M Sc ARTIFICIAL INTELLIGENCE

LOCF SYLLABUS 2024

Department of Artificial Intelligence

School of Computing Sciences

St. Joseph's College (Autonomous)

Tiruchirappalli - 620002, Tamil Nadu, India

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS) POSTGRADUATE COURSES

St. Joseph's College (Autonomous), an esteemed institution in the realm of higher education in India, has embarked on a journey to uphold and perpetuate academic excellence. One of the pivotal initiatives in this pursuit is the establishment of five Schools of Excellence commencing from the academic year 2014-15. These schools are strategically designed to confront and surpass the challenges of the 21st century.

Each School amalgamates correlated disciplines under a unified umbrella, fostering synergy and coherence. This integrated approach fosters the optimal utilization of both human expertise and infrastructure. Moreover, it facilitates academic fluidity and augments employability by nurturing a dynamic environment conducive to learning and innovation. Importantly, while promoting collaboration and interdisciplinary study, the Schools of Excellence also uphold the individual identity, autonomy, and distinctiveness of every department within.

The overarching objectives of these five schools are as follows:

Optimal Resource Utilization: Ensuring the efficient use of both human and material resources to foster academic flexibility and attain excellence across disciplines.

Horizontal Mobility for Students: Providing students with the freedom to choose courses aligning with their interests and facilitating credit transfers, thereby enhancing their academic mobility and enriching their learning experience.

Credit-Transfer Across Disciplines (CTAD): The existing curricular structure, compliant with regulations from entities such as TANSCHE and other higher educational institutions, facilitates seamless credit transfers across diverse disciplines. This underscores the adaptability and uniqueness of the choice-based credit system.

Promotion of Human Excellence: Nurturing excellence in specialized areas through focused attention and resources, thus empowering individuals to excel in their respective fields.

Emphasis on Internships and Projects: Encouraging students to engage in internships and projects, serving as stepping stones toward research endeavors, thereby fostering a culture of inquiry and innovation.

Addressing Stakeholder Needs: The multi-disciplinary nature of the School System is tailored to meet the requirements of various stakeholders, particularly employers, by equipping students with versatile skills and competencies essential for success in the contemporary professional landscape.

In essence, the Schools of Excellence at St. Joseph's College (Autonomous) epitomize a holistic approach towards education, aiming not only to impart knowledge but also to cultivate critical thinking, creativity, and adaptability – qualities indispensable for thriving in the dynamic global arena of the 21st century.

Credit system

The credit system at St. Joseph's College (Autonomous) assigns weightage to courses based on the hours allocated to each course. Typically, one credit is equivalent to one hour of instruction per week. However, credits are awarded regardless of actual teaching hours to ensure consistency and adherence to guidelines.

The credits and hours allotted to each course within a programme are detailed in the Programme Pattern table. While the table provides a framework, there may be some flexibility due to practical sessions, field visits, tutorials, and the nature of project work.

For postgraduate (PG) courses, students are required to accumulate a minimum of 110 credits, as stipulated in the programme pattern table. The total minimum number of courses offered by the department is outlined in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

OBE is an educational approach that revolves around clearly defined goals or outcomes for every aspect of the educational system. The primary aim is for each student to successfully achieve these predetermined outcomes by the culmination of their educational journey. Unlike traditional methods, OBE does not prescribe a singular teaching style or assessment format. Instead, classes, activities, and evaluations are structured to support students in attaining the specified outcomes effectively.

In OBE, the emphasis lies on measurable outcomes, allowing educational institutions to establish their own set of objectives tailored to their unique context and priorities. The overarching objective of OBE is to establish a direct link between education and employability, ensuring that students acquire the necessary skills and competencies sought after by employers.

OBE fosters a student-centric approach to teaching and learning, where the delivery of courses and assessments are meticulously planned to align with the predetermined objectives and outcomes. It places significant emphasis on evaluating student performance at various levels to gauge their progress and proficiency in meeting the desired outcomes.

Here are some key aspects of Outcome-Based Education:

Course: A course refers to a theory, practical, or a combination of both that is done within a semester.

Course Outcomes (COs): These are statements that delineate the significant and essential learning outcomes that learners should have achieved and can reliably demonstrate by the conclusion of a course. Typically, three or more course outcomes are specified for each course, depending on its importance.

Programme: This term pertains to the specialization or discipline of a degree programme.

Programme Outcomes (POs): POs are statements that articulate what students are expected to be capable of by the time they graduate. These outcomes are closely aligned with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs outline the specific skills and abilities that students should possess upon graduation within a particular discipline or specialization.

Programme Educational Objectives (PEOs): PEOs encapsulate the expected accomplishments of graduates in their careers, particularly highlighting what they are expected to achieve and perform during the initial years postgraduation.

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The Learning Outcomes-Centric Framework (LOCF) places the learning outcomes at the forefront of curriculum design and execution. It underscores the importance of ensuring that these outcomes are clear, measurable, and relevant. LOCF orchestrates teaching methodologies, evaluations, and activities in direct correlation with these outcomes. Furthermore, LOCF adopts a backward design approach, focusing on defining precise and attainable learning objectives. The goal is to create a cohesive framework where every educational element is in harmony with these outcomes.

Assessment practices within LOCF are intricately linked to the established learning objectives. Evaluations are crafted to gauge students' achievement of these outcomes accurately. Emphasis is often placed on employing authentic assessment methods, allowing students to showcase their learning in real-life scenarios. Additionally, LOCF frameworks emphasize flexibility and adaptability, enabling educators to tailor curriculum and instructional approaches to suit the diverse needs of students while ensuring alignment with the defined learning outcomes.

Some important terminologies

Core Courses (CC): *These are compulsory courses that students must undertake as essential components of their curriculum, providing fundamental knowledge within their primary discipline. Including core courses is essential to maintain a standardized academic programme, ensuring recognition and consistency across institutions.*

Common Core (CC): *A common core course is a shared educational element encompassing fundamental topics across disciplines within a school. It promotes interdisciplinary comprehension and collaboration among students by providing a foundational understanding of key subjects essential for academic and professional success across diverse fields of study.*

Elective Courses (ES): *Elective courses are offered within the main discipline or subject of study. They allow students to select specialized or advanced options from a range of courses, offering in-depth exposure to their chosen area of study. Typically, ES are more applied in nature and provide a deeper understanding of specific topics.*

Generic Elective Courses (EG): *These elective courses are chosen from disciplines unrelated to the student's main area of study, aiming to broaden their exposure and knowledge base. As per the Choice Based Credit System (CBCS) policy, students may opt for generic elective courses offered by other disciplines within the college, enhancing the diversity of their learning experience.*

Ability Enhancement Course (AE): *AE is designed to enhance skills and proficiencies related to the student's main discipline. It aims to provide practical training and hands-on experience, contributing to the overall development of students pursuing academic programmes.*

Skill Enhancement Course (SE): *SE focus on developing specific skills or proficiencies relevant to students' academic pursuits. While it is open to students from any discipline, SE is particularly beneficial for those within the related academic programme.*

Self-paced Learning (SP): *This course promotes independent learning habits among students and they have to undergo the course outside the regular class hours within a specified timeframe.*

Comprehensive Examinations (CE): *These examinations cover detailed syllabi comprising select units from courses offered throughout the programme. They are designed to assess crucial knowledge and content that may not have been covered extensively in regular coursework.*

Extra Credit Courses: *To support students in acquiring knowledge and skills through online platforms such as Massive Open Online Courses (MOOCs), additional credits are granted upon verification of course completion. These extra credits can be availed across five semesters (2 - 4). In line with UGC guidelines, students are encouraged to enhance their learning by enrolling in MOOCs offered by portals like SWAYAM, NPTEL, and others. Additionally, certificate courses provided by the college are also considered for these extra credits.*

Outreach Programme (OR): *It is a compulsory course to create a sense of social concern among all the students and to inspire them to dedicated service to the needy.*

Course Coding

The following code system (10 alphanumeric characters) is adopted for Postgraduate courses:

24	**UXX**	**0**	**XX**	**00/X**
Year of Revision	PG Department Code	Semester Number	Course Specific Initials	Running Number/with Choice

Course Specific Initials

CC - Core Course
CP - Core Practical
ES - Elective
AE - Ability Enhancement Course
SP - Self-paced Learning
EG - Generic Elective
PW - Project and Viva Voce
CE - Comprehensive Examination
OR - Outreach Programme
IS - Internship

EVALUATION PATTERN

Continuous Internal Assessment (CIA)

Sl No	Component	Mark
1	Mid Semester Test	30
2	End Semester Test	30
3	Two Components (15 + 20)	35
4	Library Referencing (K3)	5
	Total	**100**

Passing minimum: 50 marks

Mark Distribution for K-levels

Component	Theory Courses up to K6	
	K levels	Mark
Component I	K1	7
	K2	8
Component II	K4	7
	K5	7
	K6	6
Mid Semester Test/ End Semester Test	K1	7
	K2	15
	K3	18
	K4*	10
	K5#	10
	K6@	10

** Not applicable for End Semester Test*
 # Applicable for both Mid and End Semester Test
@ Not applicable for Mid Semester Test

Blue Print of Question Paper for Mid/End Semester Test

Duration: 2.00 Hours							**Maximum Mark : 60**
K levels→ / **SECTIONS ↓**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION –A (1 Mark, No choice) (7 × 1 = 7)	7						7
SECTION-B (3 Marks, No choice) (5 × 3 = 15)		5					15
SECTION-C (6 Marks, Either/or) (3×6 = 18)			3				18
SECTION-D (10 Marks, 2 out of 3) (2×10=20)	*For Mid Semester Test*			1(2)	1*		20
	For End Semester Test				1(2)	1*	
Total Marks	7	15	18	20			60
Weightage for 100 %	12	25	30	33			100

** Compulsory*

Blue Print of Question Paper for Semester Examination (SE)

Duration: 3.00 Hours							**Maximum Mark : 100**
K levels→ **SECTIONS ↓**	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
SECTION-A (1 Mark, No choice) (10×1 =10)	10						10
SECTION-B (3 Marks, No choice) (10×3=30)		10					30
SECTION-C (6 Marks, Either/or) (5×6 =30)			5				30
SECTION-D (10 Marks, 3 out of 5)(3×10=30)				1(2)	1(2)	1*	30
							100

**Compulsory*

Evaluation Pattern for One/Two-credit Courses

Title of the Course	CIA	Semester Examination	Total Marks
Ability Enhancement Course Skill Enhancement Course: Soft Skills	100	-	100
Self-paced Learning Comprehensive Examination	25 + 25 = 50	50 *(CoE)*	100
Internship Field Visit	100	100	100

COMPUTATION OF GRADE AND GRADE POINTS

Grading of the Courses		
Mark Range	**Grade Point**	**Grade**
90 & above	10	O
80 & above but below 90	9	A+
70 & above but below 80	8	A
60 & above but below 70	7	B+
50 & above but below 60	6	B
Below 50	0	RA

Grading of the Final Result		
Cumulative Grade Point Average	**Grade**	**Performance**
9.00 & above	O	Outstanding*
8.00 to 8.99	A+	Excellent*
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average

**The Candidates who have passed in the first appearance and within the prescribed duration of the PG programme are eligible. If the candidates Grade is O/A+ with more than one attempt, the Performance is fixed as "Very Good".*

Details of calculation

Final Marks = (CIA Marks + SE Marks) / 2
Weighted Marks = Final Marks × Credits
Weighted Average Marks = Total Weighted Marks / Total Credits

Formula for Cumulative Grade Point Average (CGPA)

$$CGPA = \frac{\sum_{i=1}^{n} C_i Gp_i}{\sum_{i=1}^{n} C_i}$$

Where,

Ci - credit earned for the Course i

Gpi - Grade Point obtained for the Course i

*n - Number of Courses **passed** in that semester*

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value- driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

1. Graduates will be able to accomplish professional standards in the global environment.
2. Graduates will be able to uphold integrity and human values.
3. Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to equip themselves to use critical, analytical, and deep in thought thinking and analysis in visual communication.
2. Graduates will be able to apply and create with modern Media Tools and Applications for the advancements in achieving the Professional Knowledge.
3. Graduates will be able to engage in socially relevant research and effectively communicate through the findings.
4. Graduates will progress with a sense of commitment to fully meet the expectation of the media industry.
5. Graduates will become ethically committed professional and entrepreneurs with upholding human values.

Programme Specific Objectives (PSOs)

1. Prepare students to engage respectfully with diverse ideas, behaviors, and beliefs, applying various frames of reference in their decisions and actions.
2. Cultivate effective entrepreneurs by enhancing critical thinking, problem-solving, decision-making, and leadership skills that facilitate startups and high-potential organizations.
3. Design and implement HR systems and practices grounded in research that comply with employment laws, guiding organizations towards growth and development.
4. Produce employable, ethical, and innovative professionals who can thrive in a dynamic business environment.
5. Contribute to societal development by collaborating with stakeholders for mutual benefit.

M. Sc. Artificial Intelligence

PROGRAMME STRUCTURE				
Semester	**Specification**	**Number of Courses**	**Hours**	**Credits**
1 - 4	Core Course	10	46	44
1 - 3	Core Practical	5	20	15
1, 2, 4	Elective	4	20	14
1	Ability Enhancement Course	1	2	1
2	Self-paced Learning	1	-	2
2	Skill Enhancement Course	1	4	3
2, 3	Generic Elective	2	8	6
3	Internship	1	-	2
2 - 4	Extra Credit Course	3	-	(9)
4	Project Work and Viva Voce	1	20	17
4	Comprehensive Examination	1	-	2
2 - 4	Outreach Programme (SHEPHERD)	-	-	4
	Total	**20**	**120**	**110(9)**

M Sc ARTIFICIAL INTELLIGENCE							
PROGRAMME PATTERN							
Course Details					**Scheme of Exams**		
Sem	**Course Code**	**Title of the Course**	**Hours**	**Credits**	**CIA**	**SE**	**Final**
1	24PAI1CC01	**Core Course - 1**: Artificial Intelligence and Expert Systems	5	5	100	100	100
	24PAI1CC02	**Core Course - 2**: Design and Analysis of Algorithms	5	4	100	100	100
	24PAI1CC03	**Core Course - 3**: Python Programming	4	4	100	100	100
	24PAI1CP01	**Core Practical - 1**: Python Programming	4	3	100	100	100
	24PAI1ES01	**Elective - 1:** Mathematical Foundation	5	3	100	100	100
	24PAI1ES02	**Elective - 2:** Big Data Analytics	5	3	100	100	100
	24PAI1AE01	**Ability Enhancement Course:** Algorithm Lab using C++	2	1	100	-	100
		Total	**30**	**23**			
2	24PAI2CC04	**Core Course - 4**: Machine Learning	5	5	100	100	100
	24PAI2CC05	**Core Course - 5**: Data Base Management System	4	4	100	100	100
	24PAI2CP02	**Core Practical - 2**: Machine Learning with Python/R	4	3	100	100	100
	24PAI2CP03	**Core Practical - 3**: DBMS	4	3	100	100	100
	24PAI2SP01	**Self-paced Learning:** Internet of Things*	-	2	50	50	50
	24PAI2ES03A	**Elective - 3:** Distributed Operating Systems	5	4	100	100	100
	24PAI2ES03B	**Elective - 3:** Deep Learning					
	23PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	3	100	-	100
	24PAI2EG01	**General Elective - 1: (WS):** Artificial Neural Networks and Fuzzy Systems	4	3	100	100	100
	-	Extra Credit Courses (MOOC/Certificate Courses) - 1	-	(3)			
		Total	**30**	**27(3)**			
3	24PAI3CC06	**Core Course - 6**: Natural Language Processing	5	5	100	100	100
	24PAI3CC07	**Core Course - 7**: Advanced Web Technology	4	4	100	100	100
	24PAI3CC08	**Core Course - 8**: Optimization Techniques	4	4	100	100	100
	24PAI3CC09	**Core Course - 9**: Research Methodology	5	4	100	100	100
	24PAI3CP04	**Core Practical - 4 :** Natural Language Processing	4	3	100	100	100
	24PAI3CP05	**Core Practical -5 :** Advanced Web Technology	4	3	100	100	100
	24PAI3EG02	**Generic Elective-2 (BS):** Introduction to Cyber Security	4	3	100	100	100
	24PAI3IS01	Internship	-	2	100	-	100
	-	Extra Credit Courses (MOOC/Certificate Courses) - 2	-	(3)			
		Total	**30**	**28(3)**			
4	24PAI4CC10	**Core Course - 10**: Pattern Recognition and Image Analysis	5	5	100	100	100
	24PAI4ES04A	**Elective - 4:** Cryptography and Network Security	5	4	100	100	100
	24PAI4ES04B	**Elective - 4:** Virtual Reality					
	24PAI4PW01	Project Work and Viva Voce	20	17	100	100	100
	24PAI4CE01	Comprehensive Examination*	-	2	50	50	50
	-	Extra Credit Courses (MOOC/Certificate Courses) - 3	-	(3)			
		Total	**30**	**28(3)**			
2 - 4	24PCW4OR01	Outreach Programme (SHEPHERD)	-	4			
1 - 4		**Total (2years)**	**120**	**110(9)**			

*- for grade calculation 50 marks are converted into 100 in the mark statements

Passed by	***Board of Studies held on 25.09.2024***
Approved by	***49th Academic Council Meeting held on 10.10.2024***

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1CC01	**Core Course - 1:** Artificial Intelligence and Expert Systems	5	5

Course Objectives
To understand the basics of Artificial Intelligence.
To explore various search algorithms and their problem-solving abilities.
To develop skills in using First-order Logic and PROLOG for problem-solving.
To assess the reliability of reasoning systems in handling uncertainty.
To evaluate the effectiveness of expert systems in addressing real-world problems.

UNIT I: Fundamentals of Artificial Intelligence (15 Hours)

Introduction to A. I. Representation - Non-AI & AI Techniques - Representation of Knowledge - Knowledge Base Systems - State Space Search - Production Systems - Problem Characteristics - types of production systems - Intelligent Agents and Environments - concept of rationality - the nature of environments - structure of agents - problem solving agents - problem formulation

UNIT II: Search Strategies (15 Hours)

Uninformed Search: Formulation of real-world problems - Breadth First Search - Depth First Search - Depth Limited Search - Iterative Deepening Depth First Search - Bidirectional Search - Comparison of Uninformed Search Strategies. **Informed Search:** Generate & test - Hill Climbing - Best First Search - A* and AO* Algorithm - Constraint satisfaction - Game playing: Minimax Search - Alpha-Beta Cutoffs - Waiting for Quiescence.

UNIT III: Knowledge Representation (15 Hours)

Knowledge based agents - Wumpus world. **Propositional Logic**: Representation - Inference - Reasoning Patterns - Resolution - Forward and Backward Chaining. First order Logic: Representation - Inference - Reasoning Patterns - Resolution - Forward and Backward Chaining. **Basics of PROLOG**: Representation - Structure - Backtracking.

UNIT IV: Non-Monotonic Reasoning (15 Hours)

Logics for Non-Monotonic Reasoning - Semantic Nets - Statistical Reasoning - Fuzzy logic: fuzzy set definition and types - membership function - designing a fuzzy set for a given application. Probability and Bayes' theorem - Bayesian Networks.

UNIT V: Expert Systems (15 Hours)

Architecture of expert systems - Role of expert systems – Knowledge Acquisition – Meta knowledge - Heuristics. Typical expert systems – Mycin – Prospector.

Teaching Methodology	Lecture-based instruction - Project-based learning – Discovery Learning

Books for Study

1. Rich, E. K. & Nair, S. B. (2008). *Artificial Intelligence*, (3rd Ed.). Tata McGraw Hill.
2. Russell, S. & Norvig, P. (2003). *Artificial Intelligence: A Modern Approach*. (3rd Ed.). Pearson Education.
3. Waterman, D. A. (1986). *A Guide to Expert System*s. (3rd Ed.). Addison Wesley Publishing Company.

Books for Reference

1. Bratko, I. (1986). *Prolog Programming for Artificial Intelligence*. (2nd Ed.). Addison Wesley.
2. Charniak, E. & McDermott, D. (1985). *Introduction to Artificial Intelligence*. Addison Wesley.
3. Patterson, D. W. (1992). *Introduction to Artificial Intelligence and Expert Systems*. Prentice-Hall of India.
4. Nilsson, N. J. (1980). *Principles of Artificial Intelligence*. Morgan Kaufmann.

5. Townsend, C (1989). *Introduction to Turbo Prolog*. Sybex.

Websites and eLearning Sources

1. https://www.kaggle.com/learn/ai-expert-systems
2. https://www.ibm.com/watson
3. https://www.deeplearning.ai

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	define the fundamental concepts of artificial intelligence.	**K1**
CO2	explain the workings of different uninformed search algorithms.	**K2**
CO3	develop solutions using first-order logic and prolog for problem-solving.	**K3**
CO4	analyze the reliability and accuracy of reasoning systems.	**K4**
CO5	evaluate the effectiveness of expert systems in solving complex real-world problems	**K5**
CO6	create innovative expert systems by integrating advanced knowledge acquisition techniques.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**24PAI1CC01**			**Core Course - 1:** Artificial Intelligence and Expert Systems						**5**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	3	3	2	1	**2.4**
CO2	2	2	3	2	2	2	2	3	2	2	**2.2**
CO3	3	2	3	2	2	3	2	3	2	2	**2.4**
CO4	3	2	2	2	2	3	2	2	2	2	**2.2**
CO5	2	3	3	2	1	2	3	3	2	1	**2.2**
CO6	2	3	3	2	1	2	3	3	2	1	**2.2**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1CC02	**Core Course - 2:** Design and Analysis of Algorithms	5	4

Course Objectives
To understand fundamental concepts of Algorithm.
To impart knowledge about Basic Traversal and Search Techniques and Problematic Design.
To implement the linear and non-linear data structures.
To analyze the efficiency and complexity of algorithms.
To foster problem-solving skills through algorithmic thinking.

UNIT I: **(15 Hours)**

Introduction to Algorithms Algorithm-Specification - Performance Analysis. Divide And Conquer - General Method - Binary Search - Find the Maximum and Minimum - Quick sort - Strassen's Matrix Multiplication.

UNIT II: **(15 Hours)**

Representing rooted trees Hash Tables: Direct- address tables-Hash tables- Hash functions - Open addressing- Perfect hashing – Binary Search Trees: Querying a binary search tree- Insertion and deletion- Randomly built binary search trees – Red-Black Trees: Properties of red-black trees- Rotations- Insertion- Deletion – B- Trees: Definition of B-trees- Basic Operations-Deleting a key from a B-tree.

UNIT III: **(15 Hours)**

The Greedy Method The Greedy Method: General Method - Knapsack Problem - Job Sequencing with Deadlines- Minimum Cost Spanning Tree - Single Source Shortest Path. Dynamic Programming: General Method-Multistage Graph-All Pairs Shortest Path -Optimal Binary Search Tree - 0/1 Knapsack- Travelling Salesperson Problem.

UNIT IV: **(15 Hours)**

Basic Traversal and Search Techniques Techniques for Binary Trees –Techniques for Graphs Connected Components and Spanning Trees-Bi-connected Components and DFS. Backtracking: General Method-8-Queen Problem- Sum of Subsets Graph Coloring: Hamiltonian Cycle.

UNIT V: **(15 Hours)**

Graph Algorithms Representation of Graphs- Breadth first search- Depth first search- Topological sort. Minimum Spanning Trees: Algorithms of Kruskal and Prim – Single Source Shortest Path: The Bellman-Ford Algorithm- Single source shortest path in directed acyclic graphs-Dijkstra's algorithm All Pairs Shortest Path: Shortest path and Matrix Multiplication - The Floyd-Warshall algorithm – Johnson's algorithm for sparse graphs.

Teaching Methodology	Lectures and Conceptual Explanation, Problem-Solving Workshops, Guest Lectures and Industry Insights

Books for Study

1. Horowitz, E., Sahni, S. & Rajasekaran, S. (2018). *Fundamentals of Computer Algorithms*. (2nd Ed.). Universities Press(India) Private Ltd.
2. Aho, A. V., Hoporoft, & Ulman, J. D. (2001). *The Design Methods and Analysis of Computer Algorithm*. Pearson Education.
3. Basu, S. K. (2006). *Design Methods and Analysis of Algorithms.* PHI.
4. Weiss, M. A. (2013). *Data Structure and Algorithm Analysis in C++*. Pearson Educations.
5. Sen, S. & Kumar, A. (2019). *Design and Analysis of Algorithms: A contemporary perspective*. Cambridge University Press.

Book for Reference

1. Thomas, S. C., Charles, E. L., Ronald, L. R. & Stein, C. (2001). *Introduction to Algorithms*, (2nd Ed.). The MIT Press.

Websites and eLearning Sources

1. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
2. https://www.javatpoint.com/daa-tutorial
3. https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the fundamental principles and techniques of algorithms, including specification, analysis, and optimization	**K1**
CO2	explain the characteristics, operations, and applications of various data structures	**K2**
CO3	apply algorithmic techniques to solve optimization problems such as knapsack, job sequencing, and shortest path	**K3**
CO4	analyze and evaluate the efficiency, correctness, and scalability of algorithms and data structures	**K4**
CO5	evaluate the implications of algorithmic decisions and data structure choices on problem-solving and decision-making processes	**K5**
CO6	design and implement algorithms and data structures to solve practical problems	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**	**Credits**	
1	**24PAI1CC02**			**Core Course - 2:** Design and Analysis of Algorithms					**5**	**4**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	3	3	2	1	**2.4**
CO2	2	2	3	2	2	2	2	3	2	2	**2.2**
CO3	3	2	3	2	2	3	2	3	2	2	**2.4**
CO4	3	2	2	2	2	3	2	2	2	2	**2.2**
CO5	2	3	3	2	1	2	3	3	2	1	**2.2**
CO6	2	3	3	2	1	2	3	3	2	1	**2.2**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1CC03	**Core Course - 3:** Python Programming	4	4

Course Objectives
To understanding of fundamental data types, operations, functions, modules, packages and built-in modules in Python.
To apply Regular Expression Modifiers, creating tables and connecting to databases.
To acquire skills on NumPy and effectively working with NumPy structured arrays.
To import data manipulation skills using Pandas and perform vectorized string operations.
To enhance data visualizing skills using Matplotlib and Seaborn.

UNIT I: Introduction to Python **(12 Hours)**

Features of Python - Data Types and Operations: Numbers-Strings-List-Tuple-Set-Dictionary. Functions: Function Definition –Function Calling –Function Arguments-Anonymous Functions. Modules and Packages: Built-in Modules - Creating Modules - import Statement – Locating Modules - Namespaces and Scope - dir() function - reload() function - Packages in Python –Date and Time Modules.

UNIT II: Regular Expressions and Database Programming **(12 Hours)**

Match () function - search () function - Search and Replace - Regular Expression Modifiers: Option Flags-Regular Expression Patterns - findall() method-compile() method. Database Programming: Connecting to a Database–Creating Tables–Insert, Update, Delete and Read Operation– Disconnecting from a Database.

UNIT III: Numpy **(12 Hours)**

Introduction to Numpy-Basics of NumPy Array–Computation on NumPy Array – Aggregations – Broadcasting – Comparisons, Masks and Boolean Logic– Sorting Arrays – NumPy Structured Array.

UNIT IV: Pandas **(12 Hours)**

Data Manipulation with Pandas: Introducing Panda Objects – Data Indexing and Selection -Operating Data on Pandas – Handling Missing Data – Hierarchical Indexing –Combining Data Sets– Vectorized String Operations– Working with Time Series.

UNIT V: Matplotlib **(12 Hours)**

Visualization with Matplotlib: Simple Line Plots–Simple Scatter Plots-Density and Contour Plots– Histograms, Binnings and Density–Customizing Plot Legends –Customising Colorbars–Multiple Subplots–Textand Annotation–Three Dimension Plottingin Matplotlib–Geographic Data with Base Map– Visualization with Seaborn.

Teaching Methodology	Lecture-based instruction, Demonstration, Group Discussion, Peer Learning, Problems solving, and Project-based learning,

Books for Study

1. Jose, J. & Lal, S. P. (2016). *Introduction to Computing and Problem Solving with PYTHON*. Khanna Book Publishing Co. (P) Ltd.
2. Vanderplas, J. (2016). *Python Data Science Handbook: Essential Tools for Working with Data* (1st ed.). O'Reilly Media.

Books for Reference

1. Chun, W. (2006). *Core Python Programming* (2nd ed.). Prentice Hall Publication.
2. Budd, T. A. (2011). *Exploring Python*. Tata McGraw Hill.
3. Boschetti, A. & Massaron, L. (2018). *Python Data Science Essentials* (3rd ed.). Packet Publishing.

Websites and eLearning Sources

1. https://realpython.com/
2. https://towardsdatascience.com/
3. https://jupyter.org/
4. https://pandas.pydata.org/pandas-docs/stable/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	acquire knowledge about various programming constructs and libraries like Numpy, Pandas and Matplotlib used for data analysis in Python.	**K1**
CO2	explain the basic concepts of object-oriented & procedural programming and concepts used in various data analysis libraries like Numpy, Pandas and Matplotlib available in Python.	**K2**
CO3	apply core Python concepts to write simple programs and various libraries like Numpy, Pandas and Matplotlib used in Python for performing data analysis.	**K3**
CO4	discover how to implement core python concepts in various domains and data analysis using various libraries like Numpy, Pandas and Matplotlib.	**K4**
CO5	assess simple Python applications to perform data analysis using various libraries.	**K5**
CO6	develop Python applications and perform data analysis using various libraries like Numpy, Pandas and Matplotlib.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**24PAI1CC03**			**Core Course - 3:** Python Programming						**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	1	3	3	2	2	2	**2.3**
CO2	3	3	2	2	1	3	3	3	2	3	**2.5**
CO3	3	3	2	2	1	3	3	2	2	3	**2.4**
CO4	3	3	3	2	1	3	3	3	2	3	**2.6**
CO5	3	3	3	2	1	3	3	3	2	3	**2.6**
CO6	3	3	3	2	1	3	3	3	2	3	**2.6**
Mean Overall Score											**2.5 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1CP01	**Core Practical - 1:** Python Programming	4	3

List of Exercises

Basic Python Programs

1. Flow controls, Functions and String Manipulation
2. Operations on Tuples and Lists
3. Operations on Sets and Dictionary
4. Regular Expressions
5. Database Operations

Data Analysis – NumPy

6. NumPy Arrays,
7. Sorting and Searching on Arrays

Data Analysis - Pandas

8. Data Series
9. Data Frame
10. Combining and Merging Data Sets
11. Handling Missing Values, Filter, Grouping and Aggregation

Visualization – MatplotLib & Seaborn

12. MatPlotLib – Line Chart, Scatter Plot, Histogram
13. Seaborn – Boxplot, HeatMap

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1ES01	**Elective - 1:** Mathematical Foundations	5	3

Course Objectives
To understand fundamental concepts of set theory.
To study the basic properties of matrices and its manipulations.
To develop the knowledge of graph theory.
To understand different the basic descriptive statistics.
To apply numerical techniques and solve problems.

UNIT I: **(12 Hours)**

Set Theory: Basic concepts of set theory: Notation – Inclusion of equality of sets – Power set – Operation on sets – Venn diagrams. Relations and ordering: Cartesian products - Relations – Properties of Binary Relation in a set – Relation matrix and graph – Equivalence relations – Composition of Binary Relations. Functions: Definition and Introduction – Composition of functions – Inverse function.

UNIT II: **(12 Hours)**

Matrices: Introduction – Vectors – Methods of Testing Linear Dependence – Consistency of a System of Linear Algebraic Equation –Rank of the Matrix –Inverse of the Matrix- Eigen Values and Eigen Vectors – Cayley Hamilton Theorem.

UNIT III: **(12 Hours)**

Graph Theory: Basic terminology: Different types of graphs – Directed and Undirected – Simple – Pseudo – Complete – Regular – Bipartite – Incidence and Degree – Pendant and Isolated Vertex – Null Graph – Isomorphism – Sub Graphs – Walk – Path and Circuit – Connected and Disconnected Graphs and Components - Planar graphs - Euler's formula - Operations on Graphs – Matrix representation of Graphs – Incidence Matrix – Path matrix -Adjacency Matrix

UNIT IV: **(12 Hours)**

Statistics: Measure of Central Tendency (Arithmetic Mean, Median, Mode) - Measure of Dispersion (Absolute and Relative Measures Range - Quartile Deviation - Mean Deviation - Standard Deviation and Coefficient of Variation). Correlation: Definition - Scatter diagram - Karl Pearson's coefficient of correlation - Numerical problems for determination of Correlation Coefficients.

UNIT V: **(12 Hours)**

Numerical Methods: Basics – Errors - Significant Digits – Solving Simultaneous Linear Equations – Bisection Method -Regular Falsi Method – Newton Raphson Method – Gauss Elimination Method – Gauss Jordan Method – Jacobi Iteration Method – Gauss Seidal Method.

Teaching Methodology	lecture-based instruction, technology-based learning, group learning, individual learning, inquiry-based learning

Books for Study

1. J.P Trembley, R. Manohar. (2017). *Discrete Mathematical structures with applications to Computer Science*. Tata McGraw Hill.
2. Lipschutz, S. & Lipson, M. L. (2002). *Discrete Mathematics*. (Revised 3rd Ed.). Schaum's Outline Series. Tata McGraw Hill Publications.
3. Grewal, B. S. (2018). *Numerical methods in Engineering & Science*. (5th Ed.). Khanna Publishers.

Books for Reference

1. Santha, S. (2015). *Discrete Mathematics with Combinatory and Graph Theory*. (3rd Ed.). Cengage Publications.
2. Arumugam, S. & Isaac, A. T. (2018). *Statistics*. New Gamma Publishing House.
3. Gupta, S. C. (2018). *Fundamentals of Statistics*. Himalaya Publishing House.

Websites and eLearning Sources

1. https://web.stanford.edu/class/archive/cs/cs103/cs103.1184/notes/Mathematical%20Foundations%20of%20Computing.pdf

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall key concepts of set theory, matrix operations, graph theory, statistics, and numerical methods for computer science applications.	**K1**
CO2	demonstrate the ability to perform matrix operations, analyze graphs, compute statistical measures, and apply numerical methods to solve mathematical problems	**K2**
CO3	apply set theory principles, matrix techniques, graph algorithms, statistical methods, and numerical algorithms to solve real-world problems in computer science.	**K3**
CO4	apply set theory principles, matrix techniques, graph algorithms, statistical methods, and numerical algorithms to solve real-world problems in computer science.	**K4**
CO5	design algorithms, data structures, and mathematical models using set theory, matrix operations, graph theory, statistics, and numerical methods to address specific computational problems.	**K5**
CO6	design algorithms, data structures, and mathematical models using set theory, matrix operations, graph theory, statistics, and numerical methods to address specific computational problems.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**24PAI1ES01**			**Elective - 1:** Mathematical Foundations						**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
									Mean Overall Score		**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1ES02	**Elective - 2:** Big Data Analytics	5	3

Course Objectives
To understand the fundamentals of big data analytics, data structures, and the analyst's perspective on data repositories.
To develop proficiency in basic data analytic methods using R, descriptive statistics, exploratory data analysis, and statistical methods of evaluation.
To explore advanced analytical theory and methods, such as clustering, association rules, and regression.
To learn classification techniques, including decision trees, naive Bayes, and time series analysis, to categorize and predict outcomes in diverse datasets.
To familiarize with advanced analytics technology and tools, including MapReduce, Hadoop, and SQL essentials.

UNIT I: Introduction to Big Data Analytics **(15 Hours)**

Introduction to Big Data Analytics: Big Data Overview – Data Structures – Analyst Perspective on Data Repositories - State of the Practice in Analytics – BI Versus Data Science - Current Analytical Architecture – Drivers of Big Data – Big Data Ecosystem - Data Analytics Lifecycle – Data Discovery – Data Preparation – Model Planning – Model Building – Communicate Results – Operationalize.

UNIT II: Data Analytic Methods **(15 Hours)**

Basic Data Analytic Methods Using R : Introduction to R programming – R Graphical User Interfaces – Data Import and Export Attribute and Data Types – Descriptive Statistics Exploratory Data Analysis: Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables Data Exploration Versus Presentation – Statistical Methods of Evaluation: Hypothesis Testing – Difference of Means – Wilcoxon Rank-Sum Test – Type I and Type II Errors – Power and Sample Size – ANOVA.

UNIT III: Advanced Methods **(15 Hours)**

Advanced Analytical Theory and Methods: Clustering – K Means – Use Cases – Overview – Determining number of clusters – Diagnostics Reasons to choose and cautions – Additional Algorithms - Association Rules: A Priori Algorithm – Evaluation of Candidate Rules Applications of Association Rules – Validation and Testing – Diagnostics. Regression: Linear Regression and Logistic Regression: Use cases – Model Description – Diagnostics - Additional Regression Models.

UNIT IV: Classification Techniques **(15 Hours)**

Classification: Decision Trees – Overview – Genetic Algorithm – Decision Tree Algorithms – Evaluating Decision Tree – Decision Trees in R - Naive Bayes – Bayes Theorem – Naïve Bayes Classifier – Smoothing – Diagnostics – Naïve Bayes in R – Diagnostics of Classifiers – Additional Classification Methods - Time Series Analysis: Overview – Box–Jenkins Methodology – ARIMA Model – Auto correlation Function – Autoregressive Models – Moving Average Models – ARMA and ARIMA Models–Building and Evaluating and ARIMA Model – Text Analysis: Text Analysis Steps – Example – Collecting – Representing Term Frequency – Categorizing – Determining Sentiments – Gaining Insights.

UNIT V: Distributed Technology **(15 Hours)**

Advanced Analytics-Technology and Tools: MapReduce and Hadoop: Analytics for Unstructured Data - Use Cases - MapReduce - Apache Hadoop – The Hadoop Ecosystem – pig – Hive – Hbase – Mahout – NoSQL - Tools in Database Analytics: SQL Essentials – Joins – Set operations – Grouping Extensions – In Database Text Analysis - Advanced SQL – Windows Functions – User Defined Functions and Aggregates – ordered aggregates- MADLib – Analytics Reports Consolidation – Communicating and operationalizing and Analytics Project – Creating the Final Deliverables: Developing Core Material for Multiple Audiences – Project Goals – Main Findings – Approach Model Description – Key points support with Data - Model details – Recommendations – Data Visualization

Teaching Methodology	lecture-based instruction, technology-based learning, group learning, individual learning, inquiry-based learning

Books for Study

1. John. (2015). *Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*. Wiley & Sons
2. Burlingame, N. (2012). *The little book on Big Data*. New Street Communications, LLC.
3. Maheshwari, A. (2017). *Data Analytics*, (1st Ed.). McGraw Hill Education

Books for Reference

1. Loshin, D. (2013). *Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph.* Morgan Kaufman.
2. Baesens, B. (2015). *Analytics in a Big Data World: The Essential Guide to Data Science and its Applications.* Wiley Publishers.
3. Jannach, D. & Zanker, M. (2010). R*ecommender Systems: An Introduction*. Cambridge University Press.
4. Kim, H. P. & Dunnigan, R. (2015). *Big Data Analytics: A Practical Guide for Managers*. CRC Press.

Website and eLearning Source

1. https://www.turing.com/resources/big-data-analytics

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the foundational concepts and principles of big data analytics.	**K1**
CO2	demonstrate proficiency in utilizing R programming for basic data analysis tasks, such as performing descriptive statistics, and conducting exploratory data analysis.	**K2**
CO3	apply advanced analytical theories and methodologies, to analyze complex datasets and extract meaningful insights.	**K3**
CO4	analyze and interpret data using classification techniques, to effectively categorize and predict outcomes in various domains.	**K4**
CO5	design and implement advanced analytics solutions using technologies to efficiently process and analyze large-scale datasets in real-world scenarios.	**K5**
CO6	evaluate the effectiveness and efficiency of different analytical approaches and technologies in addressing specific big data challenges.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
1	**24PAI1ES02**			**Elective - 2:** Big Data Analytics						**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
									Mean Overall Score		**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
1	24PAI1AE01	**Ability Enhancement Course:** Algorithm Lab using C++	2	1

Course Objectives
To develop problem-solving skills to understand and solve complex problems efficiently.
To enable students to select appropriate algorithms for different types of problems, considering factors such as time complexity and space complexity.
To nurture programming competence, enabling students to design and analyze algorithms and data structures effectively for diverse problem domains.

List of Exercises

1. Merge Sort, Heap Sort and QuickSort algorithms.
2. Knapsack problem (0/1).
3. Topological ordering of vertices in a given digraph.
4. Greedy algorithm to find minimum number of coins to make change for a given value of Indian currency. Assume that we have infinite supply of denominations in Indian currency.
5. Breadth First Search and Depth First search
6. Prim's Algorithm to find a minimum spanning tree.
7. Shortest path using Dijkstra's algorithm.
8. Multiply two matrices recursively.
9. String is a permutation of another given string.
10. Postfix evaluation
11. Binary tree traversal
12. Binary Search Tree

Teaching Methodology	Hands-on Programming Exercises, Peer Learning and Collaboration Lab Sessions, Code Reviews and Feedback, Problem-solving Sessions

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	demonstrate proficiency in evaluating postfix expressions and implementing algorithms	**K4**
CO2	analyze graphs and apply graph traversal algorithms	**K5**
CO3	develop proficiency in implementing and analyzing various algorithms and data structures	**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**							**Hours**	**Credits**
1	**24PAI1AE01**		**Ability Enhancement Course:** Algorithm Lab using C++							**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	3	2	2	2	2	**2.2**
CO2	2	3	3	2	2	2	3	3	2	2	**2.4**
CO3	2	3	3	2	2	2	3	3	2	2	**2.4**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2CC04	**Core Course - 4:** Machine Learning	5	5

Course Objectives
To understand the basic principles of machine learning.
To assess how the curse of dimensionality affects machine learning methods.
To understand ensemble learning techniques.
To learn about reinforcement learning and its applications.
To learn about Markov Chain Monte Carlo methods and their sampling techniques.

UNIT I: Introduction to Machine Learning **(15 Hours)**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Linear Discriminants – Perceptron – Linear Separability– Linear Regression.

UNIT II: Linear Models **(15 Hours)**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi- layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back- Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT III: Tree and Probabilistic Models **(15 Hours)**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

UNIT IV: Dimensionality Reduction and Evolutionary Models **(15 Hours)**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

UNIT V: Graphical Models **(15 Hours)**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

Teaching Methodology	Lecture-based instruction, Project-based learning, Discovery Learning

Books for Study

1. Marsland, S. (2014). *Machine learning: An algorithmic perspective*. (2nd Ed.). Chapman and Hall.
2. Mitchell, T. M. (2013). *Machine learning*. (1st Ed.). McGraw-Hill Education.

Books for Reference

1. Murphy, K. P. (2012). *Machine learning: A probabilistic perspective*. MIT Press.
2. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
3. Müller, A. C., & Guido, S. (2016*). Introduction to machine learning with Python: A guide for Data Scientists*. O'Reilly Media.

Websites and eLearning Sources

1. https://www.kaggle.com/
2. https://machinelearningmastery.com/
3. https://www.tensorflow.org/
4. https://scikit-learn.org/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K- Level)**
CO1	recall key concepts of machine learning	**K1**
CO2	explain the relationship between neural networks and linear discriminants in supervised learning	**K2**
CO3	apply ensemble learning techniques to improve classification accuracy	**K3**
CO4	analyze the impact of different parameters on the performance of genetic algorithms	**K4**
CO5	evaluate the effectiveness of ensemble learning methods in handling complex datasets	**K5**
CO6	design a simple graphical model to represent complex relationships in a given dataset	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**24PAI2CC04**			**Core Course - 4:** Machine Learning					**5**		**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	1	2	3	3	2	2	1	**2.2**
CO2	3	2	1	2	1	2	2	1	2	2	**1.8**
CO3	1	3	3	2	2	2	3	3	2	2	**2.3**
CO4	3	2	3	3	3	3	3	3	3	2	**2.8**
CO5	3	3	3	3	2	3	2	1	2	3	**2.5**
CO6	3	2	1	3	2	1	3	3	3	3	**2.4**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2CC05	**Core Course - 5:** Data Base Management System	4	4

Course Objectives
To learn the fundamentals of data models, SQL and to represent a database system using ER Diagrams.
To study relational database design concepts and normalization procedures.
To understand the fundamental concepts of transaction processing, concurrency control techniques and recovery procedures.
To understand the internal storage structure using different file systems and indexing techniques which will help in physical database design.
To gain fundamental knowledge on other databases like Distributed, XML and Object- relational databases.

UNIT I: Relational Databases **(12 Hours)**

Purpose of Database System – Views of data – Data Models – Database System Architecture - Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT II: Database Design **(12 Hours)**

Entity-Relationship model – E-R Diagrams – Enhanced- ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III: Transactions **(12 Hours)**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV: Implementation Techniques RAID **(12 Hours)**

File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V: Advanced Topics **(12 Hours)**

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object- Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Teaching Methodology	Provide Exercises for SQL Queries, Data Modeling and Normalization, Assign group work to design relational databases, Conduct regular quizzes to evaluate the knowledge level of the students, Provide students with relevant OER references.

Books for Study

1. Silberschatz, A., Korth, H. F. & Sudharsha. S. (2011). *Database System Concepts* (6th Ed.). Tata McGraw Hill.
2. Elmasri, R. & Navathe, S. B. (2011). *Fundamentals of Database Systems* (6th Ed.). Pearson Education.

Books for Reference

1. Date, C. J., Kannan, A. & Swamynathan. S. (2006). *An Introduction to Database Systems* (8th Ed.). Pearson Education.
2. Ramakrishnan, R. (2015). *Database Management Systems* (4th Ed.). McGraw Hill, College Publications.
3. Gupta, G. K. (2011). *Database Management Systems*. Tata McGraw Hill.

Websites and e-Learning Sources

1. https://www.w3schools.com/sql/
2. https://www.studytonight.com/dbms/database-normalization.php

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-level)**
CO1	recall the key concepts and terminologies in relational and advanced database systems	**K1**
CO2	interpret the implementation scenarios of database design transactions and storage mechanisms in relational data model	**K2**
CO3	map ER Model to relational model, normalize data and formulate SQL queries	**K3**
CO4	classify data accessing strategies in different types of database systems	**K4**
CO5	appraise how advanced databases differ from traditional databases	**K5**
CO6	build a complete relational database design with proper normalizations	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**24PAI2CC05**			**Core Course - 5:** Data Base Management System						**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	1	2	2	2	3	2	2	**2.2**
CO2	3	3	2	1	1	3	2	3	2	2	**2.2**
CO3	3	2	3	1	1	3	3	3	2	2	**2.3**
CO4	2	3	3	1	3	1	3	2	2	3	**2.3**
CO5	3	2	3	2	2	2	2	3	1	2	**2.2**
CO6	3	3	3	2	3	3	2	3	2	3	**2.4**
										Mean Overall Score	**2.26 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2CP02	**Core Practical - 2:** Machine Learning with Python/R	4	3

List of Exercises

1. Solving Regression and Classification using Decision Trees.
2. Selecting Root Node Attributes for Decision Trees using Information Gain.
3. Utilizing Bayesian Inference in Gene Expression Analysis.
4. Implementing Pattern Recognition Applications using Bayesian Inference.
5. Applying Bagging in Classification.
6. Exploring Bagging and Boosting Applications using Regression Trees.
7. Performing Data and Text Classification using Neural Networks.
8. Implementing Support Vector Machine (SVM) classification for classification tasks in chosen domain applications
9. Conducting Data and Text Clustering using the K-means algorithm.
10. Implementing Data and Text Clustering using Gaussian Mixture Models.
11. Applying Dimensionality Reduction Algorithms in Image Processing applications.
12. Implementing Conditional Random Fields (CRFs) in Natural Language Processing.

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2CP03	**Core Practical - 3:** DBMS	4	3

List of Exercises

SQL

1. DDL, DML and DCL Queries
2. Set Operations
3. Views
4. Joins
5. Sub Queries
6. Indexes, Sequence and Synonyms

PL/SQL

7. Cursors
8. Functions and Procedures
9. Packages
10. Triggers

FORMS AND REPORTS

11. Forms – Menus, Buttons, LOVs, Master-Detail form design
12. Simple Report Design

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2SP01	**Self-paced Learning:** Internet of Things	-	2

Course Objectives
To introduce students to the field of Internet of things.
To provide students with a foundation of IoT devices.
To teach students o know about the web services.
To train students to familiarize the IoT applications in various fields.
To expose students to the various use cases.

UNIT I: Basics of IoT

The Internet of Things: An Overview - The Flavor of the Internet of Things - The "Internet" of "Things"- The Technology of the Internet of Things - Enchanted Objects - Design Principles for Connected Devices - Calm and Ambient Technology - Magic as Metaphor – Privacy - Keeping Secrets - Web Thinking for Connected Devices - Small Pieces – Loosely Joined - First-Class Citizens On The Internet – Graceful Degradation - Affordances.

UNIT II: IoT Devices

Prototyping Embedded Devices – Electronics – Sensors – Actuators - Scaling Up the Electronics - Embedded Computing Basics – Microcontrollers - System-on-Chips - Choosing Your Platform – Arduino - Developing on the Arduino - Some Notes on the Hardware – Openness - Raspberry Pi - Cases and Extension Boards - Developing on the Raspberry Pi – Some Notes on the Hardware – Openness - Smart Objects – Challenges for Smart Objects.

UNIT III: Web Services

Interoperability - An Evolving and Versatile Architecture - Stability and Universality of the Architecture Scalability - Configuration and Management - Small Footprint - Alternatives - Gateways - Security for Smart Objects - The Three Properties of Security - Security by Obscurity – Encryption - Security Mechanisms for Smart Objects - Security Mechanisms in the IP Architecture - IPSec - TLS - Web Services for Smart Objects - Web Service Concepts - The Performance of Web Services for Smart Objects. - Connectivity Models for Smart Object Networks - Autonomous Smart Object Networks - Extended Internet.

UNIT IV: IoT Applications

Smart Object Hardware and Software – Hardware - Software for Smart Objects – Energy Management - THE APPLICATIONS - Smart Grid – Introduction – Terminology - Core Grid Network Monitoring - Control - Smart Metering (NAN) – HAN.

UNIT V: Use Cases

Industrial Automation – Opportunities – Challenges - Use Cases Smart Cities and Urban Networks – Urban Environmental Monitoring - Social Networks - Intelligent Transport Systems - Home Automation – Introduction -Main Applications and Use Cases - Technical Challenges and Network Characteristics- Building Automation – Emerging Application in Building automation- Health Monitoring–Introduction -Main Applications and Use Case - Technical Challenges in Health Monitoring.

Teaching Methodology	Lecture-based instruction, Project-based learning, Discovery Learning

Books for Study

1. Adrian McEwen, A. & Cassimally, H. (2014). *Designing the Internet of Things*. John Wiley and Sons.
2. Vasseur, J. & Dunkels, A. (2010). *Interconnecting Smart Objects with IP – The Next Internet*. Morgan Kaufmann Publishers.
3. Pfister, C. (2011). *Getting Started with the Internet of Things*. O'Reilly Publisher.

Books for Reference

1. Underdah, B. (2014). *The Internet of Things for Dummies*. (2nd Ed.). KORE Wireless

Edition.
2. Vermesan, O. & Friess, P. (2014). *Internet of Things Applications: From Research to Market Deployment*. (1st Ed.). River Publishers.
3. Costa, F. (2013). *Rethinking the Internet of Things – A Scalable Approach to Connecting Everything*. Apress.

Website and eLearning Source

1. https://aws.amazon.com/whatis/iot/#:~:text=The%20term%20IoT%2C%20or%20Internet,as%20between%20the%20devices%20themselves.

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2ES03A	**Elective - 3:** Distributed Operating Systems	5	4

Course Objectives
To understand distributed operating system fundamentals and their evolution.
To gain knowledge of computer networks and communication protocols.
To develop proficiency in message passing techniques for distributed systems.
To acquire skills in implementing remote procedure calls (RPC) transparently.
To explore synchronization mechanisms and distributed file system concepts.

UNIT I: Introduction to Distributed Operating System (15 Hours)

Fundamentals: What is Distributed Operating System – Evolution of Distributed Computing System – Distributed Computing System Models – Why are Distributed Computing Systems gaining popularity – What is a Distributed Computing System – Issues in Designing Distributed Computing System – Introduction to Distributed Computing Environment. Introduction to Computer Networks – Network types – LAN –WAN – Communication protocols – Internetworking – ATM Technology

UNIT II: Message Passing (15 Hours)

Message Passing: Introduction Desirable features – Issues in PC Message Passing – Synchronization – Buffering – Multi datagram Messages – Encoding and Decoding – Process Addressing – Failure Handling – Group Communication

UNIT III: Remote Procedure Calls (15 Hours)

Remote Procedure Calls: RPC models – Transparency of RPC – Stub generation – RPC messages – Marshaling arguments and results – Exception Handling – Lightweight RPC; Distributed Shared Memory: Introduction – General Architecture of DSM system – Design and Implementation Issues of DSM – Granularity – Structure of Shared Memory – Consistency Models – Replacement Strategy – Thrashing.

UNIT IV: Synchronization (15 Hours)

Synchronization: Introduction – Clock Synchronization – Event Ordering – Mutual Exclusion – Deadlock – Election Algorithm – Process Management: Introduction - Process Migration– Threads.

UNIT V: Distributed File System (15 Hours)

Distributed File System: Introduction – Desirable features – File Models – File Accessing Models – File Sharing Semantics – File Caching Schemes – File Replication – Fault Tolerance – Atomic Transactions – Design Principles.

Teaching Methodology	lecture-based instruction, technology-based learning, group learning, individual learning, inquiry-based learning

Books for Study

1. Sinha, P. K. (2016). *Distributed Operating Systems – Concepts and Design.* PHI Learning.
2. Tanenbaum, A. S. (2017). *Distributed Operating Systems*. (1st Ed.). PHI Learning.

Books for Reference

1. Silberschatz, A., Galvin, P. B. & Gagne, G. (2018). *Operating Systems Concepts*. (9th Ed.). Wiley.
2. George, C., Jean, D., & Gordon, B. (2017). *Distributed Systems - Concepts and Design.* Pearson.

Websites and eLearning Sources

1. https://cds.cern.ch/record/400319/
2. https://komputasi.wordpress.com/wp-content/uploads/2018/03/

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the basic principles of distributed operating systems, including models and networking protocols.	**K1**
CO2	demonstrate their understanding of message passing techniques by implementing synchronization mechanisms in a distributed system.	**K2**
CO3	apply remote procedure call (RPC) concepts to develop transparent communication mechanisms for distributed applications.	**K3**
CO4	analyze the efficiency and effectiveness of different synchronization mechanisms in preventing deadlock and ensuring consistency in distributed systems.	**K4**
CO5	design distributed file systems with fault tolerance mechanisms and atomic transaction support based on identified requirements and design principles.	**K5**
CO6	evaluate the performance and scalability of distributed systems based on predefined criteria, such as fault tolerance, reliability, and throughput.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**	**Credits**	
2	**24PAI2ES03A**			**Elective - 3:** Distributed Operating Systems					**5**	**4**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
Mean Overall Score											**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2ES03B	**Elective - 3:** Deep Learning	5	4

Course Objectives
To understand the fundamentals of neural networks.
To learn how to use neural networks for classification tasks.
To master the basics of training deep neural networks.
To understand and apply recurrent and convolutional neural networks.
To explore and implement reinforcement learning principles in deep learning.

UNIT I: Introduction to Neural Networks **(15 Hours)**

Basic Architecture of Neural Networks – Training and Neural Network with Backpropagation – Practical Issues in Neural Network Training – The Secrets to the Power of Function Composition – Common Neural Architectures – Advanced Topics.

UNIT II: Machine Learning with Shallow Neural Networks **(15 Hours)**

Neural Architectures for Binary Classification Models – Neural Architectures for Multiclass models – Back propagated saliency for Feature Selection – Matrix Factorization with Auto encoders – Simple Neural Architectures for Graph Embedding.

UNIT III: Training Deep Neural Networks **(15 Hours)**

Introduction to Deep Neural Network – Backpropagation – Setup and Initialization issues – The vanishing and exploding gradient problems – Gradient Descent Strategies' –Batch Normalization– **Teaching Deep Learners to Generalize**: Introduction –The Bias-Variance trade-off – Generalization issues in model tuning and evaluation – Penalty based regularization – Ensemble methods – Early Stopping – Unsupervised pre-training – Continuation and Curriculum learning – Parameter sharing – Regularization in Unsupervised Applications.

UNIT IV: Recurrent and Convolutional Neural Networks **(15 Hours)**

Recurrent Neural Networks: Introduction – Architecture of Recurrent Neural Networks –The challenges of training recurrent networks–Echo-State Networks– Long Short-Term memory – Gated Recurrent Units – Applications of Recurrent Neural Networks. **Convolutional Neural Networks:** Introduction – The Basic Structure of a Convolutional Network – Training a convolutional network – Case studies of Convolutional Architectures – Visualization and Unsupervised Learning – Applications of Convolutional networks.

UNIT V: Deep Reinforcement Learning **(15 Hours)**

Introduction – Stateless Algorithms – The basic framework of Reinforcement Learning – Bootstrapping for value function learning– Policy Gradient Methods – Monte Carlo Tree Search – Case Studies – Practical Challenges associated with safety. Advanced Topics associated with Deep Learning: Generative Adversarial Networks (GAN) – Competitive Learning – Limitations of Neural Networks.

Teaching Methodology	Lecture-based instruction, Project-based learning, Discovery Learning

Book for Study

1. Aggarwal, C. G. (2018). *Neural Networks and Deep Learning*. Springer.

Books for Reference

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. The MIT Press.
2. Chollet, F. (2018). *Deep Learning with Python*. Manning Publications Co.
3. Patterson, J., & Gibson, A. (2017). *Deep Learning: A Practitioner's Approach*. (1st Ed.). O'Reilly.

Websites and eLearning Sources

1. www.deeplearning.ai
2. www.nvidia.com/en-us/deep-learning-ai/education

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	recall the fundamental concepts of neural networks	**K1**
CO2	explain how to utilize neural networks effectively for various classification tasks	**K2**
CO3	apply the principles learned to effectively train deep neural networks	**K3**
CO4	evaluate the architectures and functionalities of recurrent and convolutional neural networks	**K4**
CO5	assess the effectiveness of different reinforcement learning algorithms	**K5**
CO6	design novel deep learning architectures by integrating concepts from various neural networks	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**24PAI2ES03B**			**Elective - 3:** Deep Learning					**5**		**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	3	3	3	2	2	1	1	3	**2.2**
CO2	1	3	2	3	2	3	1	3	3	3	**2.4**
CO3	1	2	3	1	2	3	1	2	3	3	**2.1**
CO4	2	3	2	3	2	3	2	2	2	2	**2.3**
CO5	3	2	3	2	2	3	3	2	1	1	**2.2**
CO6	3	2	1	3	3	2	2	2	3	3	**2.4**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	3

Course Objectives
To provide a focused training on soft skills for students in colleges for better job prospects
To communicate effectively and professionally
To help the students take active part in group dynamics
To familiarize students with numeracy skills for quick problem solving
To make the students appraise themselves and assess others

Unit I: Effective Communication & Professional Communication (12 Hours)

Definition of communication, Barriers of Communication, Non-verbal Communication; Effective Communication - Conversation Techniques, Good manners and Etiquettes; Speech Preparations & Presentations; Professional Communication.

Unit II: Resume Writing & Interview Skills (12 Hours)

Resume Writing: What is a résumé? Types of résumés, - Chronological, Functional and Mixed Resume, Purpose and Structure of a Resume, Model Resume.

Interview Skills: Types of Interviews, Preparation for an interview, Attire, Body Language, Common interview questions, Mock interviews & Practicum

Unit III: Group Discussion & Personal Effectiveness (12 Hours)

Basics of Group Discussion, Parameters of GD, Topics for Practice, Mock GD & Practicum & Team Building.

Personal Effectiveness: Self Discovery; Goal Setting with questionnaires & Exercises

Unit IV: Numerical Ability (12 Hours)

Introducing concepts Average, Percentage; Profit and Loss, Simple Interest, Compound Interest; Time and Work, Pipes and Cisterns.

Unit V: Test of Reasoning (12 Hours)

Introducing Verbal Reasoning: Series Completion, Analogy; Data Sufficiency, Assertion and Reasoning; and Logical Deduction. Non-Verbal Reasoning: Series; and Classification

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Book for study

1. Melchias G., Balaiah, J. & Joy, J. L. (Eds). (2018). *Winner in the Making: A Primer on soft Skills.* Trichy, India: St. Joseph's College.

Books for Reference

1. Aggarwal, R. S. (2010). *A Modern Approach to Verbal and Non-Verbal Reasoning.* S. Chand.
2. Covey, S. (2004). *7 Habits of Highly effective people.* Free Press.
3. Gerard, E. (1994). *The Skilled Helper* (5th Ed.). Brooks/Cole.
4. Khera, S. (2003). *You Can Win.* Macmillan Books.
5. Murphy, R. (1998). *Essential English Grammar,* (2nd Ed.). Cambridge University Press.
6. Sankaran, K., & Kumar, M. (2010). *Group Discussion and Public Speaking* (5th Ed.). M.I. Publications.
7. Trishna, K. S. (2012). *How to do well in GDs & Interview*s? (3rd Ed.). Pearson Education.
8. Yate, M. (2005). *Hiring the Best: A Manager's Guide to Effective Interviewing and Recruiting*

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	recall various soft skill sets	**K1**
CO2	understand personal effectiveness in any managerial positions	**K2**
CO3	apply verbal and non-verbal reasoning skills to solve problems	**K3**
CO4	differentiate problems at work and home; and design solutions to maintain work-life balance	**K4**
CO5	assess growth and sustainability and infuse creativity in employment that increases professional productivity	**K5**
CO6	construct plans and strategies to work for better human society	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**23PSS2SE01**			**Skill Enhancement Course:** Soft Skills					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	2	3	2	3	**2.7**
CO2	3	3	3	2	3	3	3	3	3	3	**2.9**
CO3	3	2	2	3	3	3	3	3	3	3	**2.8**
CO4	3	3	2	2	3	3	3	3	3	3	**2.8**
CO5	3	3	3	2	2	3	3	3	3	3	**2.8**
CO6	3	3	3	2	2	3	3	3	3	3	**2.8**
Mean Overall Score											**2.8 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	24PAI2EG01	**Generic Elective - 1 (WS):** Artificial Neural Networks and Fuzzy Systems	4	3

Course Objectives
To acquire foundational knowledge of Fuzzy Logic and Neural Networks.
To apply fuzzy logic principles and reasoning techniques to effectively manage uncertainty in decision-making processes.
To utilize Neural Network-based algorithms to solve real-world problems effectively.
To analyze and evaluate the performance and effectiveness of Neuro-fuzzy systems in various applications.
To understand the architecture and components of Fuzzy Systems for modeling and simulation purposes.

UNIT I: Fundamentals of Fuzzy logic **(12 Hours)**

Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements- union intersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems.

UNIT II: Architecture of Neural Networks **(12 Hours)**

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture- setting weights-common activations functions Basic learning rules- Mcculloch- Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb's rule- algorithm - perceptron - Convergence theorem-Delta rule.

UNIT III: Basic Neural Network Techniques **(12 Hours)**

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture- setting weights-common activations functions Basic learning rules- Mcculloch- Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb's rule- algorithm - perceptron - Convergence theorem-Delta rule.

UNIT IV: Competitive Neural Networks **(12 Hours)**

Neural network based on competition: fixedweight competitive nets-Kohonenself- organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2.

UNIT V: Special Neural Networks **(12 Hours)**

Introducing Verbal Reasoning: Series Completion, Analogy; Data Sufficiency, Assertion and Reasoning; and Logical Deduction. Non-Verbal Reasoning: Series; and Classification

Teaching Methodology	Lectures and Conceptual Explanation, Problem-Solving Workshops, Guest Lectures and Industry Insights

Books for study

1. Klir, G. J. &Yuan, B. (1995). *Fuzzy System and Fuzzylogi.* (1st Ed.). Prentice Hall of India.
2. Fussett, L. V. (1993). *Fundamental of Neural Network.* (1st Ed.). Prentice Hall of India.

Books for References

1. Kosko, B. (1994). *Neural network and Fuzzy System*. Prentice Hall.
2. Klir, G. J. & Folger, T. A. (1996). *Fuzzy sets.* PrenticeHall
3. Zurada, J. M. (1994). *Introduction to artificial neural systems*. Jaico Publication House.
4. Rao, V. (1996). *C++Neural network and fuzzy logic*. BPB Publication.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	demonstrate a comprehensive understanding of the fundamental principles and basic concepts of Fuzzy Logic and Neural Networks	**K1**
CO2	apply fuzzy set theory and fuzzy logic principles effectively to model and analyze complex systems with uncertainty	**K2**
CO3	utilize neural network architectures and learning algorithms to solve pattern recognition and classification problems	**K3**
CO4	analyze the architecture, operation, and performance of competitive neural networks, such as Kohonen self-organizing maps and learning vector quantization, in various applications.	**K4**
CO5	evaluate and compare different types of neural networks, including Cognitron, Neocognitron, and fuzzy associate memories, in terms of architecture, training algorithms, and applications	**K5**
CO6	synthesize knowledge of fuzzy logic systems and neural networks to design and develop integrated systems that leverage the strengths of both approaches for solving complex real-world problems	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**24PAI2EG01**			**Generic Elective - 1 (WS):** Artificial Neural Networks and Fuzzy Systems					**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	3	3	2	1	**2.4**
CO2	2	2	3	2	2	2	2	3	2	2	**2.2**
CO3	3	2	3	2	2	3	2	3	2	2	**2.4**
CO4	3	2	2	2	2	3	2	2	2	2	**2.2**
CO5	2	3	3	2	1	2	3	3	2	1	**2.2**
CO6	2	3	3	2	1	2	3	3	2	1	**2.2**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	24PAI3CC06	**Core Course - 6:** Natural Language Processing	5	5

Course Objectives
To understand the fundamentals and applications of NLP, including language modeling, parts-of-speech tagging, parsing, and semantic analysis techniques.
To explore language modeling with N-gram and neural models, and evaluate their efficacy using various evaluation metrics.
To develop proficiency in parts-of-speech tagging using rule-based, statistical, and neural approaches, and understand their strengths and limitations.
To gain insights into parsing techniques such as CKY parsing and statistical parsing, and their applications in syntactic analysis.
To explore semantic analysis methods such as vector semantics and word embeddings, and their applications in measuring similarity and word sense disambiguation.

UNIT I: Introduction to NLP **(15 Hours)**

Introduction to NLP: NLP – Introduction and applications, NLP phases - Difficulty of NLP including ambiguity - Spelling error and Noisy Channel Model - Concepts of Parts-of-speech and Formal Grammar of English.

UNIT II: Language Modelling **(15 Hours)**

Language Modelling: N-gram and Neural Language Models Language Modelling with N-gram - Simple N-gram models - Smoothing (basic techniques) - Evaluating language models - Neural Network basics – Training - Neural Language Model - Case study: application of neural language model in NLP system development.

UNIT III: Tagging **(15 Hours)**

Parts-of-speech Tagging Parts-of-speech Tagging: basic concepts - Tag set - Early approaches: Rule based and TBL - POS tagging using HMM - Introduction to POS Tagging using Neural Model.

UNIT IV: Parsing Basic Concepts **(15 Hours)**

Parsing Basic concepts: top down and bottom-up parsing, treebank; Syntactic parsing: CKY parsing - Statistical Parsing basics: Probabilistic Context Free Grammar (PCFG) - Probabilistic CKY Parsing of PCFGs.

UNIT V: Semantic Analysis **(15 Hours)**

Semantics Vector Semantics - Words and Vector - Measuring Similarity - Semantics with dense vectors - SVD and Latent Semantic Analysis - Embedding from prediction: Skip-gram and CBOW - Concept of Word Sense - Introduction to WordNet

Teaching Methodology	lecture-based instruction, technology-based learning, group learning, individual learning, inquiry-based learning

Book for Study

1. Daniel, J. & Martin, J. H. (2018). *Speech and Language Processing*. (3rd Ed.). Pearson

Books for Reference

1. Jurafsky, D. & Martin J. H. (2008). *Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. (2nd Ed.). Prentice-Hall
2. Yoav, G. (2016). *A Primer on Neural Network Models for Natural Language Processing*. Journal of Artificial Intelligence Research

Website and eLearning Source

1. https://github.com/keon/awesome-nlp

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall key concepts and terminology in natural language processing (NLP), including language modeling and parsing techniques.	**K1**
CO2	demonstrate their ability to implement N-gram models and neural language models, showcasing their proficiency in language modeling techniques.	**K2**
CO3	apply parts-of-speech tagging algorithms and parsing methods to analyze and process natural language text effectively.	**K3**
CO4	analyze the performance and effectiveness of different semantic analysis methods, such as vector semantics and word embeddings, in capturing semantic meaning from text data.	**K4**
CO5	design and develop NLP systems, integrating various techniques such as tagging, parsing, and semantic analysis to address specific language processing tasks.	**K5**
CO6	evaluate the accuracy and efficiency of their designed NLP systems, using appropriate evaluation metrics to assess their performance against predefined criteria.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**24PAI3CC06**			**Core Course - 6:** Natural Language Processing						**5**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes(PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
									Mean Overall Score		**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	24PAI3CC07	**Core Course - 7:** Advanced Web Technology	4	4

Course Objectives
To develop knowledge and to understand the fundamental concepts of Web Technologies
To enhance the utilization of XML and AJAX
To enable the use of Java Script
To enrich a proper understanding of server-side scripting
To deploy web application with MEAN stack

UNIT I: Web Technologies and HTML (12 Hours)

Internet and web Technologies - Client/Server model- Web Search Engine - Web Crawling -Web Indexing – Search Engine Optimization and Limitations - Web Services – Collective Intelligence – Mobile Web – Features of Web3.0 – HTML vs HTML5 - Exploring Editors and Browsers Supported by HTML5 - New Elements - HTML5 Semantics – Migration from HTML to HTML5 – Canvas - HTML Media – HTML Geolocation – Introduction to CSS3 - CSS2 vs CSS3 – Rounded Corner – Border Images – Multi Background – Gradients – iframe -2d and 3d transform - Animation.

UNIT II: XML and AJAX (12 Hours)

XML - Documents and Vocabularies - Versions and Declaration - Namespaces Java Script and XML: Ajax - DOM based XML processing Event - oriented Parsing: SAX - Transforming XML Documents- Selecting XML Data : XPATH – Template based Transformations: XSLT - Displaying XML Documents in Browsers - Evolution of AJAX -Web applications with AJAX -AJAX Framework.

UNIT III: Client-side Scripting with Java Script (12 Hours)

JavaScript Implementation – Use Java Script to interact with some of the new HTML5 APIS – Create and modify Java Script objects - JS Forms - Events and Event handling – JS Navigator – JS Cookies - Introduction to JSON – JSON vs XML - JSON Parse - JSON Objects – jQuery Selectors -jQuery HTML & CSS – jQuery DOM – Importance of AngularJS in web – Angular Expression and Directives - AngularJS Data Binding and Controllers - Filters.

UNIT IV: Server-side Scripting with PHP (12 Hours)

Essentials of PHP – Installation of Web Server, XAMPP Configurations – PHP Forms -GET and POST method – URL encoding – HTML Encoding – Regular Expressions - Cookies - Sessions - Usage of Include and require statements - File: read and write from the file - PHP Filters - PHP XML Parser - Introduction to Node. js -Node. js Modules and filesystem - Node. js Events.

UNIT V: MySQL and MEAN STAC (12 Hours)

PHP with MySQL - Performing basic database operation (DML) (Insert, Delete, Update, Select) - Prepared Statement - Uploading Image or File to MySQL - Retrieve Image or File from MySQL Uploading Multiple Files to MySQL – SQL Injection - Introduction to MEAN and Express. JS -Real time example for modern web applications using MEAN

Books for Study

1. Deitel, H. M., Deitel, P. & Deitel, A. (2018). *Internet and World Wide Web: How to Program.* (5th Ed.). Pearson Education.
2. Haviv, A. Q. (2016). *MEAN Web Development*. (2nd Ed.) Packt Publishing.

Books for Reference

1. Lemay, L., Colburn, R. & Kyrnin, J. (2016). *Mastering HTML, CSS & Java Script Web Publishing*. (1st Ed). BPB Publications.
2. Giamas, A. (2017). Mastering Mongo DB3.x. (1st Ed). Packt Publishing Limited.

Websites and eLearning Sources

1. https://www.w3schools.com/html/html_intro.asp
2. https://www.w3schools.com/xml/ajax_xmlfile.asp
3. https://www.w3schools.com/js/
4. https://www.w3schools.com/php/
5. https://www.javatpoint.com/mean-stack-tutorial

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the basic concepts of web technologies	**K1**
CO2	interpret the AJAX	**K2**
CO3	apply the different client-side scripting concepts with Java Script	**K3**
CO4	analyse the usages of PHP	**K4**
CO5	determine the MEAN Stack	**K5**
CO6	discuss the database connectivity using MySQL	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**24PAI3CC07**			**Core Course - 7:** Advanced Web Technology						4	4
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	3	3	3	3	3	2	3	**2.7**
CO2	2	3	2	2	3	2	3	2	2	2	**2.3**
CO3	3	3	2	2	2	2	2	2	2	2	**2.2**
CO4	2	2	2	3	2	3	2	2	2	3	**2.3**
CO5	3	3	2	2	1	1	2	3	2	3	**2.2**
CO6	3	3	2	2	2	2	2	2	2	2	**2.2**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	24PAI3CC08	**Core Course - 8:** Optimization Techniques	4	4

Course Objectives
To understand the fundamental concepts and significance of Operations Research (OR) in decision-making processes across various domains.
To formulate Linear Programming Problems (LPP) and apply graphical methods and the simplex method to find optimal solutions.
To apply artificial variable techniques and the two-phase method to solve special cases of Linear Programming Problems (LPP), including those involving integer programming.
To analyze and solve assignment and transportation problems using mathematical formulations and appropriate solution methods, such as the Hungarian method and matrix-based approaches.
To apply sequencing techniques and queuing models to optimize processes and resource utilization, including solving sequencing problems with multiple machines and analyzing queuing systems using Kendall's notation and birth-death models.

UNIT I: Introduction to Linear Programming Problem **(12 Hours)**

The Nature and Meaning of OR – Management – Applications of OR – Modeling in OR – General methods for solving OR models – Scope of OR. Linear Programming Problem: Formulation of LP problems – Graphical solution of LP problems – General formulation of LPP – Slack and Surplus variables – Standard form of LPP – Some important forms of LPP – Simplex Method and its special cases.

UNIT II: Artificial Variable Techniques and IPP **(12 Hours)**

Artificial Variable Techniques: Two Phase method and special cases. Integer Programming Problem: Importance–Definitions–Gomory's Pure Integer Programming Problem – Mixed Integer Programming Problem.

UNIT III: Assignment and Transportation Problems **(12 Hours)**

Assignment Problem: Mathematical formulation–Hungarian method–Unbalanced assignment problem – Various types. Transportation Model: Mathematical formulation – Matrixform–Methodsfor finding Initial Basic Feasible solution and Optimal solution – Degeneracy in Transportation Problems – Unbalanced Transportation Problem.

UNIT IV: Sequencing Problems and Queuing Models **(12 Hours)**

Sequencing Problems: Assumptions – Solutions to Sequencing Problems: Processing n jobs through 2 machines – Processing n jobs through 3 machines – Processing n jobs on m machines. Queuing Models: Queuing System – Transient and Steady States– Kendal's Notation for representing Queuing Models – Various Models in Queuing System – Birth and Death Model. Sequencing Problems: Assumptions – Solutions to Sequencing Problems: Processing n jobs through 2 machines – Processing n jobs through 3 machines – Processing n jobs on m machines. Queuing Models: Queuing System – Transient and Steady States– Kendal's Notation for representing Queuing Models – Various Models in Queuing System – Birth and Death Model.

UNIT V: PERT and CPM Techniques **(12 Hours)**

PERT and CPM Techniques: Basic Steps – Network Diagram representation– Rules for drawing Network Diagram – Labeling Fulkerson's I–J Rule – Time Estimates and Critical Path in Network Analysis – Examples on optimum duration and minimum duration cost – PERT.

Teaching Methodology	Lectures and Conceptual Explanation, Problem-Solving Workshops, Guest Lectures and Industry Insights

Book for Study

1. Sharma, S. K. (2017). *Operations Research. (10th Ed.).* Pearson.

Books for Reference

1. Taha, H. A. (2016). *Operations Research*. (9th Ed.). Pearson.
2. Sundaresan, V., Subramanian, K. S. G. & Ganesan, K. (2015). *Resource Management Techniques*. (9th Ed.). A. R.Publications.

Websites and eLearning Sources

1. https://www.tutorialspoint.com/artificial_neural_network/artificial_neural_network_other_optimization_techniques.html
2. https://deeplearning.neuromatch.io/tutorials/W1D5_Optimization/student/W1D5_Tutorial1.html
3. https://www.geeksforgeeks.org/optimization-techniques-set-1-modulus/

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the foundational concepts, significance, and scope of Operations Research (OR), and its applications in management decision-making.	**K1**
CO2	apply modeling techniques to formulate Linear Programming Problems (LPP), including the identification of slack and surplus variables, and represent them graphically for solution.	**K2**
CO3	analyze and solve Linear Programming Problems (LPP) using the Simplex Method and its variations, including special cases, to find optimal solutions efficiently.	**K3**
CO4	evaluate and apply artificial variable techniques, such as the Two Phase method, to solve Linear Programming Problems (LPP), and comprehend their relevance in special cases like Integer Programming.	**K4**
CO5	analyze and solve Assignment and Transportation problems using appropriate methods, including the Hungarian method and matrix-based approaches, to optimize resource allocation and distribution	**K5**
CO6	apply Project Evaluation and Review Technique (PERT) and Critical Path Method (CPM) techniques to effectively manage and analyze project schedules, including network diagram representation, critical path identification, and time estimation.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**24PAI3CC08**			**Core Course - 8:** Optimization Techniques						**4**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	3	3	2	1	**2.4**
CO2	2	2	3	2	2	2	2	3	2	2	**2.2**
CO3	3	2	3	2	2	3	2	3	2	2	**2.4**
CO4	3	2	2	2	2	3	2	2	2	2	**2.2**
CO5	2	3	3	2	1	2	3	3	2	1	**2.2**
CO6	2	3	3	2	1	2	3	3	2	1	**2.2**
Mean Overall Score											**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	24PAI3CC09	**Core Course - 9:** Research Methodology	5	5

Course Objectives
To understand the importance of Research Methodology.
To apply statistical testing to prove hypothesis.
To provide the inference using quantitative data analysis.
To make use of computer aids to analyze the data, prepare reports and presentations.
To evaluate methodology of teaching.

UNIT I: Introduction to Research and Formulation (15 Hours)

Motivation and Objectives – Research methods vs Methodology. Types of research –Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review–Primary and secondary sources – Reviews- treatise- monographs- patents –Critical literature review. **Research Design and Methods:** Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design.

UNIT II: Research Planning and Data Collection (15 Hours)

Observation and Facts- Laws and Theories- Prediction and explanation- Induction- Deduction- Development of Models - Developing a research plan - Exploration- Description- Diagnosis- Experimentation - Determining experimental and sample design. **Data Collection:** Execution of the research - Observation and Collection of data - Methods of data collection.

UNIT III: Data Analysis and Reporting (15 Hours)

Data Analysis Quantitative Methods: Online Quantitative Design and Survey – Descriptive Measures–Probability–Random Variables and Distribution Functions – Discrete Probability Distributions – Continuous Probability Distribution – Sampling Distributions – Theory of Estimation – Hypothesis Testing – Correlation – Regression – Principles of Sample Survey – Types of Sampling – Design of Experiments – crd-rbd-lsd-Factor Analysis – Cluster Analysis – Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation - Application of Statistical Software Packages - **Reporting and Thesis Writing:** Reporting and thesis writing – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout- structure and Language of typical reports – Illustrations and tables - Bibliography- referencing and footnotes – Use of Oral presentation – Software Packages for thesis Preparation– Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication.

UNIT IV: Application of Results and Ethics (15 Hours)

Application of results and ethics – Environmental impacts-Ethical issues-ethical committees- Commercialization– Copy right – royalty – Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights - Reproduction of published material – Plagiarism – Application of Plagiarism detection tools - Citation and acknowledgment - Reproducibility and accountability.

UNIT V: Teaching Strategies and Adolescent Psychology (15 Hours)

Teaching – Objectives of Teaching- Phases of Teaching – **Teaching Methods:** Lecture Method- Discussion Method- Discovery Learning- Inquiry- Problem Solving Method- Project method-Seminar – Integrating ICT in Teaching: Individualised Instruction- Ways for Effective Presentation with PowerPoint – Documentation – Evaluation: Formative - Summative & Continuous and Comprehensive Evaluation – **Later Adolescent Psychology:** Meaning- Physical - Cognitive- Emotional - Social and Moral Development – Teaching Later Adolescents.

Teaching Methodology	Lecture-based instruction, Discovery Learning

Books for Study

1. Kothari, C. R. (2014). *Research Methodology: Methods and Techniques*. New Age International (P) Limited.
2. Panneerselvam, R. (2014). *Research Methodology*. (2nd Ed.). PHI.

Books for Reference

1. Gupta, S. C., & Kapoor, V. K. (2014). *Fundamentals of Mathematical Statistics.* Sultan Chand & Sons.
2. Sampath, K., Panneerselvam, A., & Santhanam, S. (1984). *Introduction to Educational Technology.* (2nd Revised Ed.). Sterling Publishers.
3. Sharma, S. R. (2003). *Effective Classroom Teaching: Modern Methods, Tools & Techniques*. Mangal Deep.
4. Vedanayagam, E. G. (1989). *Teaching Technology for College Teachers*. Sterling Publishers.

Websites and eLearning Sources

1. https://www.socialresearchmethods.net/
2. https://www.sas.com/en_us/home.html
3. https://www.researchgate.net/

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall the fundamental concepts of quantitative data analysis	**K1**
CO2	explain the development of models and the components of a research plan	**K2**
CO3	apply statistical software packages to analyze research data and interpret results effectively	**K3**
CO4	analyze the ethical issues related to intellectual property rights	**K4**
CO5	evaluate the effectiveness of teaching strategies	**K5**
CO6	design innovative teaching strategies and assessment techniques	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
3	**24PAI3CC09**			**Core Course - 9:** Research Methodology						**5**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	3	3	3	3	3	**2.8**
CO2	2	3	3	3	3	2	3	2	3	2	**2.6**
CO3	2	1	2	3	2	3	3	3	1	3	**2.3**
CO4	1	1	2	2	2	1	3	3	1	3	**1.9**
CO5	2	2	2	1	2	1	3	3	3	3	**2.2**
CO6	2	3	2	3	1	3	3	1	3	3	**2.4**
Mean Overall Score											**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/week	Credits
3	24PAI3CP04	**Core Practical - 4:** Natural Language Processing	4	3

List of Exercises

1. Tokenizing Text and WordNet basics: Tokenizing text into sentences, Tokenizing sentences into words, Tokenizing sentences using regular expressions, Filtering stop words in a tokenized sentence, Looking up synsets for a word in WordNet, Looking up lemmas and synonyms in WordNet, Calculating WordNet synset similarity Discovering word collocations.
2. Replacing and correcting words: Stemming words, Lemmatizing words with WordNet, Translating text with Babelfish, Replacing words matching regular expressions, Removing repeating characters, Spelling correction with Enchant, Replacing synonyms, Replacing negations with antonyms.
3. Creating Custom Corpora: Setting up a custom corpus, Creating a word list corpus, Creating a part of speech tagged word corpus, Creating a chunked phrase corpus, Creating a categorized text corpus, Creating a categorized chunk corpus reader, Lazy corpus loading, Creating a custom corpus view, Creating a MongoDB backed corpus reader, Corpus editing with file locking.
4. Parts-of -Speech Tagging: Training a unigram part-of-speech tagger, Combining taggers with backoff tagging, Training and combining Ngram taggers, Creating a model of likely word tags, Tagging with regular expressions, Affix tagging, Training a Brill tagger, Training the TnT tagger Using WordNet for tagging, Tagging proper names, Classifier based tagging.
5. Extracting Chunks: Chunking and chinking with regular expressions, Merging and splitting chunks with regular expressions, Expanding and removing chunks with regular expressions, Partial parsing with regular expressions, Training a tagger-based chunker, Classification-based chunking, extracting named entities, Extracting proper noun chunks, Extracting location chunks, Training a named entity chunker.
6. Transforming Chunks and Trees: Filtering insignificant words, Correcting verb forms, Swapping verb phrases, Swapping noun cardinals, Swapping infinitive phrases, Singularizing plural nouns, Chaining chunk transformations, Converting a chunk tree to text, Flattening a deep tree, Creating a shallow tree, Converting tree nodes.
7. Parsing Specific Data: Parsing dates and times with Dateutil, Time zone lookup and conversion, tagging temporal expressions with Timex, Extracting URLs from HTML with lxml, Cleaning and stripping HTML, Converting HTML entities with Beautiful Soup.

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	24PAI3CP05	**Core Practical - 5:** Advanced Web Technology	4	3

List of Exercises

1. Display five different images. Each image should have a title and be separated by two blank lines.
2. Print two addresses in the format used on the front of envelopes: sender's address in the top left corner and recipient's address in the center.
3. Create a page with a link at the top. When clicked, this link will jump all the way to the bottom of the page. At the bottom of the page, there should be another link to jump back to the top.
4. Create a web animation with audio using HTML5 & CSS3.
5. Demonstrate geolocation and canvas using HTML5.
6. Write an XML file and validate it using a Document Type Definition (DTD).
7. Demonstrate the Document Object Model (DOM) and SAX parser.
8. Write a JavaScript program to demonstrate form validation and event handling.
9. Design a simple online test web page in PHP.
10. Write JavaScript to implement a web application that lists all cookies stored in the browser when a "List Cookies" button is clicked. You can add cookies if necessary.
11. Create an application using the AngularJS framework.
12. Demonstrate forms and directives in AngularJS.
13. Demonstrate fetching information from an XML file with AJAX.
14. Implement a web application using AJAX with JSON data.
15. Demonstrate the Node.js file system module.
16. Write a PHP program to track the number of visitors to a web page and display the visitor count with appropriate headings. Implement database connectivity using MySQL with PHP.

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	24PAI3EG02	**Generic Elective - 2 (BS):** Introduction to Cyber Security	4	3

Course Objectives
To understand cyber security basics and cybercrimes.
To learn about key security components and defences.
To explore authentication and cryptography techniques.
To study intrusion detection methods and tools.
To implement firewalls and intrusion prevention systems.

UNIT I: Introduction **(12 Hours)**

Cyber Security – History of Internet – Impact of Internet. CIA Triad - Reason for Cyber Crime - Need for Cyber Security – History of Cyber Crime. Types of Cybercrimes.

UNIT II: Cyber Security Components **(12 Hours)**

Zero day attacks – types of network attacks – Application security – endpoint security – mobile security – Data Security.

UNIT III: Fighting Cyber Attacks **(12 Hours)**

Physical security – Authentication – authentication factors – two factor authentication – multi factor authentication – authentication techniques – biometric – Passwords.Cryptography.

UNIT IV: Intrusion Detection **(12 Hours)**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT V: Intrusion Prevention **(12 Hours)**

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations –Intrusion Prevention Systems.

Teaching Methodology	Lecture Based Instruction, Peer Learning, Group Discussion, Videos, PPT,

Books for Study

1. Anand Shinde, A. (2021). *Introduction to Cyber Security Guide to the World of Cyber Security.* Notion Press**.**
   UNIT 1 Chapter 1.1,1.2,1.3,2.1,2.2,2.3,2.4,2.6,2.7
   UNIT 2 Chapter – 3.2,3.3,3.4,3.5,3.7,3.8**)**
   UNIT 3 Chapter -4.1,4.2,4.3)
2. Stallings, W. & Brown, L. (2015). *Computer Security Principles and Practice*, (3rd Ed.). Pearson Education.
   UNIT 4 Chapter 8.4,8.6,8.7,8.8, 8.9)
   UNIT 5 Chapter 9.1,9.2,9.3,9.4,9.5,9.6)

Books for Reference:

1. Godbole, N. & Belapure, S. (2011). *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives.* Wiley Publishers.

Websites and eLearning Sources

1. https://www.geeksforgeeks.org/cyber-security-types-and-importance/
2. Cyber Security Tutorial (geeksforgeeks.org)

Course Outcomes		
CO No.	**CO-Statements** On Successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	understand Cyber Security Basics and Cybercrimes.	**K1**
CO2	identify and Implement Security Measures for Networks and Devices.	**K2**
CO3	apply Authentication Methods and Cryptography.	**K3**
CO4	analyze and Use Intrusion Detection Systems.	**K4**
CO5	configure Firewalls and Intrusion Prevention Systems.	**K5**
CO6		**K6**

Relationship Matrix											
Semester	**Course Code**		**Title of the Course**						**Hours**		**Credits**
3	**24PAI3EG02**		**Generic Elective - 2 (BS):** Introduction to Cyber Security						**4**		**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	1	3	2	3	3	2	**2.3**
CO2	2	3	2	2	2	3	3	2	3	2	**2.4**
CO3	1	2	3	2	3	3	2	3	2	2	**2.3**
CO4	1	2	2	3	2	3	3	1	2	3	**2.2**
CO5	1	2	2	2	3	2	3	1	2	3	**2.1**
CO6	3	2	2	2	1	3	2	3	3	2	**2.3**
Mean Overall Score											**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
3	**24PAI3IS01**	Internship	**-**	**2**

SL	Area of Work	Maximum Marks
1	**First Review** Plan of the Internship, Problem definition, Technology Adopted	**25**
2	**Second Review** Execution of the plan / Collection of data / Organization of Materials / Fabrication Experimental study / Hypothesis, Testing etc., and Presentation	**25**
3	Documentation	**25**
4	Viva Voce Examination	**25**
	TOTAL	**100**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	24PAI4CC10	**Core Course - 10:** Pattern Recognition and Image Analysis	5	5

Course Objectives
To understand the principles and techniques of image processing and pattern recognition.
To apply image restoration and compression methods for enhancing and optimizing image data.
To comprehend the fundamentals of pattern recognition systems and their design principles.
To analyze and interpret patterns in images using statistical pattern recognition techniques.
To develop proficiency in recognizing and interpreting patterns in various image data sets.

UNIT I: **(15 Hours)**

Introduction to Image Processing: Image formation - image geometry perspective and other transformation - stereo imaging elements of visual perception. Digital Image- sampling and quantization serial and parallel Image processing.

UNIT II: **(15 Hours)**

Image Restoration: Constrained and unconstrained restoration Wiener filter- motion blur remover- geometric and radiometric correction Image data compression-Huffman and other codes transform compression- predictive compression two tone Image compression- block coding - run length coding - and contour coding.

UNIT III: **(15 Hours)**

Segmentation Techniques: Thresh holding approaches - region growing – relaxation -line and edge detection approaches - edge linking -supervised and unsupervised classification techniques - remotely sensed image analysis and applications - Shape Analysis – Gestalt principles - shape number - moment Fourier and other shape descriptors -Skelton detection -Houghtrans -form – topological and texture analysis- shape matching.

UNIT IV: **(15 Hours)**

Basics of pattern recognition: Design principles of pattern recognition system - Learning and adaptation - Pattern recognition approaches -Mathematical foundations – Linear algebra - Probability Theory- Expectation - mean and covariance - Normal distribution - multivariate normal densities - Chi squared test.

UNIT V: **(15 Hours)**

Statistical Pattern Recognition: Bayesian Decision Theory- Classifiers- Normal density and discriminant functions -Parameter estimation methods: Maximum-Likelihood estimation - Bayesian Parameter Estimation-Dimension reduction methods – Principal Component Analysis (PCA)- Fisher Linear discriminant analysis -Expectation-maximization (EM) -Hidden Markov Models (HMM) - Gaussian mixture models.

Teaching Methodology	Lectures and Presentations, Hands-on Demonstrations and Workshops, Case Studies and Real-world Applications, Group Projects and Collaborative Learning, Guest Lectures and Industry Experts

Books for Study

1. Gonzalez, R. C. & Woods, R. E. (1993). *Digital Image Processing*. Pearson**.**
2. Jain, A. K. (1989). *Fundamental of Image Processing.* Prentice Hall of India.
3. Duda, R.O., Hartand, P. E. & Stork, D. G. (2006). *Pattern Classification.* (2nd Ed.). John Wiley.

Books for Reference:

1. Rosenfeld, A. & Kak, A. C. (1982). *Digital Picture Processing*. Academic.
2. Niblack, W. (1986). *An Introduction to Digital Image Processing.* Prentice Hall.

Websites and eLearning Sources

1. https://www.geeksforgeeks.org/pattern-recognition-introduction/
2. https://www.javatpoint.com/pattern-recognition-in-machine-learning

Course Outcomes		
CO No.	**CO-Statements** On Successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall fundamental concepts and techniques of image processing and pattern recognition.	**K1**
CO2	explain the principles and methodologies of image restoration, compression, and segmentation techniques.	**K2**
CO3	apply image processing algorithms to perform restoration, compression, and segmentation tasks effectively.	**K3**
CO4	analyze and evaluate the performance of image processing techniques in various applications.	**K4**
CO5	synthesize knowledge of pattern recognition systems and design principles to develop efficient recognition algorithms.	**K5**
CO6	evaluate the effectiveness and limitations of statistical pattern recognition methods in interpreting image data.	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
4	**24PAI4CC10**	**Core Course 10:** Pattern Recognition and Image Analysis								**5**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	1	3	2	3	3	2	**2.3**
CO2	2	3	2	2	2	3	3	2	3	2	**2.4**
CO3	1	2	3	2	3	3	2	3	2	2	**2.3**
CO4	1	2	2	3	2	3	3	1	2	3	**2.2**
CO5	1	2	2	2	3	2	3	1	2	3	**2.1**
CO6	3	2	2	2	1	3	2	3	3	2	**2.3**
										Mean Overall Score	**2.3 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	24PAI4ES04A	**Elective - 4:** Cryptography and Network Security	5	4

Course Objectives
To introduce students to the fundamental principles and concepts of cryptography and network security.
To provide students with an understanding of various encryption techniques and their applications in securing data communication.
To familiarize students with authentication protocols and mechanisms used to verify the identity of users and entities in a networked environment.
To explore the principles and implementation of IP security mechanisms for securing internet protocol-based communication.
To introduce students to the concepts and practices of system security, including intrusion detection, malware protection, and firewall design.

UNIT I: Introduction to Cryptography & Network Security (15 Hours)

Security trends–The OSI security architecture– Security attacks, services and mechanisms– A Model of network security- Security Goals- Cryptographic Attacks—Classical encryption techniques: Symmetric cipher Model- substitution-transposition -steganography- Block cipher and the DES: Block cipher Principles – DES - The strength of DES- Differential and Linear Crypt Analysis-Block Cipher Design Principles.

UNIT II: Advanced Encryption Standard (15 Hours)

AES Cipher-More on Symmetric Ciphers: Block Cipher modes of operation -Stream Cipher and RC4. Public-Key Encryption and Hash Function: Prime Numbers-Testing for Primality - The Chinese remainder theorem -Public-Key Cryptography and RSA: Principles of Public Key Cryptosystem- The RSA Algorithm-Key Management -Diffie-Hellman Key Exchange-Message Authentication and Hash Function: Authentication Function – Message Authentication Codes-Hash function – HMAC – CMAC – Digital Signature-Authentication Protocol.

UNIT III: Authentication Applications (15 Hours)

Kerberos-x. 509 Authentication Service-Public- Key Infrastructure- Secret Key Algorithm-Security at the Application Layer: Electronic Mail Security-Pretty Good Privacy (PGP)- S/MIME.

UNIT IV: IPSecurity (15 Hours)

IPSecurity – Overview - IPSecurity - Architecture, -Authentication- Header- Encapsulating Security Payload- Combining Security Associations. Web Security: Web Security Considerations-Secure Socket Layer (SSL) and Transport Layer Security (TLS)-Secure Electronic Transaction (SET). Network Management Security: Basic Concepts of SNMP, SNMPv1, SNMPv3, VPN.

UNIT V: System Security (15 Hours)

Intruders - Intruders, Intrusion Detection- Password Management-Malware. Malicious Software: Viruses and Related Threats, Virus Countermeasures, Distributed Denial of Service Attacks. Firewalls: Firewall Design Principles, Trusted Systems, Common Criteria for information technology Security Evaluation. Legal and Ethical Issues in Computer Security: Protecting Programs Data-Information and the Law-Redress for Software Failures-Selling Correct Software Flaws.

Teaching Methodology	lecture-based instruction, technology-based learning, group learning, individual learning, inquiry-based learning.

Books for Study

1. William, S. (2017). *Cryptography & Network Security, Principles & Practice*. Pearson.
2. Ferouzan, B. A. (2008). *Cryptography & Network Security*, Tata McGraw Hill.
3. Pfleeger, C. P., Pfleeger, S. L. & Shaw, D. N. (2007). *Security in Computing*. (4th Ed.). Pearson.

Books for Reference

1. Rhee, Y. M. (2003). *Internet Security: Cryptographic Principles, Algorithms& Protocols.* Wiley Publications.
2. Black, U. N. (2000). *Internet Security Protocols*. Pearson Education.
3. Kaufman, C., Perlman, R. & Speciner, M. (2002). *Network Security: Private Communication In Public World*. PHI Learning.
4. Schneier, B. & Ferguson, N. (2003). *Practical Cryptography*. (1st Ed.). Wiley Dream tech India Pvt Ltd.
5. Simson, D. R. (2019). *Cryptography–Theory and Practice*. (4th Ed.). CRC Press.

Websites and eLearning Sources

1. https://www.gatevidyalay.com/tag/cryptography-and-network-security-tutorial/
2. https://www.geeksforgeeks.org/cryptography-tutorial/
3. https://www.tutorialspoint.com/cryptography/index.htm

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	understand the OSI security architecture and identify different security attacks and mechanisms employed in network security	**K1**
CO2	apply classical encryption techniques and understand the principles behind symmetric and asymmetric encryption algorithms, including AES, RSA, and Diffie-Hellman key exchange	**K2**
CO3	analyze and implement various authentication protocols and services, such as Kerberos, x.509, and Public-Key Infrastructure (PKI), to ensure secure user authentication and access control.	**K3**
CO4	implement IP security mechanisms, including IPSec and VPN, to protect data integrity, confidentiality, and authenticity in IP-based communication.	**K4**
CO5	design and implement web security solutions using protocols like SSL/TLS and secure electronic transaction mechanisms to safeguard online transactions and communications.	**K5**
CO6	evaluate and implement system security measures, including intrusion detection systems, malware protection strategies, and firewall configurations, to mitigate potential security threats and vulnerabilities in computer networks.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**24PAI4ES04A**			**Elective – 4 :** Cryptography and Network Security						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	3	3	3	3	3	2	3	**2.7**
CO2	3	2	3	2	2	2	2	2	3	2	**2.3**
CO3	2	3	2	3	3	3	2	2	2	2	**2.4**
CO4	2	2	3	2	3	2	2	3	3	3	**2.5**
CO5	3	3	2	1	2	2	2	3	3	2	**2.3**
CO6	2	2	3	2	2	3	3	2	2	3	**2.4**
										Mean Overall Score	**2.4 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	24PAI4ES04B	**Elective - 4:** Virtual Reality	5	4

Course Objectives
To understand the fundamental principles of visual design as applied to virtual reality environments.
To apply principles of visual design, such as hierarchy, contrast, and balance, to create immersive VR experiences.
To explore techniques for integrating headlines and body content effectively within virtual environments to convey information clearly.
To gain proficiency in utilizing pre-press and post-press technologies to optimize visual assets for VR applications.
To develop skills in grid-based layout design, including understanding the anatomy of grids, implementing various types of layouts, and employing mixed design approaches to enhance user experience in VR environments.

UNIT I: Basic Elements of Visual Design **(15 Hours)**

Basic elements of visual design - Principles of visual design - Creating - Headlines and Body content - Pre-press technology and post-press technology Grids in layout design: Anatomy of a grid - Types of layout design - Mixed design - Design Process - Brand Management – Branding - Brand identity design - Design thinking process.

UNIT II: Generic VR System **(15 Hours)**

Introduction - A generic VR system: Virtual environment – Technology - Modes of Interaction - VR Hardware: Sensor Hardware, Head Coupled displays - Acoustic hardware - Integrated VR - VR Software: Modelling Virtual worlds - Physical simulations - VR Applications.

UNIT III: Designing for VR **(15 Hours)**

Designing for VR -Visual aid - UI depth and eye strain - Constant velocity – Maintaining head tracking – Guiding with light – Leveraging scale – Spatial audio - Gaze Cues Image Size and resolution - Pixel density - Eye buffers - Optimal resolution - Creating Panoramic Images.

UNIT IV: Color Modes **(15 Hours)**

Color Modes: Changing color mode - Type tool options - Work path from type – Layers panel -Types of layers – Features of layers – Shape to lsand Painting Tools – Brush tools – Gradient tools – Effects panel – Graphics panel - Photo effects.

UNIT V: Filter Gallery **(15 Hours)**

Filter Gallery: Applying filters - Smart filters - Channels panel - Actions panel - Change settings - Exclude commands - Inserting a non-recordable menu command – Batch command – Roll overs – Creating buttons – Make layer duplicates – Create roll over states 360-degree illustrations for VR - Panorama – Planning and drawing 360-degree illustration - Exporting for VR 23.

Teaching Methodology	lecture-based instruction, technology-based learning, group learning, individual learning, inquiry-based learning.

Books for Study

1. Vince, J. (1995). *Virtual Reality Systems*. (1st Ed.). Addison-Wesley.
2. Aspelund, K. (2015). *The Design Process*. (3rd Ed.). Fairchild Books.
3. Wood, B. (2019). *Adobe Illustrator CC Classroom*. (1st Ed.). Adobe.
4. Gatto, J. A. (2010). *Exploring Visual Design: The Elements and Principles*. (3rd Ed.). Davis Publications.

Books for Reference

1. Erin Pangilinan, E., Lukas, S. & Mohan, V. (2019). *Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing*. O'Reiley.
2. Aukstakalnis, S. (2016). *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)*. (1st Ed.). Addison-Wesley.

Websites and eLearning Sources

1. https://msl.cs.uiuc.edu/vr/

Course Outcomes		
CO No.	**CO-Statements** On completion of this course, students will be able to	**Cognitive Levels (K-Level)**
CO1	recall and explain fundamental principles of visual design and their application within virtual reality environments	**K1**
CO2	demonstrate an understanding of principles of visual design, such as hierarchy, contrast, and balance, to create immersive virtual reality	**K2**
CO3	apply visual assets optimized for virtual reality applications, demonstrating proficiency in digital design tools	**K3**
CO4	analyze virtual reality designs, identifying areas for improvement in terms of visual aesthetics and user experience	**K4**
CO5	design cohesive visual content for virtual reality applications, including headlines, body content, and graphical elements	**K5**
CO6	evaluate the effectiveness of grid-based layouts in virtual reality environments, considering factors such as user interaction and spatial organization	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
4	**24PAI4ES04B**			**Elective - 4:** Virtual Reality						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
										Mean Overall Score	**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**24PAI4PW01**	Project Work and Viva-Voce	**20**	**17**

SL	Area of Work	Maximum Marks
1	(i) Project Work	**40**
	(ii) Execution of the plan / Collection of data / Organization of Materials / Fabrication Experimental study / Hypothesis, Testing etc., and Presentation of the report.	**90**
	(iii) Individual Initiative	**20**
2	Viva Voce Examination	**50**
	TOTAL	**200**

Semester	Course Code	Title of the Course	Hours/Week	Credits
4	**24PAI4CE01**	Comprehensive Examination	-	2

UNIT I: Fundamentals of Artificial Intelligence and Fuzzy Logic

Introduction to A. I. Representation - Non-AI & AI Techniques - Representation of Knowledge - Knowledge Base Systems - State Space Search - Production Systems - Problem Characteristics - types of production systems - Intelligent Agents and Environments - concept of rationality - the nature of environments - structure of agents - problem solving agents - problem formulation. **Fundamentals of Fuzzy logic**: fuzzy set theory- basic concept of crisp sets and fuzzy sets - complements - union intersection - combination of operation- general aggregation operations- fuzzy relations.

UNIT II: Parsing Techniques and Basics of Neural Networks

Parsing Basic concepts - top down and bottom up parsing – treebank - **Syntactic parsing -** CKY parsing - Statistical Parsing basics - Probabilistic Context Free Grammar (PCFG) - Probabilistic CKY Parsing of PCFGs**. Introduction to Neural Networks:** Basic Architecture of Neural Networks – Training and Neural Network with Backpropagation – Practical Issues in Neural Network Training – The Secrets to the Power of Function Composition – Common Neural Architectures – Advanced Topics.

UNIT III: Algorithms & Distributed Computing Essentials

Design & Analysis of Algorithms: Algorithm-Specification - Performance Analysis. Divide and Conquer - General Method - Binary Search - Find the Maximum and Minimum - Quick sort - Strassen's Matrix Multiplication. **Distributed Operating System:** Desirable features – File Models – File Accessing Models – File Sharing Semantics – File Caching Schemes – File Replication – Fault Tolerance – Atomic Transactions – Design Principles.

UNIT IV: Big Data Analytics and Database

Advanced Analytics-Technology and Tools: MapReduce and Hadoop: Analytics for Unstructured Data - Use Cases - MapReduce - Apache Hadoop – The Hadoop Ecosystem – pig – Hive – Hbase – Mahout – NoSQL - Tools in Database Analytics - SQL Essentials – Joins – Set operations – Grouping Extensions – In Database Text Analysis - Advanced SQL – Windows Functions – User Defined Functions and Aggregates. **Database:** Basics, Entity Types, Relationship Types, ER Model, ER-to- Relational Mapping algorithm. Normalization: Functional Dependency, 1NF, 2NF, 3NF, BCNF, 4NF and 5NF - **Distributed and Object based Database:** Architecture, distributed data storage, Distributed transactions, Commit protocols, Concurrency control, Query Processing.

UNIT V: Pattern Recognition and Linear Programming Basics

Basics of pattern recognition - Design principles of pattern recognition system - Learning and adaptation - Pattern recognition approaches - Mathematical foundations. **Linear Programming Problem:** The Nature and Meaning of OR – Management – Applications of OR – Modeling in OR – General methods for solving OR models – Scope of OR. **Linear Programming Problem:** Formulation of LP problems – Graphical solution of LP problems – General formulation of LPP