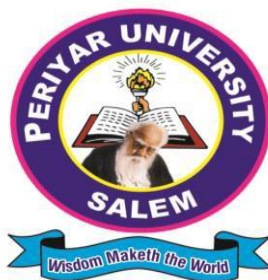


PERIYAR UNIVERSITY

NAAC A⁺⁺ Grade – State University – NIRF Rank 94 – State Public
University Rank 40 – SDG Institutions Rank Band: 11 - 50

SALEM – 636 011



DEPARTMENT OF COMPUTER SCIENCE

MASTER OF SCIENCE DEGREE

DATA SCIENCE

**CHOICE BASED CREDIT SYSTEM
(CBCS)**

**OBE REGULATIONS AND SYLLABUS
(Effective from the academic year 2026-2027 and
thereafter)**

REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	M.SC -Data Science
Programme Code	CSC03
Duration	PG -Two Years
Programme Outcomes (Pos)	PO1: Problem Solving Skill Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. PO2: Decision Making Skill Foster analytical and critical thinking abilities for data-based decision-making. PO3: Ethical Value Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. PO4: Communication Skill Ability to develop communication, managerial and interpersonal skills. PO5: Individual and Team Leadership Skill Capability to lead themselves and the team to achieve organizational goals. PO6: Employability Skill Inculcate contemporary business practices to enhance employability skills in the competitive environment. PO7: Entrepreneurial Skill Equip with skills and competencies to become an entrepreneur. PO8: Contribution to Society Succeed in career endeavors and contribute significantly to society.

	PO9 Multicultural competence Possess knowledge of the values and beliefs of multiple cultures and a global perspective. PO10 : Moral and ethical awareness/reasoning Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	PSO1–Placement To prepare the students who will demonstrate respectful engagement with others ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. PSO2-Entrepreneur To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. PSO3– Research and Development Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. PSO4– Contribution to Business World To produce employable, ethical and innovative professionals to sustain in the dynamic business world. PSO5– Contribution to the Society To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

CREDIT DISTRIBUTION FOR M.SC DATA SCIENCE PROGRAMME

Semester-I	Credit	Semester-II	Credit	Semester-III	Credit	Semester-IV	Credit
1.1. Core-I	4	2.1. Core-VII	4	3.1. Core-XIV	4	4.1 Core XXI-Project	16
1.2 Core-II	4	2.2 Core-VIII	4	3.2 Core-XV	4		
1.3 Core-III	4	2.3 Core-IX	4	3.3 Core-XVI	4		
1.4Core-IV	4	2.4 Core X-Lab	2	3.4 Core Lab -XVII	2		
1.5 Core - V	2	2.5 Core XI - Lab	2	3.5CoreLab -XVIII	2		
1.6 Core - VI	2	2.6 Core-XII Mini Project	2	3.6 Core Lab XIX	2		
1.7 Elective I	4	2.7 Elective - II	4	3.7 Elective – III	4		
Soft skill	2	2.7 Elective (Generic Centric) V Fundamentals of Human Rights	1	3.8 NME-II	2		
		2.8 NME I (Online Course) – SWAYAM / NPTEL/ MOOC	2	3.9 Core XX Internship/ Industrial Activity	2		
		2.9 Core XIII Extension Activity	1	Peace Education	2		
	26		26		28		16
	Total Credit Points						96

**CURRICULUM STRUCTURE FOR EACH SEMESTER M.Sc.
DATA SCIENCE (2026-2027)**

SEMESTER - I

Course Code	Category	Course Name	Number of Credits	Hours per Week
26UPCSC4C01	Core I	Python Programming	4	4
26UPCSC4C02	Core II	Problem Solving Techniques and C	4	4
26UPCSC4C03	Core III	Statistics-I	4	4
26UPCSC4C04	Core IV	Design and Analysis of Algorithm	4	4
26UPCSC4L01	Core V -Lab	Python Programming -Lab	2	4
26UPCSC4L02	Core VI – Lab	Problem Solving Techniques and Statistics - Lab	2	4
	Elective I	Elective Course -Theory	4	4
26UPCSC4S01		Soft Skill Development Lab	2	2
Total			26	30

SEMESTER-II

Course Code	Category	Course Name	Number of Credits	Hours per Week
26UPCSC4C05	Core VII	Machine Learning	4	4
26UPCSC4C06	Core VIII	Statistics-II	4	4
26UPCSC4C07	Core IX	Data Visualization Techniques	4	4
26UPCSC4L03	Core X - Lab	Machine Learning-Lab	2	4
26UPCSC4L04	Core XI - Lab	Data Visualization Techniques- Lab	2	4
26UPCSC4P01	Core XII	Professional Competency Skill- Mini Project	2	2
	Elective II	Elective Course-Theory	4	4
Generic Elective -V 26UPPGC1H01		Fundamentals of Human Rights	1	1

-	NME –I	Non-Major Elective –I (Online Course)	2	1
26UPCSC4X01	Core XIII	Extension Activity	1	-
Total			26	30

SEMESTER – III

Course Code	Category	Course Name	Number of Credits	Hours per Week
26UPCSC4C08	Core XIV	Deep Learning	4	4
26UPCSC4C09	Core XV	Natural Language Processing	4	4
26UPCSC4C10	Core XVI	Computer Vision	4	4
26UPCSC4L05	Core XVII-Lab	Deep Learning Lab	2	3
26UPCSC4L06	Core XVIII-Lab	Computer Vision Lab	2	3
26UPCSC4L07	Core XIX	Natural Language Processing Lab	2	3
	Elective III	Elective Course –Theory	4	4
-	NME-II	Non-Major Elective-II	2	3
26UPCSC4I01	Core XX	Internship /Industrial Activity (Carryout Summer Vacation at the end of I year-30 hours)	2	-
26UPGEN1V01		Peace Education	2	2
Total			28	30

SEMESTER-IV

Course Code	Category	Course Name	Number of Credits	Hours per Week
26UPCSC4P02	Core XXI	Project With Viva-voce	16	-
Total			16	-
Total Credits			96	

LIST OF ELECTIVE COURSES

Semester	Track A: Systems & Engineering	Track B: Intelligence & Strategy
Semester I	26UPCSC4E01 - VIBE Coding and AI Driven Development 26UPCSC4E02 - Big Data Technologies 26UPCSC4E03 - Cloud Computing	26UPCSC4E04 - Web Scraping 26UPCSC4E05 - Data Science and Predictive Analytics 26UPCSC4E06 - Information Security and Ethics
Semester II	26UPCSC4E07 – Internet of Things (IoT) and Smart Systems Design 26UPCSC4E08 - Edge Computing and Distributed Systems 26UPCSC4E09 - Secure Software Engineering	26UPCSC4E10 - Generative AI and Large Language Models 26UPCSC4E11 - Reinforcement Learning 26UPCSC4E12 - Social Network Analysis
Semester III	26UPCSC4E13 - Robotics and Automation 26UPCSC4E14 - Blockchain Technology 26UPCSC4E15 - Quantum Computing	26UPCSC4E16 - Explainable AI (XAI) 26UPCSC4E17 - AI for Business Decision Making 26UPCSC4E18 - Digital Transformation and Business Strategy

- **Students shall be enrolled in elective courses under either Track A or Track B, and once enrolled, they must continue in the same track for all three semesters.**

NON MAJOR ELECTIVE - II

26UPCSC1N01	-	Advanced Microsoft Office Lab
26UPCSC1N02	-	Bio-python Programming Lab

Value Added / Add on Courses

26UPCSCVA01	-	MS-Office (Excel)
26UPCSCVA02	-	R Programming
26UPCSCVA03	-	Bio-python
26UPCSCVA04	-	Large Language Models (LLMs)
26UPCSCVA05	-	Basics of Computer Hardware & Introduction to Networking

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
METHODS OF ASSESSMENT		
Rememberin (K1)	• The lowest level of questions requires students to recall • information from the course content • Knowledge questions usually require students to • Identify Information in the textbook.	
Understandin (K2)	• Understanding of facts and ideas by comprehending • organizing, comparing, translating, interpolating and • Interpreting in their own words. • The questions go beyond simple recall and require students to combined data together	
Application (K3)	• Students have to solve problems by using/applying a concept • Learned in the classroom. • Students must use their knowledge to determine an exact response.	
Analyzing the (K4)	• breakdown something into its component parts • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.	
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a work of art, or a solution to a problem. • Students are engaged in decision-making and problem-solving. • Evaluation questions do not have single right answers.	
Create (K6)	• The questions of this category challenge students to get • engaged in creative and original thinking. • Developing original ideas and problem-solving skills	

PROGRAMME OUTCOMES (PO) – PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PSO1	3	3	3	3	3	3	3	3	3	3
PSO2	3	3	3	3	3	3	3	3	3	3
PSO3	3	3	3	3	3	3	3	3	3	3
PSO4	3	3	3	3	3	3	3	3	3	3
PSO5	3	3	3	3	3	3	3	3	3	3

LEVEL OF CORRELATION BETWEEN PO'S AND PSO'S

(Suggested by UGC as per Six Sigma Tool – Cause and Effect

Matrix) Assign the value

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

DURATION OF THE PROGRAMME AND MEDIUM

The programme shall be of two years duration spread over four semesters under choice-based credit system. The Maximum duration to complete the course shall be two academic years after normal completion of the programme. The medium of instruction/study is English.

ELIGIBILITY FOR ADMISSION

A candidate who has passed Bachelor's Degree in Electronics and Electrical Engineering/Electronics and communication Engineering/Computer Science and Engineering/Information Technology/Electronics and Instrumentation Engineering / B.Sc. Computer Science, B.Sc. Computer Science (Cyber Security, Artificial Intelligence, Artificial Intelligence and Machine Learning, Artificial Intelligence and Data Science) /Computer Technology /Software Engineering / BCA / Mathematics / Statistics /Physics /Data Science / Data Analytics / Electronics /Electronics and Communications / B.Com (Computer Application) / UG degree in Mathematics or Computer Science as one of the subject under 10+2/3+2/3/4 system of this University or any of the degree of any other University accepted by the syndicate as equivalent there to subject to such conditions as may be prescribed therefore shall be permitted to appear and qualify for the **M.Sc. Data Science** degree examination of this University after a course of study of two academic year.

**SCHEME OF EXAMINATION FOR EACH SEMESTER FOR
M.SC DATA SCIENCE (2026-2027)**

SEMESTER– I

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	CIA	ESE	Total	
26UPCSC4C01	Python Programming	4	4		25	75	100	3
26UPCSC4C02	Problem Solving Techniques and C	4	4		25	75	100	3
26UPCSC4C03	Statistics-I	4	4		25	75	100	3
26UPCSC4C04	Design and Analysis of Algorithm	4	4		25	75	100	3
26UPCSC4L01	Python Programming -Lab	2		4	40	60	100	3
26UPCSC4L02	Problem Solving Techniques and Statistics - Lab	2		4	40	60	100	3
	Elective Course -Theory	4	4		25	75	100	3
26UPCSC4S01	Soft Skill Development Lab	2	2		40	60	100	3
Total		26	22	8	245	555	800	

SEMESTER– II

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	Examination Duration	ESE	Total	
26UPCSC4C05	Machine Learning	4	4		25	75	100	3
26UPCSC4C06	Statistics-II	4	4		25	75	100	3
26UPCSC4C07	Data Visualization Techniques	4	4		25	75	100	3
26UPCSC4L03	Machine Learning-Lab	2		4	40	60	100	3
26UPCSC4L04	Data Visualization Techniques -Lab	2		4	40	60	100	3

26UPCSC4P01	Professional Competency Skill-Mini Project	2		2	40	60	100	3
Discipline Centric Elective	Elective Course Theory	4		4	25	75	100	3
Generic Elective -V 23UPPGC1H01	Fundamentals of Human Rights	1	1		25	75	100	3
NME -I	Non-Major Elective –I (Online Course) - SWAYAM / NPTEL / MOOC	2	2				100	3
26UPCSC4X01	Extension Activity	1	1		40	60	100	3
Total		26	16	14	285	615	1000	

SEMESTER– III

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	CIA	ESE	Total	
26UPCSC4C08	Deep Learning	4	4		25	75	100	3
26UPCSC4C09	Natural Language Processing	4	4		25	75	100	3
26UPCSC4C10	Computer Vision	4	4		25	75	100	3
26UPCSC4L05	Deep Learning Lab	2		3	40	60	100	3
26UPCSC4L06	Computer Vision Lab	2		3	40	60	100	3
26UPCSC4L07	Natural Language Processing Lab	2		3	40	60	100	3
	Elective Course Theory	4		4	25	75	100	3
NME -II	Non-Major Elective-II (Supportive Course)	2	3		25	75	100	3
26UPCSC4I01	Internship Activity	2	-		40	60	100	3
26UPGEN1V01	Peace Education	2	2		25	75	100	3
Total		28	17	13	310	690	1000	

SEMESTER– IV

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	CIA	ESE	Total	
26UPCSC4P02	Project With Viva-voce	16	-		50	150	200	3
Total		16			50	150	200	

ACTUAL DISTRIBUTION OF CREDITS

Type of Courses	Component	No. of Courses	Credits	Total Credits
Core	Theory Courses	10	4	40
	Lab Courses	7	2	14
	Major Project	1	16	16
Elective	Discipline Centric – Theory Courses	3	4	12
	NME –II (Supportive Courses)	1	2	2
	Generic Centric Courses (Soft Skill Development Lab)	1	2	2
	Generic Centric Courses (Human Rights)	1	1	1
	Peace Education	1	2	2
NME -I	Skill Enhancement Courses/Online Courses (SWAYAM / Naan Mudhalvan)/ NME -I	1	2	2
	Mini Project	1	2	2
Internship / Industrial Activity	Internship	1	2	2
Extension Activity		1	1	1
Total Credits				96

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum
Framework
(LOCF) Guideline Based Credits and Hours Distribution
System for all Post – Graduate Courses including Lab
Hours**

SEMESTER - I

List of Courses	Credits	No. of Hours
Core-Theory	16	16
Core-Lab	4	8
Elective	4	4
Generic Elective – Lab	2	2
Total	26	30

SEMESTER – II

List of Courses	Credits	No. of Hours
Core-Theory	12	12
Core-Lab	7	11
Elective	4	4
NME -I	2	2
Generic Elective-Theory	1	1
Total	26	30

SEMESTER – III

List of Courses	Credits	No. of Hours
Core-Theory	14	12
Core-Lab	6	9
Discipline Centric Elective	4	4
NME -II	2	3
Peace Education	2	2
Total	28	30

SEMESTER – IV

List of Courses	Credits	No. of Hours
Core-Lab	16	-
Total	16	
Overall Credit	96	

CREDIT CALCULATION

Method of Teaching	Hours	Credits
Lecture	1	1
Tutorial/Demonstration	1	1
Practical/Internship/Self-Learning	2/1	1

ATTAINMENT RUBRICS FOR THEORY COURSES

THEORY EXAMINATION EVALUATION OF INTERNAL ASSESSMENT

Test	: 5 Marks (Best one out of Two)
Model Examination	: 5 Marks
Seminar	: 5 Marks
Assignment	: 5 Marks
Attendance	: 5 Marks

Total : 25 Marks

***** No Internal Minimum**

EVALUATION OF END SEMESTER

EXAMINATIONS QUESTION PAPER PATTERN

(THEORY)

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	One word (Answer all questions)	20x1 =20 (Multiple Choice Questions)	K1-K2	CO1
B	100 to 200 words (Answer any Three out of five questions)	3x5 =15 (Analytical type questions)	K4-K6	CO2
C	500 to 1000 words	5x8 =40 (Essay type questions)	K2-K6	CO3

ATTAINMENT RUBRICS FOR LAB COURSES

PRACTICAL\ MINI - PROJECT EXAMINATION

EVALUATION OF INTERNAL ASSESSMENT

Test : 20 Marks (Best one out of Two Tests)

Model Exam : 20 Marks

Total : 40 Marks

***** No Internal Minimum**

QUESTION PAPER PATTERN

Time duration : 3 Hours

Max. Marks : 60 Marks

Two Questions may be taken from the list of practical problems: 60 Marks

Distribution of the Marks

(i) Practical/Mini Project

Record Note Book	-	10
Problem Understanding	-	10
Implementation	-	20
Debugging and Modification	-	10
For correct output and viva	-	10

(ii) Industrial Training

o Internal Assessment	-	40
o Joint Viva-Voce	-	60

(Internal Examiner 30 and External Examiner 30)

(iii) Dissertation

O Internal Assessment	-	50
O Report Evaluation by External Examiner	-	50
O Joint Viva-Voce	-	100

(Internal Examiner 50 and External Examiner 50)

REGULATIONS FOR DISSERTATION WORK

- Students should attach themselves with well reputed Industry/Company/Institutions to do their five months dissertation work.
- The Candidate should submit the filled in format to the department for approval during the First week of December during the even semester.
- The review of the dissertation will be carried out periodically.
- The student should submit three copies of their dissertation work.
- The students may use OHP/PowerPoint presentation during their Dissertation Viva-Voce Examinations.

PASSING MINIMUM

The candidate shall be declared to have passed in the Theory/Practical/Dissertation Examination if the candidate secures:

- i. 50% marks in the ESE and
- ii. 50% in ESE and CIA put together.

GRADING SYSTEM

Evaluation of performance of students is based on ten-point scale grading system as given below.

Ten Point Scale			
Grade of Marks	Grade points	Letter Grade	Description
90 -100	9.0 -10.0	O	Outstanding
80 -89	8.0 -8.9	D+	Excellent
75 -79	7.5 -7.9	D	Distinction
70 -74	7.0 -7.4	A+	Very Good
60 -69	6.0 -6.9	A	Good
50 -59	5.0 -5.9	B	Average
00 -49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

Python Programming

COURSE OBJECTIVES:

- Understand fundamental programming concepts using Python
- Develop problem-solving skills using functions and data structures
- Apply object-oriented programming principles in Python
- Analyze and visualize data using Python libraries
- Design and develop web applications using Django framework

UNIT I

Introduction: Fundamental ideas of Computer Science - Strings, Assignment and Comments - Numeric Data types and Character sets - Expressions - Loops and Selection Statements: Definite iteration: the for Loop - selection: if and if-else statements - Conditional iteration: the while Loop

UNIT II

Strings and Text Files: Accessing Characters and substrings in strings – Data encryption - Strings and Number systems- String methods - Text - Lists and Dictionaries: Lists - Dictionaries - Design with Functions: A Quick review - Problem Solving with top-Down Design - Design with recursive Functions - Managing a Program's namespace - Higher-Order Functions

UNIT III

Design with Classes: Getting inside Objects and Classes - Data-Modeling Examples - Building a New Data Structure - The Two - Dimensional Grid - Structuring Classes with Inheritance and Polymorphism-Graphical User Interfaces-The Behavior of terminal-Based programs and GUI-Based programs - Coding Simple GUI-Based programs - Windows and Window Components - Command Buttons and responding to events

UNIT IV

Working with Python Packages: NumPy Library- Narray - Basic Operations - Indexing, Slicing and Iteration - Array manipulation - Pandas - The Series – The Data Frame - The Index Objects - Data Visualization with Matplotlib- The Matplotlib Architecture – Pyplot - The Plotting Window - Adding Elements to the Chart - Line Charts - Bar Charts - Pie charts.

UNIT V

Django: Installing Django- Building an Application - Project Creation - Designing the Data Schema - Creating an administration site for models - Working with Query Sets and Managers - Retrieving Objects - Building List and Detail Views.

TEXT BOOKS:

1. Kenneth A. Lambert, Fundamentals of Python: First Programs, 3rd Edition, Cengage Learning, 2024. **(Unit - I, II and III)**
2. Fabio Nelli, Python Data Analytics: With Pandas, NumPy, and Matplotlib, 3rd Edition, Apress, 2023. **(Unit - IV)**
3. Antonio Mele, Django 3 By Example, 3rd Edition, Packt Publishing, 2020. **(Unit - V)**

COURSE OUTCOMES:

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

CO1	Comprehend the programming skills in python and develop applications using conditional branches and loop	K1- K6
CO2	Create python applications with strings and functions	
CO3	Understand and implement the Object-Oriented Programming paradigm with the concept of objects and classes, Inheritance and polymorphism	
CO4	Evaluate the use of Python packages to perform numerical computations and data visualization	
CO5	Design interactive web applications using Django	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	M	H	H	H	H	M
CO2	H	H	H	M	H	H	H	H	H	H
CO3	H	M	H	H	M	H	M	H	H	M
CO4	H	H	H	H	H	H	H	M	H	H
CO5	H	H	H	H	H	H	H	H	H	M

H- High; M-Medium; L-Low

Problem Solving Techniques and C

COURSE OBJECTIVES:

- Develop problem-solving skills using algorithms
- Understand fundamental algorithms and mathematical computations
- Build a strong foundation in C programming concepts
- Apply structured programming using arrays, functions, and user-defined data types
- Implement advanced programming concepts using pointers and dynamic memory

UNIT I

Introduction - The Problem-solving Aspect - Top-down Design- implementation of Algorithms- Program Verification - The Efficiency of Algorithms. Fundamental Algorithms - Exchanging the values of Two Variables - Counting - Summation of a set of Numbers - Factorial Computation-Sine function computation - Generation of the Fibonacci sequence - Reversing the Digits of an Integer - Base Conversion Character to Number Conversion.

UNIT II

Finding the square Root of a number - The Smallest Divisor of an Integer - The Greatest Common Divisor of Two Integers - Generating Prime Numbers - Computing the Prime Factors of an Integer - Generation of Pseudo - random Numbers - Raising a Number to a Large Power - Computing the nth Fibonacci Number.

UNIT III

Constants, Variables and Data types - Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision making and looping.

UNIT IV

Arrays – Character Arrays and Strings – User Defined Functions - Structures and Unions

UNIT V

Pointers – File Management in c – Dynamic Memory Allocation and Linked Lists

Text Books:

1. R. G. Dromey, How to Solve It by Computer, Reprint Edition, Pearson Education India, 2007. Unit I & II (Chapters: 1, 2 and 3)
2. E. Balagurusamy, Programming in ANSI C, 8th Edition, McGraw Hill Education India, 2019. Unit III-IV (Chapters: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13)

Reference Books:

1. Seymour Lipschutz and Marc Lipson, Schaum's Outline of Discrete Mathematics, Revised 3rd Edition, McGraw Hill Education, 2017.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2nd Edition, Prentice Hall, 1988.

COURSE OUTCOMES:

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

CO1	Apply algorithmic techniques to solve computational problems and evaluate their correctness and efficiency	K1- K6
CO2	Write programs for numerical computations such as GCD, prime numbers, Fibonacci series, and base conversions.	
CO3	Develop programs using decision-making, looping, and structured input/output operations.	
CO4	Utilize arrays, strings, functions, structures, and unions to create organized and reusable code.	
CO5	Implement pointers, dynamic memory allocation, file handling, and linked lists to build efficient applications.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	H	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H- High; M-Medium; L-Low

Statistics-I**COURSE OBJECTIVES:**

- Understand fundamental concepts of statistics and data types
- Develop skills in data organization and visualization
- Apply statistical measures for data summarization
- Analyze relationships between variables using correlation and regression
- Understand probability concepts and distributions

UNIT I

Introduction to Statistics, Data Collection and Types, Origin and development of statistics- Definition and scope of statistics-concept of statistical population and sample-Types of data- Qualitative and Quantitative Data-Cross sectional and time series data-Types of scales- Nominal, ordinal-Interval and ratio-collection and security of data-primary and secondary data.

UNIT II

Tabulation and Data Visualization-Construction of tables with one or more factors of classification-Frequency distribution and cumulation frequency distribution and their graphical representation-Histogram, frequency polygon, stem leaf displays.

UNIT III

Data Summarization and Visualization Data, Measures of central tendency: Mathematical and positional averages-Arithmetic mean, harmonic mean, median and mode-Measures of dispersion: Range, IQR, QD, MD and SD-coefficient of variation-Box plot diagram-skewness of kurtosis-uses and application

UNIT IV

Correlation and Regression-Bi-variate data-definition-scatter diagram, Karl Pearson's coefficient of correlation, Spearman's rank correlation-Regression analysis-properties of regression coefficient-fitting of regression lines-coefficient and determination

UNIT V

Elements of probability and Distribution, Random experiment, sample space, events, algebra-Definition of Probability: classical, empirical, and axiomatic approaches to probability-Random variables-discrete and continuous random variables conditional probability-Bayes' theorem and its applications.

Text books:

1. M. Goon, M. K. Gupta and B. Dasgupta, Fundamentals of Statistics, Vol. I, 9th Edition, The World Press Pvt. Ltd., 2023.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 13th Edition, S. Chand & Sons, 2024.

Reference Book:

1. S. P. Gupta, Statistical Methods, 47th Edition, Sultan Chand & Sons, 2025.

COURSE OUTCOMES:

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

CO1	Identify qualitative and quantitative data, apply appropriate measurement scales, and distinguish between primary and secondary data.	K1- K6
CO2	Construct tables, frequency distributions, and visualize data through graphs and charts.	
CO3	Calculate mean, median, mode, standard deviation, and other dispersion measures, and analyze data distribution characteristics.	
CO4	Apply correlation and regression techniques to analyze relationships between variables and interpret results.	
CO5	Use probability rules, random variables, and Bayes' theorem to analyze uncertain events and make informed decisions.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	H	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H- High; M-Medium; L-Low

Design and Analysis of Algorithm

COURSE OBJECTIVES:

- Understand algorithm design principles and performance analysis
- Develop knowledge of fundamental data structures
- Apply various algorithm design techniques
- Design efficient solutions for optimization and search problems
- Explore advanced problem-solving strategies

UNIT I

Introduction: Algorithm, Pseudocode for expressing algorithms, Performance Analysis- Space complexity, Time complexity, Asymptotic Notation Big oh notation, Omega notation, Theta notation and Little oh notation Elementary Data Structures: Stacks and Queues- Trees- Dictionaries-Priority Queues-Sets and Disjoint Set Union- Graphs

UNIT II

General Sorting method Bubble, Selection, Insertion, Divide and conquer -Merge & Quicksort, applications-Binary search, Quick sort, Merge sort, Linear Search

UNIT III

The Greedy Method: 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 IV

Dynamic Programming: 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- Biconnected Components and DFS

UNIT V

Backtracking The General Method-The 8-Queens Problem- Sum of Subsets-Graph Coloring -Hamiltonian Cycles- Knapsack Problem Branch and Bound: Least Cost searched

Text Book:

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

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, MIT Press, 2022.
2. Mark Allen Weiss., Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2014.
3. Robert Sedgewick, Kevin Wayne, Algorithms, 4th Edition, Addison-Wesley, 2011.
4. G. A. Vijayalakshmi Pai, A Textbook of Data Structures and Algorithms, 1st Edition, Wiley-ISTE, 2023.
5. Gilles Brassard, Paul Bratley, Fundamentals of Algorithmics, 3rd Edition, Pearson, 1996.

COURSE OUTCOMES:

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

CO1	Analyze and evaluate algorithm efficiency	K1- K6
CO2	Implement and utilize appropriate data structures	
CO3	Design algorithms using standard paradigms	
CO4	Solve optimization and graph-related problems effectively	
CO5	Apply advanced techniques to solve complex problems	

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

MAPPINGWITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	M	L	L	L	L	H	H	H	L
CO2	H	H	H	M	M	L	L	L	L	L
CO3	H	H	H	L	L	L	M	M	M	M
CO4	H	H	H	L	L	L	M	M	M	L
CO5	H	H	H	L	M	M	H	H	H	H

H-High; M-Medium; L-Low

Python Programming Lab

COURSE OBJECTIVES:

- To master the fundamentals of writing python scripts
- To create program using elementary data items
- To implement Python programs with conditionals and loops
- To use functions for structuring Python programs
- To develop web programming with Django

LIST OF EXPERIMENTS

1. Program using elementary data items, lists, dictionaries and tuples
2. Program using conditional branches, loops
3. Program using functions
4. Program using classes and objects
5. Program using inheritance
6. Program using polymorphism
7. Program using Numpy
8. Program using Pandas
9. Program using Matplotlib
10. Program for creating dynamic and interactive web pages using

COURSE OUTCOMES:

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

CO1	Comprehend the programming skills in python and write scripts	K1- K6
CO2	Create python applications with elementary data items, lists, dictionaries and tuples	
CO3	Implement the Object-Oriented Programming concepts such as objects and classes, Inheritance and polymorphism	
CO4	Assess the use of Python packages to perform numerical computations and perform data visualization	
CO5	Create interactive web applications using Django	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	M	H	H
CO5	H	H	H	H	L	H	M	H	H	M

H- High; M-Medium; L-Low

**Problem Solving Techniques and Statistics Lab
(using C and R Programming)**

COURSE OBJECTIVES:

- Develop programming skills using C language
- Apply problem-solving techniques to computational tasks
- Understand and use structured data types in C
- Perform statistical analysis using R programming
- Analyze and interpret statistical relationships and models

LIST OF EXPERIMENTS

Using C

1. Write a C program to find the GCD of two integers
2. Write a C program to remove the duplicates from an ordered array
3. Write a C program to find smallest and largest number present in an array
4. Write a C program to sort the elements of an increasing order
5. Create a C Program with structure to specify data on students given below:
Roll no, Name, Department, Course, Year of joining. Assume that there are 100 students in the department
 - a) Write a function to print names of all students who joined in a particular year.
 - b) Write a function to print the data of students whose roll number is given

Using R

6. Practical based on coefficient of variation.
7. Practical based on skewness based on mean, median, mode and standard deviation.
8. Practical based on central moments, skewness and kurtosis.
9. Practical based on Karl Pearson correlation coefficient.
10. Practical based on lines of regression, angle between lines and estimated values of variables.

COURSE OUTCOMES:

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

CO1	Write and execute C programs for basic and intermediate problems	K1- K6
CO2	Design programs using structures and functions	
CO3	Apply algorithmic thinking to solve computational problems	
CO4	Perform statistical computations using R	
CO5	Interpret statistical results and build predictive models	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H- High; M-Medium; L-Low

Semester II

Subject Code: 26UPCSC4C05

Credits: 4

Machine Learning

Course objectives:

- Develop programming skills using C language
- Apply problem-solving techniques to computational tasks
- Understand and use structured data types in C
- Perform statistical analysis using R programming
- Analyze and interpret statistical relationships and models

UNIT I

Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik - Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade -off

UNIT II

Supervised Learning: Introduction -Discriminative and Generative Models -Linear Regression, Logistic Regression Least Squares-Under- fitting/Over fitting - Cross - Validation - Lasso Regression - Classification - Logistic Regression- Gradient Linear Models. Case Study- Walmart, Tsunami.

UNIT III

Support Vector Machines-Kernel Methods-Instance based Methods- K-NearestNeighbors-TreebasedMethods-DecisionTrees-ID3- CART - Ensemble Methods - Random Forest - Evaluation of Classification Algorithms.

UNIT IV

Unsupervised Learning: Clustering Algorithms: K Means, K Mode, K Median, Hierarchical clustering, DBSCAN, PCA, TSNE. Model, Median, Hierarchical clustering, DBSCAN, PCA, TSNE. Model Performance: Measuring Performance for Classification- Visualizing Performance Tradeoffs. Sample Case Study for Banking, Telecom and Population classification.

UNIT V

Neural Networks- Biological Motivation -Perceptron -Multi-layer Perceptron-Feed Forward Network-Back Propagation-Activation and Loss Functions-Limitations of Machine Learning-Deep Learning-Convolution Neural Networks -Recurrent Neural Networks -Use cases.

Text Books:

1. Tom M. Mitchell, Machine Learning, Reprint Edition, McGraw Hill Education, 2017.
2. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, 1st Edition (Reprint), Cambridge University Press, 2014.

Reference Books:

1. Hyatt Saleh, Machine Learning Fundamentals: Use Python and scikit-learn to Get Up and Running with the Latest Developments in Machine Learning, 1st Edition, Packt Publishing, 2018.

COURSE OUTCOMES:

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

CO1	Write and execute C programs for basic and intermediate problems	K1- K6
CO2	Design programs using structures and functions	
CO3	Apply algorithmic thinking to solve computational problems	
CO4	Perform statistical computations using R	
CO5	Interpret statistical results and build predictive models	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	H
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H-High; M-Medium; L-Low

Statistics- II

COURSE OBJECTIVES:

- Understand the fundamentals of statistical hypothesis testing
- Apply parametric tests for small and large sample analysis
- Analyze experimental data using design of experiments (DOE)
- Develop regression models for data analysis and prediction
- Utilize non-parametric statistical methods

UNIT I

Statistical Hypothesis: Simple and composite hypothesis. Test of significance. Errors in sampling. Type I and Type II errors. Critical region. Acceptance region. Level of significance. p-Value, computation of p-value. Steps involved in testing statistical hypothesis.

UNIT II

Small Sample Tests and Large Sample Tests: Definition, Statistical tests for concerning means. z test - One and Two sample z-test for Means, proportions. Student t test - One and Two sample t-test for Means, Paired t-test, F-test for Variance, Chi-square test (Chi-square test for Goodness of Fit, Independence of Attributes).

UNIT III

Design of Experiments: Analysis of variance - one and two way classifications - CRD-RBD- LSD, Confounding and Response Surface Methodology (Concepts only)

UNIT IV

Regression: Simple linear Regression Parameters - Multiple Linear Regression– Logistic Regression -Least square estimation -Residuals Analysis Residual plots-Multicollinearity

UNIT V

Non- parametric test: One sample tests - run test, test for randomness, Mann-Whitney U Test (two independent samples), Wilcoxon Signed-Rank Test (two related samples), Kruskal-Wallis Test (3+ independent groups), and Friedman Test. Median test.

Text Books:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 13th Edition, S. Chand & Sons, 2024.
2. Brian Caffo, Statistical Inference for Data Science, 1st Edition, Leanpub, 2016.
3. Joseph F. Hair Jr., William C. Black, Barry J. Babin and Rolph E. Anderson, Multivariate Data Analysis, 8th Edition, Cengage Learning, 2019.

Reference Book:

1. Jim Frost, Introduction to Statistics: An Intuitive Guide for Analyzing Data and Unlocking Discoveries, 2nd Edition, Statistics By Jim Publishing, 2023.

COURSE OUTCOMES:

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

CO1	Formulate and test statistical hypotheses effectively	K1- K6
CO2	Apply parametric statistical tests to real-world data	
CO3	Design and analyze experiments using ANOVA techniques	
CO4	Build and evaluate regression models	
CO5	Use non-parametric tests for data without distribution assumptions	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H- High; M-Medium; L-Low

Data Visualization Techniques

COURSE OBJECTIVES:

- Understand the principles of data visualization and storytelling
- Develop proficiency in visualization tools
- Apply design principles to create effective visualizations
- Create interactive and advanced visualizations
- Analyze and critique real-world visualizations

UNIT I:

Introduction: The case for data visualization and storytelling, Data visualization and storytelling details and best practices, Introduction to Tableau, Power BI Importing Data / Connecting to External Sources Interface Overview Creating Sheets and Dashboard (software Demo)

UNIT II:

Elements of Data Visualization: Measures & Dimension concepts, Design Fundamentals Design Principles, Colors, and-Chart Junk|| Design perspectives from the experts The Shaffer 4C's of Data Visualization Not-so-best practices (examples) Critique and redesign, Creating a good dataset for analysis Data modeling fundamentals for analytics Selecting data for your KPIs.

UNIT III:

Storytelling with Data: Depth Design Fundamentals of Data Visualization, What are the main approaches to storytelling with data? – Dashboards vs Story boards vs. Infographics-Designing with the user in mind The Duell Rules for Actionable Visualizations, Basic Charting Techniques (Hands-on Session).

UNIT IV:

Interactive Elements & Advance Graphics: Interactive Visualization Features– build interactive visualization Actions and filters Calculated measures Data blending, joins, and custom queries Custom Shape Files, Multiple choice and short answer on Blackboard Create graphs Appropriate for data Chart critique Geocoding and Mapping, Advanced Chart types Custom Color Palettes.

UNIT V:

Case Studies: Compare and contrast real-world examples Flowing Data – Nathan Yau Information is Beautiful Tableau Vizzes in the wild.

Text Books:

1. Yau, Nathan. Visualize this: the Flowing Data guide to design, visualization, and statistics. John Wiley & Sons, First Edition, 2011.
2. Few, Stephen. Information Dashboard Design: Displaying data for at-a glance monitoring. Vol.5. Burlingame, CA: Analytics Press, Second Edition, 2013.

Reference Books:

1. Hamilton, Max. "The visual display of quantitative information. Edward R. Tuft e. Graphics Press, Cheshire, Connecticut, 5th printing(2001).
2. Knaflic, Cole Nussbaumer. Storytelling with data: A data visualization guide for business professionals. John Wiley & Sons, First Edition, 2015.
3. Wexler, Steve, Jeffrey Shaffer, and Andy Cot greave. The big book of dashboards: visualizing your data using real-world business scenarios. John Wiley & Sons, First Edition, 2017.

COURSE OUTCOMES:

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

CO1	Understand visualization principles, design guidelines, and the role of storytelling in data analysis.	K1- K6
CO2	Create and manage data visualizations using Tableau and Power BI, including data import and dashboard creation.	
CO3	Apply best practices in chart selection, color usage, and layout to communicate insights effectively.	
CO4	Implement filters, actions, calculated fields, data blending, and geospatial visualizations.	
CO5	Critically analyze visualizations, identify design flaws, and redesign them for better communication and impact.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	M	H	H	H	H	H
CO2	H	H	H	M	H	H	H	H	H	H
CO3	H	M	H	H	M	H	M	H	H	M
CO4	H	H	H	H	H	H	H	M	H	H
CO5	H	H	H	H	H	H	H	H	H	M

H-High; M-Medium; L-Low

Machine Learning Lab

COURSE OBJECTIVES:

- Understand the fundamentals of Machine Learning and Python frameworks
- Apply supervised learning algorithms to real-world datasets
- Explore regularization and model optimization techniques
- Implement unsupervised learning techniques
- Perform dimensionality reduction and data visualization

LIST OF EXPERIMENTS

1. Introduction to Python Framework on ML &signification
2. Linear Regression on Real Time Dataset
3. Logistics Regression on Real Time Dataset
4. Lasso & Ridge Regression on Real Time Dataset
5. KNN on Real Time Dataset
6. Decision Tree on Real Time Dataset
7. SVM on Real Time Dataset
8. MLP on Real Time Dataset
9. Random Forest on Real Time Dataset
10. K-Means on Real Time Dataset
11. DBSCAN on Real Time Dataset
12. TSNE & PCA on Real Time Dataset

COURSE OUTCOMES:

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

CO1	Implement ML models using libraries such as NumPy, Pandas, and Scikit-learn on real datasets.	K1- K6
CO2	Apply regression and classification algorithms and assess their performance using appropriate metrics.	
CO3	Implement Ridge and Lasso regression to handle overfitting and enhance model generalization.	
CO4	Use K-Means and DBSCAN to identify patterns and group data without labeled outputs.	
CO5	Apply PCA and t-SNE techniques to simplify data and improve interpretability of results.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	M	H	H	H	H	M
CO2	H	H	H	M	H	H	H	H	H	H
CO3	H	M	H	H	M	H	M	H	H	M
CO4	H	H	H	H	H	H	H	M	H	H
CO5	H	H	H	H	H	H	H	H	H	M

H-High; M-Medium; L-Low

Data Visualization Techniques Lab**COURSE OBJECTIVES:**

- Understand the fundamentals of data visualization tools and techniques
- Develop visualization skills using programming languages
- Gain proficiency in Tableau for data analysis and visualization
- Design and develop interactive dashboards
- Apply visualization techniques to real-world datasets

EXERCISES**LIST OF EXPERIMENTS**

1. Introduction to various Data Visualization tools
2. Basic Visualization in Python
3. Basic Visualization in R
4. Introduction to Tableau and Installation
5. Connecting to Data and preparing data for visualization in Tableau
6. Data Aggregation and Statistical functions in Tableau
7. Data Visualizations in Tableau
8. Basic Dashboards in Tableau
9. Building R Shiny Dashboard App
10. Dashboard for Retail Dataset
11. Dashboard for Banking Dataset

COURSE OUTCOMES:

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

CO1	Select suitable tools (Python, R, Tableau) based on the data and analysis requirements.	K1- K6
CO2	Develop charts and plots to represent data effectively using programming languages.	
CO3	Connect to data sources, perform aggregation, and apply statistical functions.	
CO4	Design dashboards using Tableau and R Shiny to present data in an interactive manner.	
CO5	Create domain-specific dashboards (e.g., retail and banking) and communicate insights clearly.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	M	L	L	L	L	H	H	H	L
CO2	H	M	H	M	M	L	L	L	L	L
CO3	H	H	H	L	L	L	M	M	M	M
CO4	H	H	H	L	L	L	M	M	M	L
CO5	H	H	H	L	M	M	H	H	H	H

H-High; M-Medium; L-Low

Fundamentals of Human Rights

COURSE OBJECTIVES:

- Understand the concepts and evolution of human rights
- Examine the role of international and national institutions
- Analyze human rights provisions in the Indian context
- Explore rights of marginalized and disadvantaged groups
- Understand human rights movements and redressal mechanisms

UNIT I: INTRODUCTION

Meaning and Definitions of Human Rights- Characteristics and Importance of Human Rights- Evolution of Human Rights -Formation, Structure and Functions of the UNO -Universal Declaration of Human Rights-International Covenants-Violations of Human Rights in the Contemporary Era.

UNIT II: HUMAN RIGHTS IN INDIA

Development of Human Rights in India-Constituent Assembly and Indian Constitution-Fundamental Rights and its Classification-Directive Principles of State Policy-Fundamental Duties.

UNIT III: Rights of Marginalized and other Disadvantaged People

Rights of Women -Rights of Children-Rights of Differently Abled-Rights of Elderly-Rights of Scheduled Castes-Rights of Scheduled Tribes- Rights of Minorities- Rights of Prisoners- Rights of Persons Living with HIV/AIDS-Rights of LGBT.

UNIT IV: Human Rights Movements

Peasant Movements (Tebhaga and Telangana) – Scheduled Caste Movements (Mahar and Ad-Dharmi) - Scheduled Tribes Movements (Santhal and Munda) - Environmental Movements (Chipko and Narmada Bachao Andolan) - Social Reform Movements (Vaikom and Self Respect).

UNIT V: Redressal Mechanisms

Protection of Human Rights Act, 1993(Amendment 2019) - Structure and Functions of National and State Human Rights Commissions-National Commission for SCs-National Commission for STs – National Commission for Women-National Commission for Minorities-Characteristics and Objectives of Human Rights Education.

Reference Books:

1. Sudarshanam Gankidi, Human Rights in India: Prospective and Retrospective, 1st Edition, Rawat Publications, 2019.
2. Satvinder S. Juss, Human Rights in India, 1st Edition, Routledge India, 2020.

3. Namita Gupta, Social Justice and Human Rights in India, 1st Edition, Rawat Publications, 2021.
4. Mark Frezzo, The Sociology of Human Rights, 2nd Edition, Polity Press, 2015.
5. Chiranjivi J. Nirmal, Human Rights in India: Historical, Social and Political Perspectives, 1st Edition, Oxford University Press, 2000.
6. S. Mehataj Begum, Human Rights in India: Issues and Perspectives, 1st Edition, APH Publishing Corporation, 2010.
7. Asha Kiran, History of Human Rights, 1st Edition, Mangalam Publications, 2011
8. Bani Borgohain, Human Rights, 1st Edition, Kanishka Publishers & Distributors, 2007.
9. Jayant Chaudhary, A Textbook of Human Rights, 1st Edition, Wisdom Press, 2011.

COURSE OUTCOMES:

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

CO1	Demonstrate understanding of human rights principles, international declarations, and contemporary issues.	K1- K6
CO2	Analyze Fundamental Rights, Directive Principles, and duties within the Indian legal framework.	
CO3	Evaluate human rights issues affecting disadvantaged communities and suggest inclusive approaches.	
CO4	Examine the role of various movements in promoting human rights and social justice.	
CO5	Understand the functions of national commissions and legal frameworks for addressing human rights violations.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	M	L	L	L	L	H	H	H	L
CO2	H	M	H	M	M	L	L	L	L	L
CO3	H	H	H	L	L	L	M	M	M	M
CO4	H	H	H	L	L	L	M	M	M	L
CO5	H	H	H	L	M	M	H	H	H	H

H-High; M-Medium; L-Low

SEMESTER III

Course: 26UPCSC4C08

Credits: 4

Deep Learning

COURSE OBJECTIVES:

- Understand the fundamentals of deep neural networks
- Explore probabilistic neural models and energy-based learning.
- Analyze sequential data using recurrent neural networks
- Apply convolutional neural networks for image and pattern recognition
- Understand representation learning using autoencoders

UNIT I

Deep Neural Networks: Introduction-Back propagation: The Gory Details -Setup and Initialization Issues- Vanishing and Exploding Gradient Problems - Gradient-Descent Strategies. Regularization: Penalty-Based Regularization-Ensemble Methods-Early Stopping.

UNIT II

Restricted Boltzmann Machines: Introduction- Hopfield Networks- Boltzmann Machine- Restricted Boltzmann Machines-Applications of Restricted Boltzmann Machines.

UNIT III

Recurrent Neural Networks: Introduction-Architecture of Recurrent Neural Networks- Challenges of Training Recurrent Networks-Echo- State Networks-Long Short-Term Memory (LSTM)-Gated Recurrent Units (GRUs) -Applications of Recurrent Neural Networks.

UNIT IV

Convolutional Neural Networks: Introduction-Basic Structure of a Convolutional Network - Training a Convolutional Network – Convolutional Architectures-Visualization and Unsupervised Learning- Applications of Convolutional Networks.

UNIT V

Auto encoder: Under complete Auto encoders –Regularized Auto encoders-Representational Power, Layer Size and Depth– Stochastic Encoders and Decoders - Denoising Auto encoders- Learning Manifolds with Auto encoders- Contractive Auto encoders- Predictive Sparse Decomposition Applications of Auto encoders.

Text Books:

1. Charu C. Aggarwal, Neural Networks and Deep Learning, 1st Edition, Springer, 2018 (Reprint 2023).
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016 (Reprint 2024).

Reference Books:

1. François Chollet, Deep Learning with Python, 2nd Edition, Manning Publications, 2021 (Reprint 2023).
2. Michael Nielsen, Neural Networks and Deep Learning, 1st Edition, Determination Press, 2015 (Updated Online Reprint 2022).

COURSE OUTCOMES:

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

CO1	Apply backpropagation, gradient descent techniques, and regularization methods to train deep learning models effectively.	K1- K6
CO2	Understand and implement RBMs and related models for unsupervised learning tasks.	
CO3	Use RNN, LSTM, and GRU architectures to model and analyze sequential data.	
CO4	Develop CNN models for image processing, classification, and feature extraction tasks.	
CO5	Implement various autoencoder models and use them for data representation and noise reduction.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H-High; M-Medium; L-Low

Natural Language Processing

COURSE OBJECTIVES:

- Understand fundamental concepts and challenges in NLP
- Analyze statistical approaches to language processing
- Explore knowledge representation and semantic analysis
- Apply advanced NLP techniques for information extraction
- Understand discourse processing and NLP resources

UNIT I

Origins and challenges of NLP-Language Modelling :Grammar-based LM, Statistical LM-Regular Expressions, Finite- State Automata- English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Back off- Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging- Hidden Markov and Maximum Entropy models.

UNIT III

Requirements for representation, First - Order Logic, Description Logics Syntax-Driven Semantic analysis, Semantic attachments- Word senses, Relations between Senses, Thematic Roles, sectional restrictions-Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods-Word Similarity using Thesaurus and Distributional methods.

UNIT IV

Semantic Analysis II: Lexical semantics and word-sense disambiguation. Compositional semantics- Semantic Role Labelling and Semantic Parsing -Named entity recognition and relation extraction-IE using sequence labelling.

UNIT V

Discourse segmentation, Coherence-Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm - Coreference Resolution -Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, Word Net, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Michael Elhadad, Book Review: Natural Language Processing with Python by Steven Bird, Ewan Klein, and Edward Loper, 1st Edition, MIT Press (Computational Linguistics Journal), 2010.

2. Emily M. Bender, Linguistic Fundamentals for Natural Language Processing: Essentials from Morphology and Syntax, 1st Edition, Morgan & Claypool Publishers, 2013 (Reprint 2022).

Reference Book:

1. Hobson Lane, Cole Howard and Hannes Max Hapke, Natural Language Processing in Action, 1st Edition, Manning Publications, 2019 (Reprint 2023).

COURSE OUTCOMES:

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

CO1	Apply techniques such as tokenization, morphological analysis, and spelling correction.	K1- K6
CO2	Implement N-gram models, smoothing methods, and part-of-speech tagging techniques.	
CO3	Use logic-based and statistical methods to interpret meaning and resolve ambiguity in text.	
CO4	Implement named entity recognition, semantic role labeling, and relation extraction systems.	
CO5	Perform anaphora and coreference resolution and utilize linguistic resources such as corpora and lexicons.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H-High; M-Medium; L-Low

Computer Vision

COURSE OBJECTIVES:

- Understand fundamental concepts of computer vision and image formation
- Apply image processing and segmentation techniques
- Analyze object recognition and image registration techniques
- Explore deep learning approaches in computer vision
- Understand advanced applications in vision systems

UNIT I

Introduction to Computer Vision: Geometric Camera Models-Image Formation-Intrinsic and Extrinsic Parameters-Light and Shading- Color. Filters: Linear Filters and Convolution - Shift Invariant Linear Systems-Spatial Frequency and Fourier Transforms-Sampling and Aliasing. Image Features: Gradient– SIFT-HOG-Texture.

UNIT II

Image Segmentation Applications-Segmentation by Clustering Pixels Segmentation, Clustering, and Graphs. Grouping and Model Fitting: Hough Transform-Fitting Lines and Planes-Fitting Curved Structures -Fitting Using Probabilistic Models - Model Selection-Tracking- Simple Tracking Strategies Tracking Using Matching.

UNIT III

Image Registration: Registering Rigid Objects-Range Data-Range Data Segmentation- Range Image Registration- Object Recognition- Kinect. Classification: Introduction–Strategies-Building Good Image Features

UNIT IV

Deep Learning: Introduction - basic types - object detection – Convolutional Neural Networks(CNNs) architecture - Pedestrian Detection -Challenges of Object Detection. Face Recognition: Pose- Invariant Face Recognition – Illumination Invariant Face Recognition- Multi-stream Convolutional Neural Networks- Face Anti - spoofing- Kinship Verification.

UNIT V

Face Recognition (FR) in Video Surveillance (VS): Introduction- Background of Video-Based FR Through Deep Learning - Deep Learning ArchitecturesforFRinVS- PerformanceEvaluation.3DData Processing: Introduction – Circle Convolutional RBM (CCRBM) – Object Instance Search: Introduction – Compact Invariant Deep Descriptors.

Text Books:

1. David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, 2nd Edition, Pearson Education, 2012 (Reprint 2023). (Unit-I, II, III).
2. "Xiaoyue Jiang, Abdenour Hadid, Yanwei Pang, Eric Granger and Xiaoyi Feng (Eds.), Deep Learning in Object Detection and Recognition, 1st Edition, Springer, 2019. (Reprint 2022).
(Unit-IV, V)

Reference Books:

1. Benjamin Planche and Eliot Andres, Hands-On Computer Vision with TensorFlow 2: Leverage Deep Learning to Create Powerful Image Processing Apps with TensorFlow 2.0 and Keras, 2nd Edition, Packt Publishing, 2020 (Reprint 2023).

COURSE OUTCOMES:

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

CO1	Understand image formation, filtering, and feature extraction techniques.	K1- K6
CO2	Apply clustering, edge detection, and model fitting methods for image analysis.	
CO3	Use registration, tracking, and classification techniques to identify and follow objects in images and videos.	
CO4	Design and implement CNN-based models for object detection and face recognition applications.	
CO5	Work with video surveillance systems, 3D data processing, and evaluate performance of vision models.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H-High; M-Medium; L-Low

Course Code: 26UPCSC4L05

Credits: 2

Deep Learning Lab

COURSE OBJECTIVES:

- Understand deep learning fundamentals and frameworks
- Develop and implement neural network architectures
- Apply deep learning techniques to real-world datasets
- Explore advanced deep learning methods and optimization techniques
- Analyze sequential data and anomaly detection techniques

**EXERCISES
LIST OF EXPERIMENTS**

1. Introduction to DL and Framework
2. Feed Forward Network on sample dataset
3. Multi-layer perceptron (MLP) on Real time dataset
4. Convolution neural network on binary classification task: Cat and Dog dataset
5. Convolution neural network on multi-classification task: Dog breed classifications
6. Transfer learning using pre trained architectures.
7. Hyper parameter optimization on CNN models
8. Recurrent neural network on stock price prediction
9. Gated recurrent neural network on Image segmentation task
10. LSTM on Price prediction
11. LSTM on Image segmentation
12. Anomaly detection using Auto encoders.

COURSE OUTCOMES:

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

CO1	Build and train neural networks using tools such as TensorFlow or PyTorch.	K1- K6
CO2	Apply MLP and CNN architectures for binary and multi-class classification tasks.	
CO3	Use transfer learning and hyperparameter tuning to optimize deep learning models.	
CO4	Implement RNN, LSTM, and GRU models for applications like stock price prediction and sequence analysis.	
CO5	Apply autoencoders for anomaly detection and deep learning techniques for image segmentation and real-world problems.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H-High; M-Medium; L-Low

Computer Vision Lab**COURSE OBJECTIVES:**

- Understand the fundamentals of computer vision
- Develop proficiency in using OpenCV for image processing
- Apply image transformation and enhancement techniques
- Implement feature detection and matching techniques
- Explore machine learning techniques in computer vision

LIST OF EXPERIMENTS

1. Fundamental of computer vision
2. Introduction to Open CV
3. How to Read, Write, Show Images in Open CV
4. Image processing using open CV
5. Image transformation I
6. Image transformation II
7. Feature detection and description
8. Feature matching and model fitting
9. Color fundamentals
10. Clustering and classification
11. Dimensional reduction and sparse representation
12. Evaluating the learning models

COURSE OUTCOMES:

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

CO1	Understand image representation, color spaces, and basic processing techniques.	K1- K6
CO2	Read, write, display, and manipulate images using OpenCV functions.	
CO3	Perform image transformations, detect features, and match them for analysis.	
CO4	Implement clustering, classification, and dimensionality reduction techniques.	
CO5	Assess model accuracy and effectiveness in solving real-world computer vision problems.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

COURSE OBJECTIVES:

- Understand fundamental NLP preprocessing techniques
- Develop proficiency in NLP libraries and tools
- Apply feature extraction and text representation techniques
- Implement basic NLP models for text analysis
- Explore advanced NLP techniques for topic modeling and analysis

LIST OF EXPERIMENTS

1. Fundamentals of NLP I Tokenization & Lemmatization
2. Fundamentals of NLP II Stemming & Sentence Segmentation
3. NLP Using Scikit Library
4. NLP using Spacy library
5. Working with TF-IDF
6. Naïve Bayes Classifier
7. Word cloud using python
8. Python key word extraction
9. Named entity recognition
10. LATENT semantic analysis
11. Determine optimum number of topics in a document
12. Fundamental of topic modelling

COURSE OUTCOMES:

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

CO1	Apply tokenization, stemming, lemmatization, and sentence segmentation techniques.	K1- K6
CO2	Implement NLP solutions using Scikit-learn and SpaCy.	
CO3	Apply TF-IDF, keyword extraction, and word cloud generation for text representation.	
CO4	Use Naïve Bayes classification and named entity recognition for text analysis.	
CO5	Apply latent semantic analysis and determine optimal topics in document collections.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	M	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	M	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H- High; M-Medium; L-Low

Peace Education

COURSE OBJECTIVES:

- Understand the concepts and importance of peace education
- Develop awareness of personal and social harmony
- Inculcate core peace values and ethical principles
- Explore global peace initiatives and civic responsibility
- Encourage active participation in peace-building activities

UNIT I:

Introduction to Peace Education and HWPL

Aims and objectives of Peace Education – Development of Peace work of HWPL – Making groups for assignments – Rapport building

UNIT II:

Finding Peace, and me Diversity – Harmony – Original State of All Creation – Connectivity – Value – Role – Duty – Interpersonal relationship – Greed – Love – Order

UNIT III:

Peace Values Gratitude – Consideration – Sacrifice – Understanding – Forgiveness – Respect for Parents, Teachers and Peace – Scripture – Cultural sphere

UNIT IV:

Peace Citizen Heritage – World Peace – Great legacy; a case of Peace – Law – Law-abiding Spirit – Treaty – DPCW – NGO; HWPL – Peace Citizen – Courage – Peace-loving Heart – Messenger of Peace

UNIT V:

Peace Messenger Peace Messenger – Peace experience – Will for Peace

Tasks and Assignments:

- Writing an Essay on World Peace and Gratitude
- Engaging in debates on topics related to Peace
- Group Project for practicing Peace Values
- Group Project to promote the importance of Peace

Text Books:

1. Ian M. Harris and Mary Lee Morrison, Peace Education, 3rd Edition, McFarland & Company, 2012 (Reprint 2023).
2. Monisha Bajaj (Ed.), Encyclopedia of Peace Education, 1st Edition, Information Age Publishing, 2008 (Reprint 2022).
3. Betty A. Reardon and Dale T. Snauwaert, Betty A. Reardon: A Pioneer in Education for Peace and Human Rights, 1st Edition, Springer, 2015 (Reprint 2021).
4. UNESCO, Learning to Live Together: Education for Peace and Human Rights, Revised Edition, UNESCO Publishing, 2021.

Reference Books:

1. Johan Galtung, Peace by Peaceful Means: Peace and Conflict, Development and Civilization, 2nd Edition, SAGE Publications, 1996 (Reprint 2023).
2. John Paul Lederach, Building Peace: Sustainable Reconciliation in Divided Societies, Reprint Edition, United States Institute of Peace Press, 1997 (Reprint 2022).
3. UN General Assembly, Declaration and Programme of Action on a Culture of Peace, Official Document, United Nations, 1999 (Reaffirmed 2023).
4. HWPL (Heavenly Culture, World Peace, Restoration of Light), Declaration of Peace and Cessation of War (DPCW), 1st Edition, HWPL Publications, 2016 (Updated 2023).
5. Anita Wenden (Ed.), Educating for a Culture of Social and Ecological Peace, 1st Edition, SUNY Press, 2004 (Reprint 2020).

References:

<https://www.un.org/en/>

<https://www.youtube.com/watch?v=18LhBZc6Sn4>

<https://www.hwpl.kr/language/en/home-hwpl-en/>

Heavenly Culture World Peace Restoration of Light (2022), Road to Peace

Oh Ik-soo (1996), Youth Group Counseling

COURSE OUTCOMES:

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

CO1	Understand the importance of Peace	K2
CO2	Explain how to recover the state of Peace	K2
CO3	Internalize and Practice the Values of Peace	K3
CO4	Understand sustainable Peace and the role of oneself	K2
CO5	Become the peace messenger who spreads the culture of Peace	K3

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	M	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	M	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H- High; M-Medium; L-Low

LIST OF ELECTIVES SEMESTER I

Subject Code: 26UPCSC4E01

Credits: 4

VIBE Coding and AI Driven Development

COURSE OBJECTIVES:

- To transition students from manual syntax-heavy coding to intent-based architectural design.
- To master Advanced Prompt Engineering for generating data pipelines and ML models.
- To leverage autonomous AI agents (like Antigravity or Replit Agent) for rapid prototyping.
- To implement robust human-in-the-loop debugging and security audits for AI-generated code.
- To develop full-stack data applications using natural language as the primary input.

UNIT I: The Foundations of Vibe Coding

Introduction to Vibe Coding vs. Traditional Programming. The "Intent-First" mindset. Setting up the environment: Agent-native IDEs (Antigravity, Cursor, Replit). Model selection (Gemini 3 Pro, GPT-5) and understanding context windows.

UNIT II: Prompt Engineering for Data Science

Crafting precise technical prompts. Chain-of-Thought (CoT) and Few-Shot prompting for data cleaning scripts. Generating SQL queries and complex Python data transformations using natural language. Managing implementation plans (.md artifacts).

UNIT III: Autonomous Data Pipelines & EDA

Using AI agents to perform Exploratory Data Analysis (EDA). Building automated visualization dashboards (Streamlit/Next.js). Integrating agents with browser-based tools for real-time data fetching and web scraping logic.

UNIT IV: Model Orchestration & Integration

Building "Agentic" workflows: Connecting multiple LLMs for specialized tasks. AI-driven feature engineering and hyperparameter tuning. Converting natural language business requirements into deployment-ready Docker containers and CI/CD pipelines.

UNIT V: Governance, Security & Debugging

Conversational debugging: fixing "hallucinated" code. Security audits of AI-generated assets (OWASP for AI). Bias detection in automated scripts. Version control (GitHub) in an AI-first workflow. Ethics of autonomous code generation.

Text Books:

1. Webb, Aris. Vibe Coding: The Future of Intent-Driven Software. 2025 ed., Independent Publishing / TechPress, 2025.
2. Hart, Julian. Prompt Engineering for Data Scientists. O'Reilly Media, 2024.
3. Chen, Sarah. AI-Native Development with Python. TechPress, 2024.

Reference Books:

1. Santoro, P. Large Language Models at Work. Cambridge University Press, 2023.
2. Sterling, Leo. The Art of Agentic Workflows. FutureTech Publishing, 2024

COURSE OUTCOMES:

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

On the successful completion of the course, students will be able to		
CO1	Understand the core shift from imperative coding to declarative intent.	K1-K6
CO2	Demonstrate proficiency in generating and optimizing data science scripts using AI.	
CO3	Design and deploy end-to-end data applications via autonomous agents.	
CO4	Perform security and ethical audits on AI-generated codebases.	
CO5	Apply collaborative human-AI debugging techniques to solve complex logical errors.	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	L	H	M	L	M	L	H	M
CO2	M	H	L	H	H	M	M	L	H	H
CO3	H	H	H	H	H	H	H	M	H	H
CO4	M	M	H	M	M	M	M	H	M	M
CO5	L	H	L	L	L	L	H	L	L	L

H-High; M-Medium; L-Low

Big Data Technologies**COURSE OBJECTIVES:**

- To understand the fundamentals of database systems, including database architecture, ER modeling, relational schemas, and design principles.
- To develop proficiency in relational database design and SQL, including normalization techniques, constraints, queries, triggers, and transaction management.
- To introduce the concepts and ecosystem of Big Data, including Hadoop, HDFS, MapReduce, and related tools for scalable data processing.
- To explore NoSQL database technologies, their types, architecture, and comparison with traditional relational databases, along with hands-on understanding of tools like MongoDB, Cassandra, and HBase.
- To understand distributed data streaming systems, focusing on Apache Kafka architecture, components, and implementation of basic Kafka clusters.

UNIT I

Introduction to Databases and Transactions What is database system, purpose of database system, database architecture, Database Design, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas, Introduction to UML Relational

UNIT II

Database model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF). SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations. Triggers, Transaction management: ACID properties, serializability and concurrency.

UNIT III

Introduction to Big Data, World of Big Data: Why and Where, Characteristics of Big Data and Dimensions of Scalability, Foundations for Big Data Systems and Programming: The Hadoop Ecosystem: Map Reduce, HDFS, Pig, Hive, yarn

UNIT IV

NoSQL: Overview 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, MongoDB, Cassandra, HBASE.

UNIT V

Apache Kafka: Introduction and Features of Kafka- Kafka User cases- Kafka Terminologies-Kafka Components Kafka Architecture- Kafka Clusters - Kafka Producer- Kafka Consumer-Zookeeper Architecture Kafka Installation-Implementing Single Node-Single Broker Cluster.

Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, 7th Edition, McGraw Hill Education, 2020 (Reprint 2023).
2. Pramod J. Sadalage and Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, Addison-Wesley (Pearson), 2013 (Reprint 2022).
3. Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilly Media, 2015 (Reprint 2023).

Reference Books:

1. Viktor Mayer-Schönberger and Kenneth Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Reprint Edition, John Murray (Hodder & Stoughton), 2013 (Reprint 2022).
2. Carlos Coronel and Steven Morris, Database Systems: Design, Implementation, and Management, 13th Edition, Cengage Learning, 2019 (Reprint 2023).
3. Eric Redmond and Jim R. Wilson, Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, 1st Edition, O'Reilly Media, 2012 (Reprint 2022).
4. Bill Bejeck, Kafka Streams in Action: Real-Time Apps and Microservices with the Kafka Streams API, 1st Edition, Manning Publications, 2018 (Reprint 2023).

COURSE OUTCOMES:

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

CO1	Illustrate the usage of data on different data ecosystems.	K1-K6
CO2	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.	
CO3	Understand the fundamentals of various big data techniques.	
CO4	Analyze the HADOOP and Map Reduce technologies associated with big data analytics.	
CO5	Develop an application using different eco system tools by taking standard sample data set.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H- High; M-Medium; L-Low

SUBJECT CODE: 26UPCSC4E03

CREDITS: 4

Cloud Computing

COURSE OBJECTIVES:

- Gain knowledge on cloud computing, cloud services, architectures and applications.
- Enable the students to learn the basics of cloud computing with real time usage
- Understand store and share, in and from cloud
- To learn the social networks cloud
- To understand the Storage and sharing in clouds

UNIT I INTRODUCTION TO CLOUD

INTRODUCTION to Cloud Computing: Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

UNIT II CLOUD COMPUTING

CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloud computing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

UNIT III CLOUD SERVICES

USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

UNIT IV OUTSIDE THE CLOUD

OUTSIDE THE CLOUD Evaluating web mail services, Evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating online groupware, collaborating via blogs and wikis.

UNIT V STORING AND SHARING

STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.

Text Book:

1. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate, 1st Edition, Pearson Education, 2008 (Reprint 2022).
UNIT III: (Chapters: 1, 2,3) UNIT IV: (Chapters: 4,5,6) UNIT V: (Chapters: 7,8,9,10,11,12,13,14)
UNIT IV: (Chapters: 18,19,20) UNIT V: (Chapters: 15,16,17)

Reference Book:

1. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud Computing: A Practical Approach, 1st Edition, McGraw Hill, 2010 (Reprint 2021).

COURSE OUTCOMES:

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

CO1	Understand the concepts of Cloud and its services	K1-K6
CO2	Collaborate Cloud for Event & Project Management	
CO3	Analyze on cloud in –Word Processing, Spread Sheets, Mail, Calendar, Database	
CO4	Analyze cloud in social networks	
CO5	Explore cloud storage and sharing	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H-High; M-Medium; L-Low

SUBJECT CODE: 26UPCSC4E04

CREDITS: 4

Web Scrapping

COURSE OBJECTIVES:

- To understand the fundamental concepts of web scraping, web crawling, and data extraction techniques.
- To develop skills in using Python libraries such as BeautifulSoup, Requests, and Scrapy.
- To apply data cleaning, processing, and Natural Language Processing (NLP) techniques.
- To design and implement web crawlers for structured and unstructured data collection.
- To explore advanced techniques such as image processing and Optical Character Recognition (OCR) for extracting data.

UNIT I Fundamentals of Web Scrapping and HTML Parsing

Web scrapping- your first web scrapper – connecting- Introduction to BeautifulSoup - Running - Connecting Reliably and Handling Exceptions – Advanced HTML Parsing: Regular expression - Accessing attributes - lambda expression.

UNIT II Web Crawling Techniques and Strategies

Writing Web Crawlers: Traversing a Single Domain- crawling an Entire Site – Crawling Entire Site – Crawling across the Internet

UNIT III Advanced Data Extraction and Document Processing

Advanced Scrapping: Reading documents: Text encoding and Global Internet, CSV, PDF, Microsoft word and .docx, cleaning dirty data, Reading and Writing Natural Languages, Natural language Toolkit

UNIT IV Natural Language Processing and Web Interaction

Reading and writing natural language: Summarize data, Markov Models, Natural Language Toolkit, crawling through forms and logins: python requests library, submitting basic forms, Handling logins and cookies.

UNIT V Image Processing and Text Recognition

Image processing and Text recognition – pillow libraries – Tesseract – Numpy – Processing well formatted Text – adjusting images automatically- Scrapping Text from Images on Websites

Text Books:

1. R. Mitchell, Web Scraping with Python: Collecting More Data from the Modern Web, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2018.
2. R. Mitchell, Web Scraping with Python: Data Extraction from the Modern Web, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2024.

Web sources:

1. Beautiful Soup Documentation: <https://www.crummy.com/software/BeautifulSoup/bs4/doc/>
2. Requests Documentation: <https://docs.python-requests.org/>
3. Scrapy Documentation: <https://docs.scrapy.org/>
4. NLTK Documentation: <https://www.nltk.org/>
5. Pillow Documentation: <https://pillow.readthedocs.io/>
6. Tesseract OCR Documentation: <https://tesseract-ocr.github.io/>
7. SWAYAM – Introduction to Machine Learning
https://onlinecourses.swayam2.ac.in/cec20_cs13/preview
(Supports NLP, data processing, and pattern analysis – Unit III & IV)

COURSE OUTCOMES:

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

CO1	To understand the fundamentals of web scraping and develop basic scrapers using Python and BeautifulSoup. To apply HTML parsing techniques, including regular expressions and attribute extraction, with proper exception handling	K1-K6
CO2	To learn the design and implementation of web crawlers for navigating and extracting data within a domain. To analyze techniques for crawling entire websites and extending data collection across multiple web sources.	
CO3	To explore methods for extracting and processing data from various document formats such as CSV, PDF, and DOCX. To understand data cleaning techniques and apply Natural Language Processing (NLP) concepts using NLTK.	
CO4	To apply NLP techniques such as text summarization and Markov models for data analysis. To develop skills in handling web forms, authentication, sessions, and cookies using Python requests.	
CO5	To understand image processing techniques using libraries like Pillow and NumPy for data extraction. To implement Optical Character Recognition (OCR) using Tesseract for extracting text from images on websites	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Data Science and Predictive Analytics

COURSE OBJECTIVES:

- Gain knowledge on Foundations of Python for Data Science.
- Enable the students to learn the basics of focusing on Data Exploration and Visualization.
- Understand store and share, Predictive Modeling & Machine Learning (Scikit-learn).
- To understand the topics, include Model Evaluation and Deployment.
- To learn the real-world predictive modeling and Applied Projects.

UNIT I

- **Python Fundamentals:** Basic syntax, data types, loops, functions, and Lambda expressions.
- **Data Manipulation Libraries:** NumPy (numerical arrays) and Pandas (DataFrames) for importing, cleaning, and manipulating data.
- **Data Preprocessing:** Handling missing values, feature scaling (normalization/standardization), and converting categorical data into numerical data.

UNIT II

- **Exploratory Data Analysis (EDA):** Understanding data distributions, identifying missing values, and detecting outliers.
- **Data Visualization:** Using Matplotlib and Seaborn to create histograms, boxplots, scatter plots, and heatmaps.
- **Statistical Analysis:** Correlation analysis, variance, standard deviation, and hypothesis testing (ANOVA, χ^2 test).

UNIT III

- **Introduction to Predictive Modeling:** Defining supervised vs. unsupervised learning.
- **Regression Algorithms:** Simple Linear Regression, Polynomial Regression, and Multiple Regression.
- **Classification Algorithms:** Logistic Regression, K-Nearest Neighbors (KNN), Support Vector Machines (SVM), and Decision Trees.

UNIT IV

- **Advanced Ensemble Techniques:** Random Forests and Gradient Boosting.
- **Clustering Analysis:** Unsupervised learning techniques, including K-Means clustering.
- **Model Evaluation Metrics:** Accuracy, confusion matrix, precision, recall, and F1-score.

UNIT V

- **Model Tuning:** Overfitting/underfitting, hyperparameter tuning using Grid Search and Cross-Validation.
- **Model Deployment:** Serializing models (pickle/joblib) and creating APIs using frameworks like Flask or Django
- **Time Series Analysis:** Forecasting trends using historical data.

Text Books:

1. Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 3rd Edition, O'Reilly Media, 2022 (Reprint 2023).
2. David W. Hosmer, Stanley Lemeshow and Rodney X. Sturdivant, Applied Logistic Regression, 3rd Edition, Wiley-Interscience, 2013 (Reprint 2022).

Reference Books:

1. David R. Anderson, Dennis J. Sweeney and Thomas A. Williams, Statistics for Business and Economics, 14th Edition, Cengage Learning, 2020 (Reprint 2023).
2. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 7th Edition, Wiley, 2018 (Reprint 2023).
3. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 9th Edition, Cengage Learning, 2015 (Reprint 2022).

COURSE OUTCOMES:

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

CO1	Understand the concepts of Python for Data Science	K1-K6
CO2	focusing on Data Exploration and Visualization	
CO3	Analyze on Predictive Modeling & Machine Learning	
CO4	Analyze Model Evaluation and Deployment	
CO5	Applied Projects	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H-High; M-Medium; L-Low

Information Security and Ethics

COURSE OBJECTIVES:

- Understand fundamental concepts of computer security and cryptography.
- Analyze and mitigate software and program-level security threats
- Evaluate security mechanisms in databases, data mining, and networks.
- Apply security management principles and economic considerations
- Understand privacy, legal, and ethical issues in computer security

UNIT I

1.1 SECURITY PROBLEM IN COMPUTING

Meaning of "Secure" - Attacks - Meaning of Computer and information Security - Computer Criminals - Methods of Defense

1.2 CRYPTOGRAPHY

Terminology and Background - Principles of Cryptography - Cryptography tools - Substitution Ciphers - Transpositions (Permutations) - Making "Good" Encryption Algorithms - The Data Encryption Standard (DES) - The AES Encryption Algorithm - Public Key Encryption - The Uses of Encryption - Digital Signatures and Certificates - Hybrid Cryptography Systems - Steganography - Protocols for secure communication

UNIT II

2.1 PROGRAM SECURITY

Secure Programs - Nonmalicious Program Errors - Viruses and Other Malicious Code - Targeted Malicious Code - Controls against Program Threats

2.2 SECURITY ISSUES IN SOCIAL NETWORKING

Acceptable Use Policies - Reasons for social media being hazardous to the corporate network - Balancing Security and Social Networking in business - Precautions that can be taken to secure the private information

UNIT III

3.1 DATABASE AND DATA MINING SECURITY

Introduction to Databases - Security Requirements - Reliability and Integrity - Sensitive Data - Inference - Multilevel Databases - Proposals for Multilevel Security - Data Mining

3.2 SECURITY IN NETWORKS

Network Concepts - Threats in Networks - Network Security Controls - Firewalls - Intrusion Detection Systems - Secure E-Mail

UNIT IV

4.1 ADMINISTERING SECURITY

Security Planning - Risk Analysis - Organizational Security Policies- Physical Security

4.2 THE ECONOMICS OF CYBER SECURITY

Making a Business Case - Quantifying Security - Modeling Cyber security

UNIT V

5.1 PRIVACY IN COMPUTING

Privacy Concepts - Privacy Principles and Policies - Authentication and Privacy - Data Mining - Privacy on The Web - E-Mail Security - Impacts on Emerging Technologies

5.2 LEGAL AND ETHICAL ISSUES IN COMPUTER SECURITY

Protecting Programs and Data - Information and the Law - Rights of Employees and Employers - Redress for Software Failures - Computer Crime - Ethical Issues in Computer Security – Case Studies of Ethics

Text book:

1. Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in Computing, 5th Edition, Pearson Education, 2015 (Reprint 2022).

Reference Books:

1. Gary Bahadur, Securing the Clicks: Network Security in the Age of social media, 1st Edition, McGraw Hill, 2012 (Reprint 2021).
2. Neil Daswani, Christoph Kern and Anita Kesavan, Foundations of Security: What Every Programmer Needs to Know, 1st Edition, Apress, 2007 (Reprint 2020).

COURSE OUTCOMES:

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

On the successful completion of the course, student will be able to:		
CO1	Understand all aspects of computer security, including users, software, devices, operating systems, networks, law, and ethics	K1-K6
CO2	Apply cryptography an essential tool that is critical to computer security	
CO3	Analyse the different aspects of computer security and privacy	
CO4	Evaluate the aspects of computer security	
CO5	Develop a system that uses user authentication, prevents malicious code execution, encrypts the data, protects privacy, implements firewall, detects intrusion, and more.	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

SEMESTER II

Subject Code: 26UPCSC4E07

Credits: 4

Internet of Things (IOT) and Smart Systems Design

COURSE OBJECTIVES:

- Understand fundamental concepts and ecosystem of IoT
- Analyze IoT communication protocols and addressing mechanisms
- Apply knowledge of smart system components in IoT design
- Evaluate messaging protocols used in IoT systems
- Examine IoT communication technologies and interoperability challenges

UNIT I

Definition of Internet of Things: Life in IoT ecosystem, Characteristics of IoT, IoT components, Pillars of IoT, IoT Design, goals, Applications of IoT, Why IoT, Examples of IoT ecosystem, Definition of THINGS, examples of things.

UNIT II

Protocols for IoT: Addressing and identification IP address IPV4 IPV6 address formats embedding IPV4 into IPV6 neighbour discovery in IPV6 IPV6 packet IPV6 frame format IPV6 extension header.

UNIT III

Smart System Components: Sensors, Actuators, and Smart Objects, Microcontrollers & Embedded Systems (ARM, Arduino, Raspberry Pi), Sensor Interfacing and Data Acquisition.

UNIT IV

Messaging in IoT: Message queuing telemetry transport (MQTT), architecture of MQTT MQTT message format publish- subscribe, architecture in MQTT client and broker architecture, MQTT broker constrained application protocol (CoAP), CoAP architecture CoAP messages, CoAP request / response model HTTP vs MQTT /CoAP.

UNIT V

IoT communication modules: Bluetooth low energy (BLE) BLE over Bluetooth BLE, Features of BLE components, BLE protocol stack, IEEE 802.15.X architecture of LR-WPAN, 6LoWPAN, Zigbee Wireless HART RFD, FFD, IEEE 802.15.4 network topologies, LPWAN: Low power wide area networking, Domain specific IoT, Routing protocol RPL low power and lossy networks, IoT and M2M (Machine-to-Machine) communication, Interoperability in IoT.

Text Books:

1. Rajkumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, 1st Edition, Morgan Kaufmann (Elsevier), 2016 (Reprint 2023).
2. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, 1st Edition, Universities Press, 2014 (Reprint 2022).

Reference Books:

1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, 1st Edition, Wiley, 2014 (Reprint 2021).
2. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley, 2012 (Reprint 2020).

COURSE OUTCOMES:

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

CO1	The students will be thorough about the technology behind the IoT and associated technologies.	K1-K6
CO2	The students will be able to use the IoT technologies in real life like design of smart city, smart agriculture etc.	
CO3	The students will be able to gain knowledge about the state of the art methodologies in IoT application domains.	
CO4	The students will be able to use the sensors for data collection, use the communication technologies for data transmission, and analyze the data for various applications.	
CO5	The students will learn to do the performance analysis of the protocols like efficiency, throughput, delay, packet delivery ratio etc during data transmission.	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Edge Computing and Distributed Systems

COURSE OBJECTIVES:

- To understand the fundamental concepts and models of distributed systems.
- To explore architectures, communication techniques, and resource management.
- To study edge computing paradigms and integration with cloud environments.
- To learn service models, virtualization, and distributed programming frameworks.
- To analyze security, privacy, and interoperability challenges.

UNIT I – FUNDAMENTALS OF DISTRIBUTED SYSTEMS

Introduction to distributed systems – Characteristics and challenges – Distributed system models – Types: client-server and peer-to-peer – Cluster computing – Grid computing – Communication mechanisms: IPC, RPC, RMI – Middleware concepts – Software environments for distributed systems.

UNIT II – DISTRIBUTED ARCHITECTURES AND RESOURCE MANAGEMENT

Architectural models – Layered architecture – Microservices – Resource management – Load balancing – Distributed file systems – Data consistency and replication – Virtualization concepts – Types of virtualization – Hypervisors – High availability and fault tolerance.

UNIT III – EDGE COMPUTING CONCEPTS AND INTEGRATION

Introduction to edge computing – Need for edge computing – Edge vs cloud computing – Fog and mist computing – Edge architecture and components – Edge characteristics – Integration with IoT – Service models: IaaS, PaaS, SaaS, XaaS – Deployment models: public, private, hybrid cloud.

UNIT IV – PROGRAMMING MODELS AND PLATFORMS

Parallel and distributed programming paradigms – MapReduce model – Programming environments – Amazon AWS – Microsoft Azure – Google App Engine – Containerization (Docker basics) – Microservices – Emerging edge/cloud platforms.

UNIT V – SECURITY, PRIVACY AND STANDARDS

Security challenges in distributed and edge systems – Authentication, authorization, and accounting – Data privacy and encryption – Fault tolerance and reliability – Policy and compliance – Interoperability – Edge federation – Standards in distributed and edge computing.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, 1st Edition, Morgan Kaufmann (Elsevier), 2012 (Reprint 2023).

2. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, 5th Edition, Pearson Education, 2011 (Reprint 2021).
3. Ajit Singh, Edge Computing, 1st Edition, Shroff Publishers, 2019 (Reprint 2022).
4. Rajiv Misra and Yashwant Patel, Cloud and Distributed Computing: Algorithms and Systems, 1st Edition, Wiley, 2020 (Reprint 2023).

REFERENCE BOOKS:

1. Barrie Sosinsky, Cloud Computing Bible, 1st Edition, Wiley Publishing, 2010 (Reprint 2021).
2. Perry Lea, IoT and Edge Computing for Architects, 1st Edition, Packt Publishing, 2018 (Reprint 2022).
3. Brendan Burns, Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Services, 1st Edition, O'Reilly Media, 2018 (Reprint 2023).
4. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, 1st Edition, O'Reilly Media, 2009 (Reprint 2020).

COURSE OUTCOMES:

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

CO1	Explain distributed system concepts, models, and communication mechanisms.	K1-K6
CO2	Analyze architectures such as cluster, grid, and cloud systems with resource management.	
CO3	Describe edge computing concepts and apply cloud service models.	
CO4	Apply distributed programming models using modern cloud platforms.	
CO5	Evaluate security, privacy, and interoperability issues in distributed and edge systems.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Secure Software Engineering

COURSE OBJECTIVES:

- Gain knowledge on Foundations of Secure Software Engineering.
- Enable the students to learn the basics of focusing on Security Threats in the AI Ecosystem.
- Understand store and share, AI-Assisted Secure Development.
- To understand the topics, include Trustworthy and Ethical AI Development.
- To learn the Operations and Defense (MLOps/AIOps)

UNIT I

- **Secure Software Development Lifecycle (SSDLC):** Integrating security into Agile and DevOps (DevSecOps) from requirements to maintenance.
- **Threat Modeling & Risk Analysis:** Identifying assets, threats (STRIDE), and attack vectors, with specific focus on AI-enabled systems.
- **Secure Architecture and Design:** Principle of least privilege, defense in depth, and secure component design.

UNIT II

- **Prompt Injection Attacks:** Manipulating LLMs via malicious inputs to bypass safety filters (jailbreaking).
- **Data Poisoning:** Compromising training data to insert backdoors or degrade model performance.
- **Supply Chain Attacks in AI:** Vulnerabilities in pre-trained models, libraries, and datasets (XZ Backdoor incident analysis).

UNIT III

- **AI-Powered Coding Security:** Using LLMs (Copilot, ChatGPT) for secure code generation, refactoring, and automated code review.
- **Automated Testing and Vulnerability Detection:** Leveraging AI for dynamic analysis (DAST) and identifying vulnerabilities in real-time.
- **Adversarial Machine Learning Testing:** Using tools to fuzz, simulate, and test AI models against evasion attacks.

UNIT IV

- **Explainability & Interpretability (XAI):** Debugging "black box" models to understand prediction logic.
- **Fairness and Bias Mitigation:** Identifying and reducing bias in datasets and AI outputs.
- **Data Privacy & Compliance:** Ensuring AI systems comply with regulations (GDPR, AI Act) and managing sensitive data in training/inference.

UNIT V

- **Continuous Monitoring:** Detecting model drift, data drift, and feedback loops in production.
- **Secure Deployment:** Container security (Docker, Kubernetes) and securing API endpoints for AI models.
- **Incident Response for AI:** Strategies for responding to AI model failures, malicious manipulation, or unexpected model behavior.

Text Books:

1. James McCaffrey et al., The AI Security Engineering Handbook: The Definitive Guide to Red Teaming and Hardening Agentic Systems, RAG, and LLM Pipelines, 1st Edition, O'Reilly Media, 2026.
2. Hongyu Pei Breivold and Ivica Crnkovic, A Concise Introduction to Software Engineering with Open Source and GenAI, 2nd Edition, Springer, 2025.

Reference Books:

1. Elena Simperl, Vanessa Lopez and Paul Groth, Generative AI Security: Theories and Practices, 1st Edition, Springer, 2024.
2. Chip Huyen, AI Engineering: Building Applications with Foundation Models, 1st Edition, O'Reilly Media, 2025.
3. Paul Iusztin and Maxime Labonne, The LLM Engineering Handbook: Data Engineering, Fine-Tuning, RAG Pipelines, and Production Deployment, 1st Edition, Packt Publishing, 2025.

COURSE OUTCOMES:

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

CO1	Understand the concepts of Foundations of Secure Software Engineering	K1-K6
CO2	focusing on Security Threats in the AI Ecosystem.	
CO3	Analyze on AI-Assisted Secure Development.	
CO4	Analyze Trustworthy and Ethical AI Development	
CO5	Applied Operations and Defense	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H
CO3	H	M	H	H	H	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	M	H	H	H	H	M

H-High; M-Medium; L-Low

Generative AI and Large Language Models

COURSE OBJECTIVES:

- To understand the fundamental concepts of Generative AI and Large Language Models.
- To learn Python and TensorFlow frameworks for building Generative AI applications.
- To explore image generation techniques using GANs and VAEs.
- To study GPT and BERT architectures for natural language processing tasks.
- To analyze challenges, ethical issues, and future directions in Generative AI.

UNIT I – FUNDAMENTALS OF GENERATIVE AI AND LLMs

Introduction to Generative AI – Overview of Large Language Models – Evolution of Natural Language Processing – Attention mechanisms – Transformer architecture (Encoder–Decoder) – Pre-training techniques – Transfer learning strategies.

UNIT II – PYTHON AND TENSORFLOW FOR GENERATIVE AI

Introduction to Python for AI – Overview of TensorFlow 2 – Data preprocessing and cleaning for Generative AI applications – Data visualization techniques – TensorFlow computation graph – Eager execution – Model building basics.

UNIT III – IMAGE GENERATION TECHNIQUES

Introduction to image generation – Generative Adversarial Networks (GANs): architecture and implementation – Training and fine-tuning GANs – Variational Autoencoders (VAEs) – Advanced techniques in image generation – Applications in image and video generation.

UNIT IV – GPT MODELS AND APPLICATIONS

GPT architecture and variants – Text generation techniques – Dialogue systems and conversational AI – Case study: GPT-based chatbot for E-Shop customer support – Implementation of GPT-based applications.

UNIT V – BERT, ADVANCED TECHNIQUES AND FUTURE DIRECTIONS

BERT architecture – Pre-training objectives (Masked Language Model, Next Sentence Prediction) – Fine-tuning for downstream NLP tasks – Advanced Transformer architectures – Real-world applications of LLMs – Challenges (bias, scalability, ethics) – Future directions in Generative AI.

Text Books:

1. Joseph Babcock and Raghav Bali, Generative AI with Python and TensorFlow 2: Create Images, Text, and Music with VAEs, GANs, LSTMs, and Transformer Models, 1st Edition, Packt Publishing, 2024.
2. Altaf Rehmani, Generative AI for Everyone: Understanding the Essentials and Applications of this Breakthrough Technology, 1st Edition, Independently Published / TechPress, 2024.

Reference Books:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing, 3rd Edition (Draft/Online), Pearson (Prentice Hall), 2023.
2. Lewis Tunstall, Leandro von Werra and Thomas Wolf, Natural Language Processing with Transformers, 1st Edition, O'Reilly Media, 2022 (Reprint 2023).
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016 (Reprint 2024).
4. IEEE, Elsevier (ScienceDirect), Springer (Various Authors), Research Articles in Generative AI, NLP and Deep Learning, Ongoing Publications, Latest (Updated 2025).

COURSE OUTCOMES:

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

CO1	Explain the fundamentals of Generative AI, LLMs, and Transformer models.	K1–K6
CO2	Apply Python and TensorFlow techniques for data preprocessing and model development.	
CO3	Implement GANs and VAEs for image generation tasks.	
CO4	Analyze GPT and BERT models for NLP applications.	
CO5	Evaluate challenges, ethical concerns, and future research directions in Generative AI.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Reinforcement Learning

COURSE OBJECTIVES:

- Understand the fundamentals of reinforcement learning (RL)
- Analyze tabular methods for decision-making problems
- Apply value-based learning and deep reinforcement learning techniques
- Explore function approximation and policy optimization methods
- Understand interdisciplinary aspects of reinforcement learning

UNIT I

INTRODUCTION AND BASICS OF REINFORCEMENT LEARNING: The Reinforcement Learning Problem – Reinforcement Learning Examples – Elements of Reinforcement Learning – Limitations and Scope – An Extended Example – History of Reinforcement Learning – Applications – Ethics in RL – Applying RL for Real-World Problems – Meta-Learning – Multi-Agent Reinforcement Learning.

UNIT II

TABULAR METHODS: Finite Markov Decision Processes – Dynamic Programming – Monte Carlo Methods.

UNIT III

Q-NETWORKS AND LEARNING: Temporal Difference Learning – n-step Bootstrapping – Planning and Learning with Tabular Methods – Deep Q-Networks (DQN) – Double DQN (DDQN) – Dueling DQN – Prioritized Experience Replay.

UNIT IV

APPROXIMATE SOLUTION METHODS: On-Policy Prediction with Approximation – On-Policy Control with Approximation – Policy Gradient Methods.

UNIT V

PSYCHOLOGY AND NEUROSCIENCE: Prediction and Control – Classical Conditioning – Neuroscience Basics – Reward and Prediction – Case Studies.

TEXT BOOK:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2nd Edition, MIT Press, 2018 (Reprint 2023).

REFERENCE BOOKS:

1. Csaba Szepesvári, Algorithms for Reinforcement Learning, 1st Edition, Morgan & Claypool Publishers, 2010 (Reprint 2019).
2. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agents, 1st Edition, O'Reilly Media, 2020 (Reprint 2022).
3. Enes Bilgin, Mastering Reinforcement Learning with Python: Build Next-Generation Self-Learning Models Using Reinforcement Learning Techniques and Best Practices, 1st Edition, Packt Publishing, 2020 (Reprint 2023).

COURSE OUTCOMES:

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

CO1	Understand the fundamentals of Reinforcement Learning tasks and the core principals including policies, value and functions.	K1-K6
CO2	Apply the tabular and approximation methods to solve classical control	
CO3	Analyze policy gradient methods to solve more complex cases.	
CO4	Evaluate the tools and methods used for prediction and control.	
CO5	Investigate the current advanced techniques and applications in Reinforcement Learning.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

SUBJECT CODE: 26UPCSC4E12

CREDITS: 4

Social Network Analysis

COURSE OBJECTIVES:

- Understand the fundamentals of the Semantic Web and Social Networks
- Develop knowledge of knowledge representation and ontology design
- Apply techniques for social network data collection and management
- Analyze social networks using quantitative and graph-based methods
- Explore real-world applications and case studies

UNIT I

INTRODUCTION TO SEMANTIC WEB AND SOCIAL NETWORKS

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 II

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

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 III – DATA COLLECTION

Boundary Specification – Data Collection Process – Information Bias and Issue of Reliability – Archival Data – Understanding SNA Data – Managing SNA Data.

Book 2: Chapter 2

UNIT IV:

METHODS IN SOCIAL NETWORK ANALYSIS

Descriptive Methods – Graph – Density – Centrality – Cliques – MDS – Structural Equivalence – Two Mode Networks – Inferential Methods – QAP – ERGM.

Book 2: Chapter 3, 4

UNIT V:

CASE STUDIES

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

Text Books:

1. Peter Mika, Social Networks and the Semantic Web, 1st Edition, Springer, 2007 (Reprint 2020).
2. Song Yang, Franziska B. Keller and Lu Zheng, Social Network Analysis: Methods and Examples, 1st Edition, SAGE Publications, 2016 (Reprint 2022).

Reference Books:

1. Guandong Xu, Yanchun Zhang and Lin Li, Web Mining and Social Networking: Techniques and Applications, 1st Edition, Springer, 2011 (Reprint 2021).
2. Dion Hoe-Lian Goh and Schubert Foo, Social Information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, 1st Edition, IGI Global, 2008 (Reprint 2020).

COURSE OUTCOMES:

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

CO1	Understand the fundamentals of social web and elements of social network analysis.	K1-K6
CO2	Apply and visualize the knowledge representation in social network.	
CO3	Analyses the various methods in social network analysis.	
CO4	Evaluate the tools and methods for analyzing the social network data.	
CO5	Investigate the recent potential applications and development of social networks with real-time case studies.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

SEMESTER III

Subject Code: 26UPCSC4E13

Credits: 4

Robotics and Automation

COURSE OBJECTIVES:

- Understand basics of robotics and automation
- Apply kinematics and dynamics of robots
- Study sensors, actuators, and control systems
- Learn AI and ML for robotics
- Understand computer vision and autonomous systems

UNIT I: Fundamentals of Robotics & Automation: Definition and history of robotics, Types of robots (industrial, mobile, humanoid), Components: sensors, actuators, controllers, Degrees of freedom, work envelope, Types of automation: fixed, programmable, flexible, Laws of robotics (Asimov)

UNIT II: Robot Kinematics and Dynamics: Coordinate systems and transformations, Forward and inverse kinematics, Velocity and acceleration analysis, Robot dynamics (forces, torque), Trajectory planning

UNIT III: Sensors, Actuators & Control Systems: Types of sensors (IR, LiDAR, vision, ultrasonic), Actuators (electric, hydraulic, pneumatic), Control systems: open-loop & closed-loop, PID controllers, Embedded systems for robotics

UNIT IV: Artificial Intelligence & Machine Learning for Robotics: Introduction to AI concepts, Search algorithms (DFS, BFS, A*), Machine Learning: Supervised learning, Unsupervised learning, Reinforcement learning-Neural networks and deep learning basics

UNIT V: Computer Vision & Autonomous Systems: Image processing basics - Object detection and recognition - SLAM (Simultaneous Localization and Mapping) - Path planning and navigation - Autonomous robots (self-driving, drones) **Industrial Automation & Applications:** PLC (Programmable Logic Controller), SCADA systems - Robotic arms in manufacturing - Smart factories (Industry 4.0) - Applications: Healthcare robotics, Agriculture robotics, Service robots.

Text Book:

1. Bruno Siciliano and Lorenzo Sciavicco, Robotics: Modelling, Planning and Control, 1st Edition, Springer, 2009 (Reprint 2022).

Reference Books:

1. John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson, 2018 (Reprint 2023).
2. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, 2nd Edition, Wiley, 2020 (Reprint 2023).
3. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021 (Reprint 2024).
4. Sebastian Thrun, Wolfram Burgard and Dieter Fox, Probabilistic Robotics, 1st Edition, MIT Press, 2005 (Reprint 2022).
5. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, 2nd Edition, Springer, 2017 (Reprint 2023).

6. Richard M. Murray, Zexiang Li and S. Shankar Sastry, A Mathematical Introduction to Robotic Manipulation, 1st Edition, CRC Press, 1994 (Reprint 2020).
7. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 4th Edition, Pearson, 2015 (Reprint 2022).
8. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, 1st Edition, MIT Press, 2016 (Reprint 2024).

COURSE OUTCOMES:

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

CO1	Understand robot types, components, degrees of freedom, and automation techniques.	K1-K6
CO2	Apply kinematics, dynamics, and trajectory planning for robotic systems.	
CO3	Use sensors, actuators, and control systems to develop functional robotic solutions.	
CO4	Implement search algorithms, learning models, and neural networks for intelligent decision-making.	
CO5	Apply computer vision, SLAM, and path planning for real-world applications such as self-driving systems and industrial automation.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	H	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H- High; M-Medium; L-Low

Blockchain Technology

COURSE OBJECTIVES:

- Understand the fundamentals of blockchain and decentralized systems
- Develop knowledge of cryptographic principles used in blockchain
- Analyze blockchain architecture and consensus mechanisms
- Explore cryptocurrencies, platforms, and smart contract development
- Examine advanced blockchain concepts and real-world applications

UNIT I: Introduction to Blockchain & Decentralization : Definition and characteristics of blockchain, Evolution: from Bitcoin to modern blockchain, Centralized, decentralized, and distributed systems, Peer-to-peer networks, Advantages and limitations of blockchain.

UNIT II: Cryptography Fundamentals : Basics of cryptography, Hash functions (SHA-256), Public key cryptography , Digital signatures, Merkle trees, Role of cryptography in blockchain security.

UNIT III: Blockchain Architecture: Structure of blocks and chain, Transactions and distributed ledger, Nodes and network types, Consensus mechanisms: Proof of Work (PoW), Proof of Stake (PoS), Mining and validation, Forks: hard fork and soft fork.

UNIT IV: Cryptocurrencies & Platforms: Working of Bitcoin, Ethereum and altcoins, Wallets and key management, Overview of platforms: Ethereum, Hyperledger Fabric, **Smart Contracts & Decentralized Applications** : Smart contracts: concept, lifecycle, Introduction to Solidity programming, Deployment on Ethereum, Decentralized Applications (DApps), Web3 basics and tools.

UNIT V: Advanced Topics & Applications: Decentralized Finance (DeFi), Decentralized Autonomous Organizations (DAO), Blockchain security issues (51% attack, Sybil attack), Privacy concepts (basic idea of zero-knowledge proofs), Real-world applications: supply chain, healthcare, voting, Challenges and future trends.

Text Book:

1. Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, 1st Edition, Apress, 2017 (Reprint 2022).

Reference Books:

1. Imran Bashir, Mastering Blockchain, 4th Edition, Packt Publishing, 2023.
2. Mubashir Husain Rehmani, Blockchain Systems and Communication Networks: From Concepts to Implementation, 1st Edition, Springer, 2019 (Reprint 2022).
3. Anita Ravani, Sashi Edupuganti, Jeannette Pugh and Sooraj Sushama, Applications of Blockchain Technology, 1st Edition, CRC Press, 2020 (Reprint 2023).
4. Don Tapscott and Alex Tapscott, Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is Changing the World, Reprint Edition, Portfolio (Penguin), 2016 (Reprint 2022).

5. Antony Lewis, The Basics of Bitcoins and Blockchains, 1st Edition, Mango Publishing, 2018 (Reprint 2021).
6. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies, 1st Edition, Princeton University Press, 2016 (Reprint 2022).

COURSE OUTCOMES:

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

CO1	Understand decentralized systems, peer-to-peer networks, and advantages and limitations of blockchain.	K1-K6
CO2	Use hashing, digital signatures, and public key cryptography to ensure data integrity and security.	
CO3	Understand block structure, mining, validation processes, and consensus algorithms.	
CO4	Implement basic smart contracts using Solidity and deploy DApps on blockchain platforms.	
CO5	Evaluate real-world use cases, identify security threats, and understand emerging developments in blockchain technology.	

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

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	H	H	M	H	M	H	H	H	H	M
CO2	H	H	H	M	H	H	H	H	H	H
CO3	H	M	H	H	M	H	M	H	H	M
CO4	H	H	H	H	H	H	H	M	H	H
CO5	H	H	H	H	H	H	H	H	H	M

H- High; M-Medium; L-Low

Quantum Computing

COURSE OBJECTIVES:

- To understand the fundamental principles of quantum computing and its advantages over classical computing.
- To explore the theoretical and practical aspects of quantum computing algorithms.
- To develop the ability to implement quantum neural networks and variational quantum circuits.
- Studying the structural units of quantum computers of the future, forming an understanding of the differences between quantum bits and classical bits.
- Study of basic quantum logical operations and algorithms for processing quantum information.

UNIT I

Review of the principles of quantum computation, The Deutsch Jozsa Algorithm, Bernstein Vazirani Algorithm, Simmons Algorithm.

UNIT II

Shor's Algorithm, Grover's Search, Grover's algorithm Programming.

UNIT III

NISQ-era quantum algorithms, Variational Quantum Algorithms.

UNIT IV

Variational Quantum Eigen solver, Quantum Generative Adversarial Networks (QGANs).

UNIT V

Applications and Future Trends in Quantum Computing: Quantum Reinforcement Learning, Quantum Optimization, AI in Finance & Cryptography, Challenges & Future Research Directions.

Text Books :

1. Chris Bernhardt, Quantum Computing for Everyone, 1st Edition, MIT Press, 2019 (Reprint 2023).
2. Yuly Billig, Quantum Computing for High School Students, 1st Edition, Quantum Education Publications, 2022.

Reference Books:

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010 (Reprint 2022).
2. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Wellesley-Cambridge Press, 2016 (Reprint 2023).
3. Kexuan Shen, Research on the Application of Quantum Computing in Artificial Intelligence, 1st Edition, Springer, 2024.

COURSE OUTCOMES:

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

CO1	To understand the basic principles of quantum computing.	K1-K6
CO2	Understand the concepts of Quantum Computing and its Algorithms.	
CO3	Apply quantum feature extraction and classification techniques to complex datasets.	
CO4	Acquire knowledge of various quantum operators and their applications in quantum computation.	
CO5	The fundamental differences between conventional computing and quantum computing.	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H-High; M-Medium; L-Low

Explainable AI (XAI)**COURSE OBJECTIVES:**

- Understand the fundamentals and importance of Explainable AI (XAI)
- Explore interpretable machine learning models and post-hoc techniques
- Analyze explainability methods in deep learning and domain-specific applications
- Evaluate explainability and address ethical considerations in AI
- Apply advanced XAI techniques and tools in real-world scenarios.

UNIT I

Introduction to Explainable AI-What is Explainable AI (XAI)-Need for transparency, trust, and accountability-Black-box vs white-box models-Applications in healthcare, finance, governance- Foundations of Machine Learning for XAI-Overview of Machine Learning & Deep Learning-Supervised vs Unsupervised Learning-Model complexity vs interpretability trade-off-Bias-variance and generalization.

UNIT II

Interpretable (Transparent) Models-Linear Regression & Logistic Regression-Decision Trees & Rule-based models-k-NN and Bayesian models-Advantages of inherently interpretable models-: Post-hoc Explainability Techniques-Feature importance methods-Partial Dependence Plots (PDP), ICE plots-Surrogate models-LIME (Local Interpretable Model-Agnostic Explanations)-SHAP (Shapley values).

UNIT III

Explainability in Deep Learning-Challenges in neural network interpretability-Saliency maps, Grad-CAM-Layer-wise relevance propagation (LRP)-Feature visualization techniques- Explainability in NLP & Computer Vision-Attention mechanisms and interpretability-Explainable NLP models-Vision explainability (CNN interpretation).

UNIT IV

Evaluation of Explainability-Metrics for explanation quality-Fidelity, consistency, stability-Human-centered evaluation- Ethics, Fairness, and Responsible AI-Bias detection and mitigation-Fairness in AI models-Legal and regulatory aspects (GDPR, AI ethics)-Trustworthy AI frameworks.

UNIT V

Advanced Topics-Causal inference in explainability-Counterfactual explanations-Explainability in Large Language Models (LLMs)-Explainable Reinforcement Learning.

Case Studies & Applications.

Healthcare diagnostics-Credit scoring systems-Autonomous Systems-Real-world deployment challenges Tools & Practical Work - Python libraries: SHAP, LIME, ELI5 - TensorFlow & PyTorch explainability tools - Hands-on projects.

Text Books:

1. Uday Kamath and John Liu, Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning, 1st Edition, Springer, 2021 (Reprint 2023).
2. Pradeepta Mishra, Practical Explainable AI Using Python: Learn Interpretable Machine Learning with Python, 1st Edition, Packt Publishing, 2022 (Reprint 2023).

Reference Books:

1. Christoph Molnar, Interpretable Machine Learning, 2nd Edition, Lulu.com (Self-published), 2022 (Updated Online 2024).
2. Wojciech Samek, Grégoire Montavon, Andrea Vedaldi, Lars Kai Hansen and Klaus-Robert Müller (Eds.), Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, 1st Edition, Springer, 2019 (Reprint 2022).
3. Various Authors, Explainable AI: From Classical Models to Large Language Models, 1st Edition, Springer / Elsevier (Research Compilation), 2024 (Latest Edition).

COURSE OUTCOMES:

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

On the successful completion of the course, student will be able to:		
CO1	Understand the role of interpretability in building trustworthy AI systems.	K1-K6
CO2	Use methods like feature importance, LIME, and SHAP to explain machine learning models.	
CO3	Implement techniques such as saliency maps, Grad-CAM, and attention mechanisms for model interpretation.	
CO4	Assess models using explainability metrics and ensure compliance with ethical and regulatory standards.	
CO5	Use Python libraries and frameworks to build interpretable models and apply XAI techniques in real-world applications.	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	H	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H- High; M-Medium; L-Low

AI for Business Decision Making**COURSE OBJECTIVES:**

- Understand the role of AI in modern business environments and decision- making processes
- Apply Machine learning models for business problems such as sales prediction and customer Behavior analysis
- Analyze structured and unstructured data for actionable insights
- Evaluate AI-Driven decision systems and their ethical implications
- Develop AI- based solutions to optimize business operations and strategy

UNIT I

Introduction to AI in Business : Role of AI in Modern Organizations – Data – driven vs intuition Based decision Making –Applications in Marketing, finance, HR, Supply chain Business Intelligence (BI) concepts.

Decision- Making Fundamentals : Types of Decisions : Strategic, tactical, operational ,Decision theory & Frame works, utility theory and risk Analysis, cost- benefit analysis, Multi-criteria decision making.

UNIT II

Data-Driven Decision Making : Data collection & preprocessing – Exploratory Data Analysis Data Visualization (Power BI ,Tableau) KPI and Business Metrics.

Machine- Learning for Business : Supervised learning : Regression (Sales prediction), Classification (customer churn) Unsupervised learning : Clustering (Customer segmentation) Model evaluation & performance metrics.

UNIT III

Predictive & Prescriptive Analytics : predictive models (forecasting, demand, risk), Prescriptive Analytics (What action to take), Optimization techniques, Simulation models.

AI Techniques in Decision Systems : Bayesian decision models, Markov Decision Processes (MDP) , Reinforcement Learning, Expert Systems & recommendation Systems.

UNIT IV

Business Applications of AI : Marketing analytics (targeting, personalization), Financial Analytics (Fraud detection , credit Scoring) , Supply chain optimization, HR analytics (employee performance prediction).

Tools & Technologies : python (Numpy, Pandas, Scikit- learn) SQL for data handling, Visualization tools (Power BI, Tableau), AI Platforms.

UNIT V

Ethics & AI Governance : Bias in AI Models- Fairness and transparency- Data Privacy Laws Responsible AI use in Business.

Case Studies & Projects : Real World business problems, AI Based decision Systems, Industry Projects / Internships.

Text Books:

1. Chen Xu, Artificial Intelligence in Business Decision Making, 1st Edition, Springer, 2020 (Reprint 2023).
2. Marco Iansiti and Karim R. Lakhani (commonly used equivalent for “AI Fundamentals for Business Leaders”), Competing in the Age of AI: Strategy and Leadership When Algorithms and Networks Run the World, 1st Edition, Harvard Business Review Press, 2020 (Reprint 2023).
3. Namita Mishra and A. V. Senthil Kumar, Artificial Intelligence and Machine Learning for Business, 1st Edition, Wiley India, 2022 (Reprint 2023).

COURSE OUCOMES:

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

CO1	Explain key AI concepts and their applications	K1-K6
CO2	Explain key AI concepts and their applications in business contexts	
CO3	Build predictive models using techniques like regression, classification and clustering	
CO4	Use tools such as python, R, and AI frameworks for business analytics	
CO5	Assess risks, biases and ethical concerns in AI –based decisions	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	M	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	H	H	M	M	H	M
CO4	H	H	H	M	H	M	M	H	H	M
CO5	H	H	H	M	H	H	M	H	M	H

H- High; M-Medium; L-Low

Digital Transformation and Business Strategy**COURSE OBJECTIVES:**

- Enabling students to discuss technology-related issues with both professionals and business. Have a clear understanding of the role of the Technology in enterprises.
- This course is focused on helping students define and manage a holistic digital business transformation effort.
- Aims to develop students' critical appreciation of leadership theory in the digital age
- Gain the know-how of building and leading teams to success, and driving a culture of innovation at an organizational level
- Assess digital's potential threats or opportunities for a given market, either to identify new business opportunities, or adapt transform themselves

UNIT I**DIGITAL TRANSFORMATION OF FIRMS AND INDUSTRIES**

The Five Domains of Digital Transformation: Customer, Competition, Data, Innovation and Value. Identifying key drivers of technology's impact on the business ecosystem Rise of Platforms: From Airbnb to Alibaba Four Types of Platform: Exchange, transaction system, Ad-supported Media, Hardware/software standard. Creating Digital Assets How digital impacts platform. Using Technology as Innovation, Integration and Interconnection of business. How technologies (IT), can threaten established companies' dominance: demand-side and supply-side disruption.

Case Study Analysis: 1. Technology disrupting the music industry: A Case of BMG Entertainment, 2. The Crisis at Encyclopedia Britannica.

UNIT II**LEADING IN DIGITAL TIMES**

Leadership and globalization-Role of CIO's in digital world Role and challenges of the CIO-Cultural Shift and its impact on businesses-Encouraging and instilling a culture of curiosity and creativity-Accessing new capabilities through innovation labs and corporate accelerators -Leading for co-creation vs. "followership"- Collaborating across remote and hybrid teams to strengthen culture and foster accountability- Empowering employees to solve problems and feel greater ownership.

UNIT III**BUILDING DIGITAL BUSINESS MODELS**

Drivers and Challenges of Digital Business Models-Business model canvas. (Inspired from Osterwalder and Pigneur)-The Benefits and Challenges of Using the Business Model Canvas for DBM -Building Blocks: Customer segments, Value Propositions, Channel, Customer Relationships, Revenue streams, Key Resources, Key activities, Key Partnerships, Cost Structure .Long Tail Business Model: Focus on a large number of products, each selling in low volumes.(Logo's New Long Tail)-Open Business Model: used by companies to create and capture value by systematically-collaborating with outside partners. (Procter & Gamble: Connect & Develop) · Agile Business Model-Design Thinking.

Case Study Analysis: 1. Digital Disrupters: iPhone, Netflix, Warby Parker, 2. Apple iPod/iTunes Business Model

UNIT IV

COMPETING THROUGH DIGITAL BUSINESS STRATEGY

New rules of business strategy-Customer Networks and the New Path to Purchase-Understanding Digital customer behavior: Identify five core behaviors of networked customers - accessing, engaging, customizing, connecting, and collaborating- Digital Customer Experience in Physical environment. -Developing competitive advantage through digital strategy-Latest developments in Digital age and Future of business.

Case Study Analysis: 1. Healthcare Industry – Use of Virtual Reality (VR) for patient care, 2.BFSI – Commercial Bank of Kuwait (CBK) use of video chat

UNIT V

ROLE OF ARTIFICIAL INTELLIGENCE IN CUSTOMER SERVICE

Understanding Artificial Intelligence in Customer-Service evolution of AI in customer support-Applications of AI in customer service-Benefits of ai in customer service-Ethical and privacy considerations challenges and limitations-Future of AI in Customer Service.

Case study analysis: 1. HDFC Bank (India) – EVA Chatbot, 2. Amazon – Predictive Customer Service, 3.Starbucks – Deep Brew

Text Books:

1. David L. Rogers, The Digital Transformation Playbook: Rethink Your Business for the Digital Age, 1st Edition, Columbia Business School Publishing, 2016 (Reprint 2023).
2. Sunil Gupta, Driving Digital Strategy: A Guide to Reimagining Your Business, 1st Edition, Harvard Business Review Press, 2018 (Reprint 2022).
3. Alexander Osterwalder and Yves Pigneur, Business Model Generation, 1st Edition, Wiley, 2010 (Reprint 2023).
4. Marco Iansiti and Karim R. Lakhani, Competing in the Age of AI: Strategy and Leadership When Algorithms and Networks Run the World, 1st Edition, Harvard Business Review Press, 2020 (Reprint 2024).

Reference Books:

1. Geoffrey G. Parker, Marshall W. Van Alstyne and Sangeet Paul Choudary, Platform Revolution: How Networked Markets Are Transforming the Economy, 1st Edition, W. W. Norton & Company, 2016 (Reprint 2023).
2. Jeanne W. Ross, Cynthia M. Beath and Martin Mocker, Designed for Digital: How to Architect Your Business for Sustained Success, 1st Edition, MIT Press, 2019 (Reprint 2023).
3. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, 1st Edition, Crown Business, 2011 (Reprint 2023).
4. Satya Nadella, Greg Shaw and Jill Tracie Nichols, Hit Refresh: The Quest to Rediscover Microsoft's Soul and Imagine a Better Future for Everyone, 1st Edition, Harper Business, 2017 (Reprint 2022).
5. Bernard Marr, Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, 1st Edition, Wiley, 2019 (Reprint 2023).
6. Amit Joshi, Michael Wade and others, Competing in the Digital Age: How to Transform Your Organization for the New Digital World, 1st Edition, IMD Publishing, 2023 (Latest Edition).

COURSE OUCOMES:**On the successful completion of the course, student will be able to:**

CO1	Gain basic knowledge and skills to recognize the contributions of technology to business needs situations/scenarios.	K1-K6
CO2	Identify key drivers of technology’s impact on the business ecosystem.	
CO3	Demonstrate an integrated awareness of how to lead in the digital age, or in the knowledge era.	
CO4	Implement more collaborative decision-making approaches that empower others, bridging across generations, geographies, and functions.	
CO5	Able to evaluate the role and feasibility of digital business models and strategy based upon the company’s position in a competitive space	
K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6-Create		

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	H	H	H	H	H	M	H	M	M
CO2	H	H	M	H	H	H	M	H	H	H
CO3	H	H	H	M	M	H	M	M	H	M
CO4	H	M	H	M	H	M	M	H	H	M
CO5	M	M	H	M	H	H	M	H	M	M

H- High; M-Medium; L-Low

NON MAJOR ELECTIVE – II

SUBJECT CODE: 26UPCSC1N01

CREDITS: 2

ADVANCED MICROSOFT OFFICE LAB

LIST OF EXPERIMENTS

MS-Word:

- Design an admission/enquiry form using shapes, text boxes, colors, and tables with formatting options.
- Design a textbook with a cover page, content page, and text using indenting options, rulers, page layout, header/footer, and hyperlinks.
- Design a newspaper advertisement with images and text.
- Design a mark statement copy using tables, images, and watermarks.
- Design a conference/seminar invitation with logos, formatting options, margins, and borders.
- Write a research article with charts, tables, symbols, equations, and references.

MS-Excel:

- Design an application for student exam results using data validation, aggregate functions, and conditional formatting.
- Prepare a cost-benefit analysis for an organization using statistical tools.
- Develop an application to predict population activity using analysis macros.

MS-Access:

- Design an employee payroll system with forms and reports using macros.
- Develop relational integrity databases.
- Develop an application that automatically updates a table using triggers.
- Design an inventory database and generate conditional reports.

MS-PowerPoint:

- Prepare a presentation with embedded multimedia objects.
- Prepare a presentation with slide layouts, animations, font effects, and hyperlinks.

MS-Publisher:

- Prepare an academic calendar for an institution.

REFERENCE BOOKS:

1. Antao, Tiago. (2022). Bioinformatics with Python Cookbook: Learn how to use modern Python bioinformatics libraries and applications (3rd Edition). Packt Publishing Ltd., Birmingham, UK. **ISBN:** 978-1803247724
2. Haddock, Steven H. D., & Dunn, Casey W. (2022). Practical Computing for Biologists: Python Programming and Data Analysis (2nd Edition). Sinauer Associates / Oxford University Press, USA. **ISBN:** 978-0197612613
3. Pevsner, Jonathan. (2023). Bioinformatics and Functional Genomics (4th Edition). Wiley-Blackwell, USA. **ISBN:** 978-1118581780

NON MAJOR ELECTIVE –II

SUBJECT CODE: 23UPCSC1N02

Credits: 2

BIO PYTHON PROGRAMMING LAB

LIST OF EXPERIMENTS

Implement the following in Python:

1. Program to implement Functions.
2. Program to perform Basic Operations on Sequence objects.
3. Program to perform Operations on Sequence annotation objects.
4. Program to perform Operations on Sequence Input/Output.
5. Program to perform Operations on Multiple Sequence Alignment objects.
6. Program to perform Operations on BLAST.
7. Program to perform Sequence modify analysis.
8. Program to perform Cluster analysis.
9. Program to perform Supervised learning methods.
10. Program to perform Genome Data visualization.

REFERENCES

1. Alexander, Michael, & Kusleika, Dick. (2022). Microsoft Excel 365 Bible (1st Edition). Wiley Publications, USA. ISBN: 978-1119831419
2. Jelen, Bill, & Syrstad, Tracy. (2021). Microsoft Excel VBA and Macros (Office 2021 and Microsoft 365). Microsoft Press / Pearson Education. ISBN: 978-0137521524
3. Winston, Wayne L. (2022). Microsoft Excel Data Analysis and Business Modeling (6th Edition). Microsoft Press. ISBN: 978-1509305889
4. Alexander, Michael, & Kusleika, Dick. (2022). Excel Power Programming with VBA (Latest Edition). Wiley Publications, USA. ISBN: 978-1119699057
5. Viescas, John L., & Hernandez, Michael J. (2020). Microsoft Access 2019 Inside Out. Microsoft Press. ISBN: 978-1509306985

6. Lambert, Joan. (2022). Microsoft Office 365 Step by Step. Microsoft Press. ISBN: 978-0137564279
7. Walkenbach, John (Legacy Author), updated by Alexander, M. (2022). Excel Dashboards and Reports (3rd Edition). Wiley Publications. ISBN: 978-1119518174
8. Harvey, Greg. (2023). Excel 365 All-in-One For Dummies. Wiley Publications. ISBN: 978-1394159932

SEMESTER II

SUBJECT CODE: 26UPCSC4P01

CREDITS: 2

Professional Competency Skill– Mini Project

Students enrolled in the Master of Data Science program are required to complete a Professional Competency Skill mini project to develop practical and industry-relevant expertise. The mini project should focus on a well-defined problem statement and involve key stages such as data collection, preprocessing, exploratory data analysis, and implementation of basic analytical or machine learning techniques. Students must follow academic guidelines, maintain clear documentation of their methodology, and ensure ethical use of data with proper citations where necessary. The use of tools such as Python, SQL, and data visualization libraries is expected, along with exposure to relevant modern technologies where applicable. Regular guidance from faculty mentors should be sought to track progress and refine the approach. The final submission should include a concise report and presentation demonstrating the student's understanding, technical skills, and ability to apply data science concepts to solve real-world problems.

SUBJECT CODE: 26UPCSC1X01

CREDITS: 1

Extension Activity (EXPO)

Students of the Master of Data Science program participating in the Extension Activity (EXPO) are required to demonstrate a project based on the latest technologies through a software or hardware prototype. Each student or team should select an innovative and practical problem statement and develop a working model using contemporary tools such as machine learning frameworks, data visualization platforms, IoT devices, or cloud-based solutions. The project should clearly showcase the application of data science concepts, with proper integration of technology, functionality, and user relevance. Students must follow institutional guidelines, maintain brief documentation of objectives, methodology, and outcomes, and ensure ethical and responsible use of data. Prior preparation, testing, and validation of the demo are essential for smooth presentation during the EXPO. Students are expected to confidently explain their project, highlight its real-world applications, and effectively respond to queries from evaluators and participants.

SEMESTER III

SUBJECT CODE: 26UPCSC4I01

CREDITS: 2

Internship Activity

(Carried out in Summer Vacation at the End of I Year – 30 Hours)

As part of the Master of Data Science internship, the student followed structured academic and industry guidelines to apply theoretical knowledge in real-world scenarios. The work involved data collection, cleaning, and analysis, along with developing basic predictive models while ensuring proper documentation and adherence to ethical data practices. The student regularly reported progress to the mentor and incorporated feedback to improve outcomes. In addition to foundational tools like Python and SQL, the student gained exposure to modern technologies such as cloud platforms, big data frameworks, and machine learning libraries, enhancing the ability to handle large-scale datasets. This internship strengthened the student's analytical thinking, technical proficiency, and understanding of current industry standards in data science.

SEMESTER IV

SUBJECT CODE: 26UPCSC4P02

CREDITS: 16

Project with Viva Voce

Final year students of the Master of Data Science program are required to complete a comprehensive project integrated with a mandatory internship and appear for a Viva Voce as part of their academic evaluation. Students must select a relevant problem statement, preferably aligned with their internship work, and apply appropriate data science methodologies including data collection, preprocessing, analysis, model development, and interpretation of results. They should follow structured academic and industry guidelines, maintain proper documentation, and ensure adherence to ethical data practices. The use of foundational tools such as Python and SQL, along with exposure to modern technologies like machine learning frameworks, data visualization tools, and cloud platforms, is encouraged. Regular interaction with both academic guides and industry mentors is essential for progress monitoring and feedback incorporation. During the Viva Voce, students are expected to effectively present their internship-integrated project, demonstrate conceptual clarity, justify their methodology, and confidently answer questions posed by the evaluation panel.

Value Added Course

COURSE: 26UPCSCVA01

MS-Office (Excel)

Credits: 4

COURSE OBJECTIVES:

- Give students an in-depth understanding of how the office tool is essential in business, education and society
- To understand the basics and advanced features of Excel spread program
- To improve the Data interpretation and analysis skills of the learner
- Learner get familiar in working of Statistical functions to analyze the data

1. Create an excel sheet and perform the following operation

i) Creating and running a macro. ii) Assigning button to a defined macro. iii) Editing a macro.

2. Create a table and apply the various formatting properties and generate the chart for the table

3. Create a table and apply the various mathematical functions.

4. Prepare Excel worksheet with chart for Employee salary with the following information

(i) Name of People with their age (at least 10)

(ii) Number of years they have worked with salary per month

(iii) Show the HRA, MA, TA and Hard allowances

Calculate the total, average, maximum, minimum salary of employees and give the chart for salary

5. Create Excel worksheet for Wedding cost estimation with the following information

(i) Name of guest along with who invited them (Bride / Groom) (at least 10) (ii) Guests may be divided in to adult and children

(iii) Cost of the reception for adult Rs 650, children 60% of adult cost and 183% of GST

Calculate the total number of guests, number of adult and children and total reception cost. Show the graph for adult and children.

6. Prepare Excel table for Balance check book with the following information Ck# (Check book number), date, item description (at least 10 transactions), Debit and Credit

Calculate the balance using the formula $\text{Balance} = \text{Credit} - \text{Debit}$

7. Prepare Excel worksheet table for Cost-Benefit analysis of stadium for 10 years with the following information

Year, Costs, Benefits, Total benefits, Discount factor, Present Value

Calculate the total benefits ($\text{Total benefits} = \text{Benefits} - \text{Cost}$), discount factor ($\text{discount factor} = 1/(1+0.1)^{\text{year}}$), Present value

($\text{Present value} = \text{total benefits} * \text{discount factor}$).

8. Develop a spread program for the following case scenario

One day at a family dinner, your dad and your uncle got into a debate about which basketball team is better. Your dad is a loyal fan of the State University while your uncle graduated from the University of State, a big rival of the State University. Your great aunt chimed in that the University of Next- State's basketball team is the best.

Compare the performance of the basketball teams and you will bring in your analysis to the next family dinner.

9. Develop a spread program for the following case scenario

National Park Services (NPS) is a federal agency of the United States Government responsible for managing all U.S. National parks, many American national monuments, and many other conservation and historical properties. Information about visitation at units of the NPS is publicly available and may be downloaded at <https://irma.nps.gov/Stats/> You work for a company that specializes in guided tours of national parks across the United States. As an assistant to the Director of Marketing, you were asked to analyze some visit data at selected national parks. Your boss is specifically interested in the number of visitors as well as the trend of recreational visits over the years. The information will be used to develop marketing strategies, promotional packages, as well as advertising campaigns for the next five years.

10. Develop a spread program for the following case scenario

Headquartered in Memphis, TN, Grenadier Super Store (GSS) specializes in office supplies and furniture. The company's customers range from individual consumers and small businesses (retail), to corporate organizations (wholesale) located in the United States and Canada.

You are an intern working for the Canada division of GSS. Your supervisor has given you an Excel file containing Order data from 2009-2012 and he would like you to analyze Orders/Customers/Sales data using PivotTables and Pivot Charts.

References

1. <https://www.excel-easy.com/data-analysis.html>
 2. <https://excelwithbusiness.com/blog/15-excel-data-analysis-functions-need/>
 3. <https://www.studyanalytics.in/data-analysis-using-excel>
- Course outcomes:

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

1. Understand the basics of MS-Excel and its functions concepts
2. Gain knowledge to apply the appropriate Excel functions in the real data
3. Understand the functionality of the analysis tool pack to analyze the data
4. Learner get familiar with the analysis functions of statistics

Employability skills

The add on course in MS-Excel helps the learner to understand and identify the usage of MS-Excel in business, education and society using statistical functions. The above learning skill helps the learner to get more employability in the data analysis environment

Career scope:

Data Analyst

Data engineer

Business analyst

Business intelligence



Course Duration : 30 Hours

Value Added Course

COURSE: 26UPCSCVA02

R Programming

Credits: 4

Course Objective:

- To be able to learn how to program in R and how to use R for effective data analysis.
- Familiar with programming in R, reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code.

Implement the following concepts using R:

1. R data types-and objects,
2. Reading and writing data
3. Control structures
4. Functions
5. Dates and times
6. Loop functions
7. Vector and Matrix Operations
8. List and Data-Frame Operations
9. Data Import and export Operations
10. Data Exploration and Visualization Operations

References:

1. Kabacoff, Robert I. (2022). R in Action: Data Analysis and Graphics with R (3rd Edition). Manning Publications, USA. ISBN: 978-1617291388
2. Cotton, Richard. (2023). Learning R: A Step-by-Step Function Guide to Data Analysis (2nd Edition). O'Reilly Media, USA. ISBN: 978-1098116002
3. Wickham, Hadley, & Grolemund, Garrett. (2023). R for Data Science (2nd Edition). O'Reilly Media. ISBN: 978-1492097402
4. James, Gareth, Witten, Daniela, Hastie, Trevor, & Tibshirani, Robert. (2021). An Introduction to Statistical Learning with Applications in R (2nd Edition). Springer ISBN: 978-1071614174

Web References:

1. <https://www.w3resource.com/r-programming-exercises/>

Course Outcomes:

The students should enable to:

1. Gain knowledge to identify appropriate R Programming language constructs to write basic programs for the given problem.
2. Identify and implement the right data representation formats and data structure based on the requirements of the problem.
3. Understand the functionality of R package and to implement the same for the problem solving.

Employability Skill:

This Add-on course will help learners, especially Statistical, Mathematical & Computer .. science students improve their employment quotient and job qualifications in the marketplace.

Career Scope:

- Data Analysts
- R Programmer
- R Researcher in leading research institutions
- Data Scientists

 Course Duration : 30 Hours

Value Added Course

COURSE: 26UPCSCVA03

Bio Python

Credits: 4

COURSE OBJECTIVE:

This course should enable the students:

- To be able to introduce programming basics and design using Python Programming Language
- To understand in-depth biological data and information processing techniques using Bio Python.

Implement the following concepts using Python:

1. Basics of Python
2. Advanced Data Structure
3. Control Flow
4. Functions and modules
5. Files
6. Retrieve Sequence from FASTA and Genbank files
7. Split a Sequence File into a set of smaller files.
8. Sequence file formats conversion
9. Manipulations of sequence files
10. Visualization and analyze of Sequence data.

References

1. Lott, Steven F., & Phillips, Dusty. (2021). Python Object-Oriented Programming: Build Robust and Maintainable Object-Oriented Python Applications and Libraries (4th Edition). Packt Publishing Ltd., UK. **ISBN:** 978-1801077262
2. Antao, Tiago. (2022). Bioinformatics with Python Cookbook: Learn Programming for Genomics, Proteomics, and Data Science (3rd Edition). Packt Publishing Ltd., UK. **ISBN:** 978-1803247724
3. Cock, Peter J. A., Antao, Tiago, Chang, Jeffrey T., Chapman, Brad A., Friedberg, Iddo, Hamelryck, Thomas, & de Hoon, Michiel J. L. (Latest, Updated 2025). Biopython Tutorial and Cookbook. Available at: <https://biopython.org>

Web References:

1. <https://www.w3resource.com/python-exercises/class-exercises/>
2. <https://www.rithmschool.com/courses/python-fundamentals-part-2/python-object-oriented-programming-exercise>

Course Outcomes:

The students should enable to:

1. Gain knowledge to identify appropriate Python language constructs to write basic programs for the given problem.
2. Identify and implement the right data representation formats and data structure based on the requirements of the problem.
3. Understand the functionality of Bio Python package and to implement the same for the problem solving.

Employability Skill:

This Add-on course will help learners especially Life-Science students improve their employment quotient and job qualifications in the marketplace.

Career Scope:

1. Bioinformatics Analysts
2. Bioinformatics Programmer
3. Bioinformatics Researcher in leading research institutions
4. Data Scientists

 Course Duration : 30 Hours

Value Added Course

COURSE: 26UPCSCVA04 Large Language Models (LLMs)

Credits: 4

COURSE OBJECTIVES:

1. Understand the basic concepts and functions of Large Language Models (LLMs).
2. Apply LLMs (e.g., ChatGPT, Gemini) for summarization, analysis, and content generation.
3. Develop effective prompts to extract relevant information from LLMs.
4. Analyze sentiment, bias, and public opinion using LLM tools.
5. Demonstrate ethical considerations in using AI tools in research.

Lab Exercises

1. Introduction to LLMs & Applications
2. Working with ChatGPT / Gemini
3. Prompt Engineering Basics
4. Text Summarization & Paraphrasing
5. Sentiment & Opinion Analysis
6. Translation & Code-Switching
7. LLMs as Data Assistants
8. Generate Questionnaire
9. Visual Dashboard Plan
10. Ethical Use of AI in Social Sciences
11. Mini-Project & Presentation

References

1. Silge, Julia, & Robinson, David. (2022). Text Mining with R: A Tidy Approach (Updated Edition). O'Reilly Media. **ISBN:** 978-1491981658
2. Boyd-Graber, Jordan, Hu, Yuening, & Mimno, David. (2017, still relevant). Applications of Topic Models. Foundations and Trends in Information Retrieval.

Course Outcomes (COs)

By the end of this course, learners will be able to:

CO No.	Course Outcome Description	Bloom's Level
CO1	Recall the fundamental concepts of LLMs and their evolution and its applications.	K1 – Knowledge K2 – Comprehension
CO2	Apply LLMs to summarize, paraphrase, and classify social content.	K3 – Application
CO3	Analyze texts for sentiment, bias, or opinion using prompt engineering.	K4 – Analysis
CO4	Evaluate the ethical use of AI tools in research and media.	K5 – Evaluation
CO5	Design and present a mini-project applying LLMs to a social science issue.	K6 – Creation

Value Added Course

COURSE: 26UPCSCVA05

Credits: 4

Basics of Computer Hardware & Introduction to Networking

COURSE OBJECTIVES:

The main objectives of this course are:

1. To understand core hardware components
2. To demonstrate Hardware Assembly and Troubleshooting
3. To grasp Networking Fundamentals
4. To set up and configure Network Devices
5. To apply safety and maintenance practices

Expected Course Outcomes:

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

CO1	Understand the functions and roles of essential computer hardware components such as the CPU, RAM, motherboard, storage devices, and input/output peripherals.	K1-K6
CO2	Develop hands-on skills in assembling a computer system, identifying hardware issues, and applying basic trouble shooting techniques.	
CO3	Understand basic networking concepts including types of networks, network topologies, IP addressing, and essential protocols like TCP/IP.	
CO4	Learn to configure basic networking devices such as routers, switches, and modems, and establish simple local area networks (LANs).	
CO5	Known for hardware handling, ESD safety, and routine maintenance to ensure system reliability and longevity.	

S.No	Module Name	Outcome	Theory (Hrs)	Practical (Hrs)	Total (Hrs)
1	Basic Computer Fundamentals and Basics of Power System in a Computer	Identify different parts of a computer system	01	01	02
2	Introduction to SMPS & UPS	Install Test and Troubleshoot Switch Mode Power Supply & UPS	01	01	02
3	Introduction to Basic Input Output System	Demonstrate configurations and changes in BIOS or CMOS Setup and POST	01	01	02
4	Introduction to Operating System	Install an OS in a new Computer System and configure the machine	01	02	03
5	Computer Management	Manage the resources of a Computer System according to users need	01	01	02

6	Disk Partitioning	Create partition of the HDD, SSD of a Computer System	01	01	02
7	Details about Central Processing Unit & Main board	Install a CPU on motherboard and under lying technology used	01	01	02
8	Primary and Secondary Memory	Install RAM, SSD, HDD and explain primary memory and secondary memory in a computer system	01	01	02
9	Computer Accessories	Install and connect accessories like optical drive, keyboard, mouse, monitor, Printer and troubleshoot	01	02	03
10	Introduction to Networking	Basic of Essential Network Components	01	01	02
11	Connecting Devices	Identify different types of Cables, RJ 45 Connectors, Punching/Crimping Tools and I/O Sockets	01	02	03
12	Network Communication Devices	Explain Working Principle of Communication and utility of Network	01	01	02
13	Knowledge of Sharing of Resources	Connect computers in a networking system and able to share, files, printers or other Resources in a system	01	01	02
14	Knowledge of Internet and Internet Network Configuration	Configure the modem and setup a secured connection via Internet.	01	01	01
Total (Hrs)					30

References Books:

1. Mike Meyers, "CompTIA A+ Certification All-in-One Exam Guide", 11th Edition, McGraw-Hill Education, 2021. (ISBN: 978-1260462189).
2. Mike Meyers, "Networking + Guide to Managing and Troubleshooting Networks", 7th Edition, McGraw-Hill Education, 2019. (ISBN: 978-1260458083).
3. Mike Meyers, "PC Hardware and Maintenance", 4th Edition, McGraw-Hill Education, 2016. (ISBN: 978-0071848232)
4. Charles Severance, "Introduction to Networking: How the Internet Works", 1st Edition, CreateSpace Independent Publishing Platform, 2014. (ISBN: 978-0993449200)
5. V. Rajaraman, "Hardware and Computer Organization", 5th Edition, Prentice Hall, 2018. (ISBN: 978-9332573483)

Module No.1: Basic Computer Fundamentals & Basics of Power System in a Computer.

Outcome: Identify different parts of a computer system.

Theory Content:

- Computer Fundamentals History and Generations of Computer. (Gen1to5)
- Architecture of the Computer.
- Description of different parts of a Computer.
- Idea about Operating system, System Software and Application Software.

Practical Content:

- Identification of different Components of a computer and demonstration and uses of them.
- Different Tools / equipment used for assembling/disassembling a PC.
- Demonstrations of the power flow inside a computer through slides/PPT.
- Identification of the power source, coloured wires of interest etc.

ModuleNo.2: Introduction to SMPS & UPS.

Outcome: Install Test and Troubleshoot Switch Mode Power Supply & UPS.

- SMPS Features and Functions.
- Types of SMPS.
- Power distribution in SMPS.
- Components and Circuits inside the SMPS Unit.
- Types of Uninterrupted Power Supply (UPS) Offline and Online.

Practical Content:

- A running SMPS demonstration.
- Installation of a SMPS on a cabinet.
- Isolated Power testing by sorting.
- Live UPS Demonstration.

ModuleNo.3: Introduction to Basic Input Output System.

Outcome: Demonstrate configurations and changes in BIOS or CMOS Setup and POST.

Theory Content:

- Introduction to BIOS/CMOS Setup, POST. (Power on Self-Test)
- Demonstration of BIOS/CMOS Configuration. (Date, Time, Enable/Disable Devices)
- Dual BIOS Feature BIOS/CMOS Setup, Booting Sequence/Boot Order.

Practical Content:

- Demonstration of BIOS/CMOS setup, POST in a Computer step by step.
- Demonstration of different types of configurations and effect of changes in an existing BIOS feature for system.
- Implementation of Dual Booting setup preferably in windows.

ModuleNo.4: Introduction to Operating System.

Outcome: Install an OS in a new Computer System and configure the machine.

Theory Content:

- Definition and types of Operating Systems. Functions & Features of OS.
- MS-Dos (Prelims), Windows 8.1, 10, 11, RedHat7 Linux Server, Ubuntu, MACOS, Android etc.
- Process of Booting the Operating System.
- Installation of Operating Systems such as Windows 8.1, 10, 11 Activation and Automatic Updating procedures.

Practical Content:

- Installation of different types of Operating Systems.
- Demonstration on Windows Using: Safe Mode, Safe Mode Boot options, Last Known Good Configuration, etc.
- Demonstrating Windows Diagnostic Tools, System Restore, Creating

- Restore point.
- Windows Recovery using System Factory Defaults/Recovery tools.
- Installation of driver routines for the system.

ModuleNo.5: Computer Management.

Outcome: Manage the resources of a Computer System in Windows according to users need.

Theory Content:

- Computer Management, Disk Management, Defragmentation.
- Services and Applications, Local Users and Groups.
- Advanced System Settings, Device Manager, Task Manager, Windows Registry.

Practical Content:

- Demonstrating computer management in Windows using Disk manager, Shrink, Extend and Creating Logical Drive etc.
- Creating users, groups etc.
- Installing & uninstalling program, devices driver from control panel, uses of task manager, termination of a process etc.

ModuleNo.6: Disk Partitioning.

Outcome: Create partition of the HDD, SSD of a Computer System in Windows according to users need.

Theory Content:

- Partitioning of Hard Drive/SSD-Primary, Extended, Logical partitions using Partition Tools in Windows.

Practical Content:

- Demonstration of Partitioning of Hard Drive/ SSD - Primary, Extended and Logical

partitions using Partition Tools in Windows through Disk Manager.

ModuleNo.7: Details about Central Processing Unit & Main board

Outcome: Install a CPU on mother board & underlying technology used.

Theory Content:

- Definition of CPU, Architecture, Speed, Types of CPU (XT and AT technologies) 32/64Bit.
- Types processor technologies like Clock speed, Bus speed, Cache memory.
- Threading technologies, Core technologies, IRQ & DMA Technologies.
- Brands (Intel/AMD), CPU Series–like Pentium, PI, PII, PIII, PIV etc.
- What is “I” Technology, Core series (i3, i5, i7).
- I/O Ports (PS/2, Serial, Parallel, USB, VGA, HDMI, Audio, Ethernet, etc.)

Practical Content:

- Demonstration of different generation CPU (Intel /AMD), showing clock speed, Bus Speed & Other features.
- Demonstration of technological difference between different generation’s CPU through Slides, Lecture, picture etc.
- Hand on practice to install CPU on the slot provided on the compatible main board.
- Installation of external cards viz. graphics, sound, Ethernet and etc., on the main board.

ModuleNo.8: Primary and Secondary Memory.

Outcome: Install RAM, SSD, HDD and explain Primary Memory and Secondary Memory in a Computer system.

Theory Content:

- Introduction to RAM, ROM, Cache Memory, Buffer Memory, Virtual Memory.

Speed, Timeline (EDO, NON-EDO, SD, RD, DDR, DDR2, DDR3, DDR4), Hybrid Memory.

- Comparing and Installing RAM, Memory Module Form Factor, etc.
- Introduction to HDD & SSD, Types, Functioning of HDD, Functioning of SSD, Dual Usage.
- Tracks, Sectors, Cylinders, Cluster MBR, FAT Area, DIR Area, Zero Track.
- IDE Jumper settings (Primary/Secondary), (Master/Slave/Cable Select).
- Installing and Configuring a New HDD/SSD.

Practical Content:

- Demonstration of different generation's RAM compatible with the system.
- Hand on practice to install RAM on the slot provided on the compatible main board.
- Demonstration of different types of HDD/SSD, showing speed, characteristics & other features.
- Hand on practice to install HDD/ SSD or both in a System.
- Hands on practice to make a HDD/SSD as Primary/Secondary Master/Slave using IDE Jumper Settings or cable select.
- Fresh installation a HDD/SSD, Partition, Installation of OS, Application S/W.

ModuleNo.9: Computer Accessories

Outcome: Install & connect accessories like optical drive, keyboard, mouse, monitor, Printer and troubleshoot

Theory Content:

Optical Drive

- Types of Optical Drives-ROM/Writer,
- Types of Media-(CD/DVD), Layers of CD and DVD, Difference between CD and DVD.
- Storage Technology-Reading, Writing &Re-Writing data, Drive Interfaces - (IDE/SATA).
- Burning CD/DVD's using multiple Burning Tools, i.e., Nero, NTI, etc.

- Creating, Managing and Burning ISO Images using tools like: Magic ISO, Power ISO etc.

Keyboard & Mouse

- Types of Keyboards.
- Working Principles of Keyboard (Make/Break Scan Code, Key Matrix).
- Keyboard Interfaces (DIN Type, PS/2, USB, wireless).
- Types of Mouses (Ball Mouse, Optical Mouse, Trackball).
- Principles of Mouse (X, Y Axis in Ball Mouse & DSP, Sensor in Optical Mouse).
- Mouse Interfaces (Serial, PS/2, USB, wireless)

Monitor

- Types of Monitors (CRT/LCD/LED) and Working Principles of each type.
- Demonstration and Practical on Monitor Installation, Menu Configuration, Adjusting Monitor Settings, Monitor Power Supply types, Possible Problems and Troubleshooting.

Printer

- Types of Printers (Dot Matrix, Inkjet, Laser, Thermal, All-in-One Printers, etc.) Interface Cables, Ports & Connectors.
- Working Principles of each type, network Printer.
- Installing a Printer and Configuring Drivers.
- Possible Printer Problems and Troubleshooting Techniques.
- Types of Scanners (Handheld, Flatbed, Sheet fed, Portable Scanners). Interface Cables, Ports and Connectors.
- Installation of Scanner, Device Driver Installation.
- Scanner Settings, Scanning Documents, Photos in different Formats like JPG, PDF, etc.

Practical Content:

Optical Drive

- Hand on practice to learn on burning through requisite application Software.
- Connecting drives with the system with different interfaces.

- Hand on practice on Burning CD and DVD to create ISO image of software.

Keyboard & Mouse

- Demonstration of different types of Keyboards.
- Hands on practice with different types of mice.

Monitor

- Hands on practice with different types of monitor.
- Monitor Problems and Troubleshooting.

Printer

- Demonstration of different types of Printers (Dot Matrix, Inkjet, Laser, Thermal, All- in-One, network Printers etc.)
- Installing a Printer and Configuring Drivers.
- Printer Problems and Troubleshooting Techniques.
- Demonstration of different types of Scanners (Handheld, Flatbed, Sheet fed, Portable Scanners).
- Installing a Scanner and Configuring Drivers.
- Scanner Problems and Printer Troubleshooting Techniques.

ModuleNo.10: Introduction to

Networking. **Outcome:** Basic of Essential

Network Components. **Theory Content:**

- Essential Network Components for Data Transfer (Two Systems Required, Communication Media, Transmission Media, Connecting Devices and Protocol)

Practical Content:

- Demonstration of different types of Communication Media, Transmission Media and Connecting Devices.
- Hands on practice with Essential Network Components.