implement quantum circuits and quantum logic	1	1
3.	Analyse quantum algorithms and circuits built on actual quantum computers or simulators	2	-
4.	Collaborate effectively in teams and demonstrate the applications of quantum computers in real life	9,10	-

Course Contents:

Module 1	10 Hours

Mathematical Prerequisites for Quantum Computations: Representing and operating quantum systems by using mathematical methods. Linear algebra. Matrix operations; addition, multiplication, transpose of matrix, etc. Density matrix. Unitary matrices. Fundamental operations of complex numbers; addition, multiplication, conjugate of a complex number, Argand diagram etc.

Module 2	10 Hours

Quantum Physics for Quantum Computations Wave function, Ortho-normalization condition of wavefunction, Operators, Eigen values and Eigen functions. Dirac bracket notation. Ket state and Hilbert space. Failure of Moore's Law. Principles of quantum mechanics for quantum computing; Quantum superposition and Quantum entanglement principles. EPR paradox and Bell's inequality. Additionally, Wave-particle dualism, Heisenberg Uncertainty Principle, Quantum tunnelling, etc. All the postulates of Quantum mechanics. Quantum realm and nonlocality. Quantum teleportation. Predictions of Quantum superposition states of quantum systems.

Module 3	10 Hours

Linear algebra for Quantum Computations Difference between Classical and Quantum computers. Power of quantum computers; Reversible computation, parallel computation, exponential growth of computational power etc. Qubits, pure and mixed states of a qubit. Bloch sphere and single qubit quantum logic gates; Hadamard gate, Pauli's gates (X), Y) and Z), phase gate and other gate. Different operations of quantum logic gates on single qubit by the means of Bra-Ket and matrix operations. Multi qubit systems: Logic gates – CNOT gate, Swap gate, CZ gate, C phase gate, Taffoli gate, Fredkin (controlled swap) gate

Module 4	10 Hours

Approaches of Quantum Computers Architectures Physical realization of Quantum superposition and quantum entanglement; Superconducting Qubits, Trapped Ion Qubits, Topological Qubits, Photonic Qubits, Nuclear Magnetic Resonance (NMR), Silicon Spin Qubits, Adiabatic Quantum Computers, Hybrid Quantum-Classical Systems. Quantum simulators; IBM Qiskit. Quantum error correction.

Text Books:

1. Quantum computation and quantum information- Michael A. Nielsen, Isaac L. Chuang - Cambridge University Press, 2004.
2. Modern Quantum Mechanics, J. J. Sakurai and Jim Napolitano.
3. Quantum Computing: From Linear Algebra to Physical Realizations, Mikio Nakahara and Tetsuo Ohmi.

Reference Books:

1. Quantum AlgorithmsbyRonald de Wolf, first edition.
2. Quantum Hardware by Merzbacher and Styer, first edition.
3. Quantum Information Theory and the Foundations of Quantum Mechanics by Christopher G. Timpson, first edition.
4. Quantum Error Correctionby Daniel A. Lidar and Todd A. Brun, first edition.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview

Activity

1. Apply single & multiple quantum logic gates in an actual quantum computer and interpret its result.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	2												2	
CO3		2												
CO4									2	2				

Course Title	PYTHON FOR DATA SCIENCE		
Course Code	22AI307C	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: utilize the python constructs and libraries to perform data analysis.
Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the python libraries to load, preprocess, analysis and visualize the data.	1, 5	-
2.	Analyze the given data and interpret the results using python libraries	2,5	1
3.	Develop a python program to solve the given problem	3,5	1
4.	Work collaboratively and demonstrate the applicability of python libraries to solve real world data science problems	9,10,12	-

Course Contents:

Module 1	10 Hours

Introduction to Python for data science: Basics of Python SPYDER (TOOL), Introduction Spyder, setting working Directory, Creating and saving a script file, File execution, clearing console, removing variables from environment, clearing environment, commenting script files, Variable creation, Arithmetic and logical operators, Data types and associated operations Introduction to Data Science, Python for Data Science, Python Pandas, Python Numpy, Python Scikit-learn, Python Matplotlib

Python Basics: Taking input in Python, Python, Output using print () function, Variables, expression condition and function, Basic operator in python

Data Types: Strings, List, Tuples, Sets, Dictionary, Arrays, Loops, Loops and Control Statements (continue, break and pass) in Python, else with for, Functions in Python, Yield instead of Return, Python OOPs Concepts, Exception handling

Sequence data types and associated operations Strings, Lists, Arrays, Tuples Dictionary, Sets, Range, NumPy and Array

Module 2	10 Hours

Data Processing: Understanding Data Processing, Python: Operations on Numpy Arrays, Overview of Data Cleaning, Slicing, Indexing, Manipulating and Cleaning Pandas Dataframe, working with Missing Data in Pandas, Pandas and CSV, Python, Read CSV, Export Pandas dataframe to a CSV file, Pandas and JSON, Pandas, Parsing JSON Dataset, Exporting Pandas Dataframe to JSON File, working with excel files using Pandas

Data Visualization : Data Visualization using Matplotlib, Style Plots using Matplotlib, Line chart in Matplotlib, Bar Plot in Matplotlib, Box Plot in Python using Matplotlib, Scatter Plot in Matplotlib, Heatmap in Matplotlib, Three-dimensional Plotting using Matplotlib, Time Series Plot or Line plot with Pandas, Python Geospatial Data, Other Plotting Libraries in Python, Data Visualization with Python Seaborn, Using Plotly for Interactive Data Visualization in Python, Interactive Data Visualization

Module 3	10 Hours

Python Relational Database : Connect MySQL database using MySQL-Connector Python, Python: MySQL Create Table, Python MySQL – Insert into Table, Python MySQL – Select Query, Python MySQL – Update Query, Python MySQL – Delete Query, Python NoSQL Database, Python Datetime, Data Wrangling in Python, Pandas Group by: Summarising, Aggregating, and Grouping data, What is Unstructured Data?, Label Encoding of datasets, One Hot Encoding of datasets

Module 4	10 Hours

Statistics : Measures of Central Tendency, Statistics with Python, Measuring Variance, Normal Distribution, Binomial Distribution, Poisson Discrete Distribution, Bernoulli Distribution, P-value, Exploring Correlation in Python, Create a correlation Matrix using Python, Pearson's Chi-Square Test

Text Books:

1. Python for Data Analysis, Wes McKinney, 2nd edition, O'Reilly Media, ISBN: 978-1-

491-95766-0, 2018.
2. Python Programming and SQL, Mark Reed
3. Introduction to Data Science: Practical Approach with R and Python, B Uma Maheshwari , R. Sujatha

Reference Books:

1. Introduction to Python for Data Science:Paul J. Deitel, Harvey M. Deitel, Harvey Deite

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc23_cs99/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				2									
CO2		2			2								2	
CO3			2		2								2	
CO4									2	2	2			

Course Title	Discrete Mathematical Structures		
Course Code	22AI307D	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40

Course Objective:

1. Introduction of Discrete structures and principle of Combinatory which may be employed as tools in the applications of Computer Science & Information Technology.
2. Prepare student to use discrete mathematics as a tool in developing a consistent program in Computer Science & Information Technology.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply logic and counting principles to model and analyze problems of computer science & engineering	1,2	-
2.	Apply the concepts of logic to identify methods of mathematical proofs.	1,2	-
3.	Use concepts of functions in analyzing problems on algorithms and programs.	1,2	-
4.	Model and analyze programming problems related to coding theory.	1,2	-
5.	Derive mathematical model for real life problems related to Information science and Engineering.	1,2	-

Course Contents:

Module 1	07 Hours

Principles of Counting: The rule of sum and product, permutation principle, combination principle, rule of generalized Permutations and Combinations,

Fundamentals of Logic: Basic logic connectives and truth tables. Logical equivalence and Tautologies. Statement of laws of logic.

Self-study: Set theory – set operations, Venn diagram, Inclusion Exclusion principle.

Module 2	07 Hours

Fundamentals of Logic contd.: Logic implication - Rules of inference theory. Application of switching network.

Relations-definition and elementary properties, partially ordered sets, Hasse diagram, Lattice.

Self-study: Quantifiers, methods of proof, equivalence relations, partition of a set induced by a relation

Module 3	07 Hours

Functions: Ceiling function, Floor function, Characteristic function, and Application of Stirling numbers of second kind. Application of functions in vending machine.

Self-study: one to one and onto functions, Composition of functions

Module 4	07 Hours

Coding theory: Elements of coding theory, the humming matric**,** the parity – check and Generator matrices,

Group codes: Decoding with coset leaders. Hamming matrices.

Self-study: sub-groups, cosets, Matrix row operations.

Note –

1. **Theorems and properties without proof. Applicable to all the modules.**
2. **Self study part is not included for Semester End Examination.**

Text Books:

1. Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.

Reference Books:

1. Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006.

MOOCs:

1. **https://onlinecourses.nptel.ac.in/noc20_cs37/preview**

Activities

1. Application of switching network
2. Application to algorithm testing using computational complexity.
3. Computation of number of different ways n rooks can be arranged on an n x n chess board so that no two rooks can attack each other for all positive integers n.
4. Discuss ways in which the current telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers.
5. Application of functions in vending machine.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2												
CO2	2	2												
CO3	2	2												
CO4	2	2												
CO5	2	2												

Course Title	Social Connect & Responsibility		
Course Code	22AI308	L-T-P-C	(0-0-2) 1
Exam Hrs.	--	Hours / Week	2
SEE	--	Total Hours	24

Course Objective: Provide a formal platform for students to communicate and connect with their surroundings and create a responsible connection with society

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Work collaboratively as a member and a leader and demonstrate an understanding of the environmental, agriculture and sustainability aspects related to societal and technological practices adapting to technological advancements while adhering to ethical and professional norms	6, 7, 8, 9, 11, 12	-
2.	Produce well-structured documentaries, photo blogs, and presentations that effectively convey the essence of the learned experiences and cultural connections	5, 10	-

Course Contents:

Module 1	08 Hours

Plantation and adoption of a tree: Plantation of a tree that will be adopted by a group of students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.

Module 2	07 Hours

Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photoblog and documentary on evolution and practice of various craft forms.

Module 3	08 Hours

Organic farming and waste management: Usefulness of organic farming, wet waste management in neighbouring villages, and implementation in the campus.

Module 4	07 Hours

Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices. Food Walk City's culinary practices, food lore, and indigenous materials of the region used in cooking.

Course Conduction

A total of 14-20 hrs engagement per semester is required for the course. Students will be divided into teams and each team will be handled by two faculty mentors. Faculty mentors will design the activities for evaluation.

Guideline for Assessment Process:

Continuous Internal Evaluation (CIE)

After completion of the social connect, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor.

The report shall be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to theactivity completed.

Marks allotted for the diary are out of 50. Planning and scheduling the social connect Information/ Data collected during the social connect . Analysis of the information/data and report writing

Considering all above points allotting the marks as mentioned below

Excellent 80 to 100

Good 60 to 79

Satisfactory 40 to 59

Unsatisfactory and fail &lt <39

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						2	2	2	3		2	2		
CO2					2					3				

Ability Enhancement Course-III

Course Title	Data analytics with Excel		
Course Code	22AI309A	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2 Hrs
SEE	50 Marks	Total Hours	24

Course Objective: Students will be able to use appropriate data structures for solving problems.
Course outcomes: At the end of course, student will be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the basic excel function on given data	1,5,12	-
2.	Analyze the given data using excel function	2,5,12	-
3.	Design and develop a solution to the given real-world problems using excel functions	3,5,12	1
4.	Communicate the results effectively individually and in teams	9,10	-

List of Experiments:

1. Getting Started with Excel: Creation of spread sheets, Insertion of rows and columns, Drag& Fill, use of Aggregate functions.
2. Working with Data: Importing data, Data Entry & Manipulation, Sorting & Filtering.
3. Working with Data: Data Validation, Pivot Tables & Pivot Charts.
4. Data Analysis Process: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs.
5. Cleaning Data with Text Functions: use of UPPER and LOWER, TRIM function, Concatenate.
6. Cleaning Data Containing Date and Time Values: use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
7. Conditional Formatting: formatting, parsing, and highlighting data in spreadsheets during data analysis.
8. Working with Multiple Sheets: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
9. Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
10. Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
11. Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
12. Generation of report & presentation using Autofilter &macro.

Text Books:

1. Berk & Carey - Data Analysis with Microsoft® Excel: Updated for Offi ce 2007®, ThirdEdition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4
2. Wayne L. Winston - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180.
3. Aryan Gupta - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel)

Reference Books:

1. "Excel 2019 Bible" by Michael Alexander and Richard Kusleika
2. "Data Analysis Using Excel" by Michael R. Middleton

3. "Effective Data Visualization" by Stephanie D. H. Evergreen

MOOCs:

1. https://www.mygreatlearning.com/academy/learn-for-free/courses/data-analytics-using-excel

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2				2							2		
CO2		2			3							2		
CO3			2		2							2	1	
CO4									3	3				

Course Title	Ethics and Public Policy for AI		
Course Code	22AI309B	L-T-P	(0-0-2)1
Exam	3 Hrs	Hours/Week	2 Hrs.
SEE	50 marks	Total Hours	28 Hrs.

Course Objective:

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply ethical principles to guide the development and deployment of AI technologies.	1	-
2.	Analyze and assess the ethical implications of AI technologies, considering various ethical frameworks.	2	-
3.	Evaluate the ethical implications of AI technologies on society.	6	-
4.	Communicate effectively about AI ethics and public policy issues.	9,10	-

Course Contents:

MODULE-1	7Hrs

An Ethical Framework for a Good AI Society: opportunities, Risks, principles andRecommendations. Establishing the rules for building trustworthy AI

Translating principles into practices of digital ethics: five risks of being Unethical

MODULE-2	7 Hrs

The Ethics of Algorithms: Key problems and Solution

How to Design AI for Social Good: Seven Essential Factors.

How to design AI for social good: seven essential factors

MODULE-3	7Hrs

From What to How: An Initial Review of publicly available AI Ethics tools, Methods and Research to Translate principles into Practices.

Innovating with Confidence: Embedding AI Governance and fairness in financial Services Risk management framework,What the near future of AI could be**.**

MODULE-4	7 Hrs

Human-AI Relationship: AI and Workforce, Autonomous Machines and Moral Decisions.

AI in HealthCare: balancing Progress and Ethics.Regulation and Governance of AI Ethics

Text Books

1. "Ethics, governance and Policies in Artificial Intelligence", Author-Editor : Luciano Floridi, Springer, 1st Edition 2021, vol 144, Oxford Internet Institute, University of ixford, UK, ISSN 0921-8599, e-ISSN 2542- 8349 Philosophical Studies series, ISBN 978-3-030-81906-4 e-ISBN 978-3-030-81907-1, ://doi.orghttps/10.1007/978-3-030-81907-1, 2021. 2.
2. "Ethics and AI: Navigating the Moral Landscape of Digital Age", Author: Aaron Aboagye,

Reference Book:

1. Artificial Intelligence: A Guide to Intelligent Systems" by Michael Negnevitsky

MOOCs:

1. **https://onlinecourses.nptel.ac.in/noc23_hs47/preview**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1													
CO2		2												
CO3						3								
CO4									3	3				

Course Title	Technical writing using LATEX		
Course Code	22AI309C	L-T-P	(0-0-2)1
Exam	3 Hrs	Hours/Week	2 Hrs
SEE	50 marks	Total Hours	28 Hrs

Course Objective:

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the constructs of LATEX and create technical documents.	1	-
2.	Analyze the given template and create the technical document as per the template given.	2	-
3.	Create a sample research paper, report and typeset it in LATEX templates from publisher sites.	3	-
4.	Communicate the LATEX constructs in teams and report writing	9,10	-

Course Contents:

Module 1	7 Hours

Introduction

Introduction to LaTeX, its installation, and different IDEs. Creating the first document using LaTeX, organizing content into sections using article and book class of LaTeX.

Module 2	7 Hours

Styling Pages

Reviewing different paper sizes, examining packages, formatting the page by setting margins, customizing header and footer, changing the page orientation, dividing the document into multiple columns, reading different types of error messages.

Module 3	7 Hours

Formatting Content

Formatting text (styles, size, alignment), adding colors to text and entire page, and adding bullets and numbered items, writing complex mathematics.

Module 4	7 Hours

Tables and Images

Creating basic tables, adding simple and dashed borders, merging rows and columns, and handling situations where a table exceeds the size of a page, adding an image, exploring different properties like rotate, scale.

Text Books:

1. "Technical Writing: A Practical Guide for Engineers and Scientists", Phillip A Laplante, 1st Edition, CRC Press, 2011.
2. "The Not So Short Introduction to LATEX", Tobias Oetiker, 2e https://cslab.pepperdine.edu/warford/cosc320/lshort.pdf [retrieved 18 Oct. 22]

Reference Books:

1. LaTeX in 24 Hours: A Practical Guide for Scientific Writing 1st ed. 2017 Edition, Kindle Edition, ISBN-13: **978-3319478302**

MOOCs:

1. https://onlinecourses.swayam2.ac.in/aic20_sp17/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1													
CO2		2												
CO3			2											
CO4									3	3				

Course Title	UI/UX		
Course Code	22AI309D	(L-T-P)C	(0-0-2)1
SEE duration	3 hour	Hours / Week	02
CIE(Theory) marks	30	CIE(Practical's)/ Activity marks	20
SEE marks	50	Total contact hours	20

Course Objective: Students will be able to build UI and UX based systems.
Course outcomes: At the end of course, student will be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Summarize all stages of the UI/UX development process	-	-
2.	Experiment with various visual design aspects	1	-
3.	Theme the visual look and feel of the user experiences	2	-
4.	Create effective and compelling screen based experiences	3	-

Course Contents:

Module 1	10 Hours

Foundational Elements of Ui/Ux: User Interface - The Relationship Between UI and UX - Roles in UI/UX - A Brief Historical Overview of Interface. Formal Elements of Interface Design Before Design - Look and Feel - Language as a design tool - Active Elements of Interface Design - Static to Active - Functionality - Speed and Style - Composition and Structure - Composing the Elements of Interface Design

Module 2	10 Hours

User Experience Design Foundations: Ideation, Articulation, Development - Planning, Testing, Researching, Mapping - Mapping Content -Mapping Interaction -Non-Visual Paper Prototyping - Non-Visual User Testing -Look and Feel/Visual Research. What Goes Where: Getting real: Wireframes and Interfaces - Nielsen's Usability Heuristics - Consistency and Details - Wireframe Map - Visual Direction - Developing UI - Refining UI.

Module 3	10 Hours

Web Design: Strategies and Information Architecture: The User Experience Process - User-centric design -The UX Phases -Waterfall vs.Agile -Web vs. App. Determining Strategy: User Research - Inspiration - Analytics - User Needs and Client Needs - Target Audience - What is in and What is Out: Outlining Scope - Content and Functionality. The Sitemap: Introduction to Sitemaps - Information Architecture - Sitemap Concerns - annotated process - Elements - Treejack Introduction - Treejack Analysis

Module 4	10 Hours

Web Designs: Wire Frames to Prototypes: Introduction to Wireframes - Responsive Design: Introduction and Primary navigation - Secondary and utility navigation - Related content, inline links, indexes, and search - Wayfinding - Common Form Elements - Homepage Content Strategies - Examples of Homepage Content Strategies - Wireframing Tools. The Mockup Phase: Visual Mockups - Design Principles - Using whitespace to style a form - Web Fonts - Web Typography: Creating Visual Mockups. Putting it all Together: Clickable Prototypes - Invision - Exporting Assets - Importing Assets and Creating Hotspots - Hotspot Templates

LABORATORY EXPERIMENTS

1. Analyze an existing app and defining your app's functions step-by-step
2. Experiments with Non-Visual Prototyping & User Testing
3. Create a generic prototype of any application both in Web vs. App
4. Test your sitemap using Treejack
5. Exploring Navigation Systems, Common Design Patterns, Design Principles/Whitespace, Web Typography

TEXT BOOKS

1. Sketching User Experiences: Getting the Design Right and the Right Design - Buxton, B, Morgan Kaufmann, (2007).
2. The Elements of User Experience: User-centered Design for the Web - Jesse James Garrett, New Riders; 2 edition2010.

REFERENCES

1. A Project Guide to UX Design: For User Experience Designers in the Field orin the Making, Russ Unger, Carolyn Chandler, New Riders; 2nd edition, 2012.nd
2. The Design of Everyday Things, Basic Books; Don Norman, 2 edition, 2013.
3. UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication, Everett N. McKay, Morgan Kaufmann; Illustrated edition, 2013.
4. Design Patterns: Elements of Reusable Object - Oriented Software, Dr. Erich Gamma, Ralph Johnson, Richard Helm and John Vlissides, Pearson, 2008

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. https://onlinecourses.swayam2.ac.in/aic19_de04/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2	2													
CO3		2												
CO4			2											

SEMISTER -IV

Course Title	LINEAR ALGEBRA		
Course Code	22AI401	L-T-P-C	(2-2-0) 3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	52

Course Objective: Students will be trained to acquire knowledge in linear algebra and its applications.

Course Outcomes (COs): Having studied this course, students will be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply suitable solution procedure to solve the linear models of business, engineering, economics and apply matrix factorization to applications such as computer graphics.	1,2	-
2.	To compute suitable matrices arising in magnification, rotation of images using the knowledge of vector space, matrix of linear transformations.	1,2	-
3.	Analyze the application-oriented problems connected with difference equations, Markov chain, discrete dynamical systems by using the concept of Eigen values, Eigen vectors.	1,2	-
4.	Apply the techniques of singular value decomposition, PCA, to analyze the process of data compression/image processing.	1,2	-

Course Contents:

Module 1 — **07 Hours**

Linear Algebra: Importance of Matrices in engineering. Rank of a matrix. Consistency of non-homogeneous and homogeneous system of equations, Solution of the system of linear equations by Gauss elimination method and Gauss – Seidel iterative method. Linearly dependent and independent vectors.Applications of solution of system of equations to balance the chemical equations. Traffic flow problem. To find the suitable combination of food stuff so as to get the desired nutrients as prescribed by a dietician.

Self-Study- linear models in business and engineering, Partitioned matrices, Matrix factorization, the Leontief input –output model, application to computer graphics

Module 2 — **10 Hours**

Vector space, subspace, basis of a vector space, dimension of a vector space, introduction to linear transformation, rank, nullity of a linear transformations, matrix of a linear transformation. Special matrices-matrix of rotation, reflection, translation.

Self-Study- To find the matrix of transformation when the image of some points is given.

Module 3 — **10 Hours**

Eigen value, Eigen vectors, applications of diagonalization, Jordan canonical form. application to discrete dynamical systems- coupled differential equations governing the electrical circuits systems, applications to difference equations, applications to web page ranking.

Self-Study- Stretching of an elastic membrane, to determine the growth of a population model. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).

Module 4 — **10 Hours**

Orthogonal sets, orthogonal projections, Gram Schmidt process, QR-factorization, lest square problems, multiple regression through matrix approach, singular value decomposition theorem, examples. Principal component analysis- applications of PCA to data compression, image processing.

Self-Study- Application of eigen-value eigen-vectors in Signature testing, Face recognition. Stability analysis of differential equations which governs the dynamical systems using the concept of eigen value, eigen vectors.

Note:

1. Theorems and properties without proof. Applicable to all the modules.
2. Self study part is not included for Semester End Examination.

Text Books:

1. Linear Algebra and its Applications, David C. Lay, Steven R. Lay and J.J. Mc Donald:

5th Edition, Pearson Education Ltd., 2015.

Reference Books:

1 "Advanced Engineering Mathematics", E. Kreyszig, 10th edition, Wiley, 2015.

2 Numerical methods,R. K. Jain and S. R. K. Jain & S. R. K. Iyengar, New age International pvt. Publishers, 6th edition, 2014.

3 Linear Algebra and its Applications,Gilbert Strang: 4th Edition, Cenage publications, 2014.

Activity

1. Role of eigenvalues, eigenvectors in determining natural frequency, mode shapes of equations of motions (Spring mass system).
2. Lenovo input output method – application to balance the economy of a Country.
3. Applications of factorization of matrices-google recommendation.
4. Jordan canonical form when minimal polynomial and characteristic polynomial is given and its application in Engineering.
5. Diagonalize a matrix and determining the principal stresses.
6. Application of eigen value eigen vectors in data compression, Signature testing, Face recognition.
7. Least square solution of system of equations- a matrix approach.
8. Application of eigen value eigen vectors in Google page ranking.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS		
Course Code	22AI402	(L-T-P)C	(3-0-2)4
Exam	3Hrs	Hours/Week	5
SEE	50 Marks	Total Hours	52(40L+12P)

Course Objective: Students will be able to design algorithms using various strategies and analyze it mathematically.

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	**Apply** various algorithm design techniques to solve the given problem.	1	-
2.	**Analyse** the time and space complexity of different algorithms	2	-
3.	**Design** efficient algorithms using appropriate algorithm design techniques.	3	1
4.	Conduct **experiments** to implement the algorithms and provide valid conclusions	4, 5	1

Course Contents:

Module 1	10 Hours

Introduction: Notion of Algorithm, Fundamentals of algorithmic problem solving. **Fundamentals of the Analysis of Algorithm Efficiency:** Analysis framework, Asymptotic notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms, Examples.

Brute Force: Selection Sort and Bubble Sort, Sequential Search and String Matching, Exhaustive search.

Module 2	10 Hours

Divide-and-Conquer: Binary Search, Merge Sort, Quick Sort, Binary tree traversals and related properties, Multiplication of large integers, Strassen's Matrix multiplication.

Decrease-and-Conquer: Insertion Sort, Depth First and Breadth First Search, Topological sorting, Algorithms for generating combinatorial objects.

Module 3	10 Hours

Transform-and-Conquer: Pre-sorting, Balanced Search Trees, Heaps and Heap Sort, Problem reduction.

Space and Time Trade-off: Sorting by counting, Input enhancement in string Matching (only Horspool), Hashing.

Dynamic Programming: Computing a Binomial coefficient, Warshall's Algorithm, Floyd's algorithms, The Knapsack problem.

Module 4	10 Hours

Greedy Technique: Prim's algorithm, Kruskal's algorithm, Dijkstra's algorithm, Huffman trees,

Limitations of Algorithm Power: Lower-bound arguments, Decision trees, P, NP and NP-Complete Problems, coping with the Limitations of Algorithm Power: Backtracking, Branch-and-bound.

Practical Component/Tutorial:

Guided Experiments

Implement the following using C/Python.

1. Employees in an organization need to be grouped for a tournament based on their ages. Sort the ages using Merge sort and find the time required to perform the sorting.
2. Students in a department need to be selected for a high jump competition based on their height (integer values only). Sort the heights of students using Quick sort and find the time required for the sorting.
3. Print all the nodes reachable from a given starting node in a graph using Depth First Search method and Breadth First Search. Also check whether a graph is connected.
4. Obtain the topological ordering of vertices in a given digraph.
5. Implement Horspool algorithm for String Matching.
6. Sort a given set of elements using the Heap sort method.
7. Implement Floyd's algorithm and Warshall's algorithm for a given graph.

8. There are n different routes from hostel to college. Each route incurs some cost. Find the minimum cost route to reach the college from the hostel using Prim's algorithm.
9. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm
10. Implement 0/1 Knapsack problem using dynamic programming.
11. Implement N Queen's problem using Backtracking.

Open ended Experiments

Students have to solve a given problem using any suitable design technique and demonstrate its efficiency. Sample list of problems (but not limited to this) that can be considered are

1. Josephus problem
2. Travelling salesman problem
3. Job assignment problem
4. Boyre Moore string matching algorithm
5. Searching problem like - Given a string, find all possible palindromic substrings in it, Given a sequence of numbers between 2 and 9, print all possible combinations of words formed from the mobile keypad which has English alphabets associated with each key.
6. Sorting problem like - Given two integer arrays, reorder elements of the first array by the order of elements defined by the second array.

Text Books:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, 3rd Edition, Pearson Education, 2017.

Reference Books:

1. Introduction to Algorithms, Thomas H. Coremen, Charles E. Leiserson, Ronald L. Rivest, 3rd Edition PHI
2. Computer Algorithms, Horowitz E., Sahani S., Rajasekharan S, Galgotia Publications

MOOC Course:

1. Design and Analysis of Algorithms https://nptel.ac.in/courses/106/106/106106131/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		2												
CO3			2											
CO4			2	1	3									

Course Title	Database Management System		
Course Code	22AI403	L-T-P-C	(3-0-2) 4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	52(40 L+12P)

Course Objective: Students will acquire the concepts of databases, and application of SQL for solving problems.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	**Apply** the concepts of database management systems for various applications	1	-
2.	**Analyze** a given scenario to its correctness and use appropriate database technique	2	-
3.	**Design and demonstrate** conceptual models, query and optimization	3	1
4.	Conduct the experiment and demonstrate the same using modern tools	3, 5, 9, 10, 12	1

Course Contents:

Module 1	10 Hours

Database and Database Users: Introduction, an example, Characteristics of Database approach, Actors on the Screen, Workers Behind the Scene, Advantages of Using DBMS Approach. **Database System Concepts and Architecture:** Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.

Data Modeling Using the Entity-Relationship (ER) Model: Using High-Level Conceptual Data Models for Database Design, a Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relationship Types of Degree Higher Than Two.

Module 2	10 Hours

The Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint, Violations.

Basic SQL: SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Basic Queries in SQL. Insert, Delete and Update statements in SQL. **More SQL:** More Complex SQL Queries, Insert Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Views (Virtual Tables) in SQL, Schema Change Statements in SQL.

Module 3	10 Hours

Relational Algebra: Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra, Relational Database Design Using ER- to-Relational Mapping.

Basics of Functional Dependencies and Normalization or Relational Databases: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Module 4	10 Hours

Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializeability, Transaction Support in SQL, Two-Phase Locking Techniques for Concurrency Control.

NoSQL Databases: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores.

Text Books:

1. Fundamentals of Database Systems", Elmasri and Navathe, 7th Edition, Addison-Wesley,2015.

Reference Books:

1. Database 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, Pearson education, 8 th Edition, 2006.
3. Professional NOSQL Shashank Tiwari, Published by John Wiley & Sons, Inc. 2017.

MOOC Course:

1. **https://onlinecourses.swayam2.ac.in/cec19_cs05/preview**
2. **https://onlinecourses.nptel.ac.in/noc19_cs46/preview**

Practical Component

1. Consider the following schema: EMPLOYEE (Ename, Ssn, Bdate, Sex, Address, salary, Mgrssn, Dno) DEPARTMENT (Dname, Dnumber, Mgrssn, Mgr_start_date) PROJECT (Pname, Pnumber, Plocation, Dnum) WORKS_ON (Essn, Pno, Hours) DEPENDENT (Essn, Dependent_name,Sex) Create above tables by specifying primary key, foreign key and other suitable constraints.
   Insert atleast 5 tuples to each created table.
   i. Retrieve the name and address of all employees who work for the "ISE" department.
   ii. For each employee, retrieve the employee's name and the name of his or herimmediate supervisor
   iii. Find the sum of all salaries of all employees
   iv. For each department, retrieve the department number, the number of employees in the department and their average salary.
2. Consider the following relation schema: SAILORS (Sid: integer, Sname: string, Rating: integer, Age: real) BOATS (Bid: integer, Bname: string, Color: string) RESERVES (sid: integer, bid: integer, Day: date) Create above tables by specifying primary key, foreign key and other suitable constraints. Insert atleast 5 tuples to each created table. Design a database to the satisfy the above requirements and answer following queries
   i. Find all sailors with a rating above 7
   ii. Find the names of sailors who have reserved boat number 103
   iii. Find the names of sailors who have reserved a red boat
   iv. Find the names of sailors who have reserved a red or a green boat
3. Consider the following relation schema: STUDENT (Snum: integer, Sname: string, Major: string, Level: string, Age: integer) CLASS (Cname: string, meets at: string, Room: string, Fid: integer) ENROLLED (Snum: integer, Cname: string) FACULTY (Fid: integer, Fname: string, Deptid: integer) The meaning of these relations is straightforward; for example, enrolled has one record per student-class pair such that the student is enrolled in the class. Level is a two-character code with 4 different values (example: Junior: JR etc) Write the following queries in SQL. No duplicates should be printed in any of the answers.
   i. Find the names of all Juniors (level = JR) who are enrolled in a class taught by Prof. Harshith
   ii. Find the names of all classes that either meet in room R128 or have five or more Students enrolled.
   iii. Find the names of all students who are enrolled in two classes that meet at the same time.
   iv. Find the namesof faculty members who teach in every room in which some class is taught.
4. Consider the relation schema for book dealer database: AUTHOR (Author-id:int, Name: string, City: string, Country: string) PUBLISHER (Publisher-id:int, Name: string, City: string, Country: string) CATALOG (Book-id: int, Title: string, Author-id: int, Publisher-id: int, Category-id: int, Year: int, Price: int) CATEGORY (Category-id: int, Description: string) ORDER-DETAILS (Order-no: int, Book-id: int, Quantity: int) Create the above tables by properly specifying the primary keys and the foreign keys. Enter at least

five tuples for each relation.

i. Give thedetails of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2000.
ii. Find the author of the book which has maximum sales.
iii. Demonstrate how you increase the price of books published by a specific publisher by 10%
iv. List any department that has all its adopted books published by a specific publisher

5. Consider the schema for Movie Database: ACTOR (Act_id, Act_Name,Act_Gender) DIRECTOR(Dir_id, Dir_Name, Dir_Phone) MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id) MOVIE_CAST (Act_id, Mov_id, Role) RATING (Mov_id, Rev_Stars) Write SQL queries to Create the above tables by properly specifying the primary keys and the foreign keys. Enter at leastfive tuples for each relation.
   i. List the titles of all movies directed by 'Hitchcock'.
   ii. Find the movie names where one or more actors acted in two or more movies.
   iii. List all actors who acted in a movie before 2000 and also in a movie after 2015.
   iv. Update rating of all movies directed by 'Steven Spielberg' to
6. Consider the following database for a banking enterprise BRANCH (branch-name: String, branch-city: String, assets: real) ACCOUNTS (accno: int, branch-name: String, balance: real) DEPOSITOR (customer-name: String, customer-street: String, customer-city: String) LOAN (loan-number: int, branch-name: String, amount: real) BORROWER (customer-name: String, loan-number: int) Create the above tables by properly specifying the primary keys and the foreign keys. Enter atleastfive tuples for each relation.
   i. Find all the customers who have at least two accounts at the Main branch.
   ii. Find all the customers who have an account at all the branches located in a specific city.
   iii. Demonstrate how you delete all account tuples at every branch located in a specific city.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2		2												
CO3			2										3	
CO4			2		3				2	2		2	3	

Course Title	MACHINE LEARNING		
Course Code	22AI404	L-T-P-C	(2-2-0)3
Exam Hrs.	3Hrs.	Hours / Week	4
SEE	50 Marks	Total Hours	52

Course Objective: To utilize the machine learning algorithms to solve real time problems.

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	**Apply** data preprocessing, data modeling, supervised and unsupervised machine learning algorithms to the given scenario	1	-
2.	**Analyze** the given problem and identify the appropriate data modeling and machine learning method to solve the same	2	-
3.	**Design and develop** a solution using appropriate machine learning algorithm	3	1
4.	Investigate the real world problem and develop a machine learning system to provide a solution for the same and commutate the results through report and presentation	4,5,6,9,10, 12	2

Course Content:

Module 1 — **10 Hours**

Introduction to Machine learning: Introduction, What is Human Learning, Types of Human Learning, What is Machine Learning, Types of Machine Learning, Problems not be solved using Machine Learning, Applications of Machine Learning, State of the art languages/tools in Machine Learning, Issues in Machine Learning. **Preparing to Model:** Machine Learning Activities, Basic Types of Data in Machine Learning.

Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing. **Modeling and Evaluation:** Introduction, Selecting a Model, Training a Model, Model Representation and Interpretability.

Module 2 — **10 Hours**

Modeling and Evaluation: Evaluating Performance of a Model, Improving Performance of a Model. **Basics of Feature Engineering:** Introduction, Feature Transformation, Feature Subset Selection.

Learning Problems and Concept Learning: Find-S, Version Space and Candidate Elimination Algorithm. **Bayesian Concept Learning:** Why Bayesian Methods are Important, Bayes' Theorem, Bayes' Theorem and Concept Learning. Applications of Naïve Bayes Classifier.

Module 3 — **10 Hours**

Supervised Learning-Classification: Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms- KNN, decision tree, Random forest model, Support vector machines.

Supervised Learning- Regression: Introduction, Example of Regression, Common Regression Algorithms- Simple Linear Regression, Multiple Linear Regression, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.

Module 4 — **10 Hours**

Unsupervised Learning: Unsupervised VS Supervised Learning, Application of Unsupervised Learning, Clustering, Finding Patterns using Association Rules.

Other Types of Learning: Introduction, Representation Learning, Active Learning, Instance-based Learning, Association Rule Learning Algorithm, Ensemble Learning Algorithm.Regularizatoin Algorithm

Text Books:

1. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2023.
2. Machine Learning, Tom M. Mitchell, McGraw-Hill Education (INDIAN EDITION), 2013

Reference Books:

1. Hands-on machine learning with scikit-learn and tensorflow, Concepts, Tools, and

Techniques to Build Intelligent Systems. O'Reilly Media, AurélienGéron, Second Edition, 2019.
2. EthemAlpaydin, Introduction to Machine Learning, 2nd Ed., PHI Learning Pvt. Ltd., 2013
3. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. H. Friedman, Springer; 1st edition, 2001

e-Books:

1. https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/

MOOCS

1. https://swayam.gov.in/nd1_noc19_cs52/preview
2. https://www.coursera.org/learn/machine-learning

Tutorial Component:

1. Demonstration of Python Libraries for Machine Learning-Pandas, Sklearn, numpy, Matplotlib,
2. Demonstration of Exploratory Data Analysis and Data Visualization
3. Implement the concept learning algorithms
4. Implement the KNN classification algorithm for the given dataset
5. Implement a classification problem using Decision Tree for the given dataset
6. Implement a classification problem using Random Forest for the given dataset
7. Implement a Simple Linear Regression for the given dataset
8. Implement Multiple Linear Regression for the given dataset
9. Implement Polynomial and Logistic Regression for the given dataset
10. Implement a clustering algorithm using K-means clustering for the given dataset

Activity

Project/Problem Based Learning

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2		2												
CO3			2										3	
CO4				3	3	2			3	3		2		3

Course Title	WEB APPLICATION DEVELOPMENT LABORATORY		
Course Code	22AI405	L-T-P-C	(0-0-2) 1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28

Course Objective: equip students with the skills to develop dynamic web applications using comprehensive range of web technologies.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	**Apply** the basic web development constructs to build the web pages	1	-
2.	**Analyze** the given scenario and build the webpage using suitable web development techniques	2	-
3.	**Design** and develop interactive web pages	3	1
4.	Create an end-to-end web pages connected to database using modern tools and present the results	4, 5, 9, 10, 12	1

Course Contents:

Content	

Lab 1: Setting Up Environment

- Install and configure a local server environment (e.g., XAMPP, WAMP).
-Set up PHP, MySQL, Apache, and a text editor for coding.
-Verify functionality by running a simple PHP script and creating a basic HTML page.

Lab 2: HTML Basics

- Learn HTML syntax, elements, and attributes.
- Create a webpage structure using HTML tags, including headings, paragraphs, lists, and links.
- Understand semantic HTML and its importance for accessibility and SEO.

Lab 3: CSS Basics

- Understand the basics of CSS, including selectors, properties, and values.
- Style HTML elements using CSS to control layout, typography, colors, and backgrounds.
- Explore CSS box model and positioning techniques.

Lab 4: More CSS Techniques

- Dive deeper into CSS with advanced styling techniques such as CSS Flexbox and CSS Grid for layout design.
- Implement responsive design principles using media queries to create websites that adapt to different screen sizes.

Lab 5: Basic JavaScript

- Introduce JavaScript syntax, variables, data types, and operators.
- Write simple scripts to manipulate the DOM, such as changing text content, modifying styles, and handling events.

Lab 6: DOM Manipulation with JavaScript

- Explore the Document Object Model (DOM) and its relationship with HTML elements.
- Use JavaScript to select DOM elements and manipulate their properties and attributes.
- Implement basic interactivity by responding to user actions with event listeners and handlers.

Lab 7: Introduction to PHP

- Learn PHP fundamentals, including variables, data types, and control structures.
- Write PHP scripts to perform basic operations such as arithmetic calculations and string manipulation.

- Understand the role of PHP in server-side scripting and dynamic web content generation.

Lab 8: Working with Forms in PHP
- Handle form data using PHP, retrieve and process form submissions on the server.
- Perform form validation and sanitization to ensure data integrity and security.
- Store form data in variables, arrays, or databases for further processing.

Lab 9: XML Basics
- Introduce XML (eXtensible Markup Language) and its syntax.
- Create XML documents to represent structured data in a human-readable format.
- Explore XML elements, attributes, and namespaces.

Lab 10: Connecting PHP with MySQL
- Connect PHP scripts to a MySQL database using MySQLi or PDO.
- Execute SQL queries to perform CRUD operations (Create, Read, Update, Delete) on database records.
- Understand the importance of parameterized queries to prevent SQL injection attacks.

Lab 11: Session Management and File Handling in PHP
- Manage user sessions using PHP session handling mechanisms.
- Implement user authentication and authorization to control access to web pages and features.
- Explore file handling in PHP, including reading from and writing to files for data storage and retrieval.

Lab 12: **Building Dynamic Web Applications**
- Integrate HTML, CSS, JavaScript, and PHP to build dynamic web applications.
- Implement features such as user registration, login/logout functionality, user profile management, and data CRUD operations.
- Emphasize best practices for organizing code, separating concerns, and maintaining code readability and scalability.

Lab 13: Project-based Lab
- Work on a project that integrates concepts learned throughout the course, focusing on HTML, CSS, JavaScript, PHP, and XML.
- Design and develop a complete web application or website, incorporating responsive design principles and interactive features.
- Present the project to the class, highlighting the use of HTML, CSS, JavaScript, PHP, and XML for web development.

Text Books:

1. Learning PHP, MySQL, JavaScript, CSS & HTML5, Robin Nixon, Oreilly, 2016.

Reference Books:

1. Robert W Sebesta, “Programming the World Wide Web”, 8th Edition, Pearson Edition, 2014.
2. Chris Bates, “Web Programming Building Internet Applicatoins”, 3rd Editoin, Wiley India, 2014.
3. James Lee, Brent Ware, “Open Source Web Development with LAMP”, Pearson Education, 2013.

MOOCS:

1. **https://online-degree.swayam2.ac.in/mri22_01_d03_s1_el10/preview**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1													
CO2		2												
CO3			2										3	
CO4				2	3				3	3		2	3	

Course Title	Biology for Engineers		
Course Code	22AI406	(L-T-P)C	(2-0-0)1
Exam	3 Hrs.	Hours/Week	2
SEE	50 Marks	Total Hours	28

Course Objective: Realization of relation between Natural Engineering and man-made Engineering.

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	To familiarize engineering students with basic biological concepts	-	-
2.	Apply the interdisciplinary vision of biology to engineering	1	-
3.	Analyze how biological systems can be designed and engineered to substitute natural system	2	-
4.	To develop biological models using AI tools	5	-

Course Contents:

MODULE – 1	7 Hrs.

Introduction to Human Anatomy: Overview of human anatomy, Structural organization of the human body- cardiovascular system, endocrine system, digestive system, respiratory system, excretory system, lymphatic system, nervous system, muscular system and skeletal system.

MODULE – 2	7 Hrs.

Bio inspired Engineering based on human physiology: Circulatory system (artificial heart, pacemaker, stents), Nervous system (Artificial neural network).

MODULE -3	7 Hrs.

Bio inspired Algorithms and Applications: Genetic algorithm, Gene expression modelling. Parallel Genetic Programming: Methodology, History, and Application to Real-Life Problems. Dynamic Updating DNA Computing Algorithms. Beehive: New Ideas for Developing Routing Algorithms Inspired by Honey Bee Behaviour.

MODULE -4	7 Hrs.

Artificial Intelligence and Biology: Applications of AI in medical imaging, neural engineering, systems biology, microbiome and data mining.

Text Books:

1. Bioinspired Engineering, N Y: Momentum press, Jenkins, C.H. 2012 ISBN: 97816066502259
2. A Practical Guide to Bio-inspired Design, Hashemi Farzaneh, Helena, Lindemann, Udo, Springer2019, ISBN 978-3-662-57683-0

Reference Books:

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.

MOOCS

1. **https://onlinecourses.nptel.ac.in/noc19_ge31/preview**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2	1													
CO3		2												
CO4					2									

ENGINEERING SCIENCE COURSE/ EMERGING TECHNOLOGY COURSE/ PROGRAMING LANGUAGE COURSE

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	22AI407A	L-T-P-C	(2-0-2)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50

Course Objective: Design and develop java application programs using object-oriented concepts.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the concepts of OOP and Java constructs for the development of applications	1	-
2.	Analyze the given java program to make suitable changes and write the output	2	1
3.	Design and develop a java program, user interface to solve the given problem.	3	1
4.	Conduct practical experiments for demonstrating object oriented concepts through java.	3,5,9,10	-

Course Contents:

Module 1	10 Hours

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

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

Module 2	10 Hours

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

Module 3	10 Hours

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

Files, Streams- Byte streams, Character streams, Text input/output, Binary input/output, File management using File class

Module 4	10 Hours

GUI Programming with Swing: The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – Jbutton, JLabel, JTextField, JTextArea, simple Swing applications, Layout management – Layout manager types – border, grid and flow

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, Examples: Handling Mouse and Key events, Adapter classes.

Text Books:

1. Java Fundamentals, A comprehensive Introduction by Herbert Schildt, Dale Skrien.TataMcGraw Hill Edition 2013 (Chapters 1,2,3,4,5,6,7,8,9,10,12)
2. Java –The complete Reference, by Herbert Schildt Eight Edition Tata Mcgraw Hill Education (Chapter 19).

Reference Books:

1. Programming in JAVA2 by Dr K Somasundaram, Jaico publications
2. Java Programming by Hari Mohan Pandey, Pearson Education, 2012

MOOCs:

1. http://nptel.ac.in/courses/106106147/
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. https://www.coursera.org/specializations/object-oriented-programming

Activity:

Write and execute the following programs in java

1. Get acquainted with java environment. Print different patterns of asterisk (*) using loops (e.g. triangle of *). Compare syntactical similarities and dissimilarities between Java and C++
2. Create a class Employee and encapsulate the data members. Create demo applications to illustrate different types of inheritance.
3. Create an Array of Employee class and initialize array elements with different employee objects. Understand the No. of objects on heap memory when any array is created.
4. Create a demo application to understand the role of access modifiers. Implement multilevel, multiple and hybrid inheritance using different packages.
5. Access/invoke protected members/methods of a class outside the package. Override finalize method to understand the behaviour of JVM garbage collector.
6. Create sample classes to understand boxing & unboxing.
7. Use different methods of java defined wrapper classes.
8. Create StringDemo class and perform different string manipulation methods.
9. Understand the difference between String / StringBuffer / StringBuilder.
10. Development of applications using AWT components

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2		2											3	
CO3			2										3	
CO4			2		3				2	2				

Course Title	PYTHON FOR DATA SCIENCE		
Course Code	22AI407B	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	52

Course Objective: utilize the python constructs and libraries to perform data analysis.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the python libraries to load, preprocess, analysis and visualize the data.	1, 5	1
2.	Analyze the given data and interpret the results using python libraries	2,5	1
3.	Develop a python program to solve the given problem	3,5	1
4.	Work collaboratively and demonstrate the applicability of python libraries to solve real world data science problems	9,10,12	1

Course Contents:

Module 1 — **10 Hours**

Introduction to NumPy: Understanding data types in python, basics of NumPy arrays, NumPy array attributes, array indexing, array slicing, reshaping array, array concatenation and splitting, computations on NumPy Arrays.

Introduction to UFuncs, advanced UFancs features, Aggregation: Min, Max and in between, computation on arrays, rules of broadcasting, broadcasting in practice, comparisons, masks and Boolean logics, indexing, sorting arrays, NumPy's structured arrays.

Module 2 — **10 Hours**

Data Manipulation with Pandas: Introduction to pandas objects – Series object, DataFrame object, Index object, Data Indexing and selection for series and DataFrame, Operating on Data in Pandas, Handling missing data, Operating on Null values, hierarchical Indexing, combining datasets using Concat and Append, Merge and Join.

Aggregation and Grouping, Pivot tables, Vectorized string operations, working with Time series-Dates and Times in python, indexing by Time, time series data structures, frequencies and offsets, resampling, shifting and windowing, High-performance Pandas – eval() and query()

Module 3 — **10 Hours**

Visualization using Python: Importing matplotlib, setting styles, simple line plots, simple scatter plots, visualizing errors, density and contour plots, visualizing a three dimensional function, Histograms, binning and density, customizing plot legends, customizing ticks.

Three-Dimensional Plotting: Three-dimensional points and lines, three dimensional contour plots, surface triangulation, geographic data with basemap, visualization with Seaborn.

Module 4 — **10 Hours**

Statistics : Measures of Central Tendency, Statistics with Python, Measuring Variance, Normal Distribution, Binomial Distribution, Poisson Discrete Distribution, Bernoulli Distribution, P-value, Exploring Correlation in Python, Create a correlation Matrix using Python, Pearson's Chi-Square Test

Python Relational Database : Connect MySQL database using MySQL-Connector Python, Python: MySQL Create Table, Python MySQL – Insert into Table, Python MySQL – Select Query, Python MySQL – Update Query, Python MySQL – Delete Query

Text Books:

1. Python for Data Analysis, Wes McKinney, 2nd edition, O'Reilly Media, ISBN: 978-1-491-95766-0, 2018.
2. Python Data Science Handbook: Essential Tools for working with Data, Jake VanderPlas
3. Python Programming and SQL, Mark Reed
4. Introduction to Data Science: Practical Approach with R and Python, B Uma Maheshwari , R. Sujatha

Reference Books:

1. Introduction to Python for Data Science:Paul J. Deitel, Harvey M. Deitel, Harvey Deite

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc23_cs99/preview

Tutorial Component:

Programs with NumPy:

1. Creating NumPy arrays with different data types.
2. Exploring NumPy array attributes and performing basic operations.
3. Indexing and slicing NumPy arrays.
4. Reshaping arrays and performing array concatenation and splitting.
5. Implementing computations on NumPy arrays.

Programs with UFuncs

1. Introduction to Universal Functions (UFuncs) and advanced features.
2. Aggregation operations: finding minimum, maximum, and mean values.
3. Understanding broadcasting rules and applying them in practice.
4. Using masks and Boolean logic for array operations.
5. Sorting and indexing NumPy arrays.

Data Manipulation with Pandas

1. Creating and exploring Series and DataFrame objects in pandas.
2. Data indexing and selection for both Series and DataFrame.
3. Handling missing data and null values in pandas.
4. Hierarchical indexing and combining datasets using concatenation and append.
5. Performing merge and join operations on DataFrame objects.
6. Aggregation and grouping data in pandas.
7. Using pivot tables for data analysis.
8. Working with time series data: indexing by time and resampling.
9. Utilizing vectorized string operations in pandas.
10. Implementing high-performance operations using eval() and query().

Visualization using Python

1. Creating simple line plots and scatter plots using Matplotlib.
2. Visualizing errors and customizing plot styles.
3. Generating density and contour plots.
4. Visualizing three-dimensional functions and surfaces.
5. Creating histograms with customized bins and density plots.
6. Customizing plot legends and ticks.
7. Plotting three-dimensional points, lines, and contour plots.
8. Working with geographic data using Basemap.
9. Utilizing Seaborn for advanced visualization techniques.

Statistics and Python Relational Database

1. Calculating measures of central tendency using Python.
2. Exploring statistical distributions: Normal, Binomial, Poisson, Bernoulli.
3. Understanding p-values and hypothesis testing.
4. Exploring correlation using Python and creating correlation matrices.
5. Performing Pearson's Chi-Square Test for independence.
6. Connecting to a MySQL database using MySQL-Connector Python.
7. Creating tables, inserting, selecting, updating, and deleting data in MySQL using Python.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				3								3	
CO2		2			3								3	
CO3			2		3								3	
CO4									2	2	2			

Course Title	QUANTUM Algorithms		
Course Code	22AI407C	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40

Course Objective: The primary course objective is to develop a deep understanding of quantum mechanics and its application to quantum computing. Also, to develop practical skills in using quantum algorithms with hands on training for programming quantum solutions using Python and popular quantum programming libraries.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Implement quantum algorithms for practical problem-solving.	3,4	-
2.	Program quantum solutions using Python and quantum libraries.	5,10	-

Course Contents:

Module 1	10 Hours

Approaches of quantum computation Linear algebra essentials for quantum computing, Dirac notation and quantum states, Quantum operators and measurements, Eigenvalues and eigenvectors in quantum mechanics. Circuit and annealer model approaches of quantum computation.

Module 2	10 Hours

Basic Quantum Algorithms Quantum search algorithms: Grover's algorithm, Quantum factorization algorithms: Shor's algorithm

Quantum simulation: Applications in chemistry and physics, Quantum machine learning algorithms Quantum algorithms for solving linear systems (HHL algorithm)

Module 3	10 Hours

Advanced Quantum Algorithms Quantum Fourier transform and its applications, Quantum phase estimation, Variational Quantum Algorithms (VQAs), Quantum algorithms for optimization problems (e.g., QAOA), Quantum cryptography algorithms (e.g., BB84)

Module 4	10 Hours

Programming of Quantum Solutions with Python Introduction to quantum programming languages: Qiskit and Cirq, Building and simulating quantum circuits in Python, Error correction in quantum computing, Quantum software development tools and libraries in Python, Quantum annealing and adiabatic quantum computing with Python.

Text Books:

1. Quantum computation and quantum information- Michael A. Nielsen, Isaac L. Chuang - Cambridge University Press, 2004.
2. Modern Quantum Mechanics, J. J. Sakurai and Jim Napolitano.
3. Quantum Computing: From Linear Algebra to Physical Realizations, Mikio Nakahara and Tetsuo Ohmi.

Reference Books:

1. Quantum AlgorithmsbyRonald de Wolf, first edition.
2. Quantum Hardware by Merzbacher and Styer, first edition.
3. Quantum Information Theory and the Foundations of Quantum Mechanics by Christopher G. Timpson, first edition.
4. Quantum Error Correctionby Daniel A. Lidar and Todd A. Brun, first edition.

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview
2. https://onlinecourses.nptel.ac.in/noc23_cs04/preview

Activity	

1. Quantum Teleportation Experiment: Conduct an experiment showcasing quantum teleportation to demonstrate the principles of quantum entanglement learned in Module 1.
2. Grover's Algorithm for Multiple Items: Implement Grover's algorithm to search for multiple items in an unsorted database and analyze its performance.
3. Quantum Machine Learning Project: Develop a quantum machine learning model using Python and quantum circuits for a real-world dataset. Evaluate its performance and compare it with classical models.
4. Quantum Error Correction Simulator: Build a quantum error correction simulator in Python that models different error types and correction techniques. Test its effectiveness in preserving quantum information.
5. Quantum Annealing Project: Develop a Python program using quantum annealing techniques to solve optimization problems, such as the traveling salesman problem, and compare it with classical methods.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			2	2										
CO2					2					2				

Course Title	Discrete Mathematical Structures		
Course Code	22AI407D	L-T-P-C	(2-2-0)3
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	40

Course Objective:

1. Introduction of Discrete structures and principle of Combinatory which may be employed as tools in the applications of Computer Science & Information Technology.
2. Prepare student to use discrete mathematics as a tool in developing a consistent program in Computer Science & Information Technology.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply logic and counting principles to model and analyze problems of computer science & engineering	1,2	-
2.	Apply the concepts of logic to identify methods of mathematical proofs.	1,2	-
3.	Use concepts of functions in analyzing problems on algorithms and programs.	1,2	-
4.	Model and analyze programming problems related to coding theory.	1,2	-
5.	Derive mathematical model for real life problems related to Information science and Engineering.	1,2	-

Course Contents:

Module 1	10 Hours

Principles of Counting: The rule of sum and product, permutation principle, combination principle, rule of generalized Permutations and Combinations,

Fundamentals of Logic: Basic logic connectives and truth tables. Logical equivalence and Tautologies. Statement of laws of logic.

Self-study: Set theory – set operations, Venn diagram, Inclusion Exclusion principle.

Module 2	10 Hours

Fundamentals of Logic contd.: Logic implication - Rules of inference theory. Application of switching network.

Relations-definition and elementary properties, partially ordered sets, Hasse diagram, Lattice.

Self-study: Quantifiers, methods of proof, equivalence relations, partition of a set induced by a relation

Module 3	10 Hours

Functions: Ceiling function, Floor function, Characteristic function, and Application of Stirling numbers of second kind. Application of functions in vending machine.

Self-study: one to one and onto functions, Composition of functions

Module 4	10 Hours

Coding theory: Elements of coding theory, the humming matric**,** the parity – check and Generator matrices,

Group codes: Decoding with coset leaders. Hamming matrices.

Self-study: sub-groups, cosets, Matrix row operations.

Note –

1. **Theorems and properties without proof. Applicable to all the modules.**
2. **Self study part is not included for Semester End Examination.**

Text Books:

1. Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.

Reference Books:

1. Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006.

MOOCs:

1. **https://onlinecourses.nptel.ac.in/noc20_cs37/preview**

Activities

1. Application of switching network
2. Application to algorithm testing using computational complexity.
3. Computation of number of different ways n rooks can be arranged on an n x n chess board so that no two rooks can attack each other for all positive integers n.
4. Discuss ways in which the current telephone numbering plan can be extended to accommodate the rapid demand for more telephone numbers.
5. Application of functions in vending machine.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3												
CO2	3	3												
CO3	3	3												
CO4	3	3												
CO5	3	3												

Course Title	UNIVERSAL HUMAN VALUES		
Course Code	BUHK408	L-T-P-C	(2-0-0)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28 Hrs.

Course Objective: The course aims at the development of the value education by the right understanding through the process of self-exploration (about themselves), family, society and nature/existence. Strengthening of self-reflection by development of commitment and courage to act are presented as the prime focus throughout the course towards qualitative transformation in the life of the student.

Course Outcomes (COs): Upon completion of the course, students shall be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate an understanding of value education principles and their application in personal and professional contexts, fostering self-awareness and ethical decision-making	6, 8, 12	-
2.	Analyze the interconnectedness of human beings with themselves, their families, nature, and society, evaluating the significance of trust, respect, and harmony in fostering holistic relationships	6, 12	-
3.	Design strategies for integrating holistic understanding and ethical principles into professional practices, considering the implications of human values in decision-making, production systems, and management models	6, 8, 12	-

Course Contents:

Module 1	07 Hours

Introduction to Value Education: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations

Module 2	07 Hours

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self Lecture, Understanding Harmony in the Self Tutorial, Harmony of the Self with the Body to ensure self-regulation and Health.

Module 3	07 Hours

Harmony in the Family, Nature and Existence: Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust'– the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order.

Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 4	07 Hours

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models, Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Self-Learning Activities-

1. Sharing about One self and Exploring Natural Acceptance
2. Exploring Harmony of Self with the Body
3. Exploring the Feeling of Respect
4. Exploring the Four Orders of Nature Lecture and Exploring Co-existence in Existence
5. Exploring Humanistic Models in Education, Exploring Steps of Transition towardsUniversal Human Order

Text Books:

1. The Textbook: A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, GP Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. The Teacher's for a Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana,G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. Jeevan Vidya:EkParichaya, ANagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. HumanValues, A.N.Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5. Small is Beautiful-E.F Schumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence-JCKumarappa
8. Bharat Mein Angreji Raj–Pandit Sunderlal.
9. Redis covering India-by Dharampal
10. Hind Swarajor Indian Home Rule-by Mohandas K. Gandhi.
11. India Wins Freedom-Maulana Abdul Kalam Azad
12. Vivekananda-Romain Rolland(English)
13. Gandhi-Romain Rolland(English)

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	2	2			2		
CO2						2	2	2	2			2		
CO3						2	2	2	2			2		

Ability Enhancement Course-III

Course Title	Data analytics with Excel		
Course Code	22AI409A	L-T-P	(0-0-2)1
Exam	3 Hrs.	Hours/Week	2
SEE	50 Marks	Total Hours	28

Course Objective: Students will be able to use appropriate data structures for solving problems.
Course outcomes: At the end of course, student will be able to:

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the basic excel function on given data	1,5,12	-
2.	Analyze the given data using excel function	2,5,12	-
3.	Design and develop a solution to the given real-world problems using excel functions	3,5,12	1
4.	Communicate the results effectively individually and in teams	9,10	-

List of Experiments:

1. Getting Started with Excel: Creation of spread sheets, Insertion of rows and columns, Drag& Fill, use of Aggregate functions.
2. Working with Data: Importing data, Data Entry & Manipulation, Sorting & Filtering.
3. Working with Data: Data Validation, Pivot Tables & Pivot Charts.
4. Data Analysis Process: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs.
5. Cleaning Data with Text Functions: use of UPPER and LOWER, TRIM function, Concatenate.
6. Cleaning Data Containing Date and Time Values: use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions.
7. Conditional Formatting: formatting, parsing, and highlighting data in spreadsheets during data analysis.
8. Working with Multiple Sheets: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports.
9. Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
10. Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data.
11. Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts.
12. Generation of report & presentation using Autofilter &macro.

Text Books:

1. Berk & Carey - Data Analysis with Microsoft® Excel: Updated for Offi ce 2007®, ThirdEdition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4
2. Wayne L. Winston - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180.
3. Aryan Gupta - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel)

Reference Books:

1. "Excel 2019 Bible" by Michael Alexander and Richard Kusleika
2. "Data Analysis Using Excel" by Michael R. Middleton

3. "Effective Data Visualization" by Stephanie D. H. Evergreen

MOOCs:

1. https://www.mygreatlearning.com/academy/learn-for-free/courses/data-analytics-using-excel

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2				3							2		
CO2		2			3							2		
CO3			2		3							2	1	
CO4									3	3				

Course Title	Technical writing using LATEX		
Course Code	22AI409B	L-T-P	(0-0-2)1
Exam	3 Hrs	Hours/Week	2
SEE	50 marks	Total Hours	28

Course Objective:

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the constructs of LATEX and create technical documents.	1	-
2.	Analyze the given template and create the technical document as per the template given.	2	-
3.	Create a sample research paper, report and typeset it in LATEX templates from publisher sites.	3	-
4.	Communicate the LATEX constructs in teams and report writing	9,10	-

Course Contents:

Module 1	7 Hours

Introduction

Introduction to LaTeX, its installation, and different IDEs. Creating the first document using LaTeX, organizing content into sections using article and book class of LaTeX.

Module 2	7 Hours

Styling Pages

Reviewing different paper sizes, examining packages, formatting the page by setting margins, customizing header and footer, changing the page orientation, dividing the document into multiple columns, reading different types of error messages.

Module 3	7 Hours

Formatting Content

Formatting text (styles, size, alignment), adding colors to text and entire page, and adding bullets and numbered items, writing complex mathematics.

Module 4	7 Hours

Tables and Images

Creating basic tables, adding simple and dashed borders, merging rows and columns, and handling situations where a table exceeds the size of a page, adding an image, exploring different properties like rotate, scale.

Text Books:

1. "Technical Writing: A Practical Guide for Engineers and Scientists", Phillip A Laplante, 1st Edition, CRC Press, 2011.
2. "The Not So Short Introduction to LATEX", Tobias Oetiker, 2e https://cslab.pepperdine.edu/warford/cosc320/lshort.pdf [retrieved 18 Oct. 22]

Reference Books:

1. LaTeX in 24 Hours: A Practical Guide for Scientific Writing 1st ed. 2017 Edition, Kindle Edition, ISBN-13: **978-3319478302**

MOOCs:

1. https://onlinecourses.swayam2.ac.in/aic20_sp17/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1													
CO2		3												
CO3			2											
CO4									3	3				

Course Title	Ethics and Public Policy for AI		
Course Code	22AI409C	L-T-P	(0-0-2)1
Exam	3 Hrs	Hours/Week	2
SEE	50 marks	Total Hours	28

Course Objective:

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply ethical principles to guide the development and deployment of AI technologies.	**1**	-
2.	Analyze and assess the ethical implications of AI technologies, considering various ethical frameworks.	**2**	-
3.	Evaluate the ethical implications of AI technologies on society.	**6**	-
4.	Communicate effectively about AI ethics and public policy issues.	**9,10**	-

Course Contents:

MODULE-1	7 Hrs

An Ethical Framework for a Good AI Society: opportunities, Risks, principles andRecommendations. Establishing the rules for building trustworthy AI

Translating principles into practices of digital ethics: five risks of being Unethical

MODULE-2	7 Hrs

The Ethics of Algorithms: Key problems and Solution

How to Design AI for Social Good: Seven Essential Factors.

How to design AI for social good: seven essential factors

MODULE-3	7 Hrs

From What to How: An Initial Review of publicly available AI Ethics tools, Methods and Research to Translate principles into Practices.

Innovating with Confidence: Embedding AI Governance and fairness in financial Services Risk management framework,What the near future of AI could be**.**

MODULE-4	7 Hrs

Human-AI Relationship: AI and Workforce, Autonomous Machines and Moral Decisions.

AI in HealthCare: balancing Progress and Ethics.Regulation and Governance of AI Ethics

Text Books

1. "Ethics, governance and Policies in Artificial Intelligence", Author-Editor : Luciano Floridi, Springer, 1st Edition 2021, vol 144, Oxford Internet Institute, University of ixford, UK, ISSN 0921-8599, e-ISSN 2542- 8349 Philosophical Studies series, ISBN 978-3-030-81906-4 e-ISBN 978-3-030-81907-1, ://doi.orghttps/10.1007/978-3-030-81907-1, 2021. 2.
2. "Ethics and AI: Navigating the Moral Landscape of Digital Age", Author: Aaron Aboagye,

Reference Book:

1. Artificial Intelligence: A Guide to Intelligent Systems" by Michael Negnevitsky

MOOCs:

1. **https://onlinecourses.nptel.ac.in/noc23_hs47/preview**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2													
CO2		3												
CO3						2								
CO4									3	3				

Course Title	UI/UX		
Course Code	22AI409D	(L-T-P)C	(0-0-2)1
SEE duration	3 hour	Hours / Week	02
SEE marks	50	Total contact hours	28

Course Objective: Students will be able to build UI and UX based systems.

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

No.	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply foundational principles of UI/UX design to develop user-friendly interfaces, demonstrating proficiency in interface composition and structure.	1	1
2.	Analyze user experience design processes and methodologies, critically evaluating usability heuristics and conducting non-visual user testing to optimize interface functionality.	2	1
3.	Design and develop comprehensive information architectures and wireframes, integrating responsive design principles to create visually appealing and accessible prototypes	3	1
4.	Conduct practical experiment for interface connectivity establishment, interaction design implementation, navigation design, and creation of UI/UX prototypes, aligning with industry standards and tools and demonstrate the same.	5,6,7,8,9, 10,11,12	1

Course Contents:

Module 1	7 Hours

Foundational Elements of UI/UX: User Interface - The Relationship Between UI and UX - Roles in UI/UX - A Brief Historical Overview of Interface. Formal Elements of Interface Design Before Design - Look and Feel - Language as a design tool - Active Elements of Interface Design - Static to Active - Functionality - Speed and Style - Composition and Structure - Composing the Elements of Interface Design.

Module 2	7 Hours

User Experience Design Foundations: Ideation, Articulation, Development - Planning, Testing, Researching, Mapping - Mapping Content -Mapping Interaction -Non-Visual Paper Prototyping - Non-Visual User Testing -Look and Feel/Visual Research. What Goes Where: Getting real: Wireframes and Interfaces - Nielsen's Usability Heuristics - Consistency and Details - Wireframe Map - Visual Direction - Developing UI - Refining UI.

Module 3	7 Hours

Web Design: Strategies and Information Architecture: The User Experience Process - User-centric design - The UX Phases - Waterfall vs. Agile - Web vs. App. Determining Strategy: User Research - Inspiration - Analytics - User Needs and Client Needs - Target Audience - What is in and What is Out: Outlining Scope - Content and Functionality. The Sitemap: Introduction to Sitemaps - Information Architecture - Sitemap Concerns - annotated process - Elements - Treejack Introduction - Treejack Analysis.

Module 4	7 Hours

Web Designs: Wire Frames to Prototypes: Introduction to Wireframes - Responsive Design: Introduction and Primary navigation - Secondary and utility navigation - Related content, inline links, indexes, and search - Wayfinding - Common Form Elements - Homepage Content Strategies - Examples of Homepage Content Strategies - Wireframing Tools. The Mockup Phase: Visual Mockups - Design Principles - Using whitespace to style a form - Web Fonts - Web Typography: Creating Visual Mockups. Putting it all Together: Clickable Prototypes - Invision - Exporting Assets - Importing Assets and Creating Hotspots - Hotspot Templates.

Practical Components:

1. Identifying interface connectivity and establishing interface connectivity between two different program modules.
2. Understand front end and back end interfacing and implementation of both interfacing.
3. Identifying interaction design and functional layout. Practical implementation of interaction

design and functional layout.
4. Identify and analyse "what is navigation design" and implementing of navigation design
5. Create a working UI/UX prototype using prototyping tools.
6. Study and analysis of sharing and exporting the UI/UX design.
7. Study about custom control and operational control their working and tools used.
8. Study about implementation of information search module using UI/UX.
9. Study and analysis of navigation design and its implementation.
10. Creating Social media advertisement using online tools and applications.

TEXT BOOKS

1. Sketching User Experiences: Getting the Design Right and the Right Design - Buxton, B, Morgan Kaufmann, (2007).
2. The Elements of User Experience: User-centered Design for the Web - Jesse James Garrett, New Riders; 2 edition2010.

REFERENCES

1. A Project Guide to UX Design: For User Experience Designers in the Field orin the Making, Russ Unger, Carolyn Chandler, New Riders; 2nd edition, 2012.nd
2. The Design of Everyday Things, Basic Books; Don Norman, 2 edition, 2013.
3. UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication, Everett N. McKay, Morgan Kaufmann; Illustrated edition, 2013.
4. Design Patterns: Elements of Reusable Object - Oriented Software, Dr. Erich Gamma, Ralph Johnson, Richard Helm and John Vlissides, Pearson, 2008

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. https://onlinecourses.swayam2.ac.in/aic19_de04/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1												3	
CO2		2											3	
CO3			2										3	
CO4					3	1	1	1	3	3	2	3	3	