PERIYAR UNIVERSITY

NAAC A^{++}Grade - State University - NIRF Rank 59, NIRF Innovation Band of 11 to 50

SALEM - 636 011

DEPARTMENT OF COMPUTER SCIENCE

MASTER OF SCIENCE DEGREE

DATA SCIENCE

CHOICE BASED CREDIT SYSTEM (CBCS)

TANSCHE Based
OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2023-2024 and thereafter)

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.SC - Data Science**
Programme Code	CSC04
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.

	PO 9 Multicultural competence Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: 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. **PSO 5 – 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-V	5	3.1. Core-XII	4	4.1 Core -Project with Viva-Voce	12
1.2 Core-II	5	2.2 Core-VI	5	3.2 Core-XIII	4	4.2 Elective IV	2
1.3 Core - III	5	2.3 Core - VII	4	3.3 Core - XIV	4		
1.4Core - IV	4	2.4 Core VIII - Lab	2	3.4 Core Lab -XV	2		
1.5 Elective (Discipline Centric) - I	2	2.5 Core IX - Lab	2	3.5 Core Lab -XVI	2		
1.6 Elective (Discipline Centric) - II	4	2.6 Core –X Mini Project	2	3.6 Elective (Discipline Centric) -VI Lab	2		
1.7 Elective (Discipline Centric) - II - Lab	2	2.7 Elective (Discipline Centric) -IV Lab	2	3.7 Core Lab – XVII	2		
1.8 Elective III (Soft Skill Development Lab)	2	2.7 Elective (Generic Centric) V Fundamentals of Human Rights	1	3.8 NME-II	2		
		2.8 NME I	2	3.9 Internship/ Industrial Activity	2		
		2.9 Core XI Extension Activity	1				
	28		**26**		**24**		**14**
						Total Credit Points	**92**

CURRICULUM STRUCTURE FOR EACH SEMESTER
M.Sc. DATA SCIENCE (2023-2024)

SEMESTER - I

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC4C01	Core I	Fundamentals of Data Science	4	4
23UPCSC4C02	Core II	Mathematics for Data Science	5	5
23UPCSC4C03	Core III	Statistics - I	5	5
23UPCSC4C04	Core IV	Design of Algorithm	4	4
Discipline Centric Elective - I Lab	Elective I - Lab	Elective Course - Lab	2	3
Discipline Centric Elective - II	Elective II	Elective Course - Theory	4	4
Discipline Centric Elective - II Lab	Elective II - Lab	Elective Course - Lab	2	3
23UPCSC4S01	Elective III	Soft Skill Development Lab	2	2
		Total	**28**	**30**

SEMESTER - II

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC4C05	Core V	Machine Learning	5	5
23UPCSC4C06	Core VI	Statistics - II	5	5
23UPCSC4C07	Core VII	Data Visualization Techniques	4	5
23UPCSC4L01	Core VIII - Lab	Machine Learning - Lab	2	4
23UPCSC4L02	Core IX - Lab	Data Visualization Techniques - Lab	2	3
23UPCSC4P01	Core X	Professional Competency Skill - Mini Project	2	2
Discipline Centric Elective - IV Lab	Elective IV - Lab	Elective Course- Lab	2	3
Generic Elective -V 23UPPGC1H01	Elective V	Fundamentals of Human Rights	1	1

-	NME - I	Non-Major Elective - I (Online Course)	2	2
23UPCSC4X01	Core XI	Extension Activity	1	-
		Total	**26**	**30**

SEMESTER - III

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC4C08	Core XII	Deep Learning	4	4
23UPCSC4C09	Core XIII	Natural Language Processing	4	4
23UPCSC4C10	Core XIV	Computer Vision	4	4
23UPCSC4L03	Core XV - Lab	Deep Learning Lab	2	4
23UPCSC4L04	Core XVI - Lab	Computer Vision Lab	2	4
23UPCSC4L05	Core XVII	Professional Competency Skill - Lab	2	2
Discipline Centric Elective - VI Lab	Elective VI	Natural Language Processing Lab	2	4
-	NME-II	Non Major Elective - II	2	2
23UPCSC4I01	Core XVII	Internship / Industrial Activity (Carried out in Summer Vacation at the end of I year - 30 hours)	2	-
		Total	**24**	**28**

SEMESTER - IV

Course Code	Category	Course Name	Number of Credits	Hours per Week
23UPCSC4P02	Core XVIII	Project With Viva Voce	12	-
23UPCSC4I02	Elective – VI	Credit Seminar (Industry / Entrepreneurship)	2	2
		Total	**14**	**-**
		Total Credits	**92**	

LIST OF ELECTIVE COURSES

SEMESTER I

ELECTIVE I

23UPCSC4E01	-	Research Methodology for Computer Science
23UPCSC4E02	-	Internet of Things
23UPCSC4E03	-	Python Programming Lab

ELECTIVE II

23UPCSC4E04	-	Java Programming
23UPCSC4E05	-	Big Data Technologies
23UPCSC4E06	-	Data Structures & Algorithms

ELECTIVE II (LAB)

23UPCSC4E07	-	SQL Lab
23UPCSC4E08	-	Web Programming Lab

SEMESTER II

ELECTIVE III

23UPCSC4E09	-	Information Security and Ethics
23UPCSC4E10	-	Distributed Systems
23UPCSC4E11	-	Software Engineering for Data Science
23UPCSC4E12	-	Principles and Techniques of Data Science
23UPCSC4E13	-	R Programming Lab

ELECTIVE IV

23UPCSC4E14	-	Applied Probability
23UPCSC4E15	-	Optimisation Techniques
23UPCSC4E16	-	Discrete Mathematics

SEMESTER III

ELECTIVE V

23UPCSC4E17	-	Natural Language Processing Lab
23UPCSC4E18	-	Reinforcement Learning
23UPCSC4E19	-	Social Network Analysis

SEMESTER IV

ELECTIVE VI

23UPCSC4E20	-	Artificial Intelligence and Data Science
23UPCSC4E21	-	Image Recognition
23UPCSC4E22	-	Credit Seminar Industry/ Entrepreneurship

NON MAJOR ELECTIVE - II

23UPCSC1N01	-	Advanced Microsoft Office Lab
23UPCSC1N02	-	Biopython Programming Lab

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	
Remembering (K1)	• The lowest level of questions require students to recall information from the course content • Knowledge questions usually require students to identify information in the text book.
Understanding (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 at a together
Application (K3)	• Students have to solve problems by using/applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response.
Analyze (K4)	• Analyzing the question is one that asks the students to 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 character, 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/Computer Science/Computer Technology/Software Engineering/BCA/Mathematics/Statistics/Physics/Data Science/Data Analytics/Electronics/Electronics and Communications 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 thereto 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 years.

SCHEME OF EXAMINATION FOR EACH SEMESTER FOR M.SC DATA SCIENCE (2023-2024)

SEMESTER – I

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	CIA	ESE	Total	
23UPCSC4C01	Fundamentals of Data Science	4	4		25	75	100	3
23UPCSC4C02	Mathematics for Data Science	5	5		25	75	100	3
23UPCSC4C03	Statistics - I	5	5		25	75	100	3
23UPCSC4C04	Design of Algorithm	4	4		25	75	100	3
Discipline Centric Elective –I Lab	Elective Course - Lab	2		3	40	60	100	3
Discipline Centric Elective – II	Elective Course - Theory	4	4		25	75	100	3
Discipline Centric Elective - II Lab	Elective Course - Lab	2		3	40	60	100	3
23UPCSC4S01	Soft Skill Development Lab	2		2	100	-	100	3
	Total	**28**	**22**	**8**	**305**	**495**	**800**	

SEMESTER – II

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	CIA	ESE	Total	
23UPCSC4C05	Machine Learning	5	5		25	75	100	3
23UPCSC4C06	Statistics - II	5	5		25	75	100	3
23UPCSC4C07	Data Visualization Techniques	4	5		25	75	100	3
23UPCSC4L01	Machine Learning - Lab	2		4	40	60	100	3
23UPCSC4L02	Data Visualization Techniques - Lab	2		3	40	60	100	3

23UPCSC4P01	Professional Competency Skill - Mini Project	2		2	40	60	100	3
Discipline Centric Elective - IV Lab	Elective Course - Lab	2		3	40	60	100	3
Generic Elective -V 23UPPGC1H01	Fundamentals of Human Rights	1	1		25	75	100	3
NME - I	Non-Major Elective – I (Online Course)	2	2				100	3
23UPCSC4X01	Extension Activity	1	-		100		100	3
	Total	**26**	**18**	**12**	**365**	**545**	**1000**	

SEMESTER – III

Course Code	**Course Name**	**Credits**	**Hours**		**Marks**			**Examination Duration**
			T	P	CIA	ESE	Total	
23UPCSC4C08	Deep Learning	4	4		25	75	100	3
23UPCSC4C09	Natural Language Processing	4	4		25	75	100	3
23UPCSC4C10	Computer Vision	4	4		25	75	100	3
23UPCSC4L03	Deep Learning Lab	2		4	40	60	100	3
23UPCSC4L04	Computer Vision Lab	2		4	40	60	100	3
23UPCSC4S02	Professional Competency Skill - Lab	2		2	100		100	3
Discipline Centric Elective - VI Lab	Natural Language Processing Lab	2		4	40	60	100	3
NME - II	Non Major Elective - II	2	2		25	75	100	3
23UPCSC4I01	Internship / Industrial Activity	2	-		100		100	3
	Total	**24**	**14**	**14**	**420**	**480**	**900**	

SEMESTER – IV

Course Code	Course Name	Credits	Hours		Marks			Examination Duration
			T	P	CIA	ESE	Total	
23UPCSC4P02	Project With Viva Voce	12	-		50	150	200	3
23UPCSC4I02	Credit Seminar (Industry / Entrepreneurship)	2	2		100		100	3
Total		**14**	**2**		**150**	**150**	**300**	

ACTUAL DISTRIBUTION OF CREDITS

Type of Courses	Component	No. of Courses	Credits	Total Credits
Core	Theory Courses	4	5	20
	Theory Courses	6	4	24
	Lab Courses	6	2	12
	Major Project	1	12	12
Elective	Discipline Centric – Theory Courses	1	4	4
	Discipline Centric – Lab Courses	3	2	6
	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
	Industry / Entrepreneurship	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	**92**

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	18	18
Core - Lab	4	4
Discipline Centric Elective - Lab	4	6
Generic Elective - Lab	2	2
Total	**28**	**30**

SEMESTER – II

List of Courses	Credits	No. of Hours
Core - Theory	14	15
Core - Lab	7	9
Discipline Centric Elective – Lab	2	3
NME - I	2	2
Generic Elective- Theory	1	1
Total	**26**	**30**

SEMESTER – III

List of Courses	Credits	No. of Hours
Core - Theory	12	12
Core - Lab	8	10
Discipline Centric Elective – Lab	2	4
NME - II	2	2
Total	**24**	**28**

SEMESTER – IV

List of Courses	Credits	No. of Hours
Core - Lab	12	-
Centric Elective	2	4
Total	**14**	**4**
Overall Credit	**92**	

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	:	5Marks
Seminar	:	5Marks
Assignment	:	5Marks
Attendance	:	5Marks

Total	:	25Marks

***** No Internal Minimum**

EVALUATION OF END SEMESTER EXAMINATIONS

QUESTION PAPER PATTERN (THEORY)

Section	Approaches	Mark Pattern	K Level	C 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 COURSESPRACTICAL \ MINIPROJECTEXAMINATION

EVALUATION OF INTERNAL ASSESSMENT

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

Total	:	40 Marks

***** No Internal Minimum**

QUESTIONPAPERPATTERN

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) <u>Practical/Mini Project</u>

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

(ii) <u>Industrial Training</u>

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

  (Internal Examiner 30 and External Examiner 30)

(iii) <u>Dissertation</u>

- Internal Assessment - 50
- Report Evaluation by External Examiner - 50
- 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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">FUNDAMENTALS OF DATA SCIENCE</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>23UPCSC4C01</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : Understand the types of data and analytics, data science process, and its life cycle.
CO 2 : Apply math in data science
CO 3 : Analyze the various data intensive operations and tools
CO 4 : Evaluate the tools and methods for analyzing the data
CO 5 : Investigate the recent potential applications and development of data science with real time case studies</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNITI :INTRODUCTION OF DATA SCIENCE

Data Science - Data Science Venn diagram - Basic terminology - Data science case studies - Types of data - levels of data - Types of data analytics - Descriptive analytics - Diagnostic analytics - Predictive analytics - Prescriptive analytics - Five steps of Data science
Book 1 - Chapter 1,2,3</td></tr>
<tr><td colspan="6">UNITII :MATHEMATICAL PRELIMINARIES

2.1 Basic Maths - Mathematics as discipline - Basic symbols and terminology - Linear algebra
2.2 Basic Probability - Definitions - Probability - Bayesian vs frequentist - Compound events - Conditional probability - rules of probability
Book 1: Unit 2.1 – Chapter 4, Unit 2.2 – Chapter 5</td></tr>
<tr><td colspan="6">UNITIII :DATA MINING AND DATA WAREHOUSING

Introduction to Data warehousing - Design consideration of data warehouse - Data loading process - case study - Data mining - Data mining techniques - Tools and platforms - case study
Book 2 – Chapter 3 and 4</td></tr>
<tr><td colspan="6">UNITIV :VISUALIZING DATA

Exploratory Data Analysis - Developing the visual aesthetic - chart types - Great visualizations - Reading graphs - Interactive visualizations
Book 3 - Chapter 6</td></tr>
</table>

	UNITV:DATA SCIENCE - RECENT TRENDS Applications of Data Science, recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.
Recommended Text	1. Ozdemir, Sinan. Principles of data science. Packt Publishing Ltd, 2016.(Unit 1- Chapter 1,2,3 Unit 2.1 - Chapter 4, Unit 2.2 - Chapter 5) 2. Maheshwari, Anil. "Data analytics made accessible." Seattle: Amazon Digital Services, 2nd edition (2023). (Unit 3 - Chapter 3 and 4) 3. Skiena, Steven S. The data science design manual. Springer, 2017.(Unit 4- chapter 6)
Reference Books	1. Hadrien Jean. Education, C. (2023). Data Science. Certybox Education. 2. Pierson, Lillian. Data science for dummies. John Wiley & Sons, 2021. 3. Grus, Joel. Data science from scratch: first principles with python. O'Reilly Media, 2019. 4. Blum, Avrim, John Hopcroft, and Ravindran Kannan. Foundations of data science. Cambridge University Press, 2020.

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	H
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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MATHEMATICS FOR DATA SCIENCE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4C02</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra, probability, and calculus.
CO2 : Employ methods related to these concepts in a variety of data science applications.
CO3 : Analyse and evaluate the accuracy of common numerical methods.
CO4 : Apply numerical methods to obtain approximate solutions to mathematical problems.
CO5 : Apply Numerical analysis which has enormous application in the field of Data Science.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT I: LINEAR EQUATIONS

Systems of linear equations - Matrix notation - Solving a linear system - Row reduction and Echelon forms - Pivot positions - Row reduction algorithm - Solutions of linear system - Vector equations - vectors in R-Geometric descriptions of R-Algebraic properties of R-Linear combinations The matrix equation Ax=b, Computation of Ax- Linear independence of matrix columns</td></tr>
<tr><td colspan="6">UNIT II: VECTOR SPACES, ORTHOGONALLY AND LEAST SQUARES

Vector spaces – Axioms - A subspace spanned by a set - The dimension of a vector space change of basis - Orthogonal projections - Least square problems - Solution of general least square problems - Application of linear models - Least square lines - The general linear model</td></tr>
<tr><td colspan="6">UNIT III : DETERMINANTS AND MATRIX ALGEBRA

Introduction to Determinants - Properties of determinants - Row operations - Column operations - Determinants and matrix products - A linearity property of the determinant function - Cramer's Rule - an inverse formula - Matrix operations - sums and scalar multiples Properties of matrix multiplication - Powers of matrix - Inverse of a matrix</td></tr>
</table>

	UNIT IV : EIGENVALUES AND EIGENVECTORS, SYMMETRIC MATRICES Eigenvectors and difference equations - Positive definite matrices - Eigenvectors and Linear Transformations - Matrix of linear transformation - Linear transformation from V into V diagonal matrix representation - similarity of matrix representation - singular Value Decomposition - Hessian matrix
	UNIT V: NUMERICAL ANALYSIS Iterative method - Taylor Series - Cauchy method - Newton Raphson Method.
Recommended Text	1.David C. Lay, Steven R. Lay, Judi J. McDonald, Linear Algebra and Its Applications, Pearson publication,5th edition, 2018 2. Devi Prasad An introduction to numerical analysis Narosa publishing house
Reference Books	[1] Sheldon Axler, Linear Algebra Done Right (Undergraduate Texts in Mathematics) 3rd ed., Springer, 2015 Edition [2] Jim Hefferon, Linear Algebra, Fourth edition [3] Jeff M Philips, Mathematical Foundations for Data Analysis

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">STATISTICS - I</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>23UPCSC4C03</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to

CO1 : Organize, manage, and present data.
CO2 : Understand, describe, and calculate the measures of data and correlation.
CO3 : Recognize and understand various probability distribution functions, calculate, and interpret expected results.
CO4 : Apply the methods of estimating a parameter.
CO5 : Understand the concept of probability and apply for simple events.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNITI: INTRODUCTION TO STATISTICS

Introduction - Data Collection and Descriptive Statistics - Inferential Statistics, Populations and Samples - A Brief History of Statistics
Organization and Presentation of Data
Origin and development of Statistics, Scope, limitation and misuse of statistics. Types of data: primary, secondary, quantitative, and qualitative data. Types of Measurements: nominal, ordinal, discrete, and continuous data. Presentation of data by tables: construction of frequency distributions for discrete and continuous data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions</td></tr>
<tr><td colspan="6">UNIT II : DESCRIPTIVE STATISTICS

Introduction - Describing Data Sets - Frequency Tables and Graphs - Relative Frequency Tables and Graphs - Grouped Data, Histograms, Ogives, and Stem and Leaf Plots - Summarizing Data Sets - Sample Mean, Sample Median, and Sample Mode - Quartile deviation, Sample Variance and Sample Standard Deviation.</td></tr>
<tr><td colspan="6">UNIT III : RANDOM VARIABLES AND EXPECTATION

Scatter diagram - Karl Pearson's coefficient of correlation - concurrent deviation method - coefficient of determination - Spearman's Rank correlation - Linear regression - fitting of regression lines.</td></tr>
</table>

	UNIT IV : DISTRIBUTIONS OF SAMPLING STATISTICS Random Variables - Types of Random Variables - Jointly Distributed Random Variables - Independent Random Variables - Conditional Distributions - Expectation - Properties of the Expected Value - Expected Value of Sums of Random Variables - Variance - Covariance and Variance of Sums of Random Variables - Moment Generating Functions - Chebyshev's Inequality and the Weak Law of Large Numbers (concept only). The Bernoulli and Binomial Random Variables - Computing the Binomial Distribution Function - The Poisson Random Variable - Computing the Poisson Distribution
	UNIT V : BASICS AND ELEMENTS OF PROBABILITY Random experiment, sample point, sample space, event, algebra of events. Definition of Probability: classical, empirical, and axiomatic approaches to probability, properties of probability. Theorems on probability, conditional probability and independent events, Laws of total probability, Baye's theorem and its applications – Introduction - Sample Space and Events - Venn Diagrams and the Algebra of Events - Axioms of Probability - Sample Spaces
Recommended Text	[1] Sheldon M. Ross, Introduction to Probability and Statistics for Engineers And Scientists, Elsevier Academic Press, UK, Fifth Edition, 2023 [2]. Rohatgi V.K and Saleh E, An Introduction to Probability and Statistics, 3rd edition, John Wiley & Sons Inc., New Jersey, 2015. [3]. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons, New Delhi, 2014.
Reference Books	Jim Frost, Introduction to Statistics: An Intuitive Guide for Analysing Data and Unlocking Discoveries

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DESIGN OF ALGORITHMS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4C04</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1: Recall the components of a computer, demonstrate the appropriate use of data types, mathematical functions and strings in a program
CO2: State the use of selection and looping constructs, compare and choose an appropriate construct for a given problem
CO3: Define Functions, Classes and Objects, defend the use of functions, classes and objects in a given problem
CO4: Define Strings and Lists, implement Lists and Strings appropriately, design new problems using appropriate data structures
CO5: Define Tuples, sets, dictionaries and files, compare programs with and without files, develop applications using the different data structures</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT I
Introduction: Algorithm, Pseudo code 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</td></tr>
<tr><td colspan="6">UNITII
General Sorting method Bubble, Selection, Insertion, Divide and conquer - Merge & Quick sort, applications - Binary search, Quick sort, Merge sort, Linear Search</td></tr>
<tr><td colspan="6">UNITIII

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</td></tr>
</table>

	UNITIV 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
	UNITV Backtracking The General Method - The 8-Queens Problem - Sum of Subsets - Graph Colouring- Hamiltonian Cycles - Knapsack Problem Branch and Bound: Least Cost searched
Recommended Text	1. Y. Daniel Lang, Introduction to Programming using Python, 2nd Edition, Pearson Education Inc., 2013.
Reference Books	1. Allen B. Downey. Think Python. How to Think Like a Computer Scientist, 2ndedition, O'Reilly Publishers, 2016. 2. Corey Wade, et al : The Python Workshop, 2nd Edition, Packt, 2022. 3. David Beazley, Brian K. Jones. Python Cookbook: Recipes for Mastering Python 3, 3rd Edition, 2013 Harsh Bhasin. Python for Beginners. New Age International Publishers,2018. 4. Martin C. Brown. Python: The Complete Reference. McGraw Hill Education; Fourth edition, 2018.

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	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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">SOFT SKILL DEVELOPMENT LAB</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCSC4S01</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">● To enable students to gain basic communication skills in professional and social contexts effectively.
● To acquire useful words and apply them in situational context.
● To develop listening and reading skills through comprehension passages
● To enrich the leadership qualities and interpersonal communication
● To enhance essential characteristics in writing</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>

1. Characteristics of Technical Writing

2. Development of Employability Skills

3. Vocabulary Development

4. Sentence Completion

5. Error Spotting

6. Interpretation of Verbal Analogy

7. Interpretation of Reading (Comprehension -Conception)

8. Interpretation of Reading (Comprehension -Reasoning)

9. Practice for writing E-mails/Technical Blogs/Forums

10. PPT Preparation / Demonstration of Technical Presentation

11. Preparation of Resume

12. Preparation for Job Interviews / Mock Interview Section

13. Group Discussion Skills

14. Developing Listening Skill(Comprehension)

15. Practice for Short Speeches / Situational Conversation

16. English through Mass Media</td></tr>
</table>

	17. Essential Grammar 18. Communicating and collaborating with peer members 19. Team Empowerment 20. Persuasive Communication
TEXT BOOKS	1. Uma Narula, "Development Communication: Theory and Practice", Revised Edition, Har-Aanad Publication, 2019. 2. Annette Capel and Wendy Sharp, "Cambridge English: Objective First", Fourth Edition, Cambridge University Press, 2013. 3. Emma Sue-Prince, "The Advantage: The 7 Soft Skills You Need to Stay One Step Ahead", First Edition, FT Press, 2013. 4. Guy Brook-Hart, "Cambridge English: Business Benchmark", Second Edition, Cambridge University Press, 2014. 5. Norman Lewis, "How to Read Better & Faster", Binny Publishing House, New Delhi, 1978.

COURSE OUTCOMES

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

CO1:	To gain basic professional communication skills and social contexts effectively.	K1-K6
CO2:	To acquire useful words and apply them in situational context.	
CO3:	To develop listening and reading skills through comprehension passages	
CO4:	To enrich the leadership qualities and interpersonal communication	
CO5:	To enhance essential characteristics in writing	

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	L	M	H	L	L	L	H
CO2	H	M	H	H	H	M	L	L	L	M
CO3	H	H	H	H	H	H	L	L	L	H
CO4	H	M	M	H	M	L	L	L	L	L
CO5	H	H	M	L	H	M	L	L	L	M

H- High; M-Medium; L-Low

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">MACHINE LEARNING</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>23UPCSC4C05</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the different types, steps and algorithms involved in Machine Learning Process</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">CO1 : Apply machine learning concepts in real life problems.
CO2 : To Implement and analyze existing learning algorithms, including well-studied methods for classification, regression, clustering.
CO3 : To Identify machine learning techniques suitable for a given problem.
CO4 : To Design applications using machine learning techniques.
CO5 : To Solve the problems using various machine learning techniques</td></tr>
<tr><td colspan="2"></td><td colspan="6">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-Nearest Neighbors - Tree based Methods - Decision Trees - 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 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</td></tr>
</table>

	Perceptron - Feed Forward Network - Back Propagation - Activation and Loss Functions - Limitations of Machine Learning - Deep Learning - Convolution Neural Networks - Recurrent Neural Networks - Use cases.
Recommended Text	1. Tom M. Mitchell, "Machine Learning", McGraw Hill,U.K, 2017. 2. Shalev-Shwartz, Shai, and Shai Ben-David. Understanding machine learning: From theory to algorithms. Cambridge university press, 2014.
Reference Books	1.Saleh, Hyatt. Machine Learning Fundamentals: Use Python and scikit learn to get up and running with the hottest developments in machine learning. Packt Publishing Ltd, 2018.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">STATISTICS – II</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>23UPCSC4C06</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop knowledge and understand fundamental concepts in probability and statistics</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to

CO1 : Identify the four steps of hypothesis testing.
CO2 : Gain a thorough understanding of applied principles of statistics.
CO3 : To develop knowledge and skills in theoretical, computational, and application-oriented statistics.
CO4 : Apply the methods of analysis of variance.
CO5 : Understand and apply the concept of non-parametric tests.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNIT I

Population and Statistics - Finite and Infinite population - Parameter and Statistics - Types of sampling - Sampling Distribution - Sampling Error - Standard Error - Test of significance - concept of hypothesis - types of hypotheses - Errors in hypothesis - testing - Critical region - level of significance - Power of the test - p-value.</td></tr>
<tr><td colspan="6">UNIT II

Sampling distributions: Large sample test - Test for equality of mean and proportions - Small sample tests - Student‟s t test, Snedecor‟s F test, Chi- square test for independence of attributes - contingency table.</td></tr>
<tr><td colspan="6">UNIT III

Least Squares Estimators of the Regression Parameters -Distribution of the Estimators - The Coefficient of Determination and the Sample Correlation Coefficient - Analysis of Residuals: Assessing the Model - Transforming to Linearity - Weighted Least squares - Multiple Linear Regression – Logistic Regression</td></tr>
<tr><td colspan="6">UNIT IV

One-Way Analysis of Variance - Multiple Comparisons of Sample Means - Two-Way Analysis of Variance -Principles of experimental designs - CRD, RBD, LSD (concepts only).</td></tr>
</table>

	UNIT V The Sign Test - The Signed Rank Test - The Two-Sample Problem - The Classical Approximation and Simulation - Wilcoxon Signed Rank Test for one and paired samples - The Runs Test for Randomness - Median test and Mann – Whitney - Wilcoxon tests for two samples.
Recommended Text	[1] Sheldon M. Ross, Introduction to Probability and Statistics for Engineers And Scientists, Elsevier Academic Press, UK, Fifth Edition, 2023 [2] Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 12th edition, Sultan Chand & Sons, New Delhi, 2020. [3] Brian Caffo, Statistical Inference for Data Science, Learnpub, 2016.
Reference Books	[1] Allen B. Downey,Think Stats- Exploratory data analysis, O'reilly, 2nd Edition [2] Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Publications, Tenth Edition [3] Jim Frost, Introduction to Statistics: An Intuitive Guide for Analyzing Data and Unlocking Discoveries

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DATA VISUALIZATION TECHNIQUES</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4C07</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">An understanding of the key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to

CO1 : To demonstrate proficiency with statistical analysis of data.
CO2 : To introduce the tools required to manage and analyze the elements of data visualization.
CO3 : Apply visual design principles to simple and complex models that tell the stories found in data.
CO4 : To understand how to work with data for real life.
CO5 : To apply mathematical and statistical models and concepts to detect patterns in data, as well as draw inferences and conclusions supported by the data</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNIT I

Introduction: The case for data visualization and storytelling, Data visualization and storytelling details and best practices, Introduction to Tableau, PowerBI Importing Data / Connecting to External Sources Interface Overview Creating Sheets and Dashboard (software Demo)</td></tr>
<tr><td colspan="6">UNIT II

Elements of Data Visualization: Measures & Dimension concepts,
Design Fundamentals Design Principles, Colors, and “Chart Junk” Design perspectives from the experts The Shaffer 4 C’s of Data Visualization Not-so-best practices (examples) Critique and redesign, Creating a good data set for analysis Data modeling fundamentals for analytics Selecting data for your KPIs</td></tr>
<tr><td colspan="6">UNIT III

Story telling with Data: Depth Design Fundamentals of Data Visualization, What are the main approaches to storytelling with data? - Dashboards vs. Storyboards vs. Info graphics - Designing with the user in mind The Duell Rules for Actionable Visualizations, Basic Charting Techniques (Hands-on Session)</td></tr>
</table>

	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 Geo coding 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
Recommended Text	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-aglance monitoring. Vol. 5. Burlingame, CA: Analytics Press, Second Edition, 2013.
Reference Books	1. Hamilton, Max. "The visual display of quantitative information. Edward R. Tufte. 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 Cotgreave. The big book of dashboards: visualizing your data using real-world business scenarios. John Wiley & Sons, First Edition, 2017.

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

Title of the Course		MACHINE LEARNING LAB					
Category	Core	**Year**	I	**Credits**	2	**Course Code**	**23UPCSC4L01**
		Semester	II				
Objectives of the Course		To preprocess the data and build ML models using appropriate techniques and evaluate the model					
Learning Outcome		CO1: Apply pandas, NumPy and Matplotlib to read in , process and visualise data, implement linear classification algorithms CO2: Compare classifiers with linear and non-linear decision boundaries, select relevant features for the model construction CO3: Apply data compression and best practices for model evaluation and hyper parameter tuning CO4 : Understand about cluster formation using different models CO5: Compare various dimensionality reduction techniques					
EXERCISES		**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					

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DATA VISUALIZATION TECHNIQUES LAB</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4L02</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Understand the importance of data visualization for business intelligence and decision making.</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : Construct effective data visuals to solve workplace problems
CO2 : Explore and work with different plotting libraries
CO3 : Learn and create effective visualizations
CO4 : Creation of different dashboard
CO5 : Data Aggregation and Statistical Function in Tableau</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>
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</td></tr>
</table>

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

Title of the Course		PROFESSIONAL COMPETENCY SKILL / MINI PROJECT					
Category	Core	**Year**	I	**Credits**	2	**Course Code**	**23UPCSC4P01**
		Semester	II				

Title of the Course		EXTENSION ACTIVITY					
Category	Core	**Year**	I	**Credits**	1	**Course Code**	**23UPCSC4X01**
		Semester	II				

23UPPGC1H01 - FUNDAMENTALS OF HUMAN RIGHTS

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 HIVAIDS - 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.

REFERENCES

1. Sudarshanam Gankidi, Human Rights in India: Prospective and Retrospective, Rawat Publications, Jaipur, 2019.
2. Satvinder Juss, Human Rights in India, Routledge, New Delhi, 2020.
3. Namita Gupta, Social Justice and Human Rights in India, Rawat Publications, Jaipur, 2021.
4. Mark Frezo, The Sociology of Human Rights, John Willy & Sons, U.K. 2014.
5. Chiranjivi J. Nirmal, Human Rights in India: Historical, Social and Political Perspectives, Oxford University Press, New York, 2000.
6. Dr. S. Mehartaj Begum, Human Rights in India: Issues and perspectives, APH Publishing Corporation, New Delhi, 2010.
7. Asha Kiran, The History of Human Rights, Mangalam Publications, Delhi, 2011.
8. Bani Borgohain, Human Rights, Kanishka Publishers & Distributors, New Delhi-2, 2007.
9. Jayant Chudhary, A Textbook of Human Rights, Wisdom Press, New Delhi, 2011.

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DEEP LEARNING</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4C08</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To improve the performance of a Deep Learning model the goal is to the reduce the optimization function which could be divided based on the classification and the regression problems</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : To know the main techniques in deep learning and the main research in this field.
CO2 : Evaluate Boltzmann Machines and their types.
CO3 : To understand the fundamentals and different types of RNN models.
CO4 : Demonstrate an understanding of relations and functions of CNN models.
CO5 : Be able to identify new application requirements.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">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.</td></tr>
<tr><td colspan="6">UNIT II
Restricted Boltzmann Machines: Introduction - Hopfield Networks - Boltzmann Machine - Restricted Boltzmann Machines - Applications of Restricted Boltzmann Machines.</td></tr>
<tr><td colspan="6">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</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

	UNIT V Autoencoder: Under complete Auto encoders - Regularized Autoencoders - Representational Power, Layer Size and Depth – Stochastic Encoders and Decoders - Denoising Autoencoders - Learning Manifolds with Autoencoders - Contractive Autoencoders - Predictive Sparse Decomposition Applications of Autoencoders
Recommended Text	1. "Neural Networks and Deep Learning" Charu C. Aggarwal Springer, 2018. 2. "Deep Learning (Adaptive Computation and Machine Learning series)"Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
Reference Books	1. Deep Learning with Python by Francois Chollet, Manning Publications, December 2017. 2. Online Resources: Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NATURAL LANGUAGE PROCESSING</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4C09</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">An understanding of the key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : A language that motivates and creates change - presuppositions.
CO2 : To assist other people in an NLP based coaching relationship.
CO3 : Break out of unhelpful habits and generate the change you want.
CO4 : To understand how the mind works and the psychology of mind and behaviour.
CO5 : Enhance your mental wellbeing, overall assertiveness, and resilience. Understand the principal motivations behind human performance</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">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 Backoff - 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.</td></tr>
</table>

	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, WordNet, PropBank, Frame Net, Brown Corpus, British National Corpus (BNC).
Recommended Text	1. Elhadad, M. (2010). Book Review: Natural Language Processing with Python by Steven Bird, Ewan Klein, and Edward Loper. Computational Linguistics. 2. Bender, E. M. (2013). Linguistic fundamentals for natural language processing: essentials from morphology and syntax. Synthesis lectures on human language technologies.
Reference Books	1.Hapke, H. M., Lane, H., & Howard, C. (2019). Natural language processing inaction

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">COMPUTER VISION</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4C10</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">An understanding of the key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : To demonstrate proficiency with statistical analysis of data.
CO2 : To introduce the tools required to manage and analyze the elements of data visualization.
CO3 : Apply visual design principles to simple and complex models that tell the stories found in data.
CO4 : To understand how to work with data for real life.
CO5 : To apply mathematical and statistical models and concepts to detect patterns in data, as well as draw inferences and conclusions supported by the data</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">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 – SIFTHOG - Texture.</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td colspan="6">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</td></tr>
</table>

	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 Architectures for FR inVS - Performance Evaluation. 3D Data Processing: Introduction – Circle Convolutional RBM (CCRBM) - Object Instance Search: Introduction – Compact Invariant Deep Descriptors
Recommended Text	1. "COMPUTER VISION A MODERN APPROACH" by David A. Forsyth, Jean Ponce, Second Edition, Pearson publication, 2012.(Unit-I,II,III) 2. "Deep Learning in Object Detection and Recognition" by Editors Xiaoyue Jiang, Abdenour Hadid, Yanwei Pang, Eric Granger, Xiaoyi Feng, Springer,2019.(Unit- IV,V)
Reference Books	1.Hands-On Computer Vision with Tensor Flow 2: Leverage Deep Learning to Create Powerful Image Processing Apps with TensorFlow 2.0 and Keras by Benjamin Planche and Eliot Andres.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DEEP LEARNING LAB</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCSC4L03</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To be able to apply appropriately the python programming knowledge gained and develop computer-based solutions for a given problem</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO 1: To understand DL Frameworks
CO 2 : To Understand the working of CNN model
CO 3: To explore on LSTM
CO 4 : To Understand the working of CNN model
CO 5: To Understand on Anomaly Detection</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>
1. Introduction to DL and Framework
2. Feed Forward Network on sample dataset
3. Multi-layer perceptron (MLP) on Realtime 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 Autoencoders.</td></tr>
</table>

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

Title of the Course		COMPUTER VISION LAB					
Category	Core	**Year**	II	**Credits**	2	**Course Code**	**23UPCSC4L04**
		Semester	III				
Learning Outcome		Students will be able to CO 1 : To understand and write simple CV programs CO 2 : To Understand the concepts image transformation using CV CO 3 : To explore different application of image using CV CO 4 : To Understand the concepts image compression techniques CO 5 : To Understand the concepts of Dimensionality reduction in images Using CV					
EXERCISES		**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. Colour fundamentals 10. Clustering and classification 11. Dimensional reduction and sparse representation 12. Evaluating the learning models					

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PROFESSIONAL COMPETENCY SKILL LAB</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4L05</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">CO1 : Effectively communicate through verbal/oral communication and improve the listening skills.
CO2 : Write precise briefs or reports and technical documents.
CO3 : Actively participate in group discussion / meetings / interviews and prepare & deliver presentations.
CO4 : Become more effective individual through goal/target setting, self-motivation and practicing creative thinking.
CO5 : Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of teamwork, Inter-personal relationships, conflict management and leadership quality.</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>
1.Personality: Meaning, Personality Determinants, Traits, Personality types and its, impact on career growth,
2. Individual/ Organizational Decision Making.
3.Attitude: Meaning, Components of Attitude, changing attitude and its impact on career growth
4. Perception and Values.
5. Motivation and Leadership: Concept, Importance.
6. Goal setting: SMART (Specific, Measurable, Attainable, Realistic, Timely) Goals, personal and professional goals
7. Time and Self-Management.
8. Learning in a group, Understanding Work Teams, Dynamics of Group Behaviour, Techniques for effective participation
9. Etiquette- General & Business Etiquette, Body language
10.Emotional intelligence of self and SWOC
11. Threats v/s Challenges</td></tr>
</table>

	12. Dos and Don'ts of a presentation/meeting Online &offline. (presenter &members) 13. Effective Public Speaking 14. Group Discussions 15. Interview Techniques: Interview Techniques, Pre-Interview Preparation, Conduct during Interview, Verbal and Non-Verbal Communication, Common Mistakes. Preparation of CV.Practical (Role Plays, Mock Interviews, Telephonic Interviews, Body Language, Facial Expression)

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

Title of the Course		Internship / Industrial Activity					
Category	Core	**Year**	II	**Credits**	02	**Course Code**	**23UPCSC4I01**
		Semester	III				

Title of the Course		PROJECT WITH VIVA VOCE					
Category	Core	**Year**	II	**Credits**	12	**Course Code**	**23UPCSC4P02**
		Semester	IV				

Title of the Course		CREDIT SEMINAR / (INDUSTRY/ENTREPRENEURSHIP)					
Category	Elective	**Year**	II	**Credits**	2	**Course Code**	**23UPCSC4I02**
		Semester	IV				

LIST OF ELECTIVES

ELECTIVE I

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">RESEARCH METHODOLOGY FOR COMPUTER SCIENCE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop an understanding of the research methods relevant to effectively address a research problem</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNITI

1.1 INTRODUCTION TO RESEARCH

Meaning, Objectives and Characteristics of research - Research Methods Vs. Methodology - Types of research- Research process - Criteria of good research

1.2 RESEARCH PROJECT
Shaping a Research Project-Research Planning-Students and Advisors - Checklist</td></tr>
<tr><td colspan="6">UNITII

2.1 LITERATURE REVIEW
Reading and Reviewing - Hypotheses, Questions, and Evidence</td></tr>
<tr><td colspan="6">UNITIII

3.1 EXPERIMENTS FOR COMPUTING

Experimentation-Statistical Principles

3.2 WRITING A PAPER

Organization-Good Style-Style Specifics - Punctuation -Mathematics - Algorithms- Graphs, Figures, and Tables -Other Professional Writing</td></tr>
<tr><td colspan="6">UNITIV

4.1 Presentation

Editing - Presentations - Slides – Posters-Ethics</td></tr>
</table>

	UNITV **5.1 REPORT WRITING** Report writing using LATEX for research problem.
Recommended Text	[1] Kothari C. R. Research Methodology Methods and Techniques. 2nd ed. New Delhi: New Age, 2004. (Unit 1.1) [2] Justin Zobel. Writing for Computer Science.3rd ed. Springer-Verlag,2014
Reference Books	[1] Ranjit Kumar. Research Methodology -a step-by-step guide for beginners. 3rd ed. SAGE Publications India Pvt Ltd, 2011. [2] Panneerselvam R. Research Methodology. 2nd ed. New Delhi: Prentice Hall, 2014.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO1 : Develop an understanding of research methods

CO2 : Formulate a research problem

CO3 : Collect and analyse data

CO4 : Effectively write a research paper

CO5 : Present the Paper more professionally.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">INTERNET OF THINGS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E02</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the concepts, data, framework, standards, protocols, reliability, security, and privacy involved in IOT</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI

IoT ECOSYSTEM CONCEPTS AND ARCHITECTURES
Introduction - IoT definition and evolution - IoT Architectures - OpenIoT Architecture for IoT/Cloud Convergence - Resource Management - IoT Data Management and Analytics - Communication Protocols - Internet of Things applications-Scheduling Process and IoT Services Lifecycle - IoT enabling technologies - IoT levels and Deployments templates - Introduction to M2M - Difference between IoT and M2M - SDN and NFV for IoT</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITII

IOT DATA AND FRAMEWORK ESSENTIALS
Introduction - Programming framework for IoT - The foundation of Stream processing in IoT - Continuous Logic processing system - Challenges and Future directions - Anomaly detection - Problem statement and definitions - Efficient incremental local modelling - IoT Governance.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIII

RF PROTOCOLS RFID, NFC;IEEE 802.15.4:
ZigBee - ZWAVE, THREAD - Bluetooth Low Energy (BLE) - IPv6 for Low Power and Lossy Networks (6LoWPAN) - Routing Protocol for Low power and lossy networks (RPL) - CoAP - XMPP - Web Socket-AMQP - MQTT - WebRTC - PuSH Architectural Considerations in Smart Object Networking - TinyTO Protocol. 3.2 Introduction to IoT based applications - Scenarios - Architecture overview - Sensors - The gateway - Data Transmission - Internet of Vehicles (IoV) -IoV Characteristics, technologies and its application.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIV

DEVELOPING INTERNET OF THINGS
Introduction - IoT Design Methodology - Case study on IoT system for Weather monitoring - IoT Device - IoT physical devices and endpoints - Exemplary Device: Raspberry Pi - Linux on Raspberry Pi - Raspberry Pi interfaces - Programming Raspberry Pi and with python - Other IoT devices.</td></tr>
</table>

	UNITV **IoT RELIABILITY, SECURITY AND PRIVACY** Introduction - Concepts - IoT Security Overview - Security Frameworks for IoT - Privacy in IoT networks -IoT characteristics and reliability issues - Addressing reliability
Recommended Text	1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands -on Approach", 1st Edition 2015, University Press, ISBN: 978-81-7371-954-7 2. Buyya, Rajkumar, and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier, 2016. 3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.
Reference Books	1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978- 3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer 2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014. 3. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI

COURSE OUTCOMES

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

CO1 : To describe the concepts of IoT
CO2 : To describe the essentials IOT data and framework
CO3 : To discuss IOT protocols
CO4 : To design a basic IOT system
CO5 : To examine the reliability, security and privacy of an IOT system

MAPPING WITH PROGRAMME OUTCOMES

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

H- High; M-Medium; L-Low

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PYTHON PROGRAMMING LAB</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E03</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To be able to apply appropriately the python programming knowledge gained and develop computer based solutions for a given problem</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO 1: To understand and write simple Python programs
CO 2: To Understand the OOPS concepts of Python
CO 3: To explore different Libraries in python
CO 4 : To understand the working of Sklearn Preprocessing
CO 5 : To learn about GUI using python</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>
1. Introduction to Python, How to Use Shell, Spyder and Jupyter Notebook
2. Values, Data Types, Operators & Function Calls
3. Type Casting, Statements and Expressions
4. Input & Output Functions, Pythonic Functions, Exception Handling
5. Python OOPS Basic
6. Python OOPS Advance
7. Python GUI Development
8. Python Module: OS, Numpy
9. Python Module: Pandas
10. Python Module: Matplotlib and Seaborn
11. Python Module: Scipy
12. Python Module: Sklearn Pre-processing and Imputation</td></tr>
</table>

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

ELECTIVE II

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">JAVA PROGRAMMING</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E04</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I

1.1 INTRODUCTION TO JAVA

Overview - Features - Fundamental OOPS concepts - JDK - JRE - JVM -Structure of a Java program - Data types - Variables - Arrays - Operators - Keywords - Naming Conventions - Control statements, Type conversion and Casting - Scanner - String - equals(), equals Ignore Case(), length()</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT II

2.1 CLASSES AND OBJECTS

Class - Objects - Methods - Method Overloading - Constructors – Constructor Overloading - this keyword - usage of static with data and methods - Garbage Collection - Access Control

2.2 INHERITANCE

Concept - extends keyword - Single and Multilevel Inheritance - Composition - super keyword - Method Overriding - Abstract Classes - Dynamic Method Dispatch - Usage of final with data, methods and classes

2.3 PACKAGES AND INTERFACES

Concepts - package and import keywords - Defining, Creating and Accessing a Package - Interfaces - Multiple Inheritance in Java, Extending and Initialising fields in Interfaces</td></tr>
</table>

	UNIT III **3.1 EXCEPTION HANDLING** Exception handling - Types of Exceptions - try, catch, throw, throws and finally keywords - User defined Exceptions **3.2 JDBC** Database Connectivity - Types of JDBC drivers - Executing statements - Prepared statements - Callable statements - Mapping SQL types to Java – Result Set Meta data
	UNIT IV **4.1 MULTITHREADING** Introduction - Life Cycle of a Thread, Thread class and Runnable Interface, Thread Priorities, Synchronisation **4.2 GUI PROGRAMMING WITH JAVAFX** JavaFX Basic Concepts – Packages - Stage and Scene Classes - Nodes and Scene Graphs – Layouts - The Application Class and the Lifecycle Methods - Launching a JavaFX Application - JavaFX Application Skeleton - Compiling and Running -Application Thread **4.3 JAVAFX CONTROLS** Label - Button - Image – Radio Button – Check Box – List View – Combo Box – Text Field – Scroll Pane
	UNIT V **5.1 EVENT** Event Handling - Input Event, Action Event and Window Event **5.2 JAVA LIBRARY** Java.util – List, ArrayList
Recommended Text	1. Schildt, Herbert. Java: The Complete Reference. McGraw-Hill Education Group, 2014

Reference Books	1. Eckel, Bruce. Thinking in Java. 4th ed. Pearson Education, 2006. 2. Liang, Y. Daniel. Intro to Java Programming, Brief Version. Pearson Higher Ed, 2015. 3. Holmes, J. Barry, Joyce, T. Daniel. Object-oriented Programming with Java. Jones & Bartlett Learning. 2001
Website and e-Learning Source	http://docs.oracle.com/javase/tutorial/java/index.html/ http://www.java2s.com/Tutorial/Java/CatalogJava.htm/ https://www.edureka.co/blog/object-oriented-programming/

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO's	**Course Outcomes**
CO1	Understand the concepts of object-oriented programming
CO2	Use Java programming language at a basic level and construct simple software applications
CO3	Understand classes, objects and implementing inheritance
CO4	Analyze and understand the functionality of Inheritance, Interface and develop simple applications
CO5	To develop software applications and services using Java code

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">BIG DATA TECHNOLOGIES</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>23UPCSC4E05</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI

Introduction to Databases and Transactions What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management, Database Design, ER-Diagram overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd’s rules, Relational Schemas, Introduction to UML Relational</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITII

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</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIII

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,</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIV

The Hadoop Ecosystem: Map Reduce, HDFS, Pig, Hive, HBase, Scoop, yarn</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITV

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.</td></tr>
</table>

Recommended Text	1.Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan. Database system concepts. Vol. 4. New York: Mcgraw-hill, 1997. 2. Sadalage, Pramod J., and Martin Fowler. NoSQL distilled: a brief guide to theemerging world of polyglot persistence. Pearson Education, 2013. 3. White, Tom. Hadoop: The definitive guide. " O'Reilly Media, Inc.", 2012
Reference Books	1. Kenneth Cukier and Viktor Mayer-Schönberger, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Hodder and Stoughton, 2013. 2. Rob, Coronel, "Database Systems", Course Technology Inc, 7th edition, 2006. 3. Eric Redmond & Jim R. Wilson, Seven Databases in Seven Weeks: AGuide to Modern Databases and the NoSQL Movement, O′Reilly publisher, 2012.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO's	COURSE OUTCOMES
CO1	Illustrate the usage of data on different data ecosystems.
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.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DATA STRUCTURES AND ALGORITHMS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E06</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop an understanding of the research methods relevant to effectively address a research problem</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNITI

1.1 BASIC CONCEPTS

Basic steps in complete development of Algorithm – Analysis and complexity of Algorithm - Asymptotic notations - Problem Solving techniques and examples

1.2 ADT

List ADT, Stacks ADT, Queue ADT</td></tr>
<tr><td colspan="6">UNITII

2.1 ALGORITHM DESIGN MODEL

Greedy Method - Divide and Conquer - Dynamic Programming - Backtracking - Branch and Bound.

2.2 TREES

Preliminaries Binary Tree, Search Tree ADT, Binary Search Trees, AVL Trees, Tree Traversals, B-Trees</td></tr>
<tr><td colspan="6">UNITIII

3.1 HASHING

General Idea, Hash Function, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing, Priority Queues, Model, Simple Implementations, Binary Heap, Applications</td></tr>
<tr><td colspan="6">UNITIV

4.1 SORTING

Sorting - Preliminaries, Insertion Sort, Shell Sort, Heap Sort, Merge Sort, Quick Sort, External Sorting</td></tr>
</table>

	UNITV **5.1 GRAPHS** Definitions, Topological Sort, Shortest Path Algorithm, Minimum Spanning Tree, Application of Depth First Search **5.2 THEORY OF NP-COMPLETENESS** Formal language framework, Complexity classes - P, NP - NP Reducibility and NP-Complete, NP-Hard
Recommended Text	[1] Aho, J. E. Hopcroft and J. D. Ullman. Design and Analysis of Computer Algorithms. 1st ed. Addison-Wesley, 2009. [2] Horowitz and Sahani. Fundamentals of Computer Algorithms. 2nd ed. Galgotia, 2008. [3] Weiss, M. A. Data Structure and Algorithm analysis in C. 2nd ed. Pearson Education Asia, 2002.
Reference Books	[1] Baase, S. and Allen Van Gelder. Computer Algorithms-Introduction to Design and Analysis.New Delhi: Pearson Education, 2008 [2] Goodrich, M.T. and R. Tamassia. Algorithm Design: Foundations, Analysis, and Internet Examples. New Delhi: Wiley, 2006.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

STUDENTS WILL BE ABLE TO

CO1 : To understand the design of algorithms and analysis techniques

CO2 : To enable the students to analyse the time and space complexity of algorithms

CO3 : To have a good understanding on different data structures

CO4 : To understand the kinds of problems that uses the data structures and the algorithms for solving them

CO5 : Identify appropriate data structures for real time applications

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">SQL LAB</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCSC4E07</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To be able to apply appropriately the SQL and Hadoop knowledge gained and develop computer based solutions for a given problem</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to

CO 1 : To understand and write simple Queries
CO 2 : To Understand the working on complex queries in dataset
CO 3 : Learning about Hadoop Fundamentals
CO 4 : To explore about Map and Reduce
CO 5 : To Understand about basic Hive Commands</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>

1. Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)

2. Altering a Table, Dropping/Truncating/Renaming Tables, Backing up / Restoring a Database

3. Real time Retail dataset Database creation

4. Queries with Aggregate functions (group by and having clause)

5. Data Analysis with SQL on Big Mart Dataset

6. Join Queries- Inner Join, Left & Right Join, Full Join, Cross Join

7. Startup VM, Hadoop 1.0 & Linux Command Basic

8. Transfer of file to HDFS & Map Reduce Program-I (Counting Problem)

9. Map Reduce Program-II (Data Analysis on Sales dataset)

10. Basic Hive Commands</td></tr>
</table>

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">WEB PROGRAMMING LAB</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E08</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To be familiar with Web page design using HTML / DHTML and style sheets and exposed to creation of user interfaces using Java frames and applets.</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">CO1: Design Web pages using HTML/DHTML and style sheets.
CO2: Design and Implement database applications.
CO3: Create dynamic web pages using server-side scripting.
CO4: Write Client Server applications.
CO5: Implement Remote Applications</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>

1. Write a html program for Creation of web site with forms, frames, links, tables etc
2. Design a web site using HTML and DHTML. Use Basic text Formatting, Images,
3. Create a script that asks the user for a name, then greets the user with “Hello” and the username on the page.
4. Create a script that collects numbers from a page and then adds them up and prints them to a blank field on the page.
5. Create a script that prompts the user for a number and then counts from 1 to that number displaying only the odd numbers.
6. Create a script that will check the field in Assignment 1 for data and alert the user if it is blank. This script should run from a button.
7. Using CSS for creating web sites
8. Creating simple application to access data base using JDBC Formatting HTML with CSS.
9. Program for manipulating Databases and SQL.
10. Program using PHP database functions.
11. Write a web application that functions as a simple hand calculator, but also keeps a “paper trail” of all your previous work.
12. Install Tomcat and use JSP and link it with any of the assignments.
13. Reading and writing the files using .Net</td></tr>
</table>

	14. Write a program to implement web service for calculator application. 15. Implement RMI concept for building any remote method of your choice.

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

ELECTIVE – III

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">INFORMATION SECURITY AND ETHICS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E09</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce and familiarize the students to security issues in computing, core concepts and vocabulary of computer security</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">UNITI

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</td></tr>
<tr><td colspan="6">UNITII

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</td></tr>
<tr><td colspan="6">UNITIII

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</td></tr>
</table>

	UNITIV **4.1 ADMINISTERING SECURITY** Security Planning - Risk Analysis - Organisational Security Policies - Physical Security **4.2 THE ECONOMICS OF CYBER SECURITY** Making a Business Case - Quantifying Security - Modeling Cyber security
	UNITV **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
Recommended Text	1. Pfleeger , Charles P and Shari Lawrence Pfleeger. Security in Computing, Released January 2015, Pearson, ISBN: 9780134085074
Reference Books	1. Bahadur ,Gary. Securing the Clicks Network Security in the Age of Social Media. 1st ed. McGraw-Hill, 2012. 2.Daswani, Neil, Christoph Kern and Anita Kesavan. Foundations of Security: What Every Programming Needs to Know. A press, 2007

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

CO's	Course Outcomes
CO1	Understand all aspects of computer security, including users, software, devices, operating systems, networks, law, and ethics
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.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DISTRIBUTED SYSTEMS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E10</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To learn the principles, architectures, Processes, Communication, Co-ordination, consistency, and Replication in Distributed Systems</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNITI

INTRODUCTION - Introduction to Distributed Systems - Design Goals - Types of Distributed Systems
Chapter 1</td></tr>
<tr><td colspan="6">UNITII

ARCHITECTURES - Architectural Styles - Middleware Organization - System Architecture - Example Architectures
Chapter 2</td></tr>
<tr><td colspan="6">UNITIII

PROCESSES :Threads - Virtualisation - Clients - Servers - Code Migration
Chapter 3</td></tr>
<tr><td colspan="6">UNITIV

COMMUNICATIONS :Foundations - Remote Procedure Call -Basic RPC operation, Parameter Passing, RPC based Application Support - Message Oriented Communication - Simple transient Messaging with Sockets, Advanced Transient Messaging, Message Oriented Persistent Communication — Multicast Communication
Chapter 4
Naming: Names, Identifiers and Addresses - Flat naming - Structured naming - Attribute-based naming
Chapter 5</td></tr>
</table>

	UNITV **CO-ORDINATION:** Clock Synchronisation - Logical Clocks - Mutual Exclusion - Election Algorithms - Distributed Event Management **Chapter 6 - 6.1,6.2,6.3,6.4,6.6** **CONSISTENCY AND REPLICATION:** Introduction - Data-centric Consistency Models - Client- Centric Consistency Models - Replica Management **Chapter 7-7.1 to 7.4** **Fault Tolerance: Introduction** **Chapter 8-8.1**
Recommended Text	1. Andrew S. Tannenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Third Edition, Pearson, 2017.
Reference Books	1. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, "Distributed Systems: Concepts and Design", Fifth Edition, Addison Wesley, 2011. 2. James E. Smith, and Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", First Edition, Morgan Kaufmann, 2005.

COURSE OUTCOMES

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

CO1: To explain the significance of Distributed Systems
CO2: To explain the architecture of Distributed Systems
CO3: To relate the different types of Processes' role in Distributed Systems
CO4: To describe the rules the communicating processes must adhere to
CO5: To examine the issues in Distributed Systems

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">SOFTWARE ENGINEERING FOR DATA SCIENCE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E11</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course

Course Outline</td><td colspan="6">To understand the software engineering principles and ensure software quality

UNITI

SOFTWARE AND SOFTWARE ENGINEERING: The nature of software - Software Engineering - The Software Process - Software Engineering Practice - Software Myths
Chapter 1

PROCESS MODELS : A Generic Process Model - Process Assessment and Improvement - Prescriptive Process Models - Product and Process
Chapter 2

AGILE DEVELOPMENT : Introduction - Agility and Cost of Change - Agile Process - Scrum - Other Agile Frameworks
Chapter 3</td></tr>
<tr><td colspan="6">UNITII

RECOMMENDED PROCESS MODEL : Requirements Definition - Preliminary Architectural Design - Resource Estimation - First Prototype Construction - Prototype Evaluation - Prototype Evolution - Prototype Release - Maintain Release Software
Chapter 4

HUMAN ASPECTS OF SOFTWARE ENGINEERING: Characteristics of a Software Engineer - The Psychology of Software Engineer - The Software Team - Team Structures - The impact of Social Media - Global Teams
Chapter 5
PRINCIPLES THAT GUIDE PRACTICE : Core Principles - Principles that guide each Framework Activity - Communication Principles - Planning Principles - Modeling Principles - Construction Principles - Deployment Principles
Chapter 6</td></tr>
</table>

	UNITIII **UNDERSTANDING REQUIREMENTS:** Requirements Engineering - Establishing the groundwork - Requirements Gathering - Developing Use Cases -Building the Analysis Model - Negotiating Requirements - Requirements Monitoring - Validating Requirements **Chapter 7** **REQUIREMENTS MODELING - A Recommended Approach:** Requirements Analysis - Scenario-Based Modeling - Class-Based Modeling - Functional Modeling - Behavioural Modeling **Chapter 8**
	UNITIV **DESIGN CONCEPTS:** Design within the context of Software Engineering - The Design Process - Design Concepts - The Design Model **Chapter 9** **QUALITY AND SECURITY** : Introduction - Software Quality - The Software Quality Dilemma - Achieving Software Quality **Chapter 15** **SOFTWARE QUALITY ASSURANCE:** Background Issues - Elements of Software Quality Assurance - SQA Process and Product Characteristics - SQA Tasks, Goals and Metrics - Formal Approaches - Statistical SQA - Software Reliability - ISO 9000 Quality standards - SQA Plan **Chapter 17**

	UNITV **SOFTWARE TESTING -COMPONENT LEVEL:** A Strategic Approach to Software Testing - Planning and Record Keeping - Test-Case Design - White-box Testing - Black-Box Testing - Object-oriented Testing **Chapter 19** **SOFTWARE TESTING - INTEGRATION LEVEL:** Software Testing Fundamentals - Integration Testing - Artificial Intelligence and Regression Testing - Integration Testing in the OO context - Validation Testing - Testing Patterns **Chapter 20** **Data Science for Software Engineers** **Appendix 2**
Recommended Text	1. Pressman, Roger S., and Bruce R. Maxim. Software Engineering: A Practitioner's Approach, Ninth Edition, 2020.
Reference Books	1. Martin, Robert C. Agile software development: principles, patterns, and practices. Prentice Hall, 2002. 2. Schach, Stephen R. Object-oriented software engineering. McGraw-Hill, 2008. 3. Sommerville, Ian. "Software engineering 9th Edition." ISBN-10 137035152 (2011).

COURSE OUTCOMES

ON SUCCESSFUL COMPLETION OF THE COURSE, THE STUDENT WILL BE ABLE:

CO1: To describe the Software Engineering Principles
CO2: To apply Software Life Cycle Models for Software Development
CO3: To use Requirements Engineering skills and gather Requirements
CO4: To develop a quality Software
CO5: To apply appropriate testing methodologies

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PRINCIPLES AND TECHNIQUES Of DATA SCIENCE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E12</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To identify the scope and essentiality of Data warehousing and Data Mining.
• To develop research interest towards advances in data mining.
• To analyze the data, data science lifecycle, data collection and cleaning, exploratory data analysis and visualization, statistical inference and prediction, and decision-making algorithms for respective applications.</td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1 : Understand fundamentals of data and Data Mining Principles.
CO2 : To Understand importance of qualitative data, terminologies related to Data Science.
CO3 : Understand and Extract knowledge using data processing concepts in data science.
CO4 : Evaluate the databases, file formats and its applications using API Toolkit.
CO5 : Analyze and design data mining applications.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT I: Why Data Mining? Moving toward the Information Age Data Mining as the Evolution of Information Technology, What Is Data Mining, What Kinds of Data Can Be Mined, Database Data, Data Warehouses, Transactional Data, Other Kinds of Data, OLTP & Online Analytical Processing (OLAP), Graphs Database

UNIT II: Getting to Know Your Data: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity: Euclidean, Jaccard’s Index & Cosine Similarity

Unit III: Data Pre-processing on Big Data: Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data</td></tr>
</table>

	Discretization (ETL Operations) **Unit IV**: Data Science Tools: One API AI toolkit (Benchmark with Python Libraries) , Advantages of One API and Limitation of One API. Linear and Logistic Regression using One API and Clustering using One API **Unit V**: Data Science Applications in Uses Cases BSFI, Retail, Telecom & Healthcare

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

Title of the Course		R PROGRAMMING LAB					
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	**23UPCSC4E13**
		Semester	II				
Objectives of the Course		To be able to apply appropriately the R programming knowledge gained and develop computer based solutions for a given problem					
Learning Outcome		Students will be able to CO1: To understand and write simple R programs CO2: To Understand Dplyr function CO3: To explore Dashboard CO4 **:** To Understand different plots using R CO5 : To explore data frame functions on datasets					
EXERCISES		1. Installing R on Windows, and R Studio 2. Data Types - R Objects and Attributes, Data Types - Vectors and Lists 3. Data Types - Data Frames, Matrices, Factors & Functions 4. Expression & Logical Statement in R 5. Sub setting of List, Matrices, & Data frame 6. Data frame functions on inbuilt Dataset 7. Dplyr Function on Retail Dataset 8. Dplyr Function on Banking Dataset 9. Basic Plotting with R 10. Gplots with R 11. Working with R Markdown & pushing Code to Git 12. Building R Shiny Dashboard App					

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

ELECTIVE IV

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">APPLIED PROBABILITY</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>23UPCSC4E14</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop knowledge and understand fundamental concepts and applications of probability</td></tr>
<tr><td colspan="2" rowspan="2">Course Outline</td><td colspan="6">UNITI

1.1 BASIC NOTIONS OF PROBABILITY THEORY
Introduction - Probability and Expectation - Sample Spaces and Events - Random Experiments, Sample Spaces, Events, Counting Techniques - Interpretations and Axioms of Probability - Addition Rules - Conditional Probability - Multiplication and Total Probability Rules - Independence - Bayes’ Theorem - Random Variables - Distributions, Densities, and Moments – Convolution - Random Vectors - Multivariate Normal Random Vectors

1.2 CALCULATION OF EXPECTATIONS
Introduction - Indicator Random Variables and Symmetry – Conditioning - Moment Transforms - Tail Probability Methods - Moments of Reciprocals and Ratios - Reduction of Degree - Spherical Surface Measure</td></tr>
<tr><td colspan="6">UNITII

CONVEXITY AND COMBINATORICS
Introduction - Convex Functions - Minimization of Convex Functions - The MM Algorithm - Moment Inequalities - Combinatorics - Introduction - Bijections - Inclusion-Exclusion - Applications to Order Statistics - Catalan Numbers - Pigeonhole Principle - Combinatorial Optimization - Introduction - Quick Sort - Data Compression and Huffman Coding - Graph Coloring

UNITIII
3.1 DISCRETE RANDOM VARIABLES
Probability Distributions and Probability Mass Functions - Cumulative Distribution Functions - Mean and Variance of a Discrete Random Variable - Discrete Uniform Distribution - Binomial Distribution - Geometric and Negative Binomial Distributions - Hypergeometric Distribution - Poisson Distribution</td></tr>
</table>

	3.2 CONTINUOUS RANDOM VARIABLES Probability Distributions and Probability Density Functions - Cumulative Distribution Functions - Mean and Variance of a Continuous Random Variable - Continuous Uniform Distribution - Normal Distribution - Normal Approximation to the Binomial and Poisson Distributions - Exponential Distribution - Erlang and Gamma Distributions - Weibull Distribution - Lognormal Distribution - Beta Distribution
	UNITIV **4.1 TWO OR MORE RANDOM VARIABLES** Joint Probability Distributions - Marginal Probability Distributions - Conditional Probability Distributions – Independence - More Than Two Random Variables-Covariance and Correlation-Common Joint Distributions-Multinomial Distribution-Bivariate Normal Distribution-Linear Functions of Random Variables-General Functions of Random Variables **4.2 SAMPLING DISTRIBUTIONS AND POINT ESTIMATION OF PARAMETERS** Point Estimation-Sampling Distributions and the Central Limit Theorem-General Concepts of Point Estimation-Unbiased Estimators-Variance of a Point Estimator -Standard Error: Reporting a Point Estimate-Mean Squared Error of an Estimator-Methods of Point Estimation-Method of Moments-Method of Maximum Likelihood-Bayesian Estimation of Parameters
	UNITV **5.1 DISCRETE-TIME MARKOV CHAINS** Introduction-Definitions and Elementary Theory – Examples – Coupling-Convergence Rates for Reversible Chains-Hitting Probabilities and Hitting Times-Markov Chain Monte Carlo-simulated annealing **5.2 CONTINUOUS-TIME MARKOV CHAINS** Introduction – Finite-Time Transition Probabilities-Derivation of the Backward Equations-Equilibrium Distributions and Reversibility – Examples-Calculation of Matrix Exponentials-Kendall's Birth-Death-Immigration Process

Recommended Text	[1] Lange, Kenneth. Applied probability. Vol. 224. New York: Springer, 2003. [2] Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Fifth Edition, John Wiley & Sons, Inc.
Reference Books	[1] Mario Lefebvre, Applied Probability and Statistics, Springer Newyork, 2006 [2] Michael Mitzenmacher Eli Upfal, Probability and Computing Randomized Algorithms and Probabilistic Analysis, Cambridge University press, 2005

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO1 : Define the principal concepts about probability.

CO2 : Understand combinatorics and convexity

CO3 : Understand the nature and properties of density functions and hence determine the moments and moment generating functions of any random variable

CO4 : Obtain the value of the point estimators using the method of moments and method of maximum likelihood

CO5 : Define and formulate discrete-time and continuous-time Markov chains

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">OPTIMISATION TECHNIQUES</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E15</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To study of model formulation and apply the mathematical results and numerical techniques of optimization theory to real world problems</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">UNITI

1.1 MODELLING WITH LINEAR PROGRAMMING
Two variable LP model - Graphical LP solution - Applications.

1.2 SIMPLEX METHOD AND SENSITIVITY ANALYSIS
Simplex method- Artificial starting solution - Special cases in simplex method- Graphical sensitivity analysis.</td></tr>
<tr><td colspan="6">UNITII

2.1 DUALITY AND POST-OPTIMAL Analysis
Definition of Dual problem - Primal-Dual Relationships-Additional Simplex algorithms- Post optimal analysis

2.2 ADVANCED LINEAR PROGRAMMING
Simplex method fundamentals-Revised Simplex Method, Bounded-Variable Algorithm, Duality, Parametric programming</td></tr>
<tr><td colspan="6">UNITIII

3.1 GOAL PROGRAMMING
Goal programming formulation - Goal Programming algorithms

3.2 INTEGER PROGRAMMING
Formulation and Applications-Cutting Plane Algorithm-Branch and Bound Method</td></tr>
<tr><td colspan="6">UNITIV

4.1 HEURISTIC PROGRAMMING
Greedy Heuristics- Meta heuristic - Tabu Search algorithm - Constraint programming

4.2 DETERMINISTIC DYNAMIC PROGRAMMING
Recursive nature of Dynamic programming computations - Forward and backward recursion- Selected DP applications - Knapsack/Fly-away kit/cargo-loading model- Investment models-Inventory models</td></tr>
</table>

	UNITV **5.1 QUEUING SYSTEMS** Pure birth and Pure death models- Generalized Poisson queuing model, single server models. **5.2 CLASSICAL OPTIMIZATION THEORY** Unconstrained problems - Constrained problems
Recommended Text	[1] Hamdy A.Taha, Operations Research- An Introduction, 10th Edition, Pearson Education – 2017.
Reference Books	[1] L.R.Foulds, Optimization Techniques , Springer ,Utm , 1981 [2] Garrido José M. Introduction to Computational Models with Python. CRC Press, 2016.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO1 : Explain the fundamental knowledge of Linear Programming

CO2 : Use classical optimization techniques and numerical methods of optimization.

CO3 : Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems

CO4 : Describe the basics of different Heuristic algorithms and solve dynamic programming problems.

CO5 : Understand Queuing systems and understand constrained and unconstrained problems

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DISCRETE MATHEMATICS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E16</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To develop knowledge and understand concepts of mathematical induction, logic, functions and relations</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNITI

1.1 SETS, SEQUENCES AND FUNCTIONS
Sets - Some Special Sets - Set Operations - Functions – Sequences - Properties of Functions - Propositions - Conditional Propositions and Logical Equivalence - Arguments and Rules of Inference - Quantifiers - Nested Quantifiers

1.2 ELEMENTARY LOGIC
Informal Introduction - Propositional Calculus - Getting Started with Proofs - Methods of Proof - Logic in Proofs - Analysis of Arguments</td></tr>
<tr><td colspan="6">UNIT II

2.1 RELATIONS
Relations - Digraphs and Graphs – Matrices - Equivalence Relations and Partitions - The Division Algorithm and Integers Mod p

2.2 INDUCTION AND RECURSION
Loop Invariants - Mathematical Induction - Big-Oh Notation - Recursive Definitions - Recurrence Relations - More Induction - The Euclidean Algorithm</td></tr>
<tr><td colspan="6">UNIT III

3.1 COUNTING
Basic Counting Techniques - Elementary Probability – Inclusion - Exclusion and Binomial Methods - Counting and Partitions - Permutations and Combinations, Binomial Coefficients and Identities, Equivalence Relations, Generalized Permutations and Combinations, Generating Functions, Inclusion - Exclusion, Applications of Inclusion - Exclusion - Pigeon - Hole Principle

3.2 ALGORITHMS
Introduction - Examples of Algorithms - Analysis of Algorithms - Recursive Algorithms</td></tr>
</table>

	UNITIV **4.1 GRAPHS** Graphs - Paths and Cycles - Edge Traversal Problems - Hamiltonian Cycles and the Traveling Salesperson Problem - A Shortest - Path Algorithm - Representations of Graphs - Isomorphisms of Graphs - Planar Graphs **4.2 TREES** Trees - Terminology and Characterizations of Trees - Rooted Trees - Vertex Traversal Problems - Spanning Trees - Minimal Spanning Trees - Binary Trees - Tree Traversals - Decision Trees and the Minimum Time for Sorting - Isomorphism of Trees
	UNITV **RECURSION AND DIGRAPHS** General Recursion - Depth - First Search Algorithms - Polish Notation - Weighted Trees – Digraphs - Digraphs Revisited - Weighted Digraphs and Scheduling Networks - Digraph Algorithms
Recommended Text	[1] Kenneth A. Ross and Charles R. B. Wright, Discrete Mathematics, Pearson Education, Fifth Edition [2] Richard Johnson baugh, Discrete Mathematics, Pearson Education, Eighth Edition, 2018
Reference Books	[1] Discrete Mathematics and its Applications (6th edition), Kenneth H. Rosen, Tata McGraw Hill, Bombay, India [2] Discrete Mathematics with Applications Susanna S. Epp, Brooks/Cole 2011 [3] Discrete Mathematics an Introduction to Proofs and Combinatorics, Kevin Ferland, Houghton Mifflin Company, 2009

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO1: To introduce Mathematical Logic to understand the equivalence of statements

CO2: To acquaint the students with Inference Theory and predicate calculus to understand partial order and partition.

CO3: To introduce fundamental principles of Combinatorial Counting techniques

CO4: To explain generating functions and their utility in solving recurrence relations

CO5: To introduce graph models and tree structures with basics and significance of traversability.

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

ELECTIVE V

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NATURAL LANGUAGE PROCESSING LAB</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCSC4E17</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td colspan="2">Learning Outcome</td><td colspan="6">Students will be able to
CO1: To understand about NLP tokenization and Stemming
CO2: To Understand the different libraries for NLP
CO3: To explore the application on NLP
CO4 : To understand on key word extraction using NLP
CO5: To explore on topic modeling and basic of LLM</td></tr>
<tr><td colspan="2">EXERCISES</td><td colspan="6"><u>LIST OF EXPERIMENTS</u>
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</td></tr>
</table>

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">REINFORCEMENT LEARNING</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E18</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concepts and fundamentals of reinforcement learning and methods</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI

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</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITII TABULAR METHODS

Finite Markov Decision Processes - Dynamic Programming - Monte Carlo Methods</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIIIQ-NETWORKS AND LEARNING

Temporal difference learning - n-step Bootstrapping - Planning and learning with tabular methods, Deep Q-networks - DQN, DDQN, Dueling DQN, Prioritised Experience Replay</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITIVAPPROXIMATE SOLUTION METHODS

On-policy prediction with approximation - on-policy control with approximation - policy gradient methods</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITVPSYCHOLOGY AND NEUROSCIENCE

Prediction and control - Classical conditioning - neuroscience - basics - reward and prediction - case studies</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Sutton, Richard S., and Andrew G. Barto. Reinforcement learning: An introduction. MIT press, 2018.</td></tr>
</table>

Reference Books	1. Szepesvári, Csaba. "Algorithms for reinforcement learning." Synthesis lectures on artificial intelligence and machine learning 4.1 (2010): 1-103. 2. Winder, Phil. Reinforcement learning. O'Reilly Media, 2020. 3. Bilgin, Enes. Mastering Reinforcement Learning with Python: Build next-generation, self-learning models using reinforcement learning techniques and best practices. Packt Publishing Ltd, 2020.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO's	**COURSE OUTCOMES**
CO1	Understand the fundamentals of Reinforcement Learning tasks and the core principals including policies, value and functions.
CO2	Apply the tabular and approximation methods to solve classical control problems.
CO3	Analyse 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.

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">SOCIAL NETWORK ANALYSIS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E19</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic understanding of social networks</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce the concepts and fundamentals of social network components and analysis</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">UNITI

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</td></tr>
<tr><td colspan="6">UNITII

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</td></tr>
<tr><td colspan="6">UNITIII

DATA COLLECTION
Boundary specification - Data collection process - Information bias and issue of reliability - Archival data - Understanding SNA data - Managing SNA data
Book2 : Chapter 2</td></tr>
</table>

	UNITIV **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**
	UNITV **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**
Recommended Text	1. Peter Mika, "Social Networks and the Semantic Web", Springer 2007. 2. Yang, Song, Franziska B. Keller, and Lu Zheng. Social network analysis: Methods and examples. Sage Publications, 2016.
Reference Books	1. GuandongXu ,Yanchun Zhang and Lin Li, - Web Mining and Social Networking - Techniques and applications‖, First Edition, Springer, 2011. 2. Dion Goh and Schubert Foo, - Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO's	COURSE OUTCOMES
CO1	Understand the fundamentals of social web and elements of social network analysis.
CO2	Apply and visualize the knowledge representation in social network.
CO3	Analyse 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 network with real time case studies.

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

ELECTIVE VI

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ARTIFICIAL INTELLIGENCE AND DATA SCIENCE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCSC4E20</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To explore the approaches and principles of Artificial Intelligence (AI) algorithms, and apply them to Data Science</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI

1.1 ARTIFICIAL INTELLIGENCE
The AI Problems - The Underlying Assumptions - What is an AI Technique - The Level of the Model - Criteria for Success.

1.2 PROBLEMS, PROBLEM SPACES & SEARCH
Defining the problem as a State Space Search - Production systems - Problem Characteristics - Production Systems Characteristics - Issues in the Design of Search Programs.

1.3 HEURISTIC SEARCH TECHNIQUES
Generate and Test - Hill Climbing - Best First Search - Problem Reduction - Constraint Satisfaction - Means ends Analysis.</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNITII

2.1 KNOWLEDGE REPRESENTATION ISSUES
Representations and Mappings - Approaches to KR - Issues in KR - The Frame Problem.

2.2 USING PREDICATE LOGIC
Representing Simple Facts in Logic - Representing Instances and ISA Relationships - Computable Functions and Predicates - Resolutions - Natural Deductions.

2.3 REPRESENTING KNOWLEDGE USING RULES
Procedural versus Declarative Knowledge - Logic Programming - Forward Versus Backward Reasoning - Matching - Control Knowledge.

2.4 STATISTICAL REASONING
Probability and Bayes Theorem - Certainty Factors and Rule based Systems - Bayesian Networks - Dempsters Shafer Theory - Fuzzy Logic.</td></tr>
</table>

	UNITIII **3.1 LEARNING** What is Learning - Rote Learning - Learning by Taking Advice - Learning by Problem Solving - Learning from Examples: Induction - Explanation based Learning - Discovery - Analogy - Formal Learning Theory - Neural Net Learning and Genetic Learning **3.2 PARALLEL AND DISTRIBUTED AI** Psychological Modelling - Parallelism in Reasoning Systems - Distributed Reasoning Systems
	UNITIV **4.1 DEEP LEARNING FRAMEWORKS AND AI METHODOLOGIES** Working - Framework - programming Languages - applications - optimization - fuzzy inference systems - artificial creativity - additional AI methodologies - glimpse into the future **4.2 BUILDING DL NETWORK USING MXNET, TENSORFLOW AND KERAS** Core components -MXNet, TensorFlow and Keras in action - Summary and Visualization
	UNITV **5.1 BUILDING AND OPTIMIZER BASED ON PSO AND GA** Algorithm - implementation - variants - PSO and GA in action - Framework and tips **5.2 BUILDING AN ADVANCED DL SYSTEM** CNN - RNN **5.3 ALTERNATIVE AI FRAMEWORKS IN DS** ELMs – Caps Nets - Fuzzy logic and Fuzzy inference systems
Recommended Text	1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill2008. (Unit- 1, 2, 3)
Reference Books	2. Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. Malaysia; Pearson Education Limited, 2016. 3. Prolog Programming for Artificial Intelligence (International Computer Science Series), Addison-Wesley Educational Publishers Inc; 4th edition, 2011 By Ivan Bratko

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO's	COURSE OUTCOMES
CO1	Understand and identify problems that are amenable to solution by AI methods
CO2	Analyse and apply appropriate AI methods to solve a given problem.
CO3	Analyse and formalize a given problem in the language/framework of different AI and learning methods
CO4	Evaluate the AI methodologies and DL networks
CO5	Develop AI framework to tackle projects in our increasingly complex world

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

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">IMAGE RECOGNITION</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td>23UPCSC4E21</td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To understand the fundamentals of real time images, image transformations, detect edges and recognize objects in the image</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNITI

1.1 INTRODUCTION
The Human Vision System - Practical Applications of Computer Vision - The Future of Computer Vision

1.2 IMAGES
The Simple Pinhole Camera Model - Images - Sampling - Quantization - Color Images - Noise - Smoothing</td></tr>
<tr><td colspan="2" rowspan="3"></td><td colspan="6">UNITII

2.1 HISTOGRAMS
1D Histograms - Histogram/Image Equalization - Histogram Comparison -k-means Clustering

2.2 BINARY VISION
Thresholding - Threshold Detection Methods - Mathematical Morphology</td></tr>
<tr><td colspan="6">UNITIII

3.1 GEOMETRIC TRANSFORMATIONS
Affine Transformations - Perspective Transformations - Interpolation

3.2 EDGES
Edge Detection - Contour Segmentation - Hough Transform</td></tr>
<tr><td colspan="6">UNITIV

4.1 FEATURES
Moravec Corner Detection - Harris Corner Detection - FAST Corner Detection - SIFT - Recognition</td></tr>
</table>

	UNITV **5.1 RECOGNITION** Template Matching - Chamfer Matching - Statistical Pattern Recognition - Cascade of Haar Classifiers - Other Recognition Techniques - Performance **5.2 VISION PROBLEMS** Abandoned and Removed Object Detection - Traffic Lights - Real Time Face Tracking - Road Sign Recognition - License Plates
Recommended Text	1. Kenneth Dawson. A Practical Introduction to Computer Vision with Open CV. John Wiley & Sons Ltd, 2014.
Reference Books	1. David A. Forsyth, Jean Ponce. Computer Vision: A Modern Approach. Pearson Edition, 2015. 2. Jan Erik Solem. Programming Computer Vision with Python: Tools and Algorithms for Analyzing Images. O'Reilly Media, 2012. 3. Richard Szeliski. Computer Vision: Algorithms and Applications. Springer Publications, 2011. 4. Simon J. D. Prince. Computer Vision: Models, Learning, and Inference. Cambridge University Press, 2012.

COURSE LEARNING OUTCOME (FOR MAPPING WITH POS AND PSOS)

Students will be able to

CO's	**COURSE OUTCOMES**
CO1	Understand fundamentals of images, Computer Vision and Geometric transformations
CO2	Apply Histograms in real time images and recognize features
CO3	Analyse the edge detection techniques
CO4	Evaluate the vision related problems in further research
CO5	Develop real time projects related image recognition

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

NON MAJOR ELECTIVE – II

Subject Code : 23UPCSC1N01 **Credit : 2**

ADVANCED MICROSOFT OFFICE LAB

LIST OF EXPERIMENTS

MS-Word:

1. Design an admission/enquiry from using shapes, textbooks, colors, tables with formatting options.
2. Design a text book with cover page, content page and text using indenting options, rulers, page layout, header/footer and hyperlinks.
3. Design Newspaper advertisement with images and texts.
4. Design mark statement copy using tables, images and watermarks.
5. Design conference/seminar invitation with logos, formatting options, margins and borders.
6. Write a Research article with Chart, Tables, Symbols, Equations and References.

MS-Excel:

7. Design an application for student Exam Result using Data validation, Aggregate functions and Conditional formatting.
8. Prepare Cost-Benefit Analysis for an organization using Statistical tools.
9. Develop an application to predict population of a city using analysis Macros.

MS- Access:

10. Design an Employee payroll system with Forms and Reports using Macros.
11. Develop relational integrity databases.
12. Develop an application which automatically update a table using Triggers.
13. Design an inventory database and generate conditional report.

MS-PowerPoint:

14. Prepare a presentation with embedding multimedia objects.
15. Prepare presentation with slide layout, animations, font effects, hyperlinks.

MS-Publisher:

16. Prepare an academic calendar for an institution.

Reference Books:

1. Lisa A. Bucki, “MS Office 2013 Bible”, Wiley Publications, 2013.
2. Richard Mansfield, “Mastering VBA for Microsoft office 2016”, Wiley Publications, 2016.
3. Wayne L. Winston, “Microsoft Excel Data Analysis and Business Modeling”, PHI, 2017.
4. Manisha Nigam, “Data Analysis with Excel”, BPB Publications, 2019.
5. Michael Alexander and Dick Kusleika, “Excel Power Programming with VBA”, Wiley Publications, 2016.
6. Michael Alexander and Dick Kuskeika, “Access the Comprehensive tutorial guide”, Wiley Publications, 2016.

NON MAJOR ELECTIVE – II

Subject Code : 23UPCSC1N02 **Credit : 2**

BIOPYTHON 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 motif analysis.
8. Program to perform Cluster analysis.
9. Program to perform Supervised learning methods.
10. Program to perform Genome Data visualization.

REFERENCES

1. Via, A., Rother, K., & Tramontano, A. (2014). Managing your biological data with Python. Chapman and Hall/CRC.
2. Rocha, M., & Ferreira, P. G. (2018). Bioinformatics Algorithms: Design and Implementation in Python. Academic Press.
3. Chun, W. (2001). Core python programming (Vol. 1). Prentice Hall Professional.

SEMESTER II

Subject Code: 23UPCSC4P01 Credits: 02

Professional Competency Skill – Mini Project

Subject Code: 23UPCSC1X01 Credits: 01

Extension Activity - Internet Safety and protecting personal information

The following activities may be carried out (Internal evaluation only)

1. Understanding online threats
2. Online privacy basics
3. Securing personal information
4. Safe browsing practices
5. Managing online presence

SEMESTER III

Subject Code: 23UPCSC4I01 Credits: 02

Internship / Industrial Activity
(Carried out in summer vacation at the end of I Year – 30 hours)

SEMESTER IV

Subject Code: 23UPCSC4P02 Credits: 12

Project with Viva Voce

Subject Code: 23UPCSC4I02 Credits: 02

Credit Seminar (Industry / Entrepreneurship)

Student should attend any lecture series / workshop / panel discussion / presentation on specific subject and submit the report with detailed description