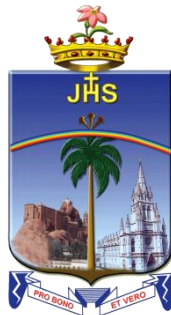


**M.Sc. DATA SCIENCE**  
**LOCF SYLLABUS – 2021**

**SCHOOLS OF EXCELLENCE**  
**WITH CHOICE BASED CREDIT SYSTEM (CBCS)**



**DEPARTMENT OF DATA SCIENCE**  
**ST. JOSEPH'S COLLEGE (AUTONOMOUS)**  
Special Heritage Status Awarded by UGC  
Accredited at A<sup>++</sup> Grade (IV Cycle) by NAAC  
College with Potential for Excellence by UGC  
DBT-STAR & DST-FIST Sponsored College  
Tiruchirappalli - 620 002, Tamil Nadu, India

## **VISION**

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

## **MISSION**

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

## **PROGRAMME EDUCATIONAL OBJECTIVES (PEO)**

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

## **PROGRAMME OUTCOMES (POs) PG**

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbued with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

<b>Programme Specific Outcomes (PSOs)</b>	
<b>PSO1</b>	Graduates will be able to apply data analytical skills that rely on mathematical and statistical methods to solve problems in a data-driven world
<b>PSO2</b>	Graduates will be able to analyse and interpret complex data to produce actionable insights
<b>PSO3</b>	Graduates will be able to understand the nuances of data analytical skills to evolve innovative ideas and communicate the social relevance and impact of their analytical findings
<b>PSO4</b>	Graduates will become analytical experts and data entrepreneurs with exemplary behaviour safeguarding the public interest
<b>PSO5</b>	Graduates will uphold professional ethics, values, standards and social responsibilities to attain a better and more sustainable future

<b>M. Sc. DATA SCIENCE</b>					
<b>PROGRAMME STRUCTURE</b>					
<b>Sem</b>	<b>Specification</b>	<b>No. of Courses</b>	<b>No. of Hours</b>	<b>Credits</b>	<b>Total Credits</b>
I-IV	Core Courses : Theory	10	43	43	43
I-IV	Core Courses : Practicals	05	20	10	10
II	Self-paced learning	1	-	02	02
IV	Comprehensive Examination	1	-	02	02
IV	Project work & Viva Voce	1	21	19	19
I- IV	Discipline Specific Elective	4	20	16	16
I	Ability Enhancement Course	1	04	03	03
II	Skill Enhancement Course (Soft Skills)	1	04	03	03
III	Generic Elective IDC (WS)	1	04	03	03
IV	Generic Elective IDC (BS)	1	04	03	03
III	Internship	1	-	02	02
I - III	Online courses (MOOC)	3	-	(2)	(06)
I-IV	Outreach Programme	1	-	04	04
I-IV	Total	30	120	110	110(6)

M.Sc. DATA SCIENCE							
PROGRAMME PATTERN							
Course Details					Scheme of Exams		
Sem	Code	Course Title	Hrs	Cr	CIA	SE	Final
I	21PDS1CC01	Statistical Computing	5	5	100	100	100
	21PDS1CC02	Data Science and Big Data Analytics	4	4	100	100	100
	21PDS1CC03	Advanced Database Management Systems	4	4	100	100	100
	21PDS1CP01	Software Lab-1: R Programming	4	2	100	100	100
	21PDS1CP02	Software Lab-2: Databases	4	2	100	100	100
	21PDS1ES01A	<b>DSE-1: Design and Analysis of Algorithms</b>	5	4	100	100	100
	21PDS1ES01B	<b>DSE-1: Object Oriented System Development</b>					
	21PDS1AE01	<b>AEC: Artificial Intelligence</b>	4	3	50	50	50
		<b>Extra Credits courses (MOOC)-1</b>	-	(2)			
	<b>Total</b>	<b>30</b>	<b>24 (2)</b>				
II	21PDS2CC04	Multivariate Techniques for Data Analytics	5	5	100	100	100
	21PDS2CC05	Advanced Web Technology	4	4	100	100	100
	21PDS2CP03	Software Lab-3: Advanced Web Technology	4	2	100	100	100
	21PDS2CP04	Software Lab-4: Machine Learning	4	2	100	100	100
	21PDS2SP01	<b>Self- Paced Learning: Python for Data Science</b>	-	2	50	50	50
	21PDS2ES02A	<b>DSE -2: Machine Learning</b>	5	4	100	100	100
	21PDS2ES02B	<b>DSE-2: WAP and XML</b>					
	21PSS2SE01	<b>SEC: Soft skills</b>	4	3	100	-	100
	21PDS2EG01	<b>GE-1(W S): Internet of Things</b>	4	3	100	100	100
	Extra Credits courses (MOOC)-2	-	(2)				
	<b>Total</b>	<b>30</b>	<b>25(2)</b>				
III	21PDS3CC06	Time Series and Sampling Theory	5	5	100	100	100
	21PDS3CC07	Software Project Management	4	4	100	100	100
	21PDS3CC08	Cloud Computing	4	4	100	100	100
	21PDS3CC09	Digital Image Processing	4	4	100	100	100
	21PDS3CP05	Software Lab-5: Image Processing	4	2	100	100	100
	21PDS3IS01	Internship	-	2	100	-	100
	21PDS3ES03A	<b>DSE-3: Cryptography and Network Security</b>	5	4	100	100	100
	21PDS3ES03B	<b>DSE-3: Natural Language Processing</b>					
	21PDS3EG02	<b>GE-2 (BS): Deep Learning</b>	4	3	100	100	100
	Extra Credits courses (MOOC)-3	-	(2)				
	<b>Total</b>	<b>30</b>	<b>28(2)</b>				
IV	21PDS4PW24	<b>Project work &amp; Viva Voce</b>	21	19	100	100	100
	21PDS4CE01	Comprehensive Examination	-	2	50	50	50
	21PDS4CC10	Business Intelligence	4	4	100	100	100
	21PDS4ES04A	<b>DSE-4: Sentiment Analysis</b>	5	4	100	100	100
	21PDS4ES04B	<b>DSE-4: Soft Computing</b>					
	<b>TOTAL</b>	<b>30</b>	<b>29</b>				
I-IV	21PCW4OR01	Outreach Programme (SHEPHERD)		4			
<b>Total (Four Semesters)</b>			<b>120</b>	<b>110(6)</b>			

\*The courses with a scheme of Exam 50 in CIA and SE will be converted to 100 for grading.

<b>GENERIC ELECTIVE -1: 2<sup>nd</sup> Semester</b>							
<b>Within school (WS)- Offered to students belong to other Departments in the School</b>							
<b>Course Details</b>					<b>Scheme of Exams</b>		
<b>School</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hrs</b>	<b>Cr</b>	<b>CIA</b>	<b>SE</b>	<b>Final</b>
<b>SBS</b>	21PBI2EG01	Herbal Technology	4	3	100	100	100
	21PBT2EG01	Medical Biotechnology	4	3	100	100	100
	21PBO2EG01	Medicinal Botany	4	3	100	100	100
<b>SCS</b>	21PCA2EG01	Applied Statistics using R	4	3	100	100	100
	21PMA2EG01	Mathematical Foundations	4	3	100	100	100
	21PCS2EG01	Mobile Adhoc Networks (MANET)	4	3	100	100	100
<b>SLAC</b>	21PEN2EG01A	Indian Literature in Translation	4	3	100	100	100
	21PEN2EG01B	English Literature For Competitive Examinations					
<b>SMS</b>	21PCO2EG01	Supply Chain Management	4	3	100	100	100
	21PEC2EG01	Labour Economics	4	3	100	100	100
	21PHR2EG01	Organizational Behaviour	4	3	100	100	100
	21PCC2EG01	Stress Management	4	3	100	100	100
<b>SPS</b>	21PCH2EG01	Industrial Products	4	3	100	100	100
	21PPH2EG01A	Solar Energy and Utilization	4	3	100	100	100
	21PPH2EG01B	Renewable Energy Resources	4	3	100	100	100

<b>GENERIC ELECTIVE -2: 3<sup>rd</sup> Semester</b>							
<b>Between schools (BS)- Offered to students in the Departments belong to other Schools</b>							
<b>(Except the school offering the course)</b>							
<b>Course Details</b>					<b>Scheme of Exams</b>		
<b>School</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Hrs</b>	<b>Cr</b>	<b>CIA</b>	<b>SE</b>	<b>Final</b>
<b>SBS</b>	21PBI3EG02	First Aid Management	4	3	100	100	100
	21PBT3EG02	Food Technology	4	3	100	100	100
	21PBO3EG02	Horticulture and Landscaping	4	3	100	100	100
<b>SCS</b>	21PCA3EG02	Web Design	4	3	100	100	100
	21PMA3EG02	Operations Research	4	3	100	100	100
	21PCS3EG02	Advances in Computer Science	4	3	100	100	100
	21PDS3EG02	Deep Learning	4	3	100	100	100
<b>SLAC</b>	21PEN3EG02	English for Effective Communication	4	3	100	100	100
<b>SMS</b>	21PCO3EG02	Basics of Taxation	4	3	100	100	100
	21PEC3EG02	Managerial Economics	4	3	100	100	100
	21PHR3EG02	Counselling and Guidance	4	3	100	100	100
	21PCC3EG02	Dynamics of Human Behaviour in Business	4	3	100	100	100
<b>SPS</b>	21PCH3EG02	Health Science	4	3	100	100	100
	21PPH3EG02A	Physics for Competitive Exam	4	3	100	100	100
	21PPH3EG02B	Nano Science	4	3	100	100	100

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CC01	CORE-1: STATISTICAL COMPUTING	5	5

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the basics of statistics and correlation techniques	K1
CO-2	demonstrate the applications of various regression methods	K2
CO-3	identify the probability distribution and analyse variables	K3
CO-4	examine the data and assess the shape of the distribution of data	K4
CO-5	determine and test various hypotheses and their implications using r	K5&K6

**Unit – I (15 Hours)**

Data Measurement, Collection and Classification: Statistical unit and population – Data - Data measurement- Collection of Data – Classification of Data - Introduction to Skewness, Moments and Kurtosis – Difference between variation and skewness – Measures of skewness – Karl Pearson’ coefficient of Skewness –Moments and skewness– Kurtosis – Concept of kurtosis – Types of curves

**Unit – II (15 Hours)**

Correlation :Definition of Correlation- Scatter Diagram- Karl Pearson’s Coefficient of Linear Correlation- Coefficient of Correlation and Probable Error of r- Coefficient of Determination - Merits and Limitations of Coefficient of Correlation- Spearman’s Rank Correlation

**Unit – III (15 Hours)**

Regression Analysis: Regression and Correlation (Intro) - Difference between Correlation and Regression Analysis- Linear Regression Equations -Least Square Method- Regression Lines- Properties of Regression Coefficients- Standard Error of Estimate

**Unit – IV (15 Hours)**

Probability Distribution: Probability Distribution and mathematical Expectation- Random Variable- Defined - Probability Distribution of a Random Variable- Expectation of Random Variable- Properties of Expected Value and Variance

**Unit – V (15 Hours)**

Statistics with R- Hypothesis testing and distributions: Probability in R - Distributions - Hypothesis Tests in R - One Sample t-Test: Review - One Sample t-Test: Example - Two Sample t-Test: Review - Two Sample t-Test: Example – Simulation - Paired Differences - Distribution of a Sample Mean

**Books for Study**

- K.L.Sehgal, “Quantitative Techniques and Statistics”, Himalaya Publishing House,2014  
**Unit-I** - Chapter 7 (Sec 7.1,7.4, 7.5-7.7,7.9,7.10)  
**Unit-II** - Chapter 8 (Sec 8.1 – 8.8)  
**Unit-III** - Chapter 12 (Sec 12.1 -12.4)  
**Unit-IV** - Chapter 14 (Sec 14.1 – 14.16)
- David dalpiaz, "Applied Statistics with R", University of Illinois, 2020.  
**Unit-V**- Chapter 5 (Sec: 5.1,5.2, 5.3)

### Books for Reference

1. Debbie L. Hahs-Vaughn, Richard G. Lomax, "Statistical Concepts - A First Course", Taylor & Francis Publication, 2020
2. Jay Lehmann, "A Pathway to Introductory Statistics", Pearson Publications, 2020
3. Cheryl Ann Willard, "Statistical Methods An Introduction to Basic Statistical Concepts and Analysis", Taylor & Francis Publication, 2020

### Relationship matrix for Course outcomes, Programme Outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1CC01	CORE-1: STATISTICAL COMPUTING									5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	3	3	2	2	2.5	
CO-2	3	3	2	2	2	3	3	2	2	2	2.4	
CO-3	3	3	2	2	2	3	3	2	2	2	2.4	
CO-4	3	3	3	2	2	3	3	3	2	2	2.6	
CO-5	3	3	3	2	2	3	3	3	2	2	2.6	
<b>Mean Overall Score</b>											<b>2.5 (High)</b>	



Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CC02	CORE-2: DATA SCIENCE AND BIG DATA ANALYTICS	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the basic and advanced methods of data science and big data technology	K1
CO-2	demonstrate the data analytics techniques using r	K2
CO-3	make use of the data by deploying r statistical tool	K3
CO-4	examine the usage of various regression methods	K4
CO-5	asses and build the data science and big data analytics projects	K5&K6

### Unit – I (12 Hours)

Introduction to Data Science: AI, Machine Learning and Data Science - Introduction to Data Science - Case for Data Science - Data Science Classification - Data Science Algorithms - Data Science Process: Prior Knowledge - Data Preparation - Modelling - Application – Knowledge - Data Exploration: Objective of Data Exploration - Datasets - Descriptive Statistics - Data Visualization - Roadmap for Data Exploration

### Unit – II (12 Hours)

Introduction to Data Science Process: The roles in a data science project - Stages of a data science project - Setting expectations. - Loading Data into R: Working with data from files - Working with relational databases.

### Unit – III (12 Hours)

Exploring Data using R: Using summary statistics to spot problems - Spotting problems using graphics and visualization - Managing Data: Cleaning data - Sampling for modelling and validation. - Choosing and evaluating models: Mapping problems to machine learning tasks - Evaluating models - Validating models

### Unit – IV (12 Hours)

Regression: Understanding linear& logistic regression - Building a linear& logistic regression model - Making predictions – Finding relations and extracting advice from linear& logistic models - Reading the model summary and characterizing coefficient quality.

### Unit – V (12 Hours)

Unsupervised Methods: Cluster Analysis - Distances - Preparing the data – Hierarchical clustering with hclust() - The k-means algorithm - Assigning new points to clusters – Clustering takeaways. Association Rules - Overview of association rules - The example problem - Mining association rules with the arules package - Association rule takeaways.

### Books for Study

1. Kotu, V., Deshpande, B, “Data Science: Concepts and Practice”. Elsevier Science Publisher, 2018.

**Unit 1** - Chapter 1 (Sec: 1.1 – 1.5), Chapter 2 (Sec: 2.1-2.5), Chapter 3 (Sec: 3.1-3.5)

2. Zumel, Nina, and Mount, John, “Practical Data Science with R”, Manning Publications, 2019.

**Unit 2** - Chapter 1 (Sec: 1.1 – 1.3), Chapter 2 (Sec: 2.1,2.2)

**Unit 3** - Chapter 3 (Sec: 3.1, 3.2), Chapter 4 (Sec: 4.1,4.2), Chapter 5 (Sec: 5.1-5.3)

**Unit 4** - Chapter 7 (Sec: 7.1, 7.2)

**Unit 5** - Chapter 7 (Sec: 8.1, 8.2)

### Books for Reference

1. Richard Hurley, "Data Science A Comprehensive Guide to Data Science, Data Analytics, Data Mining, Artificial Intelligence, Machine Learning, and Big Data", Ationa Publications, 2020
2. Thomas A. Runkler, "Data Analytics Models and Algorithms for Intelligent Data Analysis", Springer Vieweg, 2020.
3. Shah, Chirag, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1CC02	CORE-2: DATA SCIENCE AND BIG DATA ANALYTICS									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	2	3	1	2	3	3	3	2	2.4	
CO-2	2	3	2	3	3	2	2	2	3	1	2.3	
CO-3	3	2	3	3	2	3	2	3	3	3	2.7	
CO-4	2	3	3	2	3	3	3	2	2	3	2.6	
CO-5	3	2	3	2	3	2	3	2	2	2	2.4	
<b>Mean Overall Score</b>											<b>2.48 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CC03	CORE-3: ADVANCED DATABASE MANAGEMENT SYSTEMS	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	define database models and database management skills.	K1
CO-2	explain the applications of database models.	K2
CO-3	experiment with various database languages.	K3
CO-4	distinguish the acid properties and data consistency.	K4
CO-5	appraise and adopt the NoSQL databases for the recent technologies.	K5&K6

**Unit – I (12 Hours)**

Data Management: Information Systems and Data Databases – SQL Databases – Big Data – No SQL Databases – Organizing of Data Management.

**Unit – II (12 Hours)**

Data Modeling: From Data Analysis to Database – The Entity-Relationship Model – Implementation in the Relational Model – Implementation in the Graph Model – Enterprise wide Data Architecture – Formula for Database Design

**Unit – III (12 Hours)**

Database Languages: Interacting with Databases – Relational Algebra – Relationally Complete Languages – Graph based Languages – Embedded Languages – Handling NULL Values – Integrity Constraints – Data Protection Issues.

**Unit – IV (12 Hours)**

Ensuring Data Consistency: Multi-user Operation – Transaction Concept – Consistency in Massive Distributed Data – Comparing ACID and BASE.

**Unit – V (12 Hours)**

System Architecture: Processing of Homogeneous and Heterogeneous Data – Storage and Access Structure – Translation and Optimization of Relational Queries – Parallel Processing with MapReduce – Layered Architecture – Use of Different Storage Structures -NoSQL Databases: Development of Non-relational Technologies – Key-value stores – Column-Family Stores – Document Stores – XML Databases – Graph Databases.

**Books for Study**

1. Andreas Meier and Michael Kaufmann, “SQL & NoSQL Databases”, Springer, MORGAN KAUFMANN, 2019.

**Unit – I - Chapter1**

**Unit – II - Chapter2**

**Unit – III - Chapter 3**

**Unit – IV- Chapter 4**

**Unit – V - Chapter 5& 7**

**Books for Reference**

1. Abraham Silberschatz, Henry F Korth , S Sudarshan, “Database System Concepts”, 6th edition , McGraw-Hill International Edition , 2015.
2. Ramez Elmasri, Shamkant B Navathe, “Fundamental of Database Systems”, Pearson, 7th edition, 2016.
3. C.J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, 8th Edition, Pearson Education Reprint 2016

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1CC03	CORE-3: ADVANCED DATABASE MANAGEMENT SYSTEMS									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	3	1	3	3	2	3	2	2.5	
CO-2	3	2	3	2	2	3	3	2	3	3	2.6	
CO-3	1	2	3	3	3	2	3	2	2	2	2.3	
CO-4	1	2	1	1	3	2	3	2	3	3	2.1	
CO-5	1	2	1	1	2	3	3	2	2	3	2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CP01	Software Lab-1: R Programming	4	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the features and basic constructs in r programming	K1
CO-2	show how to transform the raw data into cleansed dataset by employing pre-processing techniques	K2
CO-3	apply different predictive modelling approaches in r to disentangle real time analytics problems	K3
CO-4	analyse and interpret the visualization results effectively	K4
CO-5	determine and elaborate how to link data, statistical methods, and actionable questions	K5&K6

### Lab Exercises

#### 1. R Basics

- a) R & R Studio Installation
- b) Data types
- c) Operators in R
- d) Decision Making and Looping

#### 2. Data Pre-processing

- a) Raw data
- b) Tidy data
- c) Clean data

#### 3. Statistical Concepts

- a) Descriptive Statistics
- b) Inferential Statistics
- c) Hypothesis Testing

#### 4. Predictive Modelling

- a) Linear Regression
- b) Multiple Regression
- c) Logistic Regression

#### 5. Data Visualisation in R using GGPlot

- Sa) Box Plot
- b) Histograms
- c) Scatter Plot
- d) Line chart
- e) Bar Chart
- f) Heat maps

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1CP01	Software Lab-1: R Programming									4	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	1	2	1	2	2	1	2	3	2	3	1.9	
CO-2	3	2	3	3	2	2	2	3	2	2	2.4	
CO-3	3	2	3	3	2	3	2	3	3	3	2.7	
CO-4	2	3	3	3	3	3	3	3	2	2	2.7	
CO-5	3	2	2	2	2	3	3	2	1	3	2.3	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1CP02	Software Lab-2: Databases	4	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall database models and develop database management skills.	K1
CO-2	explain the applications of database models and emerging trends.	K2
CO-3	choose various data models and develop database architectures.	K3
CO-4	distinguish object oriented databases and advanced databases.	K4
CO-5	infer and interpret the ideas on how to design databases and classify them.	K5&K6

### Lab Exercises

- DDL Statements
- Basic DML: Selection, Filtering and Join
- Built-in Functions
- Advanced Insert Commands and Bulk Load of Data
- Creating Stored Procedures
- Creating Triggers
- PL/SQL Array
- NoSQL Create Database and Collection.
- MongoDB Stitch & Atlas.
- MongoDB Compass

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1CP02	Software Lab-2: (Databases)									4	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	1	3	3	2	3	3	3	2	3	2.6	
CO-2	3	2	3	2	2	3	3	2	3	3	2.6	
CO-3	3	1	2	3	3	3	2	3	3	3	2.6	
CO-4	2	3	3	3	3	3	3	3	2	2	2.7	
CO-5	3	2	2	2	2	3	3	2	1	3	2.3	
<b>Mean Overall Score</b>											<b>2.6 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1ES01A	DSE-1: DESIGN AND ANALYSIS OF ALGORITHMS	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	choose the algorithmic procedure to determine the computational complexity of algorithms	K1
CO-2	explain the stepwise procedure to solve the sorting problems	K2
CO-3	utilize effective analytical skills in computing applications using greedy algorithms	K3
CO-4	analyse how to break down problems into small pieces for program development applications using dynamic programming techniques	K4
CO-5	select and develop efficient traversal and search approaches for Computational Modelling	K5&K6

**Unit – I (15 Hours)**

Introduction to Algorithm: Algorithm Definition – Algorithm Specification –Performance Analysis: Time Complexity – Asymptotic Notations - Performance Measurement. Elementary Data Structures: Stacks and Queues – Trees – Sets and Disjoint Set Union-Union and Find Operations - Graphs.

**Unit – II (15 Hours)**

Basic sorting algorithms: Bubble Sort- selection sort- Insertion Sort-Heap Sort - Divide and Conquer: Binary Search – Finding the Maximum And Minimum – Merge Sort – Quick Sort.

**Unit – III (15 Hours)**

The Greedy Method: Knapsack Problem - Job Sequencing with Deadlines - Minimum COst Spanning Trees - Optimal Storage on Tapes - Single Source Shortest Paths

**Unit – IV (15 Hours)**

Dynamic Programming: Multistage Graphs – All-Pairs Shortest Paths – Optimal Binary Search Trees - 0/1-knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling.

**Unit – V (15 Hours)**

Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees. Backtracking: The 8-Queens Problem – Sum of Subsets – Graph Coloring

**Books for Study**

1. Ellis Horowitz, SatrajSahni and SanguthevarRajasekaran, “Fundamentals of Computer Algorithms”, Universities Press, 2<sup>nd</sup> Edition, 2009.

**Unit-I** - Chapter 1,2 (Sec 1.1-1.3,2.1,2.2,2.5,2.6)



- Unit-II** - Chapter 3 (Sec 3.1-3.6)  
**Unit-III** - Chapter 4 (Sec 4.1 ,4.2,4.4,4.5,4.6,4.8)  
**Unit-I V** - Chapter 5 (Sec 5.2,5.3,5.5,5.7,5.8,5.9,5.10)  
**Unit-V** - Chapter 6,7(Sec 6.1,6.2, 6.3,7.2,7.3,7.4)

### Books for Reference

1. Harsh Bhasin, “Algorithms Design and Analysis”, Oxford University Press, 2015.
2. Rajesh K.Shukla, “Analysis and Design of Algorithms, A Beginner’s Approach”, Wiley,2015
3. Anany Levitin, “Introduction to design and Analysis of Algorithms”, Pearson, 2011.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1ES01A	DSE-1: DESIGN AND ANALYSIS OF ALGORITHMS									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	3	2	2	2	3	3	2	2	2	2.4	
CO-3	3	3	2	2	2	3	3	3	2	2	2.5	
CO-4	3	3	2	2	2	3	3	3	2	2	2.5	
CO-5	3	3	2	2	2	3	2	2	2	2	2.3	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1ES01B	DSE-1: OBJECT ORIENTED SYSTEM DEVELOPMENT	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the object-oriented design concepts and understand the fundamentals of OOSD life cycle and familiarize with evolution of object-oriented model, classes and its notations	K1
CO-2	explain UML in order to express the design of software projects	K2
CO-3	identify how the object-oriented analysis approach differs from the traditional approach in system analysis and design	K3
CO-4	examine the storage and interoperability of objects	K4
CO-5	assess and build OOAD testing and quality assurance strategies to ensure the quality of software products	K5&K6

**Unit – I (15 Hours)**

Fundamentals of OOSD: Overview of Object-Oriented Systems Development: Two orthogonal view of the software - OOSD methodology – Need for an object orientation. Object basics: Object Oriented Philosophy- Objects – Attributes – Object respond to messages – Encapsulation and information hiding – class hierarchy Polymorphism – Object relationship and associations. OOSD life cycle: Software development process – OOSD Use case Driven Approach – Reusability

**Unit – II (15 Hours)**

Methodology, Modeling and UML: Object Oriented Methodologies: Rumbaugh et al.’s object modeling technique – The Booch methodology – The Jacobson et al. methodology – Patterns – Frameworks - The Unified approach. Unified Modeling Language: Static and dynamic models – Need for modeling - UML diagrams – UML class diagram – Use case diagram - UML dynamic modeling – packages and model organization

**Unit – III (15 Hours)**

Object Oriented Analysis: Object Oriented Analysis process: Business Object Analysis - Use case driven object oriented analysis – Business process modeling – Use-Case model – Developing effective documentation. Object Oriented Design - Object Oriented Design Process and Design Axioms - OOD process- OOD axioms – Corollaries – Design patterns

**Unit – IV (15 Hours)**

Object Storage and Object interoperability: Database views - Database models - Hierarchical Model-Network model- Relational model-Database interface- Database schema and Data Definition Language -Data Manipulation Language and Query capabilities- Logical and Physical Database Organization and Access control- Share ability and

transactions- Concurrency policy-Distributed databases and client-server computing-distributed and cooperative processing

**Unit – V**

**(15 Hours)**

OOAD Testing and quality assurance: Software Quality Assurance: Quality assurance tests – Testing strategies – Impact of Object Orientation on Testing - Test Cases- Test Plan – Continuous testing - System Usability and Measuring User satisfaction: Usability Testing – User satisfaction test - A tool for analyzing user satisfaction.

**Books for Study**

1. Ali Bahrami, “Object Oriented Systems Development using UML”, McGraw-Hill, 2008  
**Unit-I** - Chapter 1,2,3 (Sec 1.2,1.3,2.2,2.3,2.7-2.11,3.2-3.5)  
**Unit-II** - Chapter 4,5 (Sec 4.1-4.8,5.2 -5.9)  
**Unit-III** - Chapter 6,9 (Sec 6.2-6.7, 9.2-9.5)  
**Unit-IV** - Chapter 11 (11.1-11.5)  
**Unit-V** - Chapter 13,14(13.2-13.7 ,14.1,14.2)

**Books for Reference**

1. Mahesh P.Matha, “Object-Oriented Analysis and Design Using UML”, PHI Learning Private Limited, 2012.
2. RachitaMisra, Chhabi Rani Panigrahi, Bijayalaxmi Panda, “Principles of Software Engineering and System Design”, Yesdee Publishing, 2019.
3. Brahma Dathan, SarnathRamnath, “Object Oriented Analysis, Design and Implementation”, Universities Press, 2010.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
I	21PDS1ES01B	DSE-1: OBJECT ORIENTED SYSTEM DEVELOPMENT									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	3	2	2	2	3	3	2	2	2	2.4	
CO-3	2	2	2	2	2	3	3	2	2	2	2.2	
CO-4	2	2	2	2	2	3	3	2	2	2	2.2	
CO-5	2	2	2	2	2	3	3	2	2	2	2.2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PDS1AE01	AEC: ARTIFICIAL INTELLIGENCE	4	3

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the basics of linear algebra	K1
CO-2	understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities	K2
CO-3	choose appropriate artificial intelligence functions and components involved in intelligent systems	K3
CO-4	examine the relationship between artificial intelligence and human intelligence	K4
CO-5	select and create logical statements from informal language to propositional logic expressions.	K5&K6

**Unit – I (12 Hours)**

Vectors: Overview – Vectors addition – Scalar-vector Multiplication – Inner Product – Complexity of vector computations -Linear Function: Overview – Taylor Approximation – Regression Model -Norm and Distance – Norm – Distance – Standard Deviation – Angle – Complexity- Linear Independence: Linear dependence – Basis – Orthonormal vectors – Gram- Schmidt Algorithm.

**Unit – II (12 Hours)**

Introduction to Artificial Intelligence: Overview - The Foundations of Artificial Intelligence - The History of Artificial Intelligence – The State of the Art - Intelligent Agents: Agents and Environments -Good Behavior: The Concept of Rationality – The Nature of Environments – The Structure of Agents Solving

**Unit – III (12 Hours)**

Solving Problems by Searching: Problem-Solving Agents – Searching for Solutions - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Heuristic Functions - Beyond Classical Search: Local Search Algorithms and Optimization Problems - Local Search in Continuous Spaces - Searching with Nondeterministic Actions – Searching with Partial Observations - Online Search Agents and Unknown Environments - Adversarial Search: Games – Optimal Decisions in Games - Alpha–Beta Pruning Imperfect Real-Time Decisions – Stochastic Games

**Unit – IV (12 Hours)**

Logical Agents: Knowledge-Based Agents – Logic - Propositional Logic: A Very Simple Logic Propositional Theorem Proving - Effective Propositional Model Checking - Agents Based on Propositional Logic Resolution - First-Order Logic: Representation Revisited - Syntax and Semantics of First-Order Logic – Using First-Order Logic – Knowledge Engineering in First-Order Logic - Inference in First-Order Logic: Propositional vs. First-Order Inference - Unification and Lifting – Forward Chaining- Backward Chaining.

**Unit – V (12 Hours)**

Knowledge Representation: Ontological Engineering - Categories and Objects - Events  
 Mental Events and Mental Objects - Reasoning Systems for Categories – Reasoning with  
 Default Information - The Internet Shopping World - Robotics: Introduction to Robotics -  
 Robot Hardware - Robotic Perception - Planning to Move – Planning Uncertain Movements  
 – Moving - Robotic Software Architectures – Application Domains

**Books for Study**

1. Boyd, Stephen, and Vandenberghe, Lieven. Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares. Cambridge University Press, 2018.

**Unit – I** - Chapter 1,2,3,5

2. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Prentice Hall Inc, 2010

**Unit – II** - Chapter 1,2

**Unit - III** - Chapter 3, 4,5

**Unit - IV** - Chapter 6,8,9

**Unit - V** - Chapter 12,25

**Books for Reference**

1. Anne Leslie, Ivana Bartoletti, Shân M. Millie, Susanne Chishti, The AI Book: The Artificial Intelligence Handbook for Investors, Entrepreneurs and FinTech Visionaries, Wiley Publication, 2020.
2. Chakraborty, Utpal, Artificial Intelligence for All: Transforming Every Aspect of Our Life, India, BPB Publication, 2020.
3. Janet Finlay, An Introduction To Artificial Intelligence, CRC Press, 2020.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course								Hours	Credits
I	21PDS1AE01	AEC: ARTIFICIAL INTELLIGENCE								4	4
Course Outcomes (COs)	Programme Outcomes (POs)				Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	3	2	3	3	3	3	3	2	2.8
CO-2	3	3	3	2	2	3	3	3	3	3	2.9
CO-3	2	3	3	3	2	3	3	2	2	2	2.5
CO-4	3	3	3	3	3	2	2	3	3	3	2.8
CO-5	3	3	2	3	2	3	3	3	2	3	2.7
<b>Mean Overall Score</b>										<b>2.7</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2CC04	<b>CORE-4: MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS</b>	5	5

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the meaning, objectives and applications of various types of multivariate techniques	K1
CO-2	demonstrate factoring and clustering techniques	K2
CO-3	apply appropriate multivariate techniques on data	K3
CO-4	examine canonical correlations and canonical correlation variables	K4
CO-5	explain and elaborate discriminant and principal component analysis on data	K5&K6

**Unit – I (15 Hours)**

Introduction to Multivariate Techniques: Measurement Scales (Metric and Non-metric Measurement Scales) - Classification of Multivariate Techniques (Dependence and Inter-dependence Techniques) - Applications of Multivariate Techniques in different disciplines.

**Unit – II (15 Hours)**

Canonical Correlations and Canonical Variables: Canonical Correlations and Variates in the Population - Estimation of Canonical Correlations and Variates - Statistical Inference - Factor Analysis: Introduction to Factor Analysis - Meaning, Objectives and Assumptions - Designing a Factor Analysis Study - Deriving Factors - Assessing Overall Factors - Validation of Factor Analysis.

**Unit – III (15 Hours)**

Cluster Analysis: Similarity measures-distances and similarity coefficients for pairs of items, similarities and association measures for pairs of variables-Hierarchical clustering methods-single linkage-complete linkage-average linkage- ward's hierarchical clustering method - Non-hierarchical clustering methods-K-means method

**Unit – IV (15 Hours)**

Discrimination and Classification: Separation and classification of two populations-classification with two multivariate normal populations- Classification of normal populations – scaling -Fisher's Approach to classification with two populations-Evaluating classification functions- Fisher's Method of discriminating among several populations- Using Fisher's discriminants to classify objects

**Unit – V****(15 Hours)**

Principal Component Analysis: Definition of Principal Components in the Population- Maximum Likelihood Estimators of the Principal Components and Their Variances- Computation of the Maximum Likelihood Estimates of the Principal Components - Statistical Inference.

**Books for Study**

1. T. W. Anderson , “An Introduction to Multivariate Statistical Analysis”, 3<sup>rd</sup> Edition, Wiley, 2009  
**Unit-I** - Chapter 1 (Sec 1.1-1.2)  
**Unit-II** - Chapter 12 ,14 (Sec 12.1-12.4)  
**Unit-V** - Chapter 11(Sec 11.2-11.4,11.6)
2. Johnson , "Applied Multivariate Statistical Analysis", Prentice Hall India Learning, 2012  
**Unit-III** - Chapter 12 (Sec 12.2-12.4)  
**Unit-IV** - Chapter 11 (Sec 11.2-11.4)

**Books for Reference**

1. Alan J. Izenman, “Modern Multivariate Statistical Techniques: Regression, Classification, and Manifold Learning”, Springer, 2013
2. Naresh K Malhotra, Satyabhusan Dash, “Marketing Research An applied Orientation”, pearson , 2011
3. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education, 7<sup>th</sup> edition, 2013.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2CC04	CORE-4: MULTIVARIATE TECHNIQUES FOR DATA ANALYTICS									5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	3	3	2	2	3	3	3	2	2	2.6	
CO-3	3	3	3	2	2	3	3	2	2	2	2.4	
CO-4	3	3	2	2	2	2	2	2	2	2	2	
CO-5	2	3	2	2	2	2	2	2	2	2	2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2CC05	CORE-5: ADVANCED WEB TECHNOLOGY	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	define the forms with files and databases	K1
CO-2	demonstrate Django handlers, CSS and JavaScript integration	K2
CO-3	build the routes or views using Django framework.	K3
CO-4	explain the process of web application development and manipulating the objects	K4
CO-5	determine and develop secured web applications through various testing models	K5&K6

**Unit – I (12 Hours)**

Django Overview: The Big Picture of Django Structure - Django Models -Django Templates - Django Views – URL configuration - Installing Python and Django - Installing Python - Installing a Python Virtual Environment - Installing Django - Starting a Project - Creating a Database - The Development Server - Text Editor

**Unit – II (12 Hours)**

Django Application: Django Project Structure - Django Settings - Django Applications - Creating the Pages App - Django App Structure - First View - Configuring the URLs-Creating the Page Model: The Page Model - A First Look at the Django Admin - Using the Admin Site

**Unit – III (12 Hours)**

Django Templates: Template Settings - Site Template and Static Files - Updating Your View-The Pages Template - Improving View and Adding Navigation: Modify Page URLs - Rewriting the View - Testing the View - Modify the Templates - Improving the Templates - Page Not Found! Adding a 404

**Unit – IV (12 Hours)**

Creating a Contact Form: Contact Form - Add URL to Pages App - Add Navigation to Site Template - Create the Contact Form Template - Create the Contact Form View - Emailing the Form Data. User Management - Users in the Admin -Users in the Front End - Add the Registration View - Create the Templates - The Login Template - The Register Template - The Success Template - Modify the Base Template - Create URL configuration - Testing the Authentication System - Restricting Users in the Front End

**Unit – V (12 Hours)**

Deploying a Django Website: Choosing a Host - Preparing the Site for Deployment - Deploy to Python Anywhere - Add a Database - Upload the Site Files - Install Django -



Install the Web App - Configure the Web App - Run Django Management Commands - Link to the Static Files - Add a Home Page - Set Site to Production Mode

### Books for Study

1. Nigel George, “Build a Website with Django 3: A Complete Introduction to Django 3”, GNW Independent Publishing, 2020.

**Unit 1** – Chapter 3, 4

**Unit 2** – Chapter 6, 7

**Unit 3** – Chapter 8, 9

**Unit 4** – Chapter 10, 13

**Unit 5** – Chapter 14

### Books for Reference

1. Melé, Antonio, “Django 3 By Example: Build Powerful and Reliable Python Web Applications from Scratch”, 3rd Edition. United Kingdom, Packt Publishing, 2020.
2. George, Nigel. “Build Your First Website with Python and Django”, GNW Independent Publishing, 2017.
3. Vincent, William S, “Django for Beginners: Build Websites with Python and Django”, Amazon Digital Services LLC - KDP Print US, 2020.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2CC05	CORE-5: ADVANCED WEB TECHNOLOGY									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	3	2	3	2	3	3	3	2	3	2.6	
CO-2	3	3	2	1	2	3	2	3	2	3	2.4	
CO-3	3	2	3	3	1	3	3	2	3	3	2.6	
CO-4	2	2	3	2	2	3	3	2	3	2	2.4	
CO-5	3	2	3	3	2	2	2	3	3	3	2.6	
<b>Mean Overall Score</b>											<b>2.5 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2CP03	Software Lab-3: ADVANCED WEB TECHNOLOGY	4	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	show the usage of Django frameworks	K1
CO-2	outline the new ways to design using Django templates and forms	K2
CO-3	apply the advanced and customized form designs	K3
CO-4	analyse the tools and techniques for web scrapping in Django framework using Scrapy	K4
CO-5	decide and develop a clear picture of advanced web technology and deploy it in the design and development of web applications	K5&K6

### Lab Exercises

1. Setting Up Django Environment
2. Creating Django Projects
3. Building URL Handlers
4. Working with Django Views
5. Building Django Templates
6. Working with Django Models and Import Data
7. Django Forms
8. Advanced Django Forms
9. Work with styling and customizing of Form Appearance
10. Building a REST API
11. Unit Testing and Securing Django APIs
12. Web Scrapping using ScraPy

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2CP03	Software Lab-3: ADVANCED WEB TECHNOLOGY									4	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	1	3	3	1	3	3	3	2	3	2.5	
CO-2	3	2	3	1	3	3	2	2	3	3	2.5	
CO-3	2	1	2	2	2	3	2	3	3	3	2.3	
CO-4	3	2	3	1	2	3	3	3	3	3	2.6	
CO-5	1	2	3	3	2	3	2	3	2	3	2.4	
<b>Mean Overall Score</b>											<b>2.5 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2CP04	Software Lab-4: MACHINE LEARNING	4	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall dataset characteristics	K1
CO-2	classify various extraction techniques	K2
CO-3	make use of a wide range of machine learning techniques	K3
CO-4	examine the classification and regression in machine learning on various systems	K4
CO-5	evaluate and build various machine learning techniques to solve real world problems	K5&K6

### Lab Exercises

1. Cleaning and Pre-processing Data
2. Feature Extraction
3. Feature Engineering
4. Simple Linear Regression Models
5. Complex Regression Models for Non-Linear Problems
6. Classification
7. Ensemble Models for Regression
8. Ensemble Models for Classification
9. Building Recommender Systems
10. Artificial Neural Networks for Classification
11. Artificial Neural Networks for Regression
12. Deep Learning models for Classification and Regression

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2CP04	Software Lab-4: MACHINE LEARNING									4	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	2	1	2	3	3	2	3	3	2.4	
CO-2	2	3	3	2	2	3	2	2	3	1	2.3	
CO-3	2	2	2	3	3	2	2	2	1	3	2.2	
CO-4	3	3	3	2	2	3	3	1	3	1	2.4	
CO-5	3	3	2	2	3	2	1	3	1	2	2.2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2SP01	Self- Paced Learning: PYTHON FOR DATA SCIENCE	-	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the advanced features of Python.	K1
CO-2	explain the most widely used Python packages.	K2
CO-3	make use of the NumPy, Pandas and Matplotlib to perform data analysis and data Visualization.	K3
CO-4	analyse data and perform data aggregation with Python.	K4
CO-5	determine and build various Customization techniques in Matplotlib.	K5&K6

### Unit – I

Introduction to NumPy: Understanding Data Types in Python, The Basics of NumPy Arrays, Computation of NumPy Arrays, Aggregations, Comparisons, Masks, Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data.

### Unit – II

Data Manipulation with Pandas: Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchal Indexing, Combing Datasets.

### Unit – III

Data Manipulation with Pandas: Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchal Indexing, Combing Datasets.

### Unit – IV

Visualization with Matplotlib: Simple Line Plots, Simple Scatter Plot, Visualizing Errors, Density and Contour Plots, Histograms, Binnings and Density.

### Unit – V

Customization with Matplotlib: Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotations, Customizing Ticks, Configuration and Stylesheets, Three Dimensional Plotting, Geographic Data with Basemap and Visualisation with Seaborn.

### Books for Study

1. Jake Vander Plas, “Python Data Science Handbook Essential Tools for Working with Data”, O'Reilly Media, 1st edition, 2016.

**Unit - I** - Chapter 1 & 2

**Unit – II** - Chapter 3

**Unit - III** - Chapter 3

**Unit - IV** - Chapter 4

**Unit - V** - Chapter 4

### Books for Reference

1. Wes McKinney, “Python for Data Analysis”, O'Reilly Media, 2nd edition, 2017.
2. Bharti Motwani , “Data Analytics using Python”, Wiley, 1st Edition, 2020.
3. Alberto Boschetti and Luca Massaron, “Python Data Science Essentials”, Packt publishing, 3rd Edition, 2018.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2SP01	Self- paced Learning: PYTHON FOR DATA SCIENCE									-	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	1	2	2	2	1	1	3	1	1	1.6	
CO-2	3	2	3	1	3	3	2	2	3	3	2.5	
CO-3	2	3	3	3	3	2	2	3	2	2	2.5	
CO-4	3	2	2	2	2	3	3	3	3	3	2.6	
CO-5	2	2	1	3	2	3	2	3	2	3	2.3	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2ES02A	DSE-2: MACHINE LEARNING	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	list out the fundamental issues and perspectives of machine learning	K1
CO-2	compare various linear models to find a best-fit line through a set of data points	K2
CO-3	make use of genetic algorithms as a tool for feature selection in machine learning	K3
CO-4	examine various dimensionality reduction techniques to reduce the number of input variables in the datasets	K4
CO-5	explain and construct the graphical models to exhibit the conditional dependence structure between random variables	K5&K6

**Unit – I (15 Hours)**

Introduction to Machine Learning: History and Evolution - Artificial Intelligence Evolution - Different Forms - Machine Learning Categories: Frameworks for Building Machine Learning Systems- Machine Learning Python Packages - Data Analysis Packages - Machine Learning Core Libraries

**Unit – II (15 Hours)**

Fundamentals of Machine Learning: Scales of Measurement - Feature Engineering - Exploratory Data Analysis - Supervised Learning:-Regression - Supervised Learning:-Classification - Unsupervised Learning Process Flow

**Unit – III (15 Hours)**

Model Diagnosis and Tuning: Optimal Probability Cutoff Point - Rare Event or Imbalanced Dataset - Bias and Variance - K-Fold Cross-Validation - Stratified K-Fold Cross-Validation - Ensemble Methods - Bagging - Boosting - Ensemble Voting - Stacking - Hyper parameter Tuning

**Unit – IV (15 Hours)**

Machine Learning Analysis: How to load Machine Learning Data - Understand Your Data with Descriptive Statistics - Understand Your Data with Visualisation - Prepare Your Data for Machine Learning - Feature Selection for Machine Learning

**Unit – V (15 Hours)**

Machine Learning Projects: Your first Machine Learning Projects in Python Step-By-Step - Regression Machine Learning Case Study Project - Binary Classification Machine Learning Case Study Projects

### Books for Study

- Swamynathan, Manohar. Mastering Machine Learning with Python in Six Steps: A Practical Implementation Guide to Predictive Data Analytics Using Python. United States, Apress, 2019.  
**Unit – I** - Chapter 2  
**Unit – II** - Chapter 3  
**Unit - III** - Chapter 4
- Machine Learning Mastery With Python: Understand Your Data, Create Accurate Models, and Work Projects End-to-End. N.p., Machine Learning Mastery, 2016.  
**Unit - IV** - Chapter 4,5,6,7,8  
**Unit - V** - Chapter 19,20,21

### Books for Reference

- Oliver Theobald, “Machine Learning for Absolute Beginners: A Plain English Introduction”, Third Edition, Independently Published, 2021.
- Henderson, Matt. Machine Learning for Beginners 2019: The Ultimate Guide to Artificial Intelligence, Neural Networks, and Predictive Modelling (Data Mining Algorithms & Applications for Finance, Business & Marketing), Charlotte Publishing, 2019.
- Fmello, Rodrigo, and AntonelliPonti, Moacir. “Machine Learning: A Practical Approach on the Statistical Learning Theory”, Springer International Publishing, 2018.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2ES02A	DSE-2: MACHINE LEARNING									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	2	2	3	3	2	2	3	2	2.4	
CO-2	3	3	3	2	2	3	3	3	2	2	2.6	
CO-3	2	1	2	2	2	3	2	3	3	3	2.3	
CO-4	2	3	2	2	2	2	2	3	2	3	2.3	
CO-5	2	3	3	2	2	3	3	2	1	3	2.4	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2ES02B	DSE-2: WAP and XML	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the concepts and procedures of WAP and XML	K1
CO-2	classify the functionalities of WAP gateways	K2
CO-3	make use of XML concepts to develop Web applications	K3
CO-4	examine WML script to perform processing and computation	K4
CO-5	design and develop XSL to create a style definition for one XML document or reused for many other XML documents	K5&K6

**Unit – I (15 Hours)**

Overview of WAP: WAP and the wireless world – WAP application architecture – WAP internal structure-WAP versus the Web – WAP 1.2 – WTA and push features - Setting up WAP: Available software products – WAP resources – The Development Toolkits.

**Unit – II (15 Hours)**

WAP gateways: Definition – Functionality of a WAP gateway – The Web model versus the WAP model Positioning of a WAP gateway in the network – Selecting a WAP gateway - Basic WML: Extensible Markup language – WML structure – A basic WML card – Text formatting – navigation – Advanced display features.

**Unit – III (15 Hours)**

Interacting with the user: Making a selection – Events – Variables – Input and parameter passing. WML Script: Need for WML script – Lexical Structure – Variables and literals – Operators – Automatic data type conversion – Control Constructs Functions – Using the standard libraries – programs – Dealing with Errors.

**Unit – IV (15 Hours)**

Introduction to XML: An Eagle’s Eye View of XML- Design of Domain-Specific Markup Languages- Self-Describing Data- Structured and Integrated Data- The Life of an XML Document- Parsers and Processors- The Process Summarized- Related Technologies- Hypertext Markup Language- Cascading Style Sheets- Extensible Style Language- URLs and URIs- X Links and X Pointers- An Introduction to XML Applications- Chemical Markup Language- Mathematical Markup Language- Channel Definition Format- Extensible Forms Description Language- Human Resources Markup Language-XML for XML

**Unit – V (15 Hours)**

Attributes, Empty Tags and XSL: Attributes – Attributes Versus Elements – Empty Tags – XSL – Well-formed XML documents – Foreign Languages and Non-Roman Text – Non



Roman Scripts on the Web Scripts, Character sets, Fonts and Glyphs – Legacy character sets– The Unicode Character set – Procedure to Write XML Unicode. Document Type Definitions- Document Type Definitions and Validity -Entities and External DTD Subsets - Attribute Declarations in DTDs - Embedding Non-XML Data.

### Books for Study

1. Charles Arehart and Others. “Professional WAP with WML, WML script, ASP, JSP, XML, XSLT, WTA Push and Voice XML”, Shroff Publishers and Distributors Pvt. Ltd, 2014.

**Unit I** Chapter 1,2

**Unit II** Chapter 3

**Unit III** Chapter 4-7

2. Elliotte Rusty Harold, “XML 1.1. bible”, Wiley Publishing, Inc. 2004

**Unit-IV** Chapter 1,2

**Unit –V** Chapter 5

### Books for Reference

1. Heather Williamson, “XML: The Complete Reference”, Tata McGraw-Hill Education India, 2012.
2. Chris Tull, "Wap 2.0 development", Dorling Kindersley India Pvt Ltd, 2009.
3. Cliff Binstock, "The XML Schema Complete Reference", Addison-Wesley, 2003.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2ES02B	DSE-2: WAP and XML									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	3	2	2	2	3	3	2	2	2	2.4	
CO-3	3	3	2	2	2	3	3	2	2	2	2.4	
CO-4	3	3	2	2	2	2	2	2	2	2	2	
CO-5	3	3	2	2	2	3	2	2	2	2	2.2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PSS2SE01	SEC: SOFT SKILLS	4	3

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the nuances of grooming such as, good manners and etiquettes and demonstrate the public speaking skills via extempore speeches and prepared speeches	K1
CO-2	model their own resumes and present them before the interview panel for their mock interview	K2
CO-3	select and learn the ten parameters of group discussion, perform on the stage with their associates, which is videotaped, reviewed and evaluated	K3
CO-4	apply analytical skills to solve real world problems	K4
CO-5	analyse and self-discover themselves to develop their own personalities facilitated with scientific psychological personality tests	K5&K6

**Unit – I (12 Hours)**

Basics of Communication: Definition of communication - Process of Communication - Barriers of Communication - Non-verbal Communication - Effective Communication: The Art of Listening - Exercises in Kinesthetics - Production of Speech - Organization of Speech - Modes of delivery - Conversation Techniques - Dialogue - Good manners and Etiquettes - Politeness markers & Listening links

**Unit – II (12 Hours)**

Resume Writing: Resume - Types of Resume - Chronological, Functional and Mixed Resume - Steps in preparation of Resume - structure and framework for writing resume - Intensive training / personalized training on resume writing - Interview Skills: Common interview questions - Attitude - Body Language - The mock interviews - Phone interviews - Behavioral interviews.

**Unit – III (12 Hours)**

Group Discussion: Group Discussion Basics - GD Topics for Practice - Points for GD Topics - Case-Based and Article based Group Discussions - Points for Case Studies - and Notes on Current Issues for GDS & Practicum with video coverage - Team Building: Team Vs Group – Synergy - Stages of Team Formation - Broken Square-Exercise - Win as much as you win-Exercise - Leadership – Styles, Work ethics-Personal Effectiveness: Self Discovery - Self Esteem - Goal setting - Problem-solving - Conflict and Stress Management

**Unit – IV (12 Hours)**

Numerical Ability: Average - Percentage - Profit and Loss - Problems on ages - Simple Interest - Compound Interest - Area - Volume and Surface Area - Time and Work - Pipes

and Cisterns - Time and Distance - Problems on Trains - Boats and Streams - Calendar - Clocks - Permutations and Combinations - Probability.

### Unit – V

(12 Hours)

Test of Reasoning: Series Completion - Analogy - Data Sufficiency - Blood Relations - Assertion and Reasoning - Logical Deduction – Direction-Non-Verbal Reasoning: Series - Classification

### Books for Study

1. Melchias, G., Balaiah John., John Love Joy, “ Winners in the making”,St.Joseph’s College, Trichy-2,2015

**Unit-I-Chapter 1 (Sec 1.1,1.2)**

**Unit-II - Chapter 2 (Sec 2.1,2.2)**

**Unit-III - Chapter 3,4 (Sec 3.1,3.2, 4.1-4.4)**

**Unit-V - Chapter 6**

2. Aggarwal, R. S., “ Quantitative Aptitude”, S.Chand& Sons, 2017

**Unit-IV - Chapter1 (Sec 1.6,1.8,1.10,1.11, 1.15, 1.16, 1.17, 1.18, 1.19, 1.21, 1.22, 1.25,1.27,1.28, 1.30, 1.31)**

### Books for Reference

1. Aggarwal, R.S., “A Modern Approach to Verbal and Non Verbal Reasoning”, S. Chand & Co, 2018
2. Schuller, Robert , “Positive Attitudes”, Jaico Books, 2010
3. R.S Aggarwal, Vikas Aggarwal, "Objective General English",S.Chand Limited,2018

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PSS2SE01	SEC: SOFT SKILLS									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	3	2	2	3	3	3	2	2	2.6	
CO-2	3	3	3	2	2	3	3	3	2	2	2.6	
CO-3	3	2	2	2	2	2	2	2	2	2	2	
CO-4	3	2	2	2	2	2	3	2	2	2	2.2	
CO-5	3	2	2	2	2	2	2	2	2	2	2	
<b>Mean Overall Score</b>											<b>2.3</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
II	21PDS2EG01	GE-1(WS): Internet of Things	4	3

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the basics of Internet of things and protocols	K1
CO-2	explain the protocol Standardization for IoT	K2
CO-3	identify the role of Internet of Things and its application areas	K3
CO-4	distinguish between the Web of Things versus Internet of Things	K4
CO-5	perceive and discuss the gist of Industrial Internet of Things	K5&K6

### Unit – I (12 Hours)

Definitions and Functional Requirements: Motivation - Architecture - Web 3.0 View of IoT - Ubiquitous IoT Applications - Four Pillars of IoT - DNA of IoT -The Toolkit Approach for End-user Participation in the Internet of Things - Middleware for IoT: Overview - Communication middleware for IoT - IoT Information Security

### Unit – II (12 Hours)

Protocol Standardization for IoT: Efforts - M2M and WSN Protocols - SCADA and RFID Protocols- Issues with IoT Standardization - Unified Data Standards -Protocols -IEEE 802.15.4 - BACNet Protocol Modbus - KNX – Zigbee-Network layer - APS layer –Security.

### Unit – III (12 Hours)

Web of Things versus Internet of Things: Two Pillars of the Web - Architecture standardization for WoT Platform Middleware for WoT - Unified Multitier WoT Architecture - WoT Portals and Business Intelligence - Cloud of Things: Grid/SOA and Cloud Computing - Cloud Middleware - Cloud Standards - Cloud Providers and Systems - Mobile cloud Computing - The Cloud of Things Architecture

### Unit – IV (12 Hours)

Industrial Internet of Things: Introduction to Industrial Internet of Things - Industrie 4.0 - Industrial Internet of Things (IIoT) - IIoT Architecture - Basic Technologies - Applications and Challenges - Security and Safety - Introduction to Security and Safety - Systems Security - Network Security - Generic Application Security - Application Process Security and Safety - Reliable-and-Secure-by-Design IoT Applications - Run-Time Monitoring - The ARMET Approach - Privacy and Dependability

### Unit – V (12 Hours)

Key Applications Of The Internet Of Things: The Smart Grid - The Marginal Cost of Electricity: Base and Peak Production - Managing Demand: The Next Challenge of Electricity Operators-Demand Response for Transmission System Operators (TSO) - Case Study: RTE in France - The Opportunity of Smart Distributed Energy Management-

Demand Response: The Big Picture - Electric Vehicle Charging- Charging Standards Overview - Use Cases

### Books for Study

- Honbo Zhou, "The Internet of Things in the Cloud A Middleware Perspective", CRC Press, 2013  
**Unit I** Chapter 1,2,3,4,5 Sec(1.3,2.1, 2.2,3.1-3.5,4.1-4.3,5.1,5.2)  
**Unit II** Chapter 6 Sec(6.2,6.3)
- Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.  
**Unit III** Chapter 7,8,9 (Sec 7.1-7.4,8.1-8.5,9.2-9.4)
- Dimitrios Serpanos Marilyn Wolf, " Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, 2018  
**Unit –IV** Chapter 5,6 (Sec 5.1- 5.6, 6.1 -6.9)
- Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.  
**Unit – II** Chapter 1,3,5 (Sec 1.1- 1.3, 3.1-3.4,5.1- 5.4,6.1-6.3,7.1-7.6)  
**Unit –V** Chapter 15,16 (Sec 15.1- 15.7, 16.1 -16.2)

### Books for Reference

- Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands- on approach", Universities Press, 2015.
- Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012.
- David Boswarthick, Olivier Hersent, Omar Elloumi, "M2M Communications A Systems Approach", Wiley, 2012

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PDS2EG01	GE-1(WS): Internet of Things									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	3	2	2	2	2.4	
CO-2	3	3	3	2	2	3	3	3	2	2	2.6	
CO-3	3	3	2	2	2	3	3	2	2	2	2.4	
CO-4	2	2	3	2	2	3	3	3	2	2	2.6	
CO-5	3	3	2	2	2	2	2	2	2	2	2	
<b>Mean Overall Score</b>											<b>2.4</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credit
III	21PDS3CC06	CORE-6: TIME SERIES AND SAMPLING THEORY	5	5

CO No.	CO – Statements	Cognitive Levels (K-Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the basic concepts of time series sampling theories	K1
CO-2	interpret seasonal variations using time series techniques	K2
CO-3	apply simple random sampling techniques to select samples and analyse them wisely	K3
CO-4	compare various stratified sampling techniques	K4
CO-5	evaluate and predict the trends in seasonal variations using the systematic sampling techniques	K5&K6

**Unit – I (15 Hours)**

Introduction to Forecasting: The Nature and Uses of Forecasts - Some Examples of Time Series - The Forecasting Process - Data for Forecasting- The Data Warehouse - Data Cleaning - Imputation - Resources for Forecasting- Statistics Background for Forecasting - Graphical Displays - Time Series Plots - Plotting Smoothed Data

**Unit – II (15 Hours)**

Numerical Description of Time Series Data: Stationary Time Series - Auto covariance and Autocorrelation Functions - The Variogram - Use of Data Transformations and Adjustments -Transformations - Trend and Seasonal Adjustments - General Approach to Time Series Modelling and Forecasting - Evaluating and Monitoring Forecasting Model Performance - Forecasting Model Evaluation - Choosing Between Competing Models - Monitoring a Forecasting Model

**Unit – III (15 Hours)**

Simple random sampling: Simple Random Sampling-Selection of a Simple Random Sample- Definitions and Notation - Properties of the Estimates - Variances of the Estimates - The Finite Population Correction - Confidence Limits- Random Sampling with Replacement- Estimation of a Ratio- Estimates of Totals Over Subpopulations- Comparisons Between Domain Means - Validity of the Normal Approximation - Linear Estimators of the Population Mean.

**Unit – IV (15 Hours)**

Stratified Random Sampling: Properties - Unbiased Estimate of the Mean and Variance of the Estimated Mean- Optimum Allocation - Relative Precision of Stratified Random and Simple Random Sampling

**Unit – V** **(15 Hours)**

Systematic Sampling: Estimation of the Mean and Variance - Comparison of Simple, Stratified and Systematic Sampling - Population with Linear Trend-Methods for Populations with Linear Trends - Circular Systematic Sampling - Populations with Periodic Variation – Auto correlated Populations - Natural Populations

**Books for Study**

1. Douglas C. Montgomery , Cheryl L. Jennings , Murat Kulahci , "Introduction to Time Series Analysis And Forecasting", Wiley, 2015  
**Unit-I** Chapter 1,2 (Sec 1.1-1.5, 2.1,2.2)  
**Unit-II** Chapter 2 (Sec 2.3-2.6)
2. William G. Cochran, “Sampling Techniques”, John Wiley Sons, 2007.  
**Unit-III** Chapter 2 (Sec 2.1-2.8, 2.10-2.16)  
**Unit-IV** Chapter 5 (Sec 5.3-5.6)  
**Unit-V** Chapter 8 (Sec 8.3-8.10)

**Books for Reference**

1. Box, George EP, Gwilym M. Jenkins, Gregory C. Reinsel, and Greta M. Ljung, “Time series analysis: forecasting and control”, John Wiley & Sons, 2015
2. Wilfredo Palma , "Time Series Analysis", Wiley, 2016
3. Pillai RSN and Bagavathi V, “Statistics”, S. Chand & Co., Ed, 2003.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3CC06	CORE-6: TIME SERIES AND SAMPLING THEORY									5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	3	2	2	3	3	3	2	2	2.6	
CO-2	3	3	3	2	2	3	3	3	2	2	2.6	
CO-3	3	2	2	2	2	3	2	2	2	2	2.2	
CO-4	2	2	2	2	2	3	3	2	2	2	2.4	
CO-5	2	2	2	2	2	3	3	2	2	2	2.4	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PDS3CC07	CORE-7: SOFTWARE PROJECT MANAGEMENT	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	define the software development activities and their organization	K1
CO-2	demonstrate the ways to manage goals, time, cost, changes and risks.	K2
CO-3	make use of the people to manage the organization.	K3
CO-4	analyze the software project pricing.	K4
CO-5	explain and design the project life cycle	K5&K6

**Unit – I (12 Hours)**

Project: Project – Software Project – Managing Projects – Software Project Management. - Software Development Activities and Their Organization: Software Requirements Definition – Business Modelling – Design and Implementation - Verification and Validation – Deployment – Operations and Maintenance.

**Unit – II (12 Hours)**

Managing Goals, Time and Costs: Assessing value and Risks – Formalizing the project Goals – Deciding the work – Estimating – Schedule the Plan – Optimizing a Plan – Budgeting and Accounting – Project Execution – Project Monitoring and Control – Project Closing-Managing Changes, Risks and Quality: Managing Changes – Risk Management – Quality Management.

**Unit – III (12 Hours)**

Managing People and Organizing Communication: Managing People – Project Organization Structure – Managing Communication

**Unit – IV (12 Hours)**

Software Project Pricing: From Cost to Pricing – Software Pricing – Project Pricing Strategies – Procurement and Outsourcing

**Unit – V (12 Hours)**

Managing Software Development Projects: Project Life Cycle – From Traditional to Agile – Agile Methodologies – Open Source Development Practices.

**Books for Study**

- Adolfo Villafiorita, “Introduction to Software Project Management”, CRC Press, Taylor & Francis Group, 2016.

**Unit – I** - Chapter 1 & 2

**Unit – II** - Chapter 3 & 4



- Unit – III** - Chapter 5  
**Unit – IV** - Chapter 6  
**Unit – V** - Chapter 7

**Books for Reference**

1. BOB Huges, Mike Cotterell, Rajib Mall, “Software Project Management”, McGraw Hill, 6th Edition, 2017.
2. C. Ravindranath Pandian, “Applied Software Risk Management-A Guide for Software Project Managers”, Auerbach Publications, 2015.
3. Benjamin A. Lieberman, “The Art of Software Modeling”, Auerbach Publications, 2010.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3CC07	CORE-7: SOFTWARE PROJECT MANAGEMENT									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	2	2	2	2	2	2	3	2	2	2.1	
CO-2	3	2	3	2	2	2	3	3	2	2	2.4	
CO-3	2	2	3	2	3	3	3	3	3	2	2.6	
CO-4	3	2	2	2	2	3	3	3	3	3	2.6	
CO-5	3	2	2	3	2	3	3	2	2	3	2.5	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credit
III	21PDS3CC08	CORE-8: CLOUD COMPUTING	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	show a comprehensive understanding of cloud technologies and architectures.	K1
CO-2	summarize multitenancy, Auto-Scaling and Load Balancing.	K2
CO-3	identify the Intercloud and High performance Computing.	K3
CO-4	categorize the Security, Privacy and Trust Management Issues for Cloud Computing.	K4
CO-5	compare and test the cloud monitoring and Bursting tools.	K5&K6

**Unit – I (12 Hours)**

Cloud Computing: An overview – Cloud Computing Past, Present and Future – Methodologies – Architecture and Deployment Techniques – Cloud Services – Cloud Applications – Issues with Cloud Computing - Cloud Computing and Startups: Time to Market – Implications – Changes to the Startup ecosystem – Evolution of the Cloud-Based Company - A Taxonomy of Interoperability for IaaS: Interoperability of Cloud Platforms – Taxonomy of Interoperability for IaaS - Taxonomy Study on Cloud Computing Systems and Technologies: Deployment Models – Delivery Models – Cloud Resource Management.

**Unit – II (12 Hours)**

Intercloud: From the political world to the IT – Intercloud resource sharing models – Advantages and New Business Opportunities – High Cooperation Federation Establishment – Technologies for Achieving the Intercloud - High Performance Computing Clouds: High Performance Computing vs. Cloud Computing – Taxonomy of HPC Clouds – HPC Cloud Challenges – HPC Cloud Solution – Cloud Benchmark of HPC Applications.

**Unit – III (12 Hours)**

Multitenancy: Concepts and Future – Background – Features, Advantages and Problems – Modeling Multitenancy - Auto-Scaling, Load Balancing and Monitoring in Commercial and Open-Source Clouds: Cloud Auto-Scaling – Cloud Client Load Balancing – Cloud Client Resource Monitoring.

**Unit – IV (12 Hours)**

Monitoring: Monitoring in the Cloud – Available Monitoring Tools/solution – Monitoring Infrastructure - Cloud Bursting: Aneka – Hybrid Cloud Deployment Using Aneka – Resource Provisioning Policies – Performance Analysis

**Unit – V (12 Hours)**

Energy Efficient Models for Resource Provisioning and Application Migration in Clouds: Energy Efficient in LCDSs – Energy Efficient and Applications – Energy Efficient VM

Consolidation - Security, Privacy and Trust Management Issues for Cloud Computing: Cloud Computing Securities – Scenarios – Cloud Security Challenges – Handle Cloud Security Challenges – Cloud Computing Privacy – Trust Management.

### Books for Study

1. Lizhe Wang, Rajiv Ranjan, Jinjun Chen and Boualem Benatallah, “Cloud Computing Methodology, Systems and Applications”, CRC Press, Taylor & Francis Group, 2017.

**Unit – I** - Chapter 1,2,3 & 4

**Unit – II** - Chapter 9, 11 & 12

**Unit – III** - Chapter 14 & 15

**Unit – IV** - Chapter 16 & 17

**Unit – V** - Chapter 18

### Books for Reference

1. Joseph Ingeno, “Software Architect's Handbook”, Packt Publishing,2018.
2. Scott Goessling, Kevin L. Jackson, “Architecting Cloud Computing Solutions”, Packt Publishing, 2018.
3. Dan C. Marinescu, “Cloud Computing Theory and Practice”, Elsevier, 2nd Edition, 2017.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3CC08	CORE-8: CLOUD COMPUTING									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	3	2	3	3	3	3	3	2	3	2.7	
CO-2	2	3	2	2	3	2	3	2	2	2	2.3	
CO-3	3	3	2	2	2	2	2	2	2	2	2.2	
CO-4	2	2	2	3	2	3	2	2	2	3	2.3	
CO-5	3	3	2	2	1	1	2	3	2	3	2.2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credit
III	21PDS3CC09	<b>CORE-9: DIGITAL IMAGE PROCESSING</b>	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the Digital Image Fundamentals	K1
CO-2	summarize the filtering in the frequency domain.	K2
CO-3	interpret Image restoration and reconstruction.	K3
CO-4	examine the various image transformation techniques.	K4
CO-5	assess and design the color image processing.	K5&K6

### **Unit – I (12 Hours)**

Digital Image Processing: Introduction - The Origins of Digital Image Processing - Examples of Fields that Use Digital Image Processing - Fundamental Steps in Digital Image Processing - Components of an Image Processing System - Digital Image Fundamentals: Elements of Visual Perception - Light and the Electromagnetic Spectrum. Image Sensing and Acquisition - Image Sampling and Quantization - Some Basic Relationships Between Pixels - An Introduction to the Mathematical Tools Used in Digital Image Processing.

### **Unit – II (12 Hours)**

Filtering in the Frequency Domain: Background - Preliminary Concepts - Sampling and the Fourier Transform of Sampled Functions - The Discrete Fourier Transform of One Variable - Extensions to Functions of Two Variables - Some Properties of the 2-D DFT and IDFT - The Basics of Filtering in the Frequency Domain - Image Smoothing Using Lowpass Frequency Domain Filters - Image Sharpening Using Highpass Filters - Selective Filtering - The Fast Fourier Transform.

### **Unit – III (12 Hours)**

Image Restoration and Reconstruction: Noise Models - Restoration in the Presence of Noise Only Spatial Filtering - Periodic Noise Reduction Using Frequency Domain Filtering - Linear, Position-Invariant Degradations - Estimating the Degradation Function - Inverse Filtering - Minimum Mean Square Error (Wiener) Filtering - Constrained Least Squares Filtering - Geometric Mean Filter.

### **Unit – IV (12 Hours)**

Wavelet and Other Image Transforms: Matrix-based Transforms – Correlation - Basis Functions in the Time-Frequency Plane - Basis Images - Fourier-Related Transforms - Walsh-Hadamard Transforms - Slant Transform - Haar Transform - Wavelet Transforms.

**Unit – V****(12 Hours)**

Color Image Processing: Color Fundamentals - Color Models - Pseudocolor Image Processing - Basics of Full-Color Image Processing - Color Transformations - Color Image Smoothing and Sharpening - Using Color in Image Segmentation - Noise in Color Images - Color Image Compression.

**Books for Study**

1. Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, PHI/Pearson Education, 2018.

**Unit – I** - Chapter 1 & 2

**Unit – II** - Chapter 4

**Unit – III** - Chapter 5

**Unit – IV** - Chapter 6

**Unit – V** - Chapter 7

**Books for Reference**

1. Todd R.Reed, “Digital Image Sequence Processing, Compression, and Analysis”, CRC Press, 2015.
2. L.Prasad, S.S.Iyengar, “Wavelet Analysis with Applications to Image Processing”, CRC Press, 2015.
3. A. K. Jain, “Fundamentals of Image Processing”, Second Ed., PHI, New Delhi, 2015.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3CC09	CORE-9: DIGITAL IMAGE PROCESSING									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	2	3	2	3	3	3	2	2	2	2.4	
CO-2	3	3	3	3	2	3	2	2	3	2	2.6	
CO-3	3	2	2	3	2	2	3	3	3	3	2.6	
CO-4	3	3	2	2	3	2	2	2	3	2	2.4	
CO-5	2	2	3	2	3	3	2	2	2	2	2.3	
<b>Mean Overall Score</b>											<b>2.46</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credit
III	21PDS3CP05	Software Lab-5: Image Processing	4	2

CO No.	CO – Statements	Cognitive Levels (K-Levels)
	On successful completion of this course, students will be able to	
CO-1	define various detection techniques in images.	K1
CO-2	demonstrate the techniques to create better image solutions.	K2
CO-3	develop efficient programs to disentangle problems that occur while processing the images.	K3
CO-4	analyze image processing techniques to detect accurate results.	K4
CO-5	elaborate and discuss how to process videos using various motion detection techniques.	K5&K6

#### Lab Exercises:

1. Program for Installing and configuring Open CV
2. Program for Basic Image Operations – Colors, Pixel manipulation, filtering, blur, dilation and erosion
3. Program for Scale, rotate and transform images
4. Program for Skew Detection and Correction
5. Program for Object Detection and Thresholding
6. Program for Contour Object Detection and Edge Detection
7. Program for Digit Detection
8. Program for Handling Video Input
9. Program for Motion Detection using Open CV
10. Program for Build a CAR Number Plate Detection System.

#### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credit
III	21PDS3CP05	Software Lab-5: IMAGE PROCESSING									4	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	2	3	2	2	3	3	2	2	2	2.3	
CO-2	3	2	3	3	2	3	2	2	3	2	2.5	
CO-3	3	3	2	2	3	2	2	2	2	2	2.3	
CO-4	2	2	2	2	3	3	2	2	2	2	2.2	
CO-5	3	2	2	3	3	3	2	3	2	2	2.5	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credit
III	21PDS3IS01	Internship	-	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	find their specific areas of interest, refine their skills and abilities	K1
CO-2	show a greater sense of self-awareness and <i>appreciation</i> for others	K2
CO-3	develop work habits and attitudes that are essential to succeed in the workplace	K3
CO-4	discover the importance of communication, interpersonal and other critical skills in the job interview process.	K4
CO-5	choose and prioritize employment contacts leading directly to a full-time job following graduation from college.	K5&K6

### Internship:

The Student has to undergo 40 Hours of Internship Programme in the Industry

Sl. No	Area of Work	Maximum Marks
1.	a) Work Related performance – Work Attitude / Academic Preparation / Problem Solving Ability / Adaptability / Overall Attendance / Progress towards learning goals.	25
	b) Organizational skills – Time Management Skills / Planning Skills/ Communication skills	25
	c) Relationships with others - Willingness to cooperate with co-workers / Ability to work with supervisor / Acceptance of constructive comments / Ability to take direction	25
2.	VIVA VOCE EXAMINATION	25
TOTAL		100

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3IS01	INTERNSHIP									-	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	2	3	3	3	3	2	3	2	3	2.6	
CO-2	3	2	3	3	3	3	3	2	3	3	2.8	
CO-3	3	3	3	3	3	2	3	2	3	2	2.7	
CO-4	2	3	2	2	2	2	2	3	2	3	2.3	
CO-5	3	2	1	1	2	3	2	3	2	3	2.2	
<b>Mean Overall Score</b>											<b>2.5 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credit
III	21PDS3ES03A	DSE-3: CRYPTOGRAPHY AND NETWORK SECURITY	5	4

CO No.	CO – Statements	Cognitive Levels (K-Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the fundamentals of networks security, security architecture, threats and vulnerabilities	K1
CO-2	explain Symmetric Encryption principles and Message Confidentiality	K2
CO-3	make use of various Public-key Cryptography techniques for secure data transmission	K3
CO-4	analyse essential approaches and techniques to ensure IP security and network management security	K4
CO-5	assess and build the various Message Authentication and Hash Functions to provide message authentication	K5&K6

**Unit – I (15 Hours)**

Introduction to cryptography: Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple Levels, Security Policies – Model of network security – Security attacks, services and mechanisms OSI security architecture - Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

**Unit – II (15 Hours)**

Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Stream Ciphers and RC4, Cipher Block Modes of Operation, Location of Encryption Devices, Key Distribution - Confidentiality Using Symmetric Encryption - Placement of Encryption Function - Traffic Confidentiality - Key Distribution - Random Number Generation.

**Unit – III (15 Hours)**

Public-key Cryptography: Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures, Key Management.

**Unit – IV (15 Hours)**

Message Authentication and Hash Functions: Authentication Requirements - Authentication Functions - Message Authentication Codes - Hash Functions - Security of Hash Functions and Macs - Authentication Applications - Kerberos, x.509 Authentication Service, Public-Key Infrastructure. Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.



**Unit – V****(15 Hours)**

IP Security: IP Security Over view, IP Security Architecture, Authentication Header, Encapsulating Security Payload, and Combining Security Associations. Web Security: Web Security Considerations, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET). Network Management Security: Basic Concepts of SNMP, SNMPv1 Community Facility, SNMPv3.

**Books for Study**

1. Stallings William, “Cryptography and Network Security - Principles and Practice”, Pearson Education India, 2017.

**Unit-I** - Chapter 1,2 (Sec 1.1-1.6,2.1-2.3,2.5)

**Unit-II** - Chapter 6,7 (Sec 6.1-6.3, 7.1- 7.4)

**Unit-III** - Chapter 8,9,10

**Unit-IV** - Chapter 11,14,15 (Sec 11.1-11.5,14.1-14.3,15.1,15.2)

**Unit-V** - Chapter 16,17 (Sec 16.1-16.5,17.1-17.3)

**Books for Reference**

1. Ajay Kumar, Dr S.Bose, “Cryptography and Network Security”, Pearson Education India,2017
2. Manoj Kumar, “Cryptography and Network Security”, Krishna Prakashan Media,2012
3. Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security (SIE)”,Tata McGraw Hill Education Private Limited,2011.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credit
III	21PDS3ES03A	DSE-3: CRYPTOGRAPHY AND NETWORK SECURITY									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	2	2	2	3	2	2	2	2	2.2	
CO-2	3	2	2	2	2	3	2	2	2	2	2.2	
CO-3	3	2	2	2	2	3	2	2	2	2	2.2	
CO-4	2	2	2	2	2	2	2	2	2	2	2	
CO-5	3	2	2	2	2	3	2	2	2	2	2.2	
<b>Mean Overall Score</b>											<b>2.2</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
III	21PDS3ES03B	DSE-3: NATURAL LANGUAGE PROCESSING	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	define the Linear Text Classification of NLP	K1
CO-2	demonstrate the Nonlinear classification	K2
CO-3	identify the various Language Models of NLP	K3
CO-4	analyse and Apply the Formal Language Theory	K4
CO-5	explain and formulate the Logical Semantics & Predicate-argument Semantics	K5&K6

**Unit – I (15 Hours)**

NLP Introduction: Natural Language Processing and Its Neighbours – Three Themes in NLP - Linear Text Classification: The bag of words – Naïve Bayes – Discriminative Learning – Loss Functions and Large-margin Classification – Logistic Regression – Optimization.

**Unit – II (15 Hours)**

Nonlinear Classification: Feedforward Neural Network – Designing Neural Network – Learning Neural Network – Conventional Neural Network - Linguistic Applications of Classification: Sentiment and Opinion Analysis – Word Sense Disambiguation – Design Decisions for Text Classification – Evaluating Classifier – Building Datasets.

**Unit – III (15 Hours)**

Language Models: N-Gram Language Models – Smoothing and Discounting – Recurrent Neural Network Models – Evaluating Language Models – Out of Vocabulary Words - Sequence Labeling: Sequence Labeling as Classification – Structure Prediction – The Viterbi Algorithm – Hidden Markov Model.

**Unit – IV (15 Hours)**

Formal Language Theory: Regular Languages – Context Free Languages - Context Free Parsing: Deterministic Bottom up Parsing – Ambiguity – Weighted Context Free Grammars – Learning Weighted Context Free Grammars – Grammar Refinement

**Unit – V (15 Hours)**

Logical Semantics: Meaning and Denotation – Logical Representation of Meaning – Semantic Parsing and the Lambda Calculus – Learning Semantic Parsers - Predicate-Argument Semantics: Semantic Roles – Semantic Role Labeling – Abstract Meaning Representation.

### Books for Study

1. Jacob Eisenstein, "Introduction to Natural Language Processing", MIT Press, 2019.

**Unit – I** - Chapter 1 (1.1, 1.2), Chapter 2

**Unit – II** - Chapter 3 & 4

**Unit – III** - Chapter 6 & 7

**Unit – IV** - Chapter 9 & 10

**Unit – V** - Chapter 12 & 13

### Books for Reference

1. Majumder, Bodhisattwa, et al. "Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems", O'Reilly Media, 2020.
2. Hobson Lane, Cole Howard, Hannes Hapke, "Natural Language Processing in Action Understanding, analyzing, and generating text with Python", Manning Publications, 2019.
3. Eisenstein, Jacob, "Introduction to Natural Language Processing", MIT Press, 2019.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3ES03B	DSE-3: NATURAL LANGUAGE PROCESSING									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	3	1	3	3	2	3	2	2.5	
CO-2	3	2	3	2	2	3	3	2	3	3	2.6	
CO-3	1	2	1	2	3	2	3	2	3	3	2.2	
CO-4	2	3	2	2	2	2	2	3	2	3	2.3	
CO-5	2	2	2	2	2	3	3	2	2	3	2.3	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PDS3EG02	GE-2 (BS): DEEP LEARNING	4	3

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the Deep Learning techniques	K1
CO-2	explain Boltzmann machines and computer vision of Deep learning	K2
CO-3	apply the neural network technology and its functions	K3
CO-4	analyse the deep learning concepts and acquaint themselves with the usage of ANN, CNN, RNN techniques	K4
CO-5	evaluate and solve the challenging computer vision problems through deep learning	K5&K6

**Unit – I (12 Hours)**

Foundation of Neural Networks and Deep Learning: Neural Networks–Training Neural Networks - Activation Function –Loss Function- Hyperparameters

**Unit – II (12 Hours)**

Fundamentals of Deep Networks: Defining Deep Learning – Common Architecture Principles of Deep Networks – Building Blocks of Deep Network

**Unit – III (12 Hours)**

Convolutional Neural Networks (CNNs): Biological Inspiration – Intuition - CNN Architecture Overview - Input Layers - Convolutional Layers - Pooling Layers - Fully Connected Layers - Other Applications of CNNs

**Unit – IV (12 Hours)**

Recurrent Neural Networks: Modeling the Time Dimension - 3D Volumetric Input - General Recurrent Neural Network Architecture - LSTM Networks - Domain-Specific Applications and Blended Networks. - Recursive Neural Networks: Network Architecture - Varieties of Recursive Neural Networks - Applications of Recursive Neural Networks

**Unit – V (12 Hours)**

Tensor Flow: Introduction - Go with the Flow: Up and Running with TensorFlow - Understanding TensorFlow Basics - Convolutional Neural Networks

**Books for Study**

1. Josh Patterson and Adam Gibson, “Deep Learning A practitioners Approach”,Shroff publishers & Distributors, First edition 2017.

**Unit – I** - Chapter 1

**Unit – II** - Chapter 2

**Unit - III** - Chapter 3

**Unit - IV** - Chapter 4

- Resheff, Yehezkel S., et al., "Learning TensorFlow: A Guide to Building Deep Learning Systems", O'Reilly Media, 2017.

**Unit - V** - Chapter 1,2,3,4

### Books for Reference

- BeyLevelsd, Grant, et al., "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", Pearson Education, 2019.
- Afzal, Saduf, et al., "Advances in Deep Learning", Springer Singapore, 2019.
- Chollet, François, "Deep Learning with Python", Manning Publications, 2018.

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
III	21PDS3EG02	GE-2 (BS): DEEP LEARNING									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	2	3	1	3	2	1	3	2	2.5	
CO-2	3	3	3	2	3	3	2	2	2	2	2.6	
CO-3	3	3	2	1	2	3	2	1	3	2	2.2	
CO-4	2	2	2	3	2	2	3	2	2	2	2.3	
CO-5	3	1	3	2	3	3	1	3	2	2	2.3	
<b>Mean Overall Score</b>											<b>2.4</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4PW01	PROJECT WORK	21	19

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	show leadership skills and learn time management	K1
CO-2	identify various tools to be applied to a specific problem	K2
CO-3	evaluate the reports	K3
CO-4	take part in a team as well as manage it to deliver stunning outcomes	K4
CO-5	assess and develop the individual skills to present and organize projects	K5&K6

### Project Work

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

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PDS4PW01	PROJECT WORK									21	19
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	3	2	3	2	3	2	3	2	2.5	
CO-2	2	1	3	3	1	2	3	3	2	2	2.2	
CO-3	1	3	1	3	3	3	3	2	3	3	2.5	
CO-4	3	2	3	3	3	3	3	2	3	2	2.7	
CO-5	2	2	3	3	2	1	1	3	2	3	2.2	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4CE01	COMPREHENSIVE EXAMINATION	-	2

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the basics of statistics and correlation techniques	K1
CO-2	illustrate the basic and advanced methods of big data technology	K2
CO-3	develop a comprehensive understanding of cloud technologies and architectures	K3
CO-4	examine Project life cycle and Organization	K4
CO-5	evaluate and construct BI tools critically to support the strategic decision-making of an organization	K5&K6

### Unit - I

Correlation: Definition of Correlation- Scatter Diagram- Karl Pearson's Coefficient of Linear Correlation- Spearman's Rank Correlation. Canonical Correlations and Canonical Variables: Canonical Correlations and Variates in the Population- Estimation of Canonical Correlations and Variates - Statistical Inference. Concepts of time series - Components of time series - Additive and multiplicative models for the analysis of time series

### Unit – II

Introduction to Big Data Analytics: Big Data Overview – Big Data ECO system - Data Analytics Lifecycle – Data Discovery – Data Preparation – Model Planning – Model Building – Communicate Results – Operationalize - Relational and parallel Database Design: Basics, Entity Types, Relationship Types, ER Model, ER-to- Relational Mapping algorithm. Normalization: Functional Dependency, 1NF, 2NF, 3NF, BCNF, 4NF and 5NF - Distributed and Object based Database: Architecture, distributed data storage, Distributed transactions, Commit protocols, Concurrency control, Query Processing

### Unit – III

Cloud Computing: Evolution of Cloud Computing -Essential Characteristics of cloud computing - Operational models - Service models. Google cloud platform - Amazon AWS - Microsoft Azure - Pivotal cloud foundry and Open Stack - Machine Learning: Definition- Main Types of Learning-Supervised Learning- The Brain and the Neuron –Design a Learning System –Perspectives and Issues in Machine Learning –Concept Learning Task

### Unit – IV

Definitions and Functional Requirements of IoT: Architecture - Web 3.0 View of IoT - Ubiquitous IoT Applications - Four Pillars of IoT - DNA of IoT -The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview - Communication middleware for IoT - IoT Information Security - Introduction to Business Intelligence: Definition– Business Intelligence into Context – Task and Analysis Format

## Unit – V

Introduction to algorithms: Algorithm Definition – Algorithm Specification –Asymptotic Notations. Elementary Data Structures: Stacks and Queues – Trees – Graphs - Project Management Framework: Project - Project management - Relationship among Project, Program and Portfolio management -Project and operations management-Role of project manager Project management body of knowledge - Enterprise Environmental factors - Project life cycle and Organization: Overview of project life cycle-Projects vs Operational Work-Stakeholders-Organizational influences on project management

### Books for Reference

1. Cheryl Ann Willard, "Statistical Methods An Introduction to Basic Statistical Concepts and Analysis", Taylor & Francis Publication, 2020.
2. EMC Education Services, "Data Science & Big Data Analytics: Discovering, Analysing, Visualizing and Presenting Data", Wiley & Sons, Inc Publications, 2016
3. Abraham Silberschatz, Henry F Korth , S Sudarshan, "Database System Concepts", 6<sup>th</sup> edition , McGraw-Hill International Edition , 2015
4. Buyya, Vecciola and Selvi, "Mastering Cloud Computing: Foundations and Applications Programming", Tata McGraw Hill, 2013
5. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
6. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands- on approach", Universities Press, 2015
7. Grossmann, Wilfried, and Rinderle-Ma, Stefanie., "Fundamentals of Business Intelligence", Belgium, Springer Berlin Heidelberg, 2015.
8. Ellis Horowitz, Satraj Sahnii and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, Second Edition, Reprint 2009.
9. BOB Huges, Mike Cotterell, Rajib Mall, "Software Project Management", McGraw Hill, Fifth Edition, 2011

### Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PDS4CE01	COMPREHENSIVE EXAMINATION									-	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	2	3	2	3	2	3	1	3	3	2	2.4	
CO-2	2	1	3	2	2	1	3	3	3	3	2.3	
CO-3	3	2	1	2	1	3	2	3	3	2	2.2	
CO-4	3	2	3	3	1	2	3	3	2	3	2.5	
CO-5	2	3	2	3	3	3	1	1	2	3	2.3	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	



Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4CC10	CORE-10: BUSINESS INTELLIGENCE	4	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall the concepts and components of Business Intelligence (BI)	K1
CO-2	interpret the data provisioning in BI to fetch the desired data from the source to the target system	K2
CO-3	apply the data visualization in Business Intelligence to translate the <i>information</i> into a visual context	K3
CO-4	analyse large sets of data through process analysis in BI	K4
CO-5	evaluate and construct BI tools critically to support the strategic decision-making of an organization	K5&K6

**Unit – I (12 Hours)**

Introduction to Business Intelligence: Definition– Putting Business Intelligence into Context – Task and Analysis Format

**Unit – II (12 Hours)**

Modelling in Business Intelligence: Models and Modelling in Business Intelligence – Logical and Algebraic Structure – Graph Structure – Analytical Structure – Models and Data

**Unit – III (12 Hours)**

Data Provisioning: Data Collection and Description – Data Extraction – Transactional Data Towards Analytical Data – Scheme and Data Integration

**Unit – IV (12 Hours)**

Data Description and Visualization: Description and visualization for Business process – Description and visualization of data in customer perspective -Basic Visualization Technique -Reporting

**Unit – V (12 Hours)**

Process Analysis: Business process analysis and Simulation – Process performance Management and Warehousing – Process Mining – Business Process Compliance – Evaluation Assessment

**Books for Study**

- Grossmann, Wilfried, and Rinderle-Ma, Stefanie. Fundamentals of Business Intelligence. Belgium, Springer Berlin Heidelberg, 2015.

**Unit – I** - Chapter 1

**Unit – II** - Chapter 2

- Unit - III** - Chapter 3  
**Unit - IV** - Chapter 4  
**Unit - V** - Chapter 7

**Books for Reference**

1. Olszak, Celina M, “Business Intelligence and Big Data: Drivers of Organizational Success”. United States, CRC Press, 2020.
2. King, David, et al. Business Intelligence, Analytics, and Data Science: A Managerial Perspective. Germany, Pearson, 2017.
3. Brijs, Bert. “Business Analysis for Business Intelligence”, CRC Press, 2016.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PDS4CC10	CORE-10: BUSINESS INTELLIGENCE									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	2	2	3	3	2	2	2	2	2	2.3	
CO-2	2	3	3	3	3	3	3	3	3	3	2.9	
CO-3	3	2	2	2	2	2	3	3	2	2	2.3	
CO-4	3	2	2	3	3	3	2	2	2	3	2.5	
CO-5	1	3	3	2	3	1	2	2	3	2	2.2	
<b>Mean Overall Score</b>											<b>2.4 (High)</b>	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4ES04A	DSE-4: SENTIMENT ANALYSIS	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall various tools used for sentiment analysis	K1
CO-2	classify the whole document text as expressing a positive, neutral or negative opinion.	K2
CO-3	make use of Subjectivity and Sentiment Classification to classify a sentence as subjective or objective	K3
CO-4	examine the aspects of sentiment classification in social media platforms	K4
CO-5	explain and choose domain specific Sentiment Lexicon generation	K5&K6

**Unit – I (15 Hours)**

Introduction to Sentiment Analysis: Sentiment Analysis Applications -Sentiment Analysis Research- Different Levels of Analysis - Sentiment Lexicon and Its Issues - Analyzing Debates and Comments - Mining Intentions - Opinion Spam Detection and Quality of Reviews - The Problem of Sentiment Analysis - Definition of Opinion - Definition of Opinion Summary - Affect, Emotion, and Mood - Different Types of Opinions

**Unit – II (15 Hours)**

Document Sentiment Classification: Supervised Sentiment Classification- Classification Using Machine Learning Algorithms - Classification Using a Custom Score Function - Unsupervised Sentiment Classification - Classification Using Syntactic Patterns and Web Search - Classification Using Sentiment Lexicons - Sentiment Rating Prediction - Cross-Domain Sentiment Classification - Cross-Language Sentiment Classification - Emotion Classification of Documents

**Unit – III (15 Hours)**

Sentence Subjectivity and Sentiment Classification: Sentence Subjectivity Classification - Sentence Sentiment Classification - Assumption of Sentence Sentiment Classification - Classification Methods - Dealing with Conditional Sentences - Dealing with Sarcastic Sentences - Cross-Language Subjectivity and Sentiment Classification - Using Discourse Information for Sentiment Classification - Emotion Classification of Sentences

**Unit – IV (15 Hours)**

Aspect Sentiment Classification: Rules of Sentiment Composition - Negation and Sentiment - Modality and Sentiment - Coordinating Conjunction But - Sentiment Words in Non-opinion Contexts - Rule Representation - Word Sense Disambiguation and Coreference Resolution

**Unit – V****(15 Hours)**

Sentiment Lexicon Generation: Dictionary-Based Approach - Corpus-Based Approach - Identifying Sentiment Words from a Corpus - Dealing with Context-Dependent Sentiment Words - Lexicon Adaptation - Some Other Related Work - Desirable and Undesirable Facts - Analysis of Comparative Opinions- Problem Definition- Identify Comparative Sentences - Identifying the Preferred Entity Set - Special Types of Comparison- Sentences Involving Compare and Comparison - Entity and Aspect Extraction

**Books for Study**

1. Bing Liu, “Sentiment Analysis - Mining opinion, Sentiments and Emotions”, Cambridge University Press, 2015.

**Unit-I** -Chapter 1,2 (Sec 1.1-1.5, 2.1,2.2)

**Unit-II**- Chapter 3 (Sec 3.1-3.6)

**Unit-III** - Chapter 4 (Sec 4.1-4.8)

**Unit-IV** - Chapter 5 (Sec 5.1-5.8)

**Unit-V** - Chapter 7,8 (Sec 7.1-7.3, 8.1-8.5)

**Books for Reference**

1. Roy De Groot, “Data mining for Tweet sentiment classification - Twitter sentiment analysis”, LAP Lambert Academic Publishing, 2012.
2. Bing Liu, “Sentiment Analysis and Opinion Mining”, Morgan and Claypool publishers, 2012.
3. Ghowsalya Balu, "Forecast rating based on public comments by sentiment analysis",LAP LAMBERT Academic Publishing,2019.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PDS4ES04A	DSE-4: SENTIMENT ANALYSIS									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	2	2	2	3	2	2	2	2	2.2	
CO-2	3	2	2	2	2	3	3	2	2	2	2.4	
CO-3	3	2	2	2	2	3	3	2	2	2	2.4	
CO-4	3	3	2	2	2	3	2	2	2	2	2.2	
CO-5	3	2	2	2	2	3	2	2	2	2	2.2	
<b>Mean Overall Score</b>											<b>2.2</b>	<b>(High)</b>

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PDS4ES04B	DSE-4: SOFT COMPUTING	5	4

CO No.	CO – Statements	Cognitive Levels (K- Levels)
	On successful completion of this course, students will be able to	
CO-1	recall various tools used for sentiment analysis	K1
CO-2	interpret artificial neural networks and fuzzy theory from an engineering perspective	K2
CO-3	apply Genetic Algorithms to find optimal or near-optimal solutions to difficult problems	K3
CO-4	examine the concepts of Supervised Learning Networks	K4
CO-5	explain and discuss neural network theory and fuzzy logic theory	K5&K6

**Unit – I (15 Hours)**

Introduction to Neural Networks: Application Scope of Neural Networks - Fuzzy Logic - Genetic Algorithm - Hybrid Systems - Soft Computing- Artificial Neural Network: An Introduction -Fundamental Concept - Evolution of Neural Networks - Basic Models of Artificial Neural Network

**Unit – II (15 Hours)**

Supervised Learning Network: Introduction to Supervised Learning Network- Perceptron Networks - Adaptive Linear Neuron (Adaline) - Multiple Adaptive Linear Neurons - Back-Propagation Network - Radial Basis Function Network - Time Delay Neural Network - Functional Link Networks - Tree Neural Networks -Wavelet Neural Networks

**Unit – III (15 Hours)**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Classical Sets (Crisp Sets) - Fuzzy Sets - Classical Relations and Fuzzy Relations- Cartesian Product of Relation - Classical Relation - Fuzzy Relations - Tolerance and Equivalence Relations – Non-interactive Fuzzy Sets

**Unit – IV (15 Hours)**

Classical Relations and Fuzzy Relations: Cartesian Product of Relation- Classical Relation- Fuzzy Relations -Tolerance and Equivalence Relations- Non-interactive Fuzzy Sets- Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Arithmetic-Extension Principle-Fuzzy Measures - Measures of Fuzziness -Fuzzy Integrals

**Unit – V (15 Hours)**

Genetic Algorithm: Biological Background - Traditional Optimization and Search Techniques - Genetic Algorithm and Search Space -Genetic Algorithm vs. Traditional Algorithms - Basic Terminologies in Genetic Algorithm - Simple GA- General Genetic Algorithm --Operators in Genetic Algorithm - Stopping Condition for Genetic Algorithm Flow -Constraints in Genetic Algorithm -Problem Solving Using Genetic Algorithm -The

Schema Theorem- Classification of Genetic Algorithm- Holland Classifier Systems - Genetic Programming -Advantages and Limitations of Genetic Algorithm -Applications of Genetic Algorithm

**Books for Study**

1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, 3<sup>rd</sup> Edition, Wiley India Pvt. Limited, 2018.

**Unit-I** -Chapter 1,2 (Sec 1.1-1.6, 2.1-2.3)

**Unit-II-** Chapter 3 (Sec 3.1-3.10)

**Unit-III** - Chapter 10 (Sec 10.1-10.3)

**Unit-IV** -Chapter 11,14 (Sec 11.1-11.6,14.1-14.6)

**Unit-V-**Chapter 21 (Sec 21.1-21.18)

**Books for Reference**

1. Roy, Samir;Chakraborty. Soft Computing. India, Pearson Education India, 2013
2. Saroj Kaushik, Sunita Tiwari, "Soft Computing: Fundamentals, Techniques and Applications",McGraw-Hill Education, 2018
3. N.P. Padhy, S.P. Simon , "Soft Computing with MATLAB programming",Oxford University Press,2015.

**Relationship matrix for Course Outcomes (COs), Programme outcomes /Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PDS4ES04B	DSE-4: SOFT COMPUTING									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	3	2	2	3	3	3	2	2	2.6	
CO-2	3	3	3	2	2	2	3	3	2	2	2.4	
CO-3	3	3	2	2	2	3	3	2	2	2	2.4	
CO-4	2	2	2	2	2	3	2	2	2	2	2.2	
CO-5	2	2	2	2	2	2	2	2	2	2	2	
<b>Mean Overall Score</b>											<b>2.3 (High)</b>	