MANONMANIAM SUNDARANAR UNIVERSITY

M.Sc., COMPUTER SCIENCE with ARTIFICIAL INTELLIGENCE

SYLLABUS

FROM THE ACADEMIC YEAR2026 - 2027

VISION AND MISSION OF THE UNIVERSITY

1. Vision

"To provide quality education to reach the un-reached"

2.Mission

- To conduct research, teaching and outreach programs to improve conditions of human living
- To create an academic environment that honors women and men of all races, castes, creeds, and cultures and an atmosphere that values intellectual curiosity, the pursuit of knowledge, academic freedom and integrity
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnerships with industries and government to improve the quality of the workplace and to serve as the catalyst for economic and cultural development
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently-abled

M.Sc., COMPUTER SCIENCE with ARTIFICIAL INTELLIGENCE

3.PREAMBLE

The Master of Science in Computer Science with Artificial Intelligence is a postgraduate programme designed to equip students with advanced knowledge, practical skills, and research competencies in the rapidly evolving domains of Computer Science and Artificial Intelligence. The programme aims to develop professionals capable of designing intelligent systems, solving complex computational problems, and contributing to technological innovations that address societal and industrial needs.This programme integrates the core foundations of Computer Science with emerging areas such as Machine Learning, Deep Learning, Data Science, Natural Language Processing, Computer Vision, Robotics, Cloud Computing, Cyber Security, and Intelligent Automation. It provides students with a strong theoretical background along with hands-on experience through laboratory work, mini projects, internships, and research-oriented activities.

4.PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 – Advanced Knowledge and Technical Competence

Graduates will acquire strong theoretical and practical knowledge in Computer Science and Artificial Intelligence to develop innovative and efficient computing solutions for real-world problems.

PEO2 – Professional Skills and Employability

Graduates will demonstrate technical proficiency, programming expertise, analytical ability, and problem-solving skills required for successful careers in software industries, AI-based enterprises, research institutions, and allied sectors.

PEO3 – Research, Innovation, and Lifelong Learning

Graduates will engage in research, innovation, and continuous learning to adapt to emerging technologies such as Machine Learning, Deep Learning, Data Analytics, Cloud Computing, and Intelligent Systems.

PEO4 – Ethical and Social Responsibility

Graduates will apply ethical principles, professional values, and social responsibility in the design, development, and deployment of Artificial Intelligence and computing technologies for the benefit of society.

PEO5 – Leadership and Entrepreneurship

Graduates will develop leadership qualities, teamwork, communication skills, and entrepreneurial abilities to manage projects, lead multidisciplinary teams, and create technology-driven solutions and startups.

5. Programme Outcomes (POs)

After successful completion of the programme, the graduates will be able to:

PO1 – Computational Knowledge

Apply advanced knowledge of Computer Science, Artificial Intelligence, Machine Learning, Data Science, and related technologies to analyze and solve complex computing problems.

PO2 – Problem Analysis and Intelligent Solutions

Identify, formulate, and develop efficient algorithmic and AI-based solutions for real-world problems using analytical and critical thinking skills.

PO3 – Design and Development of Intelligent Systems

Design, develop, test, and implement software applications and intelligent systems using modern programming tools, frameworks, and emerging technologies.

PO4 – Research and Innovation

Conduct research, analyze data, interpret results, and contribute innovative solutions in the areas of Artificial Intelligence, computing, and interdisciplinary applications.

PO5 – Modern Tool Usage

Utilize modern computing tools, AI platforms, cloud technologies, data analytics tools, and software development environments for effective problem-solving and system development.

PO6 – Ethics, Society, and Sustainability

Apply ethical principles, professional responsibilities, cyber security awareness, and sustainable practices in the development and deployment of computing and AI technologies.

PO7 – Communication, Leadership, and Lifelong Learning

Demonstrate effective communication, teamwork, leadership qualities, entrepreneurial skills, and continuous learning necessary for professional growth and adaptation to evolving technologies.

6. ProgrammeSpecific Outcomes (PSOs)

After successful completion of the programme, the graduates will be able to:

PSO1 – Advanced Computing Knowledge

Apply advanced concepts of Computer Science, Artificial Intelligence, Machine Learning, Data Structures, Algorithms, and Software Engineering to solve complex computational problems efficiently.

PSO2 – Intelligent System Development

Design, develop, and implement intelligent systems using Artificial Intelligence techniques such as Machine Learning, Deep Learning, Natural Language Processing, Expert Systems, and Computer Vision.

PSO3 – Data Analytics and Decision Making

Analyze, process, and interpret structured and unstructured data using Data Analytics, Data Mining, and AI-based tools to support intelligent decision-making and predictive analysis.

PSO4 – Programming and Emerging Technologies

Demonstrate proficiency in modern programming languages, AI frameworks, cloud platforms, and emerging technologies for developing scalable, secure, and innovative software applications.

PSO5 – Research and Innovation

Conduct interdisciplinary research, apply scientific methodologies, and develop innovative AI-driven solutions to address real-world challenges in academia, industry, healthcare, business, and society.

PSO6 – Ethical AI and Professional Responsibility

Apply ethical principles, cybersecurity awareness, privacy standards, and professional responsibilities in the development and deployment of Artificial Intelligence systems and computing technologies.

PSO7 – Leadership, Entrepreneurship, and Lifelong Learning

Exhibit leadership qualities, teamwork, communication skills, entrepreneurial mindset, and continuous learning abilities to adapt to evolving technological advancements and global industry requirements.

7. Programme Details

- Eligibility Criteria : Candidates with three year Bachelor's degree in Computer Science / Computer Applications / Information Technology / Computer Technology / Software Engineering or equivalent degree as recognized by Manonmaniam Sundaranar University are eligible for this programme
- Medium of Instruction : English
- Duration of the Programme : Full time 2 years programme spread over four semesters.

8. Examination Scheme

1. **Internal Assessment (25 Marks)**

Continuous Internal Assessment Test	15 marks
Assignments / Snap Test / Quiz	5 marks
Seminars	5 marks

2. **External Assessment (75 Marks)**

Written exams, Practical, Project report and Comprehensive Viva Voce

3. **Practical Assessment**

The Maximum Marks for Practical Examination is 100 for PG.

External Mark 50. Internal Mark 50.

4. **Project Assessment**

Mini Project Guidelines

Mode of Mini Project:	Individual Project
Nature of Mini Project:	Every student shall undertake a unique project title (Novel Concept/ idea/system or a small research problem, which shall be designed and implemented using Web Application Development and hosting using open-source software like Python, PHP, HTML, etc., (or) Implementation of Cryptographic Algorithms–RSA–DSA–ECC using C or JAVA Programming approved by her/his guide (or) any recent development
Guide:	Each Student shall be allotted under the Guidance of one Department faculty member by the Programme coordinator/Head
Duration:	One semester - (6 hours per week) Students carry out the Mini Project work in her/his college itself. In the case of a Company project, students are permitted to do the mini-project work in reputed IT companies without affecting the minimum attendance and other classes of the third semester
Continuous Assessment:	Based on periodic reviews (Three reviews during the semester. Tentative review dates are decided by the department and will be communicated to the students at the beginning of the third semester.)

Internal (CIA) (50 Marks) (All the three reviews are mandatory)		External (50 Marks)	
Review I (Problem identification, Title & Abstract submission, Novelty of the idea, proposed outcomes, issues in existing methods, tools to be used)	15 Marks	Both the internal and external examiners will evaluate the student at the end of the semester based on the following criteria: an internal examiner, determined by the HOD, such as a faculty member from the Guide or any other department, and an external examiner appointed by the COE.	
Review II System Design / Database Design or Research Methodology / Algorithms and Techniques/ detailed Implementation plan	15 Marks	**Internal Examiner** Project Report	20 Marks
Review III System Implementation status, Testing, demo of working system and completion of report writing	20 Marks	**External Examiner shall evaluate under the following criteria** • Presentation of the Mini Project • Demonstration of the mini-project working • Viva -voce	 10 Marks 10 Marks 10 Marks
Total	**50 Marks**		**50 Marks**

Major Project Guidelines:

Mode of Major Project: Individual Project

Nature of Major Project: Every student must choose a unique project title (novel concept, idea, system, or a small research problem) approved by their guide and then design and implement it using available software development tools or programming languages.

Guide: Each Student shall be allotted under the Guidance of one Department faculty member by the Programme coordinator/Head

Duration : One semester - (30 hours per week) Major project students may also opt for company projects with prior permission from the Head of the Department/Principal

Continuous Assessment: Based on periodic reviews (Three reviews during the Semester. Tentative review dates are decided by the department and to be intimated to the students at the beginning of the fourth Semester)

Evaluation criteria

Each student is evaluated by the Internal Examiner (Guide) continuously during the respective semester. External Examination will be conducted at the end of the respective semester.
Passing Criteria: Student shall secure a minimum of **50 % marks in the external** evaluation and shall secure a **minimum of 50 % marks in combined Internal and External evaluation**.
(There is no passing minimum for the internal evaluation)

Internal (50 Marks) (All the three reviews are mandatory)		**External (50 Marks)**	
Review I (Problem identification, Title & Abstract submission, The novelty of the idea proposed outcomes, issues in existing methods, tools to be used)	15 Marks	Both Internal and External Examiner Shall evaluate the student based on the following criteria at the end of the semester: (Guide or any other department faculty decided by the HOD shall be internal examiner. External Examiner will be appointed by the COE	
Review II System Design / Database Design / Methodology / Algorithms and Techniques/ detailed Implementation plan	15 Marks	**Internal Examiner** Project Report	 20 Marks
Review III System Implementation status, Testing, outcomes and report writing	20 Marks	**External Examiner shall evaluate under the following criteria** • Presentation of the Project • Demonstration of the working project • Viva -voce	 10 Marks 10 Marks 10 Marks
Total	**50 Marks**		**50 Marks**

Testing Pattern (25+75)

Internal Assessment

Theory Course: For theory courses, there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks. The duration of each test shall be one /one and a half hours.

Computer Laboratory Courses: For Computer Laboratory Oriented Courses, there shall be two

tests in the Theory part and two tests in the Laboratory part. Choose one best from the Theory part and the other best from the two Laboratory parts. The average of the best two can be treated as the CIA for a maximum of 25 marks. The duration of each test shall be one /one and a half hours. There is no improvement for CIA of both theory and laboratory, and, also for UniversityEnd Semester Examination.

Note: In both Internal and Semester End Examinations

Lower Order Thinking (K1, K2, & K3) – 40 % in each part

Higher Order Thinking (K4, K5, & K6) – 60 % in each part

9. Question Paper Pattern for the Theory Papers

1. The Maximum Marks for Semester End Examination is 75 for PG.

2. The question paper shall have three Parts with the maximum of 75 marks for three hours with the following division

Part-A shall contain **Ten** Multiple Choice Questions drawn from all the units on the basis of three questions from each unit. Each question shall carry one mark (15×1 = 15 Marks). Answer all the questions.

Part-B shall contain **Five** either or type questions drawn from all the 5 units. One either or type question from each unit. Each question shall carry 4 marks (5×4 = 20 Marks). Answer all the questions.

Part-C shall contain **Five** either or type questions drawn from all the 5 units. One either or type question from each unit. Each question shall carry 8 marks (5×8 = 40 Marks). Answer all the questions.

10 Model Theory Question Paper

Computer Science with Artificial Intelligence

Mobile Computing

Time : 3 Hrs Max. Marks: 75

Part – A (15x1=15)

Answer All Questions. Choose the correct answer

1. K1 Identify one of the following is a universally adopted shape of cell?
   a) Hexagon b) Square c) Circle d) Triangle

2. K2 In general, a mobile computing environment can also be considered as the type of _____ environment.
   a) Grid computing b) Mobile computing
   c) Distributed computing d) None of the above

3. K4 Select one of the following is not a mobile device?

a) Laptop b) Smartwatch c) Smartphone d) Gaming console

4. K1 What is a mobile application?
   a) An application that runs on a desktop computer
   b) An application that runs on a server
   c) An application that runs on a gaming console
   d) An application that runs on a mobile device

5. K2 Which of the following wireless technologies is commonly used for mobile communication?
   a) Bluetooth b) Wi-Fi c) NFC d) Cellular

6. K4 BSC comes under which of the following category?
   a) Operation b) Radio c) Network d) Mobile

7. K4 What is a mobile device camera?
   a) A camera that can be used for mobile communication
   b) A camera that can be carried easily
   c) A camera that is built into a mobile device
   d) All of the above

8. K3 What is a mobile device GPS?
   a) A device that can be used for mobile communication
   b) A device that can run mobile applications
   c) A device that is used for location tracking and navigation
   d) A device that can make phone calls

9. K1 What is a mobile payment system?
   a) A payment system for mobile devices
   b) A payment system for desktop computer
   c) A payment system for gaming consoles
   d) A payment system for smartwatches

10. K2 The term "HLR" stands for the _____
   a) Home Location Register b) House Location Register
   c) Home Live Register d) None of the above

11. K4 What is an IMEI number?
   a) An identifier for a mobile device
   b) An identifier for a mobile app
   c) An identifier for a mobile operating system
   d) An identifier for a mobile hotspot

12. K4 The main tasks of the _____ comprise channel coding & error detection /correction.
   a) physical layer b) datalink layer c) transport layer d) application layer

13. K4 The only important number for a user of GSM is the _____
   a) phone number b) location number c) identify number d) security number

14. K3 Which of the following is a common means for losing encrypted data?
   a) lose the keys b) lose the encryption standard
   c) lose the account d) all of the mentioned

15. Which of the following is used for Web performance management and load testing?
    a) VMware Hyperic b) Webmetrics
    c) Univa UD d) Tapinsystems

Part -B(5x4=20)
Answer All Questions, choosing either (a) OR (b)
Each answer should not exceed 250 words

16. a) K2 What are smart clients in wireless internet? Explain briefly (or)
b) K1 What is location-based services in mobile computing

17. a) K5 How to develop mobile applications in GUI (or)
    b) K2 Explain the strengths of SMS

18. a) K2 Explain briefly about GPS technology (or)
    b) K1 Define M-commerce. Explain briefly

19. a) K6 Write briefly about MAC protocol (or)
    b) K6 Write the parameter of QoS
20. a) K2 What are the different types of attacks? Explain (or)
    b) K2 Explain about password security

Part -C(5x8=40)
Answer All Questions, choosing either (a) OR (b)
Each answer should not exceed 600 words

21. a) K4 Illustrate the types of middleware components and gateways (or)
b) K6 Develop three tier architecture with diagram for mobile computing

22. a) K5 Write about the characteristics and benefits of mobile computing through the internet(or)
    b) K3 Explain the GPRS architecture with its constituent elements.
23. a) K2 Explain briefly about event-based programming (or)
    b) K3 Discuss about pros and cons of mobile payment system
24. a) k6 What are the routing protocols in transport layer? Formulate. (or)
    b) K3 Discuss about dynamic linking in wireless network.
25. a) K3 Explain about Wireless sensor network(or)
    b) K6 Design Energy Model

11. Entire Programme Structure

Template for P. G., Programmes

Semester–I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester–IV	Credit	Hours
1.1. Core-I	4	5	**2.1. Core-IV**	4	5	3.1. Core-VI	4	5	4.1 Project with Viva- Voce	18	30
1.2 Core-II	4	5	**2.2 Core-V**	4	5	3.2 Core-VII	4	4	4.2 Extension Activity	1	
1.3 **Core III**	4	4	**2.3 Elective – III**	4	4	3.3 Core – VIII	4	4			
1.4 Elective-I	4	4	**2.4 Elective-IV**	4	4	3.4 Elective (Generic / Discipline Centric) – V	4	4			
1.5 Elective-II	4	4	2.5 **Core LAB-III**	2	4	3.5 Core Practical V	2	4			
1.6 **Core LAB-I**	2	4	2.6 **Core LAB-IV**	2	4	3.6 Mini Project	3	6			
1.7 **Core LAB-II**	2	4	2.7 **Skill Enhancement Course SEC 1**	2	4	3.7 Skill Enhancement Course –SEC 2	2	3			
						3.8 Internship/ Industrial Activity/Research Updation Activity	2	-			
	24	30		22	30		25	30		19	30
Total Credits 90											

Component-wise Credit Distribution

Credits	Sem I	Sem-II	Sem III	Sem IV	Total
Core/Core LAB/Mini Project/ Major Project	18	14	12+6	18	68
Electives (i)Discipline– Centric	6	6	3		15
(ii Skill Enhancement		2	2		6
(iii)Summer Internship / Industrial Training/ Project			2		
Ability Enhancement / Extension				1	1
Total Credits	24	22	25	19	90

12. Bloom's Taxonomy Levels with Course Outcomes (CO)

In Outcome-Based Education (OBE), Course Outcomes (COs) are usually written based on Bloom's Taxonomy Cognitive Levels. These levels indicate the depth of learning and the type of questions asked in examinations.

Bloom's Taxonomy Levels

Level	Taxonomy Name	Action Verbs	Type of Questions
K1	Remember	Define, List, Recall, Identify	Objective / Recall Questions
K2	Understand	Explain, Describe, Discuss, Summarize	Short Answer Questions
K3	Apply	Solve, Use, Implement, Demonstrate	Problem Solving / Practical Questions
K4	Analyze	Compare, Differentiate, Analyze, Examine	Analytical Questions
K5	Evaluate	Justify, Criticize, Evaluate, Validate	Critical Thinking Questions
K6	Create	Design, Develop, Construct, Formulate	Project / Design Questions

Mapping Between CO and Bloom's Taxonomy

CO	**Description**	**Bloom's Level**
CO1	Basic Understanding	K1, K2
CO2	Application Skills	K3
CO3	Analytical Ability	K4
CO4	Evaluation Skills & Design & Innovation	K5,K6

Level of Correlation between COs and POs

0 – No Correlation 1 – Low 2 – Medium 3 – High

Mapping of Courses with Programme Specific Outcomes (PSOs)

Sl. No	Title of the Paper	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PS07	Total Score
1	Artificial Intelligence & Expert Systems	3	2.5	2.25	2.25	1.75	1.25	1.75	14.75
2	Fundamentals of Data Science	3	2.5	2.25	2.25	1.5	1.5	1.5	14.5
3	Design & Analysis of Algorithms	3	2.75	2.25	2.5	1.5	1.5	1.5	15
4	Mathematics for Data Science	3	2.75	2.25	2	1.5	1.25	1.5	14.25
5	Web services	3	2.75	2	2.5	1.75	1.5	1.25	14.75
5	Compiler Design	3	2.75	2.25	2.5	1.5	1.5	1.5	15
6	Virtual and Augmented Reality	3	2.75	2.25	2.5	1.5	1.25	1.5	14.75
7	Algorithm Lab	3	2.75	2.5	3	1.75	1.5	1.5	16
8	Python Programming Lab	3	2.75	2.5	3	1.75	1.5	1.5	16
9	Machine Learning	3	2.75	2.75	2.75	2	1.5	1.75	16.5
10	Big Data Analytics	3	2.75	2.75	2.75	2	1.5	1.75	16.5
11	Pattern Recognition & Image Analysis	3	2.75	2.75	2.75	2	1.5	1.75	16.5
12	/Optimization Techniques	3	2.75	2.25	2.25	1.75	1.5	1.5	15
13	Wireless Networks & Mobile Computing	3	2.75	2.25	2.25	2	1.5	1.5	15.25
14	Databases for Data Science	3	2.75	2.25	2.25	2	1.5	1.75	15.5
15	Machine Learning Lab	3	2.75	2.75	2.25	2	1.5	1.75	16
16	Big Data Analytics Lab	3	2.75	2.75	2.25	2.25	1.5	1.75	16.25
17	Social Network Analysis	3	2.75	2.25	2.25	2	1.5	1.75	15.5
18	Deep Learning	3	2.75	2.25	2.25	2	1.5	1.5	15.25
19	Natural Language processing	3	2.75	2.25	2.25	2	1.5	1.5	15.25
20	Cryptography and Network Security	3	2.75	2.25	2.25	2.5	2	1.5	16.25
21	Robotics Process Automation for Business	3	2.75	2.5	2.25	2.25	1.75	1.5	16
22	Advanced Software Engineering	3	2.75	2.25	2.25	2.25	2	1.5	16
23	Critical thinking, Design Thinking & Problem Solving	2.75	2.5	2.25	2	2.75	2.25	2	16.5
24	Natural Language Processing Lab	3	2.75	2.25	2.25	2.75	1.75	1.5	16.25
25	Mini Project	3	2.75	2.25	2	2	1.5	1.25	14.75
26	Data Visualization Tools	3	2.75	2.25	2.25	2.75	1.75	1	15.75
27	Internship	2.75	2.75	2.25	2	2	2.25	2.25	16.25
28	Major Project	3	2.75	2.5	2	2	1.5	1.25	15
29	Extension Activity	1.75	2	2	1.5	1.25	2.25	2.25	13
30	Total Score	88.25	81	70.5	69.5	59	48.25	47.75	464.25

13. Detailed Syllabus with L-P-T Distribution of Hours

SEMESTER - I

Course status	**Course Title**	Credits	Hours
Core I	Artificial Intelligence & Expert Systems	4	5
Core II	Fundamentals of Data Science	4	5
Core III	Design & Analysis of Algorithms	4	4
Elective - I	Mathematics for Data Science/ Web services	4	4
Elective - II	Compiler Design / Virtual and Augmented Reality	4	4
Practical 1	Algorithm Lab	2	4
Practical 2	Python Programming Lab	2	4
	Total	**24**	**30**

SEMESTER - II

Course status	**Course Title**	Credits	Hours
Core IV	Machine Learning	4	5
Core V	Big Data Analytics	4	5
Elective 3	Pattern Recognition & Image Analysis /Optimization Techniques	4	4
Elective 4	Wireless Networks & Mobile Computing/ Databases for Data Science	4	4
Practical 3	Machine Learning Lab	2	4
Practical 4	Big Data Analytics Lab	2	4
Skill Enhancement Course [SEC 1]	Social Network Analysis	2	4
	Total	22	30

SEMESTER -III

Course status	Course Title	Credits	Hours
Core - VI	Deep Learning	4	5
Core – VII	Natural Language processing	4	4
Core – VIII	Cryptography and Network Security	4	4
Elective - V	Robotics Process Automation for Business / Advanced Software Engineering /Critical thinking, Design Thinking & Problem Solving	4	4
Core Practical 5	Natural Language Processing Lab	2	4
Mini Project	Web Application Development& Hosting	3	6
SEC 2	Data Visualization Tools	2	3
Internship/ Industrial Activity/ Research Updation Activity		2	-
	Total	25	30

SEMESTER IV

Course status	Course Title	Credits	Hours
Core Project	Project work and Viva-voce	18	30
	Extension Activity	1	
	Total	19	30

TOTAL CREDITS 90

I – SEMESTER

Course code		ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS	L	T	P	C
Core/Elective/ Supportive		Core -I	4	1		4
Course Outcomes:						
On the successful completion of the course, students will be able to:						
CO1	Understand the fundamentals of Artificial Intelligence, intelligent agents, knowledge representation, and problem-solving techniques					K1, K2
CO2	Apply informed search strategies, game-playing algorithms, and constraint satisfaction techniques to solve AI problems.					K3
CO3	Analyze knowledge representation schemes and reasoning mechanisms using propositional and first-order logic..					K4
CO4	Design expert systems and implement AI solutions using Prolog programming and knowledge-based system concepts.					K5,K6
K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create						

Unit:1	**Fundamentals of Artificial Intelligence**	**15hours**
Introduction: What is AI? AI Techniques, Representation of Knowledge, Knowledge-Based Systems, State Space Search. Production Systems: Problem Characteristics, Types of Production Systems. Intelligent Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem-solving agents, problem formulation, Knowledge-based agents.		
Unit:2	**Search Strategies**	**15hours**
Informed Search: Generate & test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint Satisfaction, Means-Ends Analysis. Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence		
Unit:3	**Knowledge Representation**	**15hours**
Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and BackwardChaining. First-order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.		
Unit:4	**Expert systems**	**15hours**
Architecture of expert systems, Steps to build Expert Systems - Role of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, PROSPECTOR		
Unit:5	**Prolog Programming**	**13hours**
Introduction to Prolog: Syntax and Numeric Function, Basic List Manipulation Functions in Prolog, Functions, Predicates and Conditional, Input, Output and Local Variables, Iteration and Recursion,Property Lists and Arrays		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars– webinars		
	Total Lecture hours	**75hours**

	Text Books
1	Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence." Tata McGraw Hill, 3rd Edition
2	Stuart Russell & Peter Norvig, "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.
3	Donald A. Waterman, "A Guide to Expert Systems", Addison Wesley Publishing Company
4	Carl Townsend, "Introduction to Prolog Programming"
5	Ivan Bratko, "PROLOG Programming for Artificial Intelligence", Addison-Wesley, 2nd Edition.
6	Klocksin and Mellish, "Programming with PROLOG"
	Reference Books
1	Eugene, Charniak, Drew McDermott, "Introduction to Artificial Intelligence", Addison Wesley
2	Patterson, "Introduction to AI and Expert Systems", PHI
3	Nilsson, "Principles of Artificial Intelligence", Morgan Kaufmann.
4	Carl Townsend, "Introduction to Turbo Prolog", Paperback
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://nptel.ac.in/courses/106/105/106105077/
2	**https://lecturenotes.in/materials/29314-note-for-artificial-intelligence-ai-by-jaswanth-chowdary**
3	**https://www.tutorialspoint.com/artificial_intelligence/index.htm**

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	2	2	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	8	10	5	4	9

CO- PSO Mapping

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	1	2	1	1	1	11
CO2	3	3	2	2	2	1	1	14
CO3	3	2	3	2	2	1	2	15
CO4	3	3	3	3	2	2	3	19
Total Score	12	10	9	9	7	5	7	59

Course code		FUNDAMENTALS OF DATA SCIENCE	L	T	P	C
Core/Elective/ Supportive		Core -II	4	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the types of data and analytics, the data science process,and its life cycle	K1, K2
CO2	Apply math in data science	K3
CO3	Analyze the various data-intensive operations and tools	K4
CO4	Evaluate the tools and methods for analyzing the data and development ofdata science with real-time case studies	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION OF DATA SCIENCE	15hours

Data Science – Data science Venn diagram - Basic terminology – Data science case studies- Types of data – levels of data- Types of data analytics - Descriptive analytics-Diagnostic analytics- Predictive analytics-Prescriptive analytics- Five steps of Data Science **Book 1 - Chapter 1,2,3**

Unit:2	MATHEMATICAL PRELIMINARIES	15hours

Basic Maths – mathematics as a discipline – basic symbols andterminology –linear algebra Basic Probability – definitions- probability – Bayesian vs frequentist –compound events – conditional probability – rules of probability **Book 1: Unit 2.1 – Chapter 4, Unit 2.2 – Chapter 5**

Unit:3	DATA MINING AND DATA WAREHOUSING	15hours

Introduction to Data warehousing – Design consideration of data warehouse - Data loading process – case study – Data mining – Datamining techniques – Tools and platforms – case study **Book 2 – Chapter 3 and 4**

Unit:4	VISUALIZING DATA	15hours

Exploratory Data Analysis – Developing the visual aesthetic – chart types – Great visualizations – Reading graphs – Interactive visualizations **Book 3 - Chapter 6**

Unit:5	Data Science – Recent Trends	13hours

Applications of Data Science, recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars– webinars

	Total Lecture hours	75hours

Text Books	
1	Ozdemir, Sinan. Principles of data science. Packt Publishing Ltd,2016.(Unit 1- Chapter 1,2,3 Unit 2.1 – Chapter 4, Unit 2.2 – Chapter 5
2	Maheshwari, Anil. "Data analytics made accessible." Seattle: AmazonDigital Services, 2 nd edition (2023).(Unit 3 – Chapter 3 and 4)
3	Skiena, Steven S. The data science design manual. Springer, 2017.(Unit 4- chapter 6)
Reference Books	
1	Hadrien Jean.Education, C. (2023). Data Science. Certybox Education.
2	Pierson, Lillian. Data science for dummies. John Wiley & Sons, 2021.
3	Grus, Joel. Data science from scratch: first principles with python.O'Reilly Media, 2019
4	Blum, Avrim, John Hopcroft, and Ravindran Kannan. Foundations of data science. Cambridge University Press, 2020.
Website and e-Learning Source	
1	https://www.analyticsvidhya.com/ https://www.simplilearn.com
2	https://www.ibm.com/in-en/topics/data-science
3	https://www.mygreatlearning.com/blog/what-is-data-science/

FUNDAMENTALS OF DATA SCIENCE

CO-PO Mapping

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	2	1	2	1	1	2
CO2	3	3	2	2	1	1	2
CO3	3	3	2	3	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	8	10	5	4	9

CO-PSO Mapping

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**Total Score**
CO1	3	2	1	1	1	1	1	10
CO2	3	2	3	2	1	1	1	13
CO3	3	3	2	3	2	2	1	16
CO4	3	3	3	3	2	2	3	19
Total Score	12	10	9	9	6	6	6	58

I – SEMESTER

Course code		DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
Core/Elective/ Supportive		Core -III	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand and solve complex problems	K1, K2
CO2	Select an appropriate algorithm for the problem	K3
CO3	Evolve as a competent programmer capable of designing and analyzing algorithms anddata structures for different kinds of problems.	K4
CO4	Classify problems into complexity classes like P and NP.Analyze graphs and determine shortest path	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	Introduction	15hours

Algorithm Definition – Algorithm Specification – Performance Analysis- Asymptotic Notations. Elementary Data Structures: Stacks and Queues – Trees – Dictionaries –Priority Queues – Sets and Disjoint Set Union – Graphs

Unit:2	Divide and Conquer	15hours

The General Method – Defective Chessboard – Binary Search – Findingthe Maximum and Minimum – Merge Sort – Quick Sort – Selection - Strassen's Matrix Multiplication.

Unit:3	The Greedy Method	15hours

General Method - Container Loading - Knapsack Problem - Tree Vertex Splitting – Job Sequencing With Deadlines - Minimum Cost Spanning Trees - Optimal Storage On Tapes – Optimal Merge Patterns - Single Source Shortest Paths.

Unit:4	Dynamic Programming	13hours

The General Method – Multistage Graphs – All-Pairs Shortest Paths – Single-Source Shortest Paths - Optimal Binary Search Trees - String Editing - 0/1 Knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling. Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees – Bi-connected Components and DFS.

Unit:5	Backtracking	15hours

The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Knapsack Problem Branch and Bound: Least Cost search - 0/1 Knapsack Problem.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75hours**

Text Books	
1	Ellis Horowitz, Satraj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms,Universities Press, Second Edition, Reprint 2009.
Reference Books	
1	Data Structures Using C - Langsam, Augenstien, Tenenbaum, PHI
2	Data structures and Algorithms, V.Aho, Hopcropft, Ullman , LPE
3	Introduction to design and Analysis of Algorithms - S.E. Goodman, ST. Hedetniem- TMH.
4	Carlos A.Coello Coello, Gary B.Lamont, David A.Van Veldhuizen, "Evolutionary Algorithms for Solving Multi-Objective Problems", Springer 2nd Edition, 2007.

DESIGN AND ANALYSIS OF ALGORITHMS

CO-PO Mapping

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	2	1	2	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	3	3	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	9	11	5	4	9

CO-PSO Mapping

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**Total Score**
CO1	3	2	1	1	1	1	1	10
CO2	3	3	2	3	1	1	1	14
CO3	3	3	3	3	2	2	1	17
CO4	3	3	3	3	2	2	3	19
Total Score	12	11	9	10	6	6	6	60

I – SEMESTER

Course code		MATHEMATICS FOR DATA SCIENCE	**L**	**T**	**P**	**C**
Core/Elective/ Supportive		**Elective 1-1**	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra	K1, K2
CO2	Describe properties of linear systems using vectors, and perform and interpret matrix operations.	K3
CO3	Describe and compute orthogonality and determinants	K4
CO4	Solve linear differential equations and Understand and apply the concept of Linear transformations	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	**Vectors and Matrices**	**15hours**

Vectors and Linear Combinations-Lengths and Angles from Dot Products- Matrices and Their Column Spaces-Matrix Multiplication AB and CR Solving Linear Equations Ax = b Elimination and Back Substitution-Elimination Matrices and Inverse Matrices-Matrix Computations and A = LU-Permutations and Transposes

Unit:2	**The Four Fundamental Subspaces**	**15hours**

Vector Spaces and Subspaces-Computing the Nullspace by Elimination: A = CR-The Complete Solution to Ax = b-Independence, Basis, and Dimension-Dimensions of the Four Subspaces

Unit:3	**Orthogonality**	**15hours**

Orthogonality of Vectors and Subspaces-Projections onto Lines and Subspaces-Least Squares Approximations-Orthonormal Bases and Gram- Schmidt-The Pseudoinverse of a Matrix Determinants 3 by 3. Determinants and Cofactors-Computing and Using Determinants- Areas and Volumes by Determinants

Unit:4	**Eigenvalues and Eigenvectors**	**13hours**

Introduction to Eigenvalues : Ax = λx - Diagonalizing a Matrix- Symmetric Positive Definite Matrices-Complex Numbers and Vectors and Matrices-Solving Linear Differential Equations

Unit:5	**The Singular Value Decomposition (SVD)**	**15hours**

Singular Values and Singular Vectors-Image Processing by Linear Algebra-Principal Component Analysis (PCA by the SVD). Linear Transformations The Idea of a Linear Transformation-The Matrix of a Linear Transformation-The Search for a Good Basis

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**75hours**

Text Books	
1	Gilbert Strang, Introduction to Linear Algebra, Wellesley - Cambridge Press, Sixth Edition, 2023
Reference Books	
1	David Lay, Steven Lay, Judi McDonald, Linear Algebra and Its Applications 5th Edition, Pearsons
2	Sheldon Axler, Linear Algebra Done Right (Undergraduate Texts in Mathematics) 3rd ed., Springer, 2015 Edition
3	Jim Hefferon, Linear Algebra, Fourth edition.
4	Jeff M Philips, Mathematical Foundations for Data Analysis
	Website and e-Learning Source https://joshua.smcvt.edu/linearalgebra/

MATHEMATICS FOR DATA SCIENCE

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	3	2	2	1	1	2
CO3	3	3	2	3	1	1	2
CO4	3	3	3	3	1	1	3
Total Score	12	11	8	10	4	4	9

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	1	1	1	1	1	10
CO2	3	3	2	2	1	1	1	13
CO3	3	3	3	2	2	1	1	15
CO4	3	3	3	3	2	2	3	19
Total Score	12	11	9	8	6	5	6	57

I – SEMESTER

Course code		WEB SERVICES	L	T	P	C
Core/Elective/ Supportive		Elective 1-2	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Explain the concepts, architecture, standards, and platforms of web services and distributed computing	K1, K2
CO2	Apply XML fundamentals, namespaces, schemas, and XML processing techniques in web service applications.	K3
CO3	Analyze SOAP, WSDL, and UDDI models for designing and integrating web services	K4
CO4	Evaluate advanced web service technologies, workflow management systems, and security mechanisms in enterprise applications and Design QoS-enabled web service applications using modern standards, management techniques, and emerging trends.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**12hours**

Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.

Unit:2	**XMLFUNDAMENTALS**	**12hours**

XMLFundamentals–XMLdocuments-XMLNamespaces-XMLSchema–ProcessingXML.

Unit:3	**SOAP MODEL**	**12hours**

SOAP: The SOAP model- SOAP messages-SOAP encoding- WSDL: WSDL structure- interface definitions-bindings-services-Using SOAP and WSDL-UDDI: About UDDI- UDDI registry Specification- Core data structures-Accessing UDDI

Unit:4	**TECHNOLOGIESANDSTANDARDS**	**12hours**

Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. Workflow: business process management- workflows and workflow management systems Security: Basics-data handling and forwarding- data storage-errors-Web services security issues.

Unit:5	**QUALITY OF SERVICE**	**10 hours**

Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS-enabled web services-QoS-enabled applications. Web services management services standards and future trends.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services: An Architects Guide", Prentice Hall, Nov 2003.
2	Keith Ballinger, "NET Web services: Architecture and Implementation with .Net", Pearson Education, First Edition, Feb 2003.
Reference Books	
1	Ramesh Nagappan,"DevelopingJavaWebServices:Architectinganddevelopingsecure Web Services Using Java", John Wiley and Sons, first Edition Feb 2003.
2	Eric A Marks and Mark J Werrell ," Executive Guide to Webservices" ,John Wiley and sons, March 2003.
3	Anne Thomas Manes, "Web Services :A managers Guide", AddisonWesley,June2003.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.tutorialspoint.com/webservices/index.htm
2	https://www.javatpoint.com/web-services-tutorial
3	https://www.btechguru.com/training--programming--xml--web-services--web-services-part- 1-video-lecture--11801--24--147.html

WEB SERVICES

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	3	3	1	1	2
CO4	3	3	2	3	2	2	3
Total Score	12	11	8	11	5	5	9

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	1	1	1	1
CO2	3	3	2	3	1	1	1
CO3	3	3	3	3	2	2	1
CO4	3	3	2	3	3	2	2
Total Score	12	11	8	10	7	6	5

I – SEMESTER

Course code		COMPILER DESIGN	**L**	**T**	**P**	**C**
Core/Elective/ Supportive		**Elective 2-1**	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the structure and phases of compilers, translators, symbol tables, and error handling techniques.	K1, K2
CO2	Apply lexical analysis techniques, regular expressions, finite automata, and parsing methods in compiler construction.	K3
CO3	Analyze symbol table management, compiler errors, and compiler generation tools such as Lex and Yacc.	K4
CO4	Evaluate code optimization methods, flow analysis, and memory management strategies for efficient compilation and Design efficient code generation and register allocation techniques using optimization algorithms.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**13 hours**

Compilers &Translators, Need of Translators, Structure of a Compiler, Phases, Lexical Analysis, Syntax Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Book Keeping, A Symbol Table in brief, Semantic Analysis, L-value, r-values, Error Handling

Unit:2	**Lexical Analyzer**	**15hours**

Rules of Lexical Analyser, Need for Lexical Analysis, Input Buffering, Preliminary Scanning, A simple Approach to the Design of Lexical Analysers, Transition Diagrams, Regular Expression, String & Languages, Finite Automata, Non-deterministic Automata, Deterministic Automata, From regular Expression to Finite Automata, Context free Grammars, Derivations & Parse Trees, Parsers, Shift Reduce Parsing, Operator-Precedence Parsing.

Unit:3		**15hours**

Symbol Table Management, Contents of a Symbol Table, Names &Symbol table records, reusing of symbol table spaces, array names, Indirection in Symbol Table entries, Data Structures for Symbol Tables, List, Self Organizing Lists, Search Trees, Hash Tables, Errors, Reporting Errors, Sources of Errors Syntactic Errors, Semantic Errors, Dynamic Errors, Lexical Phase Errors, Minimum Distance Matching,Syntactic Phase Error, Time of Detection, Ponic mode, Case study on Lex and Yacc

Unit:4		**15hours**
Principal Sources of Optimization, Inner Loops, Language Implementation Details Inaccessible to the User. Further Optimization, Algorithm Optimization, Loop Optimization, Code Motion, Induction Variables, Reduction in Strength, Basic Blocks, Flow Graphs, DAG Representation of Basic Blocks, Value Numbers & Algebraic Laws, Global Data Flow Analysis, Memory Management Strategies , Fetch Strategy, Placement Strategies, Replacement Strategies, Address Binding, Compile Time, Load Time, Execution Time, Static Loading, Dynamic Loading, Dynamic Linking.		
Unit:5		**15 hours**
Problems in Code Generation, a Simple Code Generator, Next- Use Information, Register Descriptors, Address Descriptors, Code Generation Algorithm, Register Allocation & Assignment, Global Register Allocation, Usage Counts, Register Assignment for Outer Loops, Register Allocation by Graph Coloring, Code Generation from DAG's, Peep- Hole Optimization, Redundant Loads & Stores, Un- Reachable Code, Multiple Jumps, Algebraic Simplifications, Use of Machine Idioms		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Compilers: Principles, Techniques Tools, Second Edition by A. V. Aho, Monicas. Lam, Ravi Sethi, J. D. Ullman
Reference Books	
1	Dhamdhere D.M., “Compiler Construction: Theory and Practice”, McMillan India Ltd., 1983
2	Holub Allen, “Compiler Design in C”, Prentice Hall of India, 1990
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.geeksforgeeks.org/compiler-design- tutorials/
2	https://www.tutorialspoint.com/compiler_design
3	https://www.javatpoint.com/compiler-tutorial
4	https://onlinecourses.nptel.ac.in/noc19_cs01/pr eview
5	http://ecomputernotes.com/compiler-design

Compiler Design

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	3	3	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	9	11	5	4	9

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	1	1	1	1	1	10
CO2	3	3	2	3	1	1	1	14
CO3	3	3	3	3	2	2	1	17
CO4	3	3	3	3	2	2	3	19
Total Score	12	11	9	10	6	6	6	60

I – SEMESTER

Course code		VIRTUAL AND AUGMENTED REALITY	L	T	P	C
Core/Elective/ Supportive		Elective 2-2	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the fundamentals, history, components, and interfaces of Virtual Reality systems.	K1, K2
CO2	Apply VR rendering techniques, graphics architecture, and VR Programming tools in application development.	K3
CO3	Analyze the concepts, principles, and working mechanisms of Augmented Reality systems.	K4
CO4	Evaluate AR hardware, software, tools, and technologies for immersive application development and Design interactive AR content and mobile collaborative AR applications for real-world scenarios.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**12hours**

Virtual Reality: The Three I's of VR – History – Early commercial VR Technology – Components of a VR System – Input Devices: Trackers –Navigation and Manipulation Interfaces – Gesture Interfaces

Unit:2		**12hours**

Output Devices: Graphics Displays – Sound Displays – Haptic Feedback -Computer Architecture for VR: The Rendering Pipeline- PC Graphics Architecture - VR Programming: Toolkits and Scene Graphs – Traditional and Emerging Applications of VR

Unit:3		**12hours**

Augmented Reality: Introduction – Augmented Reality Concepts: Working Principle of AR –Concepts related to AR- Ingredients of an Augmented Reality Experience

Unit:4		**12hours**

Augmented Reality Hardware– Augmented Reality Software– Software to create content for AR Application – Tools and Technologies

Unit:5		**10 hours**

Augmented Reality Content: Introduction- Creating Content for Visual, Audio, and other senses – Interaction in AR - Mobile Augmented Reality: Introduction – Augmented Reality Applications Areas- Collaborative Augmented Reality

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**
Text Books		
1	Grigore C. Burdea and Philippe Coiffet, “Virtual Reality Technology”,Wiley Student Edition , Second Edition (Unit I: Chapter 1,2 Unit II:Chapter 3,4,6,8, 9)	
2	Alan B. Craig(2013), “Understanding Augmented Reality: Concepts and Applications”(Unit III: Chapter 1, 2, Unit IV : Chapter 3, 4 & Unit V:Chapter 5,6,8)	
3	Jon Peddie (2017), “Augmented Reality: Where We Will All Live”, Springer, Ist Edition (Unit IV: Chapter 7 (Tools& Technologies)	
Reference Books		
1	Alan Craig & William R. Sherman &Jeffrey D. Will, Morgan	
2	Kaufmann(2009), “Developing Virtual Reality Applications: Foundations of Effective Design”, Elsevier(Morgan Kaufmann Publishers)	
3	Paul Mealy (2018), “Virtual and Augmented Reality”,Wiley Bruno Arnaldi & Pascal Guitton & Guillaume Moreau(2018),“Virtual Reality and Augmented Reality: Myths and Realities”, Wiley	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Manivannan, M., (2018), “Virtual Reality Engineering,”IIT Madras, https:// nptel.ac.in/ courses/121106013	
2	Dube, A., (2020), “Augmented Reality - Fundamentals and Development,”NPTEL Special Lecture Series, https:// www.youtube.com /watch?v=MGuSTAqlZ9Q	
3	https://www.javatpoint.com/compiler-tutorial	
4	http://www.britannica.com/technology/virtual reality/Living-in -virtual-worlds	
5	https://mobidev.biz/blog/augmented-reality-development-guide	

VIRTUAL AND AUGMENTED REALITY

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	3	3	3	1	1	2
CO3	3	3	2	3	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	9	11	5	4	9

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	1	1	1	1	1	10
CO2	3	3	3	3	1	1	1	15
CO3	3	3	2	3	2	1	1	15
CO4	3	3	3	3	2	2	3	19
Total Score	12	11	9	10	6	5	6	59

I – SEMESTER

Course code		ALGORITHM LAB	L	T	P	C
Core/Elective/ Supportive		CORE LAB 1	0	0	4	2
Course Outcomes:						
On the successful completion of the course, students will be able to:						
CO1	Understand the concepts of AI search techniques, graph algorithms, and optimization problems using Prolog and C++.					K1, K2
CO2	Apply Prolog programming techniques to implement AI-based algorithms such as A*, MinMax, Alpha-Beta pruning, and game problems.					K3
CO3	Analyze graph-based algorithms including shortest path, minimum spanning tree, and topological sorting.					K4
CO4	Evaluate algorithm efficiency and complexity through sorting and optimization techniques and Design and implement real-world problem-solving applications using advanced algorithms and programming paradigms.					K5,K6
K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create						

Prolog:

- Write Prolog program to implement A* algorithm.
- Write Prolog program to implement MinMax search
- Write Prolog program to solve water jug problem
- Write Prolog program to implement TicTacToe
- Write Prolog program to implement alpha-beta pruning
- Write Prolog program to solve 4 Queen problem

C++

- Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n.

- Write a program to obtain the topological ordering of vertices in a given digraph.
- Implement travelling salesman problem.
- Find minimum cost spanning tree of a given undirected path using a Prim's algorithm.
- From a given vertex in a weighted connected graph, find shortest paths to other vertices using
- Dijkstra's algorithm.
- Solve N queen problem

ALGORITHM LAB (Using Prolog and C++)

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	3	3	1	1	2
CO4	3	3	3	3	2	1	3
Total Score	12	11	10	12	5	4	9

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	2	3	1	1	1	13
CO2	3	3	2	3	2	1	1	15
CO3	3	3	3	3	2	2	1	17
CO4	3	3	3	3	2	2	3	19
Total Score	12	11	10	12	7	6	6	64

I – SEMESTER

Course code		PYTHON PROGRAMMING LAB	L	T	P	C
Core/Elective/ Supportive		CORE LAB 2	0	0	4	2
Course Outcomes:						
On the successful completion of the course, students will be able to:						
CO1	Explain Python programming fundamentals including strings, lists, tuples, dictionaries, functions, and file handling concepts.					K1, K2
CO2	Apply object-oriented programming concepts such as inheritance, interfaces, and overloading to develop Python applications					K3
CO3	Analyze database operations, regular expressions, file processing, and data manipulation techniques using Python					K4
CO4	Evaluate data processing methods using data frames, aggregation, merging, grouping, and related analytical operations and Design and develop Python applications involving GUI widgets, data visualization, and real-world data analysis tasks					K5,K6
K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create						

List of Programs

- Program using Strings - Program to Sort Words in AlphabeticOrder
- Program to perform various list operations, such as:
- Insert an element (include appending also)
- Search an element
- Modify an existing element
- Delete an existing element (position & Value)
- Sort the list
- Program using Tuples - swap two numbers without using a temporary variable.
- Program using Dictionaries - count the number of times a character appears in a given string

- Write a function to convert number into corresponding number in words

  For eg, if the input is 876 then the output should be 'Eight Seven Six'.
- Program using Inheritance.
- Program using Interfaces.
- Program involving Overloading
- Program using Regular Expressions.
- Working with Widgets.
- Program to Insert, Delete and Update in Database.
- Program to create and perform operations using Data Frames.
- Program to implement Data Visualization.
- Reading and Writing Text Files and Binary Files
- Combining and Merging Data Sets
- Data Aggregation and GroupWise Operations

CO - PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	1	1	2
CO2	3	3	2	3	1	1	2
CO3	3	3	3	3	2	1	2
CO4	3	3	3	3	2	2	3
Total Score	12	11	10	12	6	5	9

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	2	3	1	1	1	13
CO2	3	3	2	3	1	1	1	14
CO3	3	3	3	3	2	2	1	17
CO4	3	3	3	3	3	2	3	20
Total Score	12	11	10	12	7	6	6	74

II – SEMESTER

Course code		Machine Learning	L	T	P	C
Core/Elective/ Supportive		CORE 4	4	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Describe the data, essential steps for creating a typical ML model and the fundamentals of pattern classification.	K1, K2
CO2	Able to examine different ML algorithms and unprocessed data and features	K3
CO3	Implement the essential techniques to reduce the number of features in a dataset and test the performance of predictive models	K4
CO4	Select multiple algorithms, combine and produce ensembles, discuss the essential techniques for modeling linear relations and Discuss the clustering algorithms, develop a Web application embedding a ML model	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**15hours**

Data Analytics with pandas and NumPy - NumPy and basic stats -Matrices - pandas library - Working with data - Null Values - Creating statistical graphs Book 1, Chapter -10

Giving Computers the ability to learn from data - Introduction – Building intelligent systems to transform data into knowledge - The three different types of Machine Learning(ML) - Introduction to basic terminology and notations - Aroadmap for building ML systems - Using Python for ML Book 2, Chapter - 1Training Simple ML Algorithms for Classification - Early History of ML -Implementing a Perceptron learning algorithm - Adaptive linear neurons and the convergence of learning Book 2, Chapter – 2

Unit:2		**15hours**

ML Classifiers using sckikit-learn - Choosing a classification algorithm - Training a perceptron - Modeling class probabilities via logistic regression - Maximum margin classification with support vector machines(SVM)

- Solving nonlinear problems using a kernel SVM - Decision tree learning - K- nearest neighbours: a lazy learning algorithm Book 2 Chapter 3

Data Preprocessing - Missing data - Categorical data - Partitioning a dataset into separate training and test datasets - Bringing features onto the same scale - Selecting meaningful features - Assessing feature importance with random forests Book 2 Chapter – 4

Unit:3		**15hours**

Compressing Data via Dimensionality Reduction – Unsupervised dimensionality reduction via principal component analysis - Supervised data compression via linear discriminant analysis - Using kernel principal

component analysis for nonlinear mappings Book 2, Chapter – 5 **Learning Best Practices for Model Evaluation and Hyperparameter Tuning** - Streamlining workflows with pipelines - Using k-fold cross-validation to assess model performance - Debugging algorithms with learning and validation curves -Fine-tuning ML models via grid search - Looking at different performance evaluation metrics Book 2, Chapter – 6		
Unit:4		**15hours**
Combining different models for ensemble learning - Learning with ensembles - Combining classifiers via majority vote - Bagging: building an ensemble of classifiers from bootstrap samples - Leveraging weak learners via adaptive boosting Book 2, Chapter – 7 **Predicting Continuous Target Variables with Regression Analysis** -Introducing Linear regression - Implementing an ordinary least squares linear regression model - Fitting a robust regression model using RANSAC – Evaluating the performance of linear regression models - Using regularised methods for regression - Turning a linear regression model into a curve - polynomial regression - Dealing with nonlinear relationships using random forests Book 2, Chapter – 10		
Unit:5		**13 hours**
Working with Unlabelled Data – Grouping objects by similarity using k-means - Organising clusters as a hierarchical tree - Locating regions of high density via DBSCAN Book 2, Chapter – 11 **Introduction to Embedding a ML model into a Web Application** – Serialising fitted scikit-learn estimators - Setting up an SQLite database for data storage - Developing a web application with Flask - Turning any classifier into a web application - Deploying the web application to a public server Book 2, Chapter – 9		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022
2	Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packt publishing, 2019
Reference Books	
1	Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python.O'Reilly Media, Inc., 2016.
2	Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, http://mitpress.mit.edu/catalog/item/default.asp? ttype=2&tid=12012, 2010
3	Wes McKinney. Python for Data Analysis. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://data-flair.training/blogs/machine-learning-tutorial/
2	https://www.geeksforgeeks.org/machine-learning/

CO - PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	2	1	2
CO2	3	3	2	3	2	1	2
CO3	3	3	3	3	2	2	2
CO4	3	3	3	3	3	2	3
Total Score	12	11	9	11	9	6	9

6

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total Score
CO1	3	2	2	2	1	1	1	12
CO2	3	3	3	3	2	1	1	16
CO3	3	3	3	3	2	2	2	18
CO4	3	3	3	3	3	2	3	20
Total Score	12	11	11	11	8	6	7	66

II – SEMESTER

Course code		BIG DATA ANALYTICS	L	T	P	C
Core/Elective/ Supportive		CORE 5	4	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the basic concepts of big data analytics and technologies	K1, K2
CO2	Apply the concept of HDFS, Map reduce for storing andprocessing of Big data	K3
CO3	Analyze and perform different operations on data usingPig, Hive, and Hbase	K4
CO4	Evaluate tools and methods for analyzing Big data analytics model and Develop real time big data analytics applications	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION TO BIG DATA ANALYTICS	**15hours**

Classification of Digital Data, Structured and Unstructured Data - Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data -Other Characteristics of Data - Why Big Data Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment Big Data Analytics: Classification of Analytics – Challenges – Big Data Analytics important - Data Science - Data Scientist Terminologies used in Big Data Environments. Book 1 - Chapter 1,2,3

Unit:2	BIG DATA TECHNOLOGY LANDSCAPE	**15hours**

NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN – Interacting with Hadoop Ecosystem Book 1: Chapter 4, 5

Unit:3	**HADOOP AND HDFS**	**15hours**

Introduction to Hadoop – RDBMS vs Hadoop- distributed computing challenges -A Brief History of Hadoop- The Hadoop Distributed Filesystem- Processing Data with Hadoop - Anatomy of a MapReduce Works - Anatomy of a MapReduce Job Run- Job Scheduling- Shuffle and Sort- Task Execution Book 2 – Chapter 1, 3,6

Unit:4	**HADOOP ECO SYSTEM**	**15hours**

Hive: Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins –Aggregations - Group by and Having - RCFile Implementation - Hive User Defined Function - Serialization and Deserialization. Pig: Introduction – Anatomy – Features – Philosophy - Use Case for Pig - Pig Latin Overview - Pig Primitive Data Types - Running Pig - Execution Modes of Pig - HDFS Commands - Relational Operators - Eval Function - Complex Data Types - Piggy Bank - User-Defined Functions - Parameter Substitution - Diagnostic Operator - Word Count Example using Pig - Pig at

Yahoo! - Pig Versus Hive Hbase -HBasics, Concepts. Book 1 - Chapter 9, 10 Book 2 - Chapter 11, 12,13		
Unit:5	**Case Studies**	**13 hours**
Hadoop Usage at Last.fm - Hadoop and Hive at Facebook-Nutch Search Engine- Log Processing at Rackspace – Cascading - TeraByte Sort on Apache Hadoop 601 - Using Pig and Wukong to Explore Billion-edge Network Graphs - Recent Trends in Big Data Analytics Book 2 - Chapter 16		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**75 hours**

Text Books	
1	Big Data and Analytics, Seema Acharya, Subhashini Chellappan, First Edition, 2015, Wiley.
2	Tom White, Hadoop: The Definitive Guide, O'Reilly Media Inc., 2015.
Reference Books	
1	Lublinsky, Boris, Kevin T. Smith, and Alexey Yakubovich. Professional Hadoop solutions. John Wiley &Sons, 2013.
2	Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017,Wiley
3	Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.ibm.com/analytics/big-data-analytics https://www.simplilearn.com/what-is-big-data-analytics-article https://azure.microsoft.com/en-us/resources/cloud-computing- dictionary/what-is-big-data-analytics

CO - PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	2	1	2
CO2	3	3	2	3	2	1	2
CO3	3	3	3	3	2	2	2
CO4	3	3	3	3	3	2	3
Total Score	12	11	9	11	9	6	9

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	2	1	1	1
CO2	3	3	3	3	2	1	1
CO3	3	3	3	3	2	2	2
CO4	3	3	3	3	3	2	3
Total Score	12	11	11	11	8	6	7

Course code		PATTERN RECOGNITION AND IMAGE ANALYSIS	L	T	P	C
Core/Elective/ Supportive		Elective 3-1	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the fundamentals, Get acquainted with image processing	K1, K2
CO2	Apply basic algorithms in image processing	K3
CO3	Grasp basics of knowledge representation	K4
CO4	Analyze the texture of images and Recognize patterns	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**12hours**

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

Unit:2		**12hours**

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:3		**12hours**

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, Hough transform, topological and texture analysis, shape matching.

Unit:4		**12hours**

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 square test.

Unit:5		**10 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.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars

	Total Lecture hours	**60 hours**
Text Books		
1	Digital Image Processing – Gonzalez and Wood, Addison Wesley, 1993.	
2	Fundamental of Image Processing – Anil K. Jain, Prentice Hall of India.	
3	Pattern Classification – R.O. Duda, P.E. Hart and D.G. Stork, Second Edition John Wiley, 2006	
Reference Books		
1	Digital Picture Processing – Rosenfeld and Kak, vol.I & vol.II, Academic,1982	
2	Computer Vision – Ballard and Brown, Prentice Hall, 1982	
3	An Introduction to Digital Image Processing – Wayne Niblack, Prentice Hall, 1986	
4	Pattern Recognition and Machine Learning – C. M. Bishop, Springer, 2009.	
5	Pattern Recognition – S. Theodoridis and K. Koutroumbas, 4th Edition, Academic Press,2009	

CO – PO MAPPING

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	2	1	2
CO2	3	3	2	3	2	1	2
CO3	3	3	3	3	2	2	2
CO4	3	3	3	3	3	2	3
Total Score	12	11	9	11	9	6	9

CO – PSO MAPPING

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	2	1	1	1
CO2	3	3	3	3	2	1	1
CO3	3	3	3	3	2	2	2
CO4	3	3	3	3	3	2	3
Total Score	12	11	11	11	8	6	7

Course code		OPTIMIZATION TECHNIQUES	L	T	P	C
Core/Elective/ Supportive		Elective 3-2	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the concepts of Linear Programming Problems and apply graphical and simplex methods to obtain optimal solutions.	K1, K2
CO2	Apply duality principles, revised simplex method, dual simplex method, and integer programming techniques to solve optimization problems.	K3
CO3	Analyze transportation, assignment, and travelling salesman problems using appropriate optimization techniques.	K4
CO4	Evaluate and solve replacement, project scheduling, PERT/CPM, and resource scheduling problems to support	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION	**12hours**

Linear Programming Problem (LPP): Formulations and graphical solution of (2 variables) canonical and standard terms of linear programming problem. Simplex method, Two phase simplex

Unit:2		**12hours**

Duality in LPP- dual problem to primal- primal to dual problem-dual simplex method- Revised simplex method-Integer programming problem

Unit:3		**12hours**

Transportation Model: North West corner Method, Least cost method, and Vogel's Approximation Method. Determining Net evaluation-Degeneracy in TP Assignment Model: Hungarian assignment model – Travelling salesman problem.

Unit:4		**12hours**

Replacement Problem: Replacement policy for equipment that deteriorate gradually, Replacement of item that fail suddenly-Individual and group replacement, Problems in mortality and staffing.

Unit:5		**10 hours**

Project Scheduling PERT/CPM Networks – Fulkerson's Rule – Measure of Activity – PERT Computation – CPM Computation – Resource Scheduling.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars

	Total Lecture hours	**60 hours**

Text Books

1	KantiSwarup, P.K. Gupta & Manmohan, “Operations Research”, Sultan Chand & Sons. 1996.
2	S.Kalavathy, “Operations Research”, Second Edition – Vikas Publishing House Pvt.Ltd.,
Reference Books	
1	1. P. K. Gupta & Manmohan. Problems in Operations Research: Methods and Solutions Sultan Chand & Sons

CO - PO Mapping

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	1	1	2
CO3 (K4)	3	3	3	3	2	1	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	7	5	8

CO - PSO Mapping

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	1	1	1
CO3 (K4)	3	3	3	3	2	2	1
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	7	6	6

Course code		Wireless Networks and Mobile Computing	L	T	P	C
Core/Elective/ Supportive		Elective 4-1	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Explain the basic concepts of wireless network and wireless generations.	K1, K2
CO2	Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc	K3
CO3	Appraise the importance of mobile computing networks and mobile client IP-Protocols	K4
CO4	Explain the design considerations for deploying the wireless network infrastructure and Differentiate and support the security measures, standards. Services and layer wise security considerations	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	Mobile Computing Architecture	**12hours**

Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Wireless Networks :Global Systems for Mobile Communication (GSM and Short Service Messages (SMS): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Introduction to SMS, SMS Architecture, SM MT, SM MO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS, Spread Spectrum technology, IS- 95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Introduction to WiMAX

Unit:2		**12hours**

Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6

Unit:3		**12hours**

Mobile OS and Computing Environment :Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux,Proprietary OS Client Development: The development process,Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators

Unit:4		**12hours**
Building, Mobile Internet Applications : Thin client:Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML,WML, HTML, cHTML, XHTML, VoiceXML		
Unit:5		**10 hours**
J2ME:Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP,Security Considerations in MIDP		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**

Text Books	
1	Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing,Technology, Applications and Service Creation, 2 nd Edition, Tata McGraw Hill, 2010..
Reference Books	
1	Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003
2	Raj kamal: Mobile Computing, Oxford University Press, 2007.
3	ItiSahaMisra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.
	Website and e-Learning Source https://nptel.ac.in/courses/108/106/106106167/ https://nptel.ac.in/courses/117/104/117104099/ https://nptel.ac.in/courses/106/106/106106147/

CO - PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	2	1	2
CO3 (K4)	3	3	3	3	2	1	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	8	5	8

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	2	1	1
CO3 (K4)	3	3	3	3	2	2	1
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	8	6	6

Course code		Databases for Data Science	L	T	P	C
Core/Elective/ Supportive		Elective 4-2	3	1		4

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand and discuss the importance of relational data modelling and conceptual modelling.	K1, K2
CO2	Experiment with various databases and compose effective queries	K3
CO3	Analyse the process of OLAP system construction	K4
CO4	Evaluate the use of NOSQL and its approach to the database and Develop applications using Relational and NoSQL databases	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	Fundamental Concepts of Database Management	**12hours**

Applications of Database Technology - Key Definitions - File versus Database Approach to Data Management - Elements of a Database System - Advantages of Database Systems and Database Management - Architecture and Categorization of DBMSs

Conceptual Data Modeling using the ER Model and UML Class Diagram Phases of Database Design - The Entity-Relationship Model - UML Class Diagram

Unit:2		**12hours**

Types of Database Systems Legacy Databases – Relational Databases: The Relational Model – Normalization-

Relational Databases: Structured Query Language - SQL Data Definition Language - SQL Data Manipulation Language

Unit:3		**12hours**

Data Warehousing and Business Intelligence Operational versus Tactical/Strategic Decision-Making - Data Warehouse Definition - Data Warehouse Schemas - The Extraction, Transformation, and Loading (ETL) Process - Data Marts - Virtual Data Warehouses and Virtual Data Marts - Operational Data Store - Data Warehouses vs Data Lakes – Business Intelligence

Introduction of NO SQL Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points Comparison of relational databases to new NoSQL stores, Mongo DB, Cassandra,HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, AggregateOriented Databases. sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to- Peer replication, Combining Sharding and

Replication.		
Unit:4	**Key Value Data Stores**	**12hours**
NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations,Queries against Varying Aggregate Structure.		
Unit:5		**10 hours**
Document Oriented Database: Column- oriented NoSQL databases using Apache HBASE, Column- oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage. **Data Modeling with Graph:**Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page RankMarkov chain,page rank computation, Topic specific page rank Page Ranking Computation techniques iterative processing, Random walk distribution Querying Graphs		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars –webinars		
	Total Lecture hours	**60 hours**
Text Books		
1	Lemahieu, W., Broucke, S.vanden and Baesens, B. (2018) Principles of database management: The Practical Guide to storing, managing and analyzing big and small data. Cambridge, United Kingdom: Cambridge University Press.	
2	Sadalage, P. & Fowler,NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition,2022	
Reference Books		
1	SQL for Data Scientists: A Beginner Guide for Building Datasets for Analysis Renee M. P. Teate	
2	SQL for Data Science: Data cleaning, wrangling and analytics with relational databases, Antonio Badia.	
3	Guy Harrison, Next Generation Database: NoSQL & big data, Apress	
Website and e-Learning Source		
	https://www.geeksforgeeks.org/introduction-to-nosql/	

CO - PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	2	1	2
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	8	6	8

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	2	1	1
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	8	6	7

Course code		Machine Learning – Lab	L	T	P	C
Core/Elective/ Supportive		Core Lab-3			4	2

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Apply pandas, NumPy and Matplotlib to read in , process and visualise data, implement linear classification algorithms.	K1, K2
CO2	Compare classifiers with linear and non-linear decision boundaries, select relevant features for the model construction	K3
CO3	Apply data compression and best practices for model evaluation and hyper parameter tuning	K4
CO4	Select appropriate algorithms and ensemble and apply clustering algorithms on un-labelled data, construct a web application embedding a ML model	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

List of Programs	
	UNIT-I
1	Programs using NumPy and pandas
2	Visualising using graphs
3	Perceptron learning algorithm
4	Adaline
UNIT-II	
5	Training a perceptron
6	Modeling class probabilities via logistic regression
7	Maximum margin classification with support vector machines (SVM)
8	Solving nonlinear problems using a kernel SVM
9	Decision tree
UNIT-III	
10	Unsupervised dimensionality reduction via principal component analysis
11	Supervised data compression via linear discriminant analysis
12	Using k-fold cross-validation to assess model performance
13	Debugging algorithms with learning and validation curves
14	Fine-tuning ML models via grid search
15	Implementing different performance evaluation metrics
UNIT-IV	
16	Ensemble Learning
17	Ordinary least squares linear regression model
18	Evaluating the performance of linear regression models
19	Regularised methods for regression
20	Nonlinear relationships using random forests

UNIT-V	
21	Grouping objects by similarity using k-means
22	Organising clusters as a hierarchical tree
23	Locating regions of high density via DBSCAN
24	Embedding a ML model into a Web Application

Text Books	
1	Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022.
2	Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packet publishing, 2019
Reference Books	
1	Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python.O'Reilly Media, Inc., 2016.
2	Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012, 2010
3	Wes McKinney. Python for Data Analysis. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018
Website and e-Learning Source	
1. 2. 3.	https://machinelearningmastery.com/machine-learning-in-python-step-by-step/ https://www.tutorialspoint.com/machine_learning_with_python/index.htm https://pythonprogramming.net/machine-learning-tutorial-python-introduction/

CO - PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	2	2	3	1	2
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	11	6	8

CO - PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	1	1
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	11	9	8	6	7

Course code		BIG DATA ANALYTICS LAB	L	T	P	C
Core/Elective/ Supportive		Core Lab-4			4	2

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Configure Hadoop and perform File Management.	K1, K2
CO2	Apply Map Reduce program to real time issues.	K3
CO3	Critically analyze huge data set using Hadoop distributed file systems and MapReduce	K4
CO4	Experimenting different data processing tools like Pig, Hive and Develop real time big data analytics applications	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

List of Programs	
	UNIT-I
1	Install Apache Hadoop
2	Perform setting up and Installing Hadoop in its three operating modes: Standalone Pseudo Distributed Fully Distributed
3	To use Web Based Tools to Manage Hadoop Set-up
4	Implement the following file management tasks in Hadoop: Adding files and
5	Retrieving files & Deleting Files
UNIT-II	
6	Develop a MapReduce program to calculate the frequency of a given word in a given file.
7	Develop a MapReduce program to find the maximum temperature in each year.
8	Develop a MapReduce program to find the grades of student's.
9	Develop a MapReduce program to implement Matrix Multiplication.
10	Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.
UNIT-III	
11	Develop a MapReduce to analyze weather data set and print whether the day is shinny or cool day. (National Climatic Data Centre (NCDC) Data set)
12	Develop a MapReduce program to find the number of products sold in each country by considering sales data containing fields like Transaction _Date Product Price Payment_Type Name City\State Country Account_Created Last_Login Latitude Login Data sets from different sources as Input
13	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data. (https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset)
14	Sorting the data using MapReduce
15	Count the number of missing and invalid values by joining two large given datasets.
UNIT-IV	
16	Install and Run Pig then write Pig Latin scripts to sort, group, join, project and filter the data.
17	Install and Run Hive then use Hive to Create, alter and drop databases, tables, views, functions and

	Indexes.
18	Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin
19	Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin
20	Write queries to sort and aggregate the data in a table using HiveQL
21	Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.
22	Write a program to implement combining and partitioning in Hadoop to implement a custom partitioner and Combiner
UNIT-V	
23	Analyze the sentiment for product reviews, this work proposes a MapReduce technique provided by Apache Hadoop
24	Trend Analysis based on Access Pattern over Web Logs using Hadoop.
25	Implementation of decision tree algorithms using MapReduce.
26	Implementation of K-means Clustering using MapReduce.
27	Generation of Frequent Itemset using MapReduce.

Text Books	
1	Big Data and Analytics, Seema Acharya, Subhashini Chellappan, First Edition, 2015, Wiley.
2	Tom White, Hadoop: The Definitive Guide, O'Reilly Media Inc., 2015.
Reference Books	
1	Lublinsky, Boris, Kevin T. Smith, and Alexey Yakubovich. Professional hadoop solutions. John Wiley &Sons, 2013.
2	Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley
3	Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, Perf Math Publishers
Website and e-Learning Source	
1.	https://www.ibm.com/analytics/big-data-analytics
2.	https://www.simplilearn.com/what-is-big-data-analytics-article
3.	https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics

CO-PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1 (K1&K2)	3	2	1	1	2	1	1
CO2 (K3)	3	3	2	2	3	1	2
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	11	6	8

CO-PSO Mapping

COs \ PSOs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1&K2)	3	2	2	1	1	1	1
CO2 (K3)	3	3	3	2	2	1	1
CO3 (K4)	3	3	3	3	3	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	11	9	9	6	7

Course code		SOCIAL NETWORK ANALYSIS	L	T	P	C
Core/Elective/ Supportive		SEC1	3	1		2

Course Outcomes:

On the successful completion of the course, students will be able to:

CO1	Understand the fundamentals of social web and elements of social network analysis.	K1, K2
CO2	Apply and visualize the knowledge representation in social network.	K3
CO3	Analyse the various methods in social network analysis.	K4
CO4	Evaluate the tools and methods for analysing the social network data and Investigate the recent potential applications and development of social network with real time case studies.	K5,K6

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate; **K6**-Create

Unit:1	INTRODUCTION TO SEMANTIC WEB AND SOCIAL NETWORKS	**12hours**

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis- Brief history of Social network analysis Book 1- Chapter 1,2,3 Book 2: Chapter 1

Unit:2	MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION	**12hours**

Knowledge Representation on the semantic web- Ontology and their role in the Semantic Web - Ontology languages for the Semantic Web- Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations Book 1: Chapter 4,5,6

Unit:3	**DATA COLLECTION**	**12hours**

Boundary specification – Data collection process- Information bias and issue of reliability – Archival data – Understanding SNA data – Managing SNA data Book2 : Chapter

Unit:4	**METHODS IN SOCIAL NETWORK ANALYSIS**	**12hours**

Descriptive methods – Graph – Density- Centrality – cliques – MDS- structural equivalence – Two mode networks – Inferential methods – QAP- ERGM Book 2- Chapter 3, 4

Unit:5	**CASE STUDIES**	**10 hours**

Case studies – Evaluation of web-based social network extraction – semantic – based social network analysis in the sciences – emergent semantics Book 1: Chapter 7,8,9

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars –webinars

	Total Lecture hours	**60 hours**
Text Books		
1	Peter Mika, "Social Networks and the Semantic Web", Springer 2007.	
2	Yang, Song, Franziska B. Keller, and Lu Zheng. Social network analysis: Methods and examples. Sage Publications, 2016.	
Reference Books		
1	Guandong Xu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.	
2	Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008..	
Website and e-Learning Source		
	https://bookdown.org/chen/snaEd/ch4.html https://www.sciencedirect.com/topics/social-sciences/social-network-analysis https://www.publichealth.columbia.edu/research/population-health-methods/social-network-analysis https://www.ibm.com/docs/en/spss-modeler/18.0.0?topic=analysis-about- social-network	

CO-PO Mapping

COs \ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	2	1	2
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	8	6	8

CO-PSO Mapping

COs \ PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**
CO1 (K1&K2)	3	2	1	1	1	1	1
CO2 (K3)	3	3	2	2	2	1	1
CO3 (K4)	3	3	3	3	2	2	2
CO4 (K5&K6)	3	3	3	3	3	2	3
Total Score	12	11	9	9	8	6	7