

PG DEPARTMENT OF DATA SCIENCE
LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK (LOCF)

M.Sc. DATA SCIENCE

I - IV Semesters

Scheme and Syllabus

Effective for the students admitted from the

Academic Year 2025-2026

and onwards



DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(AUTONOMOUS)

Reaccredited with A++ Grade by NAAC

College with Potential for Excellence

Linguistic Minority Institution, Affiliated to University of Madras,

E.V.R. PERIYAR HIGH ROAD,

ARUMBAKKAM, CHENNAI – 600106, TAMILNADU

APRIL 2025

S.No	CONTENTS	PAGE NO
1	Vision, Mission and Program Educational Objectives (PEO)	1
2	Program Outcomes (PO) with Graduate Attributes	2
3	Mapping of POs with PEOs	3
SCHEME		
4	Scheme of First Semester	5
5	Scheme of Second Semester	6
6	Scheme of Third Semester	7
7	Scheme of Fourth Semester	8
SYLLABUS		
8	Syllabus of First Semester	
a	Core Course I – Data Visualization for Analytics using R and Python	10
b	Core Course II- An Introduction to Data Analytics	12
c	Core Course III- Advanced Web Technology	14
d	Discipline Specific Elective I (A) Discrete Mathematics (B) Linear Algebra (C) Statistics for Data Science	16 18 20
e	Discipline Specific Elective II (A) Digital Image Processing (B) Web Database and Information System (C) Data Science Ethics	22 24 26
f	Core Practical - I: Data Visualization for Analytics Laboratory Using R and Python	28
g	Core Practical - II: Advanced Web Technology Lab	30
h	Soft Skill - I : Effective Communication in English	
9	Syllabus of Second Semester	
a	Core Course IV-NoSQL Database Management	32
b	Core Course V-Descriptive and Discovery Analytics	34
c	Core Course VI- Cloud Analytics	36
d	Discipline Specific Elective III (A) Regression Analysis (B) Probability and Distribution Models (C) Design And Analysis of Experiments	38 40 42

	e	Discipline Specific Elective IV (A) Cyber Security (B) Digital Forensics (C) Big Data Security	44 46 48
	f	Core Practical - III : NoSQL Database Management Lab	50
	g	Core Practical – IV : Descriptive and Discovery Analytics Lab	52
	h	Soft Skill –II : English Or Competitive Exams	
10		Syllabus of Third Semester	
	a	Core Course VII- Predictive Analytics	54
	b	Core Course VIII- Exploratory Data Analysis	56
	c	Core Course IX- Block Chain & Crypto currency Fundamentals	58
		Multi – Discipline Elective/Open Elective I	
	d	(A) Bio-informatics/ (B) Genetic Engineering/ (C) Bioethics and Diversity.	60 62 64
	e	Core Practical - V : Predictive Analytics Lab	66
	f	Core Practical - VI : Exploratory Data Analysis Lab	68
	g	Internship	
	h	Discipline Specific I • Skill Enhancement Course – Quantitative Aptitude	70
11		Syllabus of Fourth Semester	
	a	Project & Viva-Voce	72
	b	Discipline Specific II • Skill Enhancement Course – Logical Reasoning	73
		Appendix A Outcome Based Education	75
		Appendix B Graduate Attributes	77
		Appendix C Bloom’s Taxonomy	78

DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE

VISION

To impart value based quality academia; to empower students with wisdom and to charge them with rich Indian traditions and culture; to invoke the self, to broaden the same towards nation building, harmony and Universal brotherhood.

MISSION

To impart knowledge, enable the students acquire skills and imbibe values, develop their personality, mould their character, evoke a sense of empathy and social concern, and thereby help them evolve into humane and responsible citizens.

M.Sc. DATA SCIENCE

VISION

Delivering quality education, equipping students with cutting-edge computer skills to thrive in tech and society.

MISSION

M1	To foster a focused and friendly learning atmosphere.
M2	To provide the team-sprit and leadership qualities.
M3	Sharpening skills in Data science through analytical and applied learning.
M4	Enhancing skills through internships and industrial exposure

PROGRAMME EDUCATION OBJECTIVES (PEOs)

PEO1	Apply terminologies and principles in problem solving adapting to applications of Mathematics, Statistics, Business and emerging computing technologies in the field of Data science to conceptualize real world problems.
PEO2	Exhibit proficiency as data analytics professionals through latest technologies to business and organizations in demonstrating the ability for work efficacy.
PEO3	Work and collaborate with interdisciplinary backgrounds as a part of team to address the contemporary issues with innovation.
PEO4	Pursue entrepreneurship, research and higher studies associated with the program to function efficiently and effectively addressing challenging problems innovatively in the society.
PEO5	Communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavor.

MAPPING OF PEO WITH MISSION

MISSION STATEMENTS	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	3	3	3	3
M2	2	3	3	2	3
M3	3	3	2	3	3
M4	3	3	3	3	2

Correlation: 3- Strong, 2- Medium, 1- Low

PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES

PROGRAMME OUTCOMES

At the completion of the M.Sc. Data Science program, the student of our department will be able to:

PO1	Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline
PO2	Cultivate the skills to acquire and use appropriate learning resources including library, e learning resource, ICT tools to enhance knowledge base and stay abreast of recent developments
PO3	Ability to handle/use appropriate tools/ techniques/ equipment with an understanding of the standards operation procedures safety aspects/ limitations.
PO4	Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions / solutions
PO5	Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solution. Exhibit organisational skills and the ability to manage time and resources
PO6	Engage in continuous learning to stay current with emerging technologies and trends in computer science, also Integrating real-world application, practical exposure, and project-based learning

MAPPING OF POS WITH PEOS

PEO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
PEO 1	3	3	2	3	3	3
PEO 2	3	3	3	2	2	3
PEO 3	3	2	3	3	2	3
PEO 4	2	3	2	3	2	3
PEO 5	3	3	3	3	2	3

Correlation: 3- Strong, 2- Medium, 1- Low

PROGRAM SPECIFIC OUTCOME

PSO 1	Take leading roles in industry, academia, entrepreneurship and applications.
PSO 2	Analyze the data and apply statistical with machine learning concepts, and interpret the results obtained in their operational context.
PSO 3	Scientific, ethical and socially responsible approach for conducting and contributing to research in their specific area of study and to international trends in and related to their field of study
PSO 4	Implement the concepts of Statistics, optimization techniques, Data Repository, Data Analytics on real-world problems, and take a decision on the problem
PSO 5	Identify the appropriate mathematical and statistical techniques to solve the problems and give right solution to the industry and scientific communities, and the society.

SCHEME OF I SEMESTER M.Sc. DATA SCIENCE PROGRAM

SEMESTER I												
Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs Distribu-tion				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part I	Core Course I	2569101	Data Visualization for Analytics using R and Python	4	3	1	0	-	4	50	50	100
	Core Course II	2569102	An Introduction to Data Analytics	4	3	1	0	-	4	50	50	100
	Core Course III	2569103	Advanced Web Technology	4	3	1	0	-	4	50	50	100
	Discipline Specific Elective I	2569104(A)	Discrete Mathematics	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective I	2569104(B)	Linear Algebra	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective I	2569104(C)	Statistics for Data Science	3	3	1	0	-	4	50	50	100
	Discipline Specific Elective II	2569105(A)	Digital Image Processing	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective II	2569105(B)	Web Database and Information System	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective II	2569105(C)	Data Science Ethics	3	3	1	0	-	4	50	50	100
	Core Practical I	2569106	Data Visualization for Analytics Laboratory Using R and Python	3	0	1	4	-	5	50	50	100
	Core Practical II	2569107	Advanced Web Technology Lab	3	0	1	4	-	5	50	50	100
Part II	Soft Skill - I	2550101	Effective Communication in English	2								
Total				26					30	350	350	700

SCHEME OF II SEMESTER M.Sc. DATA SCIENCE PROGRAM

SEMESTER II												
Component	Course Category	CourseCode	Name of the course	Over All Credits	Hrs Distribu-tion				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part I	Core Course IV	2569208	NoSQL Database Management	4	3	1	0	-	4	50	50	100
	Core Course V	2569209	Descriptive and Discovery Analytics	4	3	1	0	-	4	50	50	100
	Core Course VI	2569210	Cloud Analytics	4	3	1	0	-	4	50	50	100
	Discipline Specific Elective III	2569211(A)	Regression Analysis	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective III	2569211(B)	Probability And Distribution Models	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective III	2569211(C)	Design And Analysis Of Experiments	3	3	1	0	-	4	50	50	100
	Discipline Specific Elective IV	2569212(A)	Cyber Security	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective IV	2569212(B)	Digital Forensics	3	3	1	0	-	4	50	50	100
	OR											
	Discipline Specific Elective IV	2569212(C)	Big Data Security	3	3	1	0	-	4	50	50	100
	Core Practical III	2569213	No SQL Database Management Laboratory	3	0	1	4	-	5	50	50	100
	Core Practical IV	2569214	Descriptive and Discovery Analytics Lab	3	0	1	4	-	5	50	50	100
Part II	Soft Skill II	2550201	English for Competitive Exams	2								
Total				26					30	350	350	700

SCHEME OF III SEMESTER M.Sc. DATA SCIENCE PROGRAM

SEMESTER III												
Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part I	Core Course VII	2569315	Predictive Analytics	4	4	1	0	-	5	50	50	100
	Core Course VIII	2569316	Exploratory Data Analysis	4	4	1	0	-	5	50	50	100
	Core Course IX	2569317	Block Chain & Crypto currency Fundamentals	4	4	1	0	-	5	50	50	100
	Multi Discipline Elective/ Open Elective I	2569318(A)/ 2569318(B)/ 2569318(C)	Bio-informatics/Genetic Engineering/Bioethics and Diversity.	3	2	1	0	-	3	50	50	100
	Core Practical V	2569319	Predictive Analytics Lab	3	0	1	4	-	5	50	50	100
	Core Practical VI	2569320	Exploratory Data Analysis Lab	3	0	1	4	-	5	50	50	100
	Internship	2569321		2				-				
Part II	Soft Skill III	2550304	Personality Development	2				-				
	SEC-DS I	2569322	Quantitative Aptitude	3	2	1	0	-	3	50	50	100
Total				28					31	350	350	700

SCHEME OF IV SEMESTER M.Sc. DATA SCIENCE PROGRAM

SEMESTER IV												
Component	Course Category	Course Code	Name of the course	Over All Credits	Hrs Distribution				Total contact Hours	Marks		
					L	T	P	S		CIA	ESE	Total
Part I	Core Project	2569423	Project & Viva Voce	5	0	7	20	-	27	50	50	100
Part II	SEC- DS II	2569424	Logical Reasoning	3	2	1	0	-	3	50	50	100
	Soft skill IV	2550404	Presentation	2								
	Industrial Visit	2569425		1								
Total				11					30	100	100	200

- **Part-II courses** are **not** included in Total Marks and CGPA Calculation.
- **Summer Internship** will be carried out by the students during the summer vacation of the first year with a minimum of 3 weeks or 21 days (as per UGC guidelines) and the internship certificate should be sent to the COE office and the same will be included in the Third Semester Marks Statement to earn 2 credit.
- **Project & Viva-Voce** will be conducted in fourth semester, Soft Skill and Spoken Tutorial Certificate course will be conducted. Summer Internship and one MOOC certificate course will be conducted for the entire course.
- **Soft Skill** Syllabus framed and approved by English Department.

OVERALL SEMESTER WISE CREDIT DISTRIBUTION

Component	Credits
Part I	76
Part II	15
Total	91

S. No	Category	Course Category	No of Courses	Credits	Total Credits
1.	Part I	Core Theory	9	4	36
2.		Core Practical	6	3	18
3.		Core Project	1	5	5
4.		Core Internship	1	2	2
5.		Discipline Specific Elective	4	3	12
6.		Multi-Disciplinary Elective	1	3	3
7.	Part II	Skill Enhancement Course-Discipline Specific	2	3	6
8.		Soft Skill	4	2	8
9.		Industrial Visit	1	1	1
10.	Total Mandatory Credits				91

Syllabus Co-ordinator

Academic Council-Member Secretary

BOS-Chairman

**DEPARTMENT OF M.Sc. DATA SCIENCE
FIRST SEMESTER
CORE I**

Course Title: – DATA VISUALIZATION FOR ANALYTICS USING R AND PYTHON

Course Code : 2569101	Credits	04
L:T:P:S : 3:1:0:0	CIA Marks	: 50
Exam Hours : 03	ESE Marks	: 100

LEARNING OBJECTIVES:

- *Understand the principles of data visualization, including the importance of visual representation in data analysis and storytelling.*
- *Gain proficiency in using key libraries for data visualization in R (e.g., ggplot2, plotly) and Python (e.g., Matplotlib, Seaborn, Plotly).*
- *Learn techniques for cleaning and transforming data to make it suitable for visualization.*
- *Develop skills to create a variety of visualizations (e.g., bar charts, line graphs, scatter plots, heatmaps) to effectively communicate data insights.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain expertise in data visualization principles to transform data into actionable insights
CO2	Develop skills in manipulating and visualizing data using both R and Python for versatile programming applications.
CO3	Create various plots and graphics through hands-on exercises to effectively communicate data.
CO4	Emphasize the application of visualization techniques in real world scenarios to inform data-driven decisions
CO5	Establish a strong foundation for further studies in data analytics, statistics, and machine learning

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S. No	CONTENTS OF MODULE	Hrs	COs
1	MODULE –I Introduction to Data Visualization: Data, Information, Knowledge, Data Analysis and Insights, Transforming Data into Information, Transforming Information into Knowledge, Transforming Data into Insight, Data Visualization Tools for Analytics.	9	CO1
2	MODULE- II Basic Data Manipulation in R: Installing and getting help in R, Data types in R, Data Import and Export, Basic Data Manipulation, Summary Statistics, Vectors-Generating Vectors, Vector Indexing, Vectorized Functions, Filtering Vectors, Matrices-General Operations, Indexing, Preliminary Analysis, Adding, Deleting Elements Matrices. Filtering Matrices, Apply function	9	CO2
3	MODULE- III Basic Graphics and Sample Analysis: Histogram, A simple Bar Plot, An Interactive Bar Plot, Scatter Plot-Scatter Plot with texts, labels and lines, An interactive Scatter Plot, Box Plot, Plotting Multiple Curves, Lines function, Adding Legend, Text in a graph, Pin pointing a Location, Replaying a Plot, the Polygon function, lowness function, Graphing an explicit function.	9	CO3
4	MODULE- IV Basic Concepts in Python for Visualization: Installing and getting help in Python, Data types in Python, Data Import and Export, Basic Data Manipulation, Summary Statistics Bar graphs, Pie charts, Box Plots, Scatter Plots, Bubble Charts, KDE Plots.	9	CO4
5	MODULE-V Interactive Plotting and IDE in Python: Types of Interactive tools-I Python, Plotly, Interactive Plotting- NumPly, SciPly and MKL functions, Types of Python IDEPyCharm, PyDev, Visualization Plots using Anaconda, Visualization using matplotlib	9	CO5

TEXT BOOKS

1. Kirthi Raman, “Mastering Python Data Visualization”, Packt Publishing Ltd., UK.
2. Atmajithsingh Gohil, “R Data Visualizing Codebook”, Packt Publishing Ltd., UK.
3. Brian S. Everitt and Torsten Hothorn, “A Handbook of Statistical Analyses Using R”, 2nd Edition, Taylor and Francis Group.
4. Norman Mattloff, “The Art of R Programming”, No Starch Press, San Francisco.

REFERENCE BOOKS

1. Chambers, J.M. (1998), “Programming with Data”, New York, USA: Springer.
2. Meyer, D., Zeileis, A., Karatzoglou, A., and Hornik, K. (2006), “Visualizing Categorical Data”, URL <http://CRAN.R-project.org>, R package version 0.9-91.

E- REFERENCES

1. <https://www.towardsdatascience.com/r-for-beginners-learn-how-to-visualize-data-like-a-pro-840d1828c09c>
2. <https://www.geeksforgeeks.org/python-data-visualization-tutorial/>
3. <https://en.wikipedia.org/wiki/Matplotlib>

CORE II

Course Title: AN INTRODUCTION TO DATA ANALYTICS

Course Code : 2569102	Credits	04
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES

- *Understand what data analytics is and its role in modern decision-making across various industries.*
- *Learn about the four main types of analytics: descriptive, diagnostic, predictive, and prescriptive.*
- *Gain insight into various data collection methods, including surveys, experiments, and existing data sources.*
- *Develop skills in data cleaning, preprocessing, and transformation to ensure data quality for analysis.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Explore the definition, significance, and applications of data analytics and big data across various sectors, including healthcare, advertising, and smart cities.
CO2	Gain insights into the hardware architecture required for data analytics, distributed file systems like Hadoop, and comparisons between traditional data warehousing and big data solutions.
CO3	Learn the stages of data analytics, including descriptive, predictive, prescriptive, and discovery analytics, as well as the complete project life cycle from discovery to operationalization.
CO4	Analyze how data analytics is utilized in diverse fields such as healthcare, business, sports, and disaster management, focusing on personalized treatments, targeted advertising, and more.
CO5	Examine practical case studies from organizations like common wealth Bank, Aetna Innovation Labs, and Walmart to understand successful big data analytics implementations and their impacts.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	2	3	2	3	3	3	2	3
CO3	3	3	3	3	2	2	2	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Data Analytics and Big Data: Data Analytics- Definition, Launch, Importance of Data Analytics, Big Data-Definition, Sources, Characteristics, Data Analytics Applications-Biomedical, Mobile Advertising, Sentimental Analysis, Disaster Management, Recommendation Engines, Smart Cities.	9	CO1
2	MODULE-II Architectural Elements for Data Analytics: Hardware Architecture for Data Analytics, Characteristics, Requirements, Distributed File System for Big Data- Commodity Cluster for Big Data, Storage and Programming Model of Hadoop for Big Data, Data in Warehouse and Data in Hadoop- a comparison, Data Analytics on Cloud.	9	CO2
3	MODULE- III Stages of Data Analytics and Data Analytics Project Life Cycle: Stages of Data Analytics- Descriptive Analytics, Discovery Analytics, Prescriptive Analytics, Predictive Analytics. Data Analytics Project Life Cycle- Roles of Data Scientist.	9	CO3
4	MODULE-IV Analytics Applications: Data Analytics in Health Care- Personalized Treatment, Business-Targeted advertising, introducing a new Product, Fraud Prediction, Data Analytics in Sports, Disaster Management, Data Analytics for Smart Cities, Requirements for being successful with Big Data Analytics.	9	CO4
5	MODULE-V Data Analytics Projects-Case Studies: Big Data Analytics in Common wealth Bank of Australia for Risk Analysis, Aetna Innovation Labs Analytics for Improving Health, Walmart’s analytics to improve online shopping, Jio and Data Analytics.	9	CO5

TEXT BOOKS

1. “A Guide to Big Data Analytics”, Datameer.com.
2. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Pack Publications.
3. D.Dietrich, B.Heller, B.Yang, “Data Science and Big Data Analytics”, EMC Education Services.

REFERENCE BOOKS

1. "Data Analytics Made Accessible" by Anil Maheshwari
2. Data Science for Business “by Foster Provost and Tom Fawcett
3. "Naked Statistics: Stripping the Dread from the Data “by Charles Wheelan
4. "Practical Statistics for Data Scientists" by Peter Bruce and Andrew Bruce

E-REFERENCES

1. <https://www.techtarget.com/searchbusinessanalytics/definition/data-analytics>
2. <https://www.simplilearn.com/tutorials/hadoop-tutorial/what-is-hadoop>
3. <https://www.dataversity.net/big-data-case-study-commonwealth-bank-australia/>

CORE III

Course Title: **ADVANCED WEB TECHNOLOGY**

Course Code : 2569103	Credits	04
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES

- *Understand the concepts of Object Oriented Programming*
- *Become proficient programmers through the java programming language.*
- *Give insight into real world applications.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain a comprehensive overview of the .NET framework, including its languages, data types, and object manipulation techniques essential for web development
CO2	Learn to develop ASP.NET applications, focusing on code-behind structures, web forms, server controls, and the use of Visual Studio.NET for project management and debugging
CO3	Acquire detailed knowledge of ADO.NET for data access and management, including SQL operations, data binding, and handling disconnected data models
CO4	Explore web services, including WSDL and SOAP, and learn to create, document, and consume web services effectively.
CO5	Understand component-based programming, custom controls, caching techniques, and performance tuning strategies to enhance web application efficiency and scalability.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	2	3	3	2	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE- I OVERVIEW OF ASP.NET - The .NET framework – Learning the .NET languages : Data types – Declaring variables- Scope and Accessibility- Variable operations- Object Based manipulation- Conditional Structures- Loop Structures- Functions and Subroutines. Types, Objects and Namespaces : The Basics about Classes- Value types and Reference types- Advanced class programming- Understanding name spaces and assemblies.	9	CO1
2	MODULE– II Developing ASP.NET Applications - ASP.NET Applications: ASP.NET applications– Code behind- The Global.asax application file- Understanding ASP.NET Classes- ASP.NET Configuration. Web Form fundamentals: A simple page applet- Improving the currency converter- HTML control classes- The page class- Accessing HTML server controls. Web controls: Web Control Classes – AutoPostBack and Web Control events- Accessing web controls. Using Visual Studio.NET: Starting a Visual Studio.NET Project- Web form Designer- Writing code- Visual studio.NET debugging. Validation and Rich Controls: Validation- A simple Validation example- Understanding regular expressions- A validated customer form. State management - Tracing, Logging, and Error Handling.	9	CO2
3	MODULE- III Working with Data - Overview of ADO.NET - ADO.NET and data management- Characteristics of ADO.NET-ADO.NET object model. ADO.NET data access : SQL basics– Select , Update, Insert, Delete statements- Accessing data- Creating a connection- Using a command with a DataReader - Accessing Disconnected data - Selecting multiple tables – Updating Disconnected data. Data binding: Single value Data Binding- Repeated value data binding- Data binding with data bases. Data list – Data grid – Repeater – Files, Streams and Email – Using XML	9	CO3
4	MODULE–IV Web Services - Web Services Architecture: Internet programming then and now- WSDL–SOAP- Communicating with a web Service-Web service discovery and UDDI. Creating Web services: Web service basics- The StockQuote web service – Documenting the web service- Testing the web service- Web Service Data types- ASP.NET intrinsic objects. Using web services: Consuming a web service- Using the proxy class- An example with TerraService.	9	CO4
5	MODULE – V Advanced ASP.NET - Component Based Programming: Creating a simple component – Properties and state- Database components- Using COM components. Custom controls: User Controls- Deriving Custom controls. Implementing security: Determining security requirements- The ASP.NET security model- Forms authentication- Windows authentication.	9	CO5

TEXT BOOK

1. Mathew Mac Donald, “ASP.NET Complete Reference”, TMH 2005.

REFERENCE BOOKS

1. Crouch Matt J, “ASP.NET and VB.NET Web Programming”, Addison Wesley 2002.
2. J.Liberty, D.Hurwitz, “Programming ASP.NET”, Third Edition, O’REILLY, 2006.

E-REFERENCES

1. <https://www.tutorialspoint.com/asp.net/index.htm>
2. <https://www.geeksforgeeks.org/data-binding-in-asp-net/>
3. <https://www.tutorialsteacher.com/aspnet/user-controls-in-aspnet>

DISCIPLINE SPECIFIC ELECTIVE I

Course Title: (A) DISCRETE MATHEMATICS

Course Code : 2569104(A)	Credits	03
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- To develop knowledge and understand concepts of mathematical induction, logic, functions and relations.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To introduce Mathematical Logic to understand the equivalence of statements.
CO2	To acquaint the students with Inference Theory and predicate calculus to understand partial order and partition.
CO3	To introduce fundamental principles of Combinatorial Counting techniques
CO4	To explain generating functions and their utility in solving recurrence relations
CO5	To introduce graph models and tree structures with basics and significance of reversibility.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	2	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	2	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENT OF MODULE	Hrs	COs
1	MODULE-I Sets, Sequences and Functions: Sets-Some Special Sets-Set Operations-Functions Sequences-Properties of Functions-Propositions-Conditional Propositions and Logical Equivalence-Arguments and Rules of Inference-Quantifiers-Nested Quantifiers. Elementary Logic: Informal Introduction-Propositional Calculus-Getting Started with Proofs-Methods of Proof-Logic in Proofs-Analysis of Arguments	9	CO1
2	MODULE-II Relations: Relations-Digraphs and Graphs-Matrices-Equivalence Relations and Partitions The Division Algorithm and Integers Mod p. Induction and Recursion: Loop Invariants Mathematical Induction-Big-Oh Notation-Recursive Definitions-Recurrence Relations-More Induction-The Euclidean Algorithm.	9	CO2
3	MODULE-III Counting: Basic Counting Techniques-Elementary Probability-Inclusion-Exclusion and Binomial Methods-Counting and Partitions-Permutations and Combinations, Binomial Coefficients and Identities, Equivalence Relations, Generalized Permutations and Combinations, Generating Functions, Inclusion-Exclusion, Applications of Inclusion Exclusion-Pigeon-Hole Principle. Algorithms: Introduction-Examples of Algorithms Analysis of Algorithms-Recursive Algorithms.	9	CO3
4	MODULE-IV Graphs: Graphs-Paths and Cycles-Edge Traversal Problems-Hamiltonian Cycles and the Traveling Salesperson Problem-A Shortest-Path Algorithm-Representations of Graphs Isomorphism's of Graphs-Planar Graphs. Trees: Trees-Terminology and Characterizations of Trees-Rooted Trees-Vertex Traversal Problems-Spanning Trees-Minimal Spanning Trees Binary Trees- Tree Traversals-Decision Trees and the Minimum Time for Sorting - Isomorphism of Trees.	9	CO4
5	MODULE-V Recursion and Digraphs: General Recursion-Depth-First Search Algorithms-Polish Notation-Weighted Trees-Digraphs-Digraphs Revisited-Weighted Digraphs and Scheduling Networks-Digraph Algorithms.	9	CO5

TEXT BOOKS:

1. Kenneth A. Ross and Charles R. B. Wright, Discrete Mathematics, Pearson Education, Fifth Edition
2. Richard Johnson Baugh, Discrete Mathematics, Pearson Education, Eighth Edition, 2018

REFERENCE BOOKS:

1. Discrete Mathematics and its Applications (6th edition), Kenneth H. Rosen, Tata McGraw Hill, Bombay, India
2. Discrete Mathematics with Applications Susanna S. Epp, Brooks/Cole 2011
3. Discrete Mathematics an Introduction to Proofs and Combinatorics, Kevin Ferland, Houghton Mifflin Company, 2009.

E- REFERENCES:

1. <https://www.geeksforgeeks.org/propositional-logic-in-artificial-intelligence/>
2. https://www.tutorialspoint.com/discrete_mathematics/generating_functions.htm

DISCIPLINE SPECIFIC ELECTIVE I

Course Title: (B) LINEAR ALGEBRA

Course Code : 2569104(B)	Credits	03
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- *Learn the elementary concepts and basic ideas involved in matrix theory*
- *Particular attention is given to canonical forms of linear transformations, diagonalizations of linear transformations, matrices and determinants.*
- *Applications to linear models and Inner product spaces are also analyzed.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Determine whether a square matrix is diagonalizable, and compute its diagonalization.
CO2	Find the minimal polynomial and the rational forms of a real square matrix
CO3	Compute the Eigen values and eigenvectors of a square matrix and determine the dimension of the corresponding Eigen spaces
CO4	Discuss the kernel and image of linear of a linear transformation in terms of nullity and rank of a matrix.
CO5	Applications to linear models such as curve fitting, regression etc.,

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	2	3	3	3	3	3	3
CO4	2	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S. No	CONTENTS OF MODULE	Hrs	COs
1	MODULE -I Linear Equations in Linear Algebra: Systems of linear equations - Row reduction and Echelon forms - Vector Equations - Matrix equations $Ax = b$ - Solution set of linear systems - Applications of linear systems - Linear Independence - Introduction to linear transformations - The matrix of linear transformation.	9	CO1
2	MODULE- II Matrix Algebra: Matrix operations - The inverse of a matrix - Characterizations of Invertible Matrices - Partitioned Matrices - Matrix factorizations - Subspaces of R^n -Dimension and Rank.	9	CO2
3	MODULE- III: Vector Spaces: Vector spaces and subspaces - Null spaces, Column spaces and linear transformations - Linearly independent sets: Bases - Coordinate systems - The dimension of a vector space – Rank - Change of Basis.	9	CO3
4	MODULE- IV : Eigenvalues and Eigenvectors: Eigenvectors and Eigenvalues - The Characteristic equations – Diagonalization - Eigenvectors and linear transformations - Complex eigenvalues.	9	CO4
5	MODULE- V: Orthogonality and Least Squares: Inner product, length and orthogonality - Orthogonal sets - Orthogonal projections - The Gram - Schmidt Process - Least square problems - Applications to linear models - Inner product spaces - Applications of Inner product spaces.	9	CO5

TEXT BOOK:

1. “Linear Algebra and its Applications” by David C. Lay, Steven R. Lay, Judi. J. McDonald, Fifth Ed., 2016 Pearson.

REFERENCE BOOK:

1. Gilbert Strang, Introduction to Linear Algebra, Fifth Edition, 2016.

E- REFERENCES:

1. <https://www.geeksforgeeks.org/introduction-to-matrix-representation-of-linear-equations/>
2. <https://www.geeksforgeeks.org/matrix-factorization-types-applications/>
3. <https://www.coursera.org/lecture/linear-algebra-machine-learning/least-squares-regression-5Ckpy>

DISCIPLINE SPECIFIC ELECTIVE I

Course Title: (C) STATISTICS FOR DATA SCIENCE

Course Code : 2569104(C)	Credits	03
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- To perform Explanatory data analysis.
- To study the relationship between the features and develop a model.
- To apply statistical techniques and derive factors.
- To perform dimension reduction and feature selection and fine tune the precision of the model

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Concepts of descriptive Statistics and definitions.
CO2	Problems in correlation and regression and its interpretation
CO3	Frame appropriate model and test its significance.
CO4	Perform Factor analysis and its efficiency
CO5	Data reduction and feature selection using discriminant analysis.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	2	2	3
CO2	3	3	3	3	3	3	2	3	3	2	3
CO3	3	3	3	2	3	3	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Sampling Techniques – Data Classification – Tabulation – Frequency and graphic Representation – Measures of Central Tendency – Measures of Variation – Quartiles and Percentiles– Moments - Skewness and Kurtosis.	9	CO1
2	MODULE-II Scatter Diagram – Karl Pearson’s Correlation Coefficient – Rank Correlation –Correlation Coefficient for Bivariate Frequency Distribution – Regression Coefficients – Fitting of Regression Lines	9	CO2
3	MODULE-III Statistical Tests of Significance - Test of significance for mean(s), variance(s), correlation coefficient(s), regression coefficient, based on t, Chi-square and Fdistributions. Applications of Chi-square in test of significance (independence of attributes, goodness off it).	9	CO3
4	MODULE-IV Introduction to Factor Analysis – Meaning, Objectives and Assumptions – Designing a Factor Analysis Study – Deriving Factors – Assessing Overall Factors – Validation of Factor Analysis	9	CO4
5	MODULE-V Introduction to Discriminant Analysis – Concepts, Objectives and Applications – Procedure for conducting Discriminant Analysis – Stepwise Discriminant.	9	CO5

TEXT BOOKS:

1. Gupta, S. C. and Kapoor, V. K.: “Fundamentals of Mathematical Statistics”, Sultan & Chand & Sons, New Delhi, 11th Ed, 2002.
2. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education,7th edition, 2013.
3. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education,7th edition, 2013.
4. T. W. Anderson, “An Introduction to Multivariate Statistical Analysis, 3rd Edition”, Wiley, 2003.

REFERENCE BOOKS

1. James D. Miller, “Statistics for Data Science”, Packt, 2017.
2. Chatfield C, A. J. Collins, “Introduction to Multivariate Analysis”, Springer Nature, 2020.
3. Dawn Iacobucci, “Multivariate Statistics and Marketic Analytics”, 2014.

E- REFERENCES:

1. <https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/sampling-methods/>
2. <https://www.statisticshowto.com/rank-correlation-coefficient/>
3. <https://www.statisticssolutions.com/discriminant-analysis/>

DISCIPLINE SPECIFIC ELECTIVE II

Course Title: (A) DIGITAL IMAGE PROCESSING

Course Code : 2569105(A)	Credits	03
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- *The main objective is to familiarize the students with the image enhancement techniques and expose them to a broad range of image processing techniques and their applications.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Identify the characteristics and features of images
CO2	Compare the various image restoration and reconstruction techniques for different types of images.
CO3	Analyze the filters like Mean Filters, Statistic Filters and Adaptive Filters for processing various images.
CO4	Assess the role of segmentation models in handling the color images.
CO5	Design an application that uses different concepts of Image Processing techniques.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	3	3
CO2	3	3	3	2	3	3	3	3	3	2	3
CO3	2	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Image - Processing System: Introduction - Image Sampling - Quantisation - Resolution - Human Visual System - Classification of Digital Images - Image Types - Elements of an Image-Processing System.	9	CO1
2	MODULE-II Image File Formats - Applications of Digital Image Processing - Intensity Transformations and Spatial Filtering: Background - Basic Intensity Transformation Functions - Histogram Processing - Fundamentals of Spatial Filtering - Smoothing Spatial Filters	9	CO2
3	MODULE-III Sharpening Spatial Filters: Foundation - Second Derivative for Image Sharpening - Laplacian - Image Restoration and Reconstruction: Model Of Image Degradation/Restoration Process - Noise Models - Periodic Notes.	9	CO3
4	MODULE-IV Estimation of Noise Parameters - Restoration in the presence of Noise only - Spatial Filtering: Mean Filters - Order - Statistic Filters - Adaptive Filters - Color Image Processing: Color Fundamentals	9	CO4
5	MODULE-V Color Models: RGB Color Model - CMY and CMYK Color Models - HIS Color Model – Pseudo color Image Processing: Intensity Slicing - Intensity to Color Transformations.	9	CO5

TEXT BOOKS

1. S Jayaraman, S Essakkirajan and T Veerakumar, Digital Image Processing, Tata Mcgraw Hill Education Pvt. Ltd.
2. Rafael C Gonzalez, Richard E Woods 3rd Edition (2008), Digital Image Processing, Pearson Education.

REFERENCE BOOKS:

1. William K Pratt, (2001), Digital Image Processing, John Willey.
2. A.K. Jain, (1995), Fundamentals of Digital Image Processing, PHI, New Delhi.
3. Chanda Dutta Magundar, (2000), Digital Image Processing and Applications, Prentice Hall of India.

E-REFERENCES:

1. <https://www.tutorialride.com/digital-image-processing/digital-image-processing.htm>
2. <https://www.geeksforgeeks.org/image-sharpening-techniques/>

DISCIPLINE SPECIFIC ELECTIVE II

Course Title: (B) WEB DATABASE AND INFORMATION SYSTEM

Course Code : 2569105(B)	Credits	03
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- Aims to provide students with both theoretical knowledge and practical skills necessary to design, develop, and manage web-based databases and information systems.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students will be able to design effective relational and non-relational database schemas for web applications.
CO2	Develop dynamic, data-driven web applications that interact with databases through server-side code.
CO3	Designing user-friendly, scalable, and secure web-based information systems, ensuring functionality, security, and scalability.
CO4	Students will be able to optimize database queries and ensure the performance of web databases by using indexing, query optimization, and caching techniques.
CO5	Students will be able to implement advanced database features like transactions, concurrency control, stored procedures, and triggers in web applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	2	3	2	2	3	3	2	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Overview of databases and information systems- Types of databases (Relational, NoSQL), Web applications and data-driven systems, Role of databases in web applications, Web architecture (Client-server, Web Services, APIs), Web database models and technologies, Client-server architecture for web databases.	9	CO1
2	MODULE-II Introduction to Relational Database : Relation, Optimization, The Catalog, Base Relvars and Views, Transactions, The Suppliers and Parts Database. Relational Model Concepts, Relational Model, Constraining, Referential Integrity Constraints, Defining Referential Integrity Constraints, Update Operations on Relations,	9	CO2
3	MODULE-III Introduction and IS in Global Business Today. Global E-Business: How Business Use Information System, IT Infrastructure and Emerging Technologies, Foundations of Business Intelligence, Telecommunications, the internet, and wireless Technology, Securing Information Systems, Enterprise Applications, Knowledge Management	9	CO3
4	MODULE-IV Design and implement data-driven web applications, such as content management systems (CMS), e-commerce platforms, and social media applications. Apply principles of data integrity, security, and error handling in the development of web-based information systems. Understand the lifecycle of web information systems, from planning and analysis to implementation and maintenance.	9	CO4
5	MODULE-V Web Frameworks for Database Interaction-Overview of popular web frameworks (e.g., Django, Flask, Express, Laravel), MVC (Model-View-Controller) architecture for web applications. ORM (Object-Relational Mapping) and database abstraction layers. RESTful APIs-Introduction to REST (Representational State Transfer),Designing RESTful services for database interaction ,SOAP vs. REST-Differences between SOAP (Simple Object Access Protocol) and REST	9	CO5

TEXT BOOKS:

1. "Database System Concepts" by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan
2. "Web Development with Node and Express" by Ethan Brown

REFERENCE BOOK:

1. "Learning PHP, MySQL & JavaScript" by Robin Nixon

E-REFERENCES:

1. https://www.tutorialspoint.com/dbms/dbms_overview.htm
2. <https://www.simplilearn.com/role-of-information-systems-in-business-article>
3. <https://expressjs.com/en/starter/installing.html>

DISCIPLINE SPECIFIC ELECTIVE II

Course Title: (C) DATA SCIENCE ETHICS

Course Code : 2569105(C)	Credits	03
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- *Understand the Foundations of Data Ethics in a Data-Driven World.*
- *Analyze Research Ethics in Data Science and the Ethical Implications of Data Practices.*
- *Evaluate the Ethical Concerns of Algorithmic Discrimination and Categorical Bias.*
☐Explore Privacy, Surveillance, and Ethical Data Practices in Various Contexts.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain an overview of ethical issues in data-driven organizations, the ethical practice of data science, and the unique challenges posed by big data, along with philosophical frameworks for assessing fairness.
CO2	Understand the ethical implications of the publish-or-perish culture, issues like p-hacking and small sample sizes, informed consent in data surveillance and techniques for ethical data handling.
CO3	Explore ethical concerns regarding price discrimination and algorithmic decision-making in criminal justice, and examine the philosophical challenges related to categorization and perception in social contexts.
CO4	Delve into ethical considerations specific to health and educational research, including the ethics of data scraping, storage practices, and the implications of mosaic and found data.
CO5	Investigate contemporary issues in surveillance, including advertising technology and employment practices, while learning about differential privacy and guidelines for ethical data practices.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	3	3	3	2	3	2	3
CO2	2	3	3	3	2	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	2	3	2	3
CO4	2	3	3	3	2	3	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3	2	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction: Overview of ethical issues in data-driven organizations, Overview of data science as an ethical practice, Introduction to the unique ethical challenges of „big data“, Ethical Theory - Philosophical frameworks for assessing fairness, Moving towards contemporary theories of fairness.	9	CO1
2	MODULE-II Research ethics for data science: Ethical side effects of the publish or perish system: phacking and small sample size, The misapplication of informed consent in dataveillance practices, Techniques of data ethics, Getting from data to individuals: Internet traces and Geo finger prints.	9	CO2
3	MODULE-III Discrimination and algorithms: The ethics of price discrimination, Criminal justice by algorithm, The philosophical challenge of thinking in categories, How humans explain their social worlds through perceptions and statistics, Social processes and the impact of categorical life.	9	CO3
4	MODULE-IV Data ethics for researchers: Health Research, Educational Research, The ethics of data scraping and storage, Mosaic data, found data, and designed data.	9	CO4
5	MODULE-V Privacy and Surveillance: Special topics in surveillance: Adtech, Special topics in surveillance: Employment, Differential privacy, Guidance for acting ethically with data.	9	CO5

TEXT BOOKS:

1. "Data Ethics: The New Competitive Advantage" by Kord Davis and Doug Patterson, 1st Edition, 2019.
2. "Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy" by Cathy O'Neil, 1st Edition, 2016.

REFERENCE BOOKS:

1. "Ethics of Big Data: Balancing Risk and Innovation" by Kord Davis, 1st Edition, 2012.
2. "The Ethical Algorithm: The Science of Socially Aware Algorithm Design" by Michael Kearns and Aaron Roth, 1st Edition, 2019.

E-REFERENCES:

1. <https://datasociety.net/library/ethics-of-data-and-analytics/>
2. <https://www.privacyinternational.org/topic/adtech>

CORE PRACTICAL I

Course Title: DATA VISUALIZATION FOR ANALYTICS LABORATORY USING R AND PYTHON

Course Code :2569106	Credits	03
L:T:P:S : 0:1:4:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES

- *Learn the stages of data analytics, including descriptive, predictive, prescriptive, and discovery analytics, as well as the complete project life cycle from discovery to operationalization.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain expertise in data visualization principles to transform data into actionable insights
CO2	Develop skills in manipulating and visualizing data using both R and Python for versatile programming applications.
CO3	Create various plots and graphics through hands-on exercises to effectively communicate data.
CO4	Emphasize the application of visualization techniques in real world scenarios to inform data-driven decisions
CO5	Establish a strong foundation for further studies in data analytics, statistics, and machine learning

Mapping of Course Outcomes to Program Outcome and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	Install and configure essential software packages and libraries for data analysis and visualization in a statistical programming environment.	12	CO1
2	Load, import, and manage various data formats (CSV, Excel, JSON, etc.) efficiently using appropriate functions and packages.	12	CO2
3	Use built-in and custom functions to compute and interpret basic statistical measures such as mean, median, variance, and standard deviation from datasets.	12	CO3
4	Demonstrate proficiency in creating and manipulating vectors and matrices, including performing arithmetic and logical operations.	12	CO4
5	Identify and select appropriate plots (bar, line, scatter, histogram, etc.) based on the type and characteristics of the dataset.	12	CO5

REFERENCE BOOKS:

1. Python for Data Analysis by Wes McKinney, O'Reilly Media
2. R for Data Science by Hadley Wickham & Garrett Golemund, O'Reilly Media
3. Data Visualization: A Practical Introduction by Kieran Healy, Princeton University Press
4. *Hands-On Programming with R* by Garrett Golemund, O'Reilly Media

CORE PRACTICAL II

Course Title: ADVANCED WEB TECHNOLOGY LAB

Course Code : 2569107	Credits	03
L:T:P:S : 0:1:4:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES

- *Explore the backbone of web page creation by developing .NET skill.*
- *Enrich knowledge about HTML control and web control classes*
- *Provide depth knowledge about ADO.NET*
- *Understand the need of usability, evaluation methods for web services.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain a comprehensive overview of the .NET framework, including its languages, data types, and object manipulation techniques essential for web development
CO2	Learn to develop ASP.NET applications, focusing on code-behind structures, web forms, server controls, and the use of Visual Studio.NET for project management and debugging
CO3	Acquire detailed knowledge of ADO.NET for data access and management, including SQL operations, data binding, and handling disconnected data models
CO4	Explore web services, including WSDL and SOAP, and learn to create, document, and consume web services effectively.
CO5	Understand component-based programming, custom controls, caching techniques, and performance tuning strategies to enhance web application efficiency and scalability.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	2	3	3	2	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	Demonstrate proficiency in creating static web pages using HTML tags including formatting, tables, images, links, and frames. Related Programs: <ul style="list-style-type: none"> ○ Program 1: HTML with image, link, formatting tags ○ Program 2: HTML table – class timetable ○ Program 4: Frame tag in HTML 	12	CO1
2	Design and implement web forms using HTML and apply appropriate input types and attributes. <ul style="list-style-type: none"> • Related Programs: <ul style="list-style-type: none"> ○ Program 3: HTML forms 	12	CO2
3	Apply internal, inline, and external Cascading Style Sheets (CSS) to enhance the presentation of web content. <ul style="list-style-type: none"> • Related Programs: <ul style="list-style-type: none"> ○ Program 5: HTML with CSS styling 	12	CO3
4	Develop and validate structured XML documents with the help of Document Type Definitions (DTD). <ul style="list-style-type: none"> • Related Programs: <ul style="list-style-type: none"> ○ Program 6: XML DTD 	12	CO4
5	Implement client-side scripting to perform validation, calculations, and DOM manipulation using JavaScript. <ul style="list-style-type: none"> • Related Programs: <ul style="list-style-type: none"> ○ JavaScript form validation ○ JavaScript calculator ○ JavaScript multiplication table ○ MySQL connection with PHP ○ Insert record using PHP ○ Create, Insert, Delete, Edit (CRUD) using PHP & MySQL 	12	CO5

REFERENCE BOOKS:

1. HTML and CSS: Design and Build Websites, Jon Duckett, Wiley
2. Eloquent JavaScript by Marijn Haverbeke, No Starch Press
3. PHP & MySQL: PHP and MySQL Web Development by Luke Welling and Laura Thomson, Addison-Wesley
4. Complete Web Development: Web Technologies Black Book by Kogent Learning Solutions, Dreamtech Press

*****End of First Semester*****

SECOND SEMESTER

CORE- IV

Course Title: NoSQL DATABASE MANAGEMENT

Course Code :2569208	Credits	04
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- *Grasp the fundamental differences between NoSQL and traditional relational databases, including key concepts like schema flexibility, data models, and horizontal scaling.*
- *Analyze various NoSQL data models, including key-value, document, column-family, and graph databases, understanding their use cases and advantages.*
- *Develop skills in designing NoSQL database architecture tailored to specific application needs, considering factors like scalability, performance, and consistency.*

Course outcomes: At the end of course, the student will be able

CO1	Understand about Database Management System.
CO2	Understand the concept of NoSQL using MongoDB
CO3	Analyze various Query features on NoSQL
CO4	Understand and examine the relationship among data and its operations using MongoDB
CO5	Develop Web applications with No SQL and it's administration.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	2	3	2	3	3	3	3	2	3	2	2
CO4	3	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	2	3	2	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Management: History of Database Systems. Database System Applications, database System VS file System. Data Models: ER Model, Relational Model and Other Models. Database Languages: DDL, DML. Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical database Design – Introduction to Views – Destroying /altering Tables and Views.	9	CO1
2	MODULE-II Introduction to NoSQL Overview and History of NoSQL, Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points. Comparison of relational databases to new NoSQL stores. Introduction to MongoDB: MongoDB, Cassandra use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, Aggregate Oriented Databases.	9	CO2
3	MODULE-III Data And Distribution Models Replication and Sharding, Map-Reduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication. NoSQL Key/Value databases using MongoDB, Document Databases, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging	9	CO3
4	MODULE-IV Key-value Databases NoSQL Key/Value databases using Riak, Key-Value Databases, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets.	9	CO4
5	MODULE-V Transactions Management: Transaction Management, NoSQL Transactions - ACID properties, States of Transaction and Transaction State Diagram, Scheduling - Serial, nonSerial and non-Serializable Scheduling. Failure classification, concurrent execution of transaction– problems with concurrent execution, Concurrency control.	9	CO5

TEXT BOOKS:

1. Raghuramakrishnan and Johannes Gehrke, “Database Management Systems”, 3rd Edition, TMH, 2006.
2. Sadalage, P. & Fowler, M., NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. (1st Ed.). Upper Saddle River, NJ: Pearson Education, In, 2012.

REFERENCE BOOKS:

1. Gauravvaish, Getting started with NoSQL , PACKT publishing
2. Redmond, E. & Wilson, J., Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement (1st Ed.), 2012

E-REFERENCES:

1. https://university.mongodb.com/mercury/MongoDB_Overview
2. <https://cassandra.apache.org/doc/latest/>

CORE -V

Course Title: - DESCRIPTIVE AND DISCOVERY ANALYTICS

Course Code : 2569209	Credits	04
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- *Gain a comprehensive understanding of analytics concepts, including the differences between descriptive, diagnostic, predictive, and prescriptive analytics.*
- *Learn techniques for data preprocessing, including data cleaning, transformation, and normalization, to prepare datasets for analysis.*
- *Master key descriptive statistical measures and techniques, such as measures of central tendency, dispersion, and distribution, to summarize and interpret data.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Demonstrate the ability to analyze and summarize data using descriptive statistics, extracting meaningful insights that inform decision-making.
CO2	Create compelling data visualizations that effectively communicate analytical findings to various stakeholders, using appropriate tools and techniques.
CO3	Perform exploratory data analysis (EDA) to identify patterns, trends, and anomalies in datasets, leading to actionable insights.
CO4	Utilize discovery analytics techniques such as clustering, association rule mining, and anomaly detection to uncover hidden insights in complex datasets.
CO5	Exhibit enhanced critical thinking and problem-solving abilities, applying analytical reasoning to formulate hypotheses and interpret data-driven outcomes.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	2	3	3	3	2	3
CO2	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	2	3
CO4	3	2	3	3	2	3	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Descriptive Analytics – Examples - The Role of Descriptive Analytics in Future Data Analysis – An industry Applications - Descriptive Data Collection: Survey Overview - Descriptive Data Collection: Net Promoter Score and Self-Reports - Descriptive Data Collection: Survey Design - Passive Data Collection - Media Planning- Causal Data Collection and Summary.	9	CO1
2	MODULE-II Empowering data analysis with Pandas-Packages- The data structure of pandas- Inserting and Exporting Data- Data Cleansing Checking and Filling Missing Data- String Operations Merging Data- Aggregation operations -Joins – Case Study.	9	CO2
3	MODULE-III Basics of Discovery Analytics Comparing two groups - Drawing inferences - Independent groups - Dependent groups - Independent groups - Categorical association - Chi-squared test for association - The Chi- squared test - Interpreting the Chi-squared test - Chi-squared test for goodness of fit – An alternative to the Chi-squared test- Case Study	9	CO3
4	MODULE-IV Simple and Multiple Regressions - Simple regression - Describing quantitative association - Simple regression – Drawing inferences - Pitfalls in regression - Testing the model - Checking assumptions – Simple regression - Exponential regression - Multiple regression – Model- Tests – Overall test -Individual tests - Checking assumptions	9	CO4
5	MODULE-V Parametric Tests and Non-Parametric Tests - Basics and One-way ANOVA - Assumptions and F-test - Post-hoc t-tests – Factorial ANOVA - Assumptions and tests - ANOVA and regression - Non-parametric tests - The basics -Comparing groups with respect to mean rank - Several samples - Kruskal-Wallis test.	9	CO5

TEXT BOOKS:

1. Data Science for Business: What You Need to Know About Data Mining and Data Analytic Thinking" by Foster Provost and Tom Fawcett.
2. "Practical Statistics for Data Scientists: 50 Essential Concepts" by Peter Bruce and Andrew Bruce.
3. Statistics for Data Science" by James D. Miller

REFERENCE BOOKS:

1. "Business Analytics: Data Analysis & Decision Making" by S. Christian Albright and Wayne L. Winston
2. "Practical Statistics for Data Scientists" by Peter Bruce and Andrew Bruce
3. "Linear Regression Analysis" by Douglas C. Montgomery, Elizabeth A. Peck, and G. Geoffrey Vining

E- REFERENCES:

1. <https://www.coursera.org/learn/wharton-customer-analytics>
2. <http://www.dataversity.net/fundamentals-descriptive-analytics>
3. Samir Madhavan, "Mastering Python for Data Science", Packt, 2015.

CORE VI

Course Title: - CLOUD ANALYTICS

Course Code : 2569210	Credits	04
L:T:P:S : 3:1:0:0	CIA Marks	50
Exam Hours : 03	ESE Marks	100

LEARNING OBJECTIVES:

- Understand the fundamental concepts of cloud computing and its relevance to analytics.
- Learn the design and implementation of scalable analytics solutions using cloud platforms.
- Gain hands-on experience in utilizing cloud-based tools for big data analytics.
- Explore case studies and practical applications of cloud analytics in various domains.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Explain the key concepts and architecture of cloud computing and analytics.
CO2	Apply cloud-based platforms and tools to process and analyze large datasets.
CO3	Design and develop scalable analytics pipelines in cloud environments.
CO4	Evaluate cloud analytics solutions for business and research purposes.
CO5	Demonstrate practical knowledge of using cloud services such as AWS, Azure, or Google Cloud for analytics tasks.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	3	2	3	2	3	3	3
CO2	3	2	3	3	3	3	2	3	3	2	3
CO3	2	3	3	3	2	3	3	3	2	2	3
CO4	3	3	3	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Cloud Analytics Overview of cloud computing: Characteristics, service models (IaaS, PaaS, SaaS), deployment models.-Fundamentals of analytics: Descriptive, predictive, and prescriptive analytics-Introduction to cloud analytics and its applications in data science.	9	CO1
2	MODULE-II Cloud Platforms for Analytics Overview of cloud service providers: AWS, Microsoft Azure, Google Cloud Platform (GCP)-Key services for analytics: Data storage, processing, and visualization tools-Cost management and optimization strategies in cloud analytics.	9	CO2
3	MODULE-III Big Data and Cloud Integration Big Data concepts: Hadoop, Spark, and their integration with cloud platforms-Building scalable analytics pipelines in the cloud-Real-time analytics and streaming services (e.g., Apache Kafka, AWS Kinesis).	9	CO3
4	MODULE-IV Security and Governance in Cloud Analytics Data privacy, security, and compliance in cloud analytics-Access control and authentication mechanisms-Governance strategies for maintaining data integrity.	9	CO4
5	MODULE-V Case Studies and Applications Case studies in healthcare, finance, marketing, and education-Practical projects using cloud services for analytics tasks-Emerging trends and future directions in cloud analytics.	9	CO5

TEXT BOOKS:

1. Rittinghouse, J. W., & Ransome, J. F. (2017). Cloud Computing: Implementation, Management, and Security. CRC Press.
2. Hurwitz, J., Kaufman, M., & Halper, F. (2020). Cloud Computing for Dummies. Wiley.

REFERENCE BOOKS:

1. Mahmood, Z. (2019). Cloud Analytics for Industry 4.0. Springer.
2. Amazon Web Services Documentation (AWS).

E- REFERENCES:

1. [https://www.wiley.com/en-us/Cloud Computing for Dummies-p-9781119546653](https://www.wiley.com/en-us/Cloud+Computing+for+Dummies-p-9781119546653)
2. <https://aws.amazon.com/analytics/>
3. <https://aws.amazon.com/blogs/big-data/>

DISCIPLINE SPECIFIC ELECTIVE III

Course Title: (A) REGRESSION ANALYSIS

Course Code: 2569211(A)	Credits : 03
L:T:P:S : 3:1:0:0	CIA Marks: 50
Exam Hours : 03	ESE Marks: 100

LEARNING OBJECTIVES:

- *Develop an understanding of regression analysis and model building.*
- *Provide the ability to develop relationship between variables*
- *Investigate possible diagnostics in regression techniques*
- *Formulate feasible solution using regression model for real-life problems.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To develop in-depth understanding of the linear and nonlinear regression model
CO2	To demonstrate the knowledge of regression modeling and model selection techniques
CO3	To examine the relationships between dependent and independent variables.
CO4	To estimate the parameters and fit a model
CO5	To investigate possible diagnostics in regression modeling and analysis.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	2	2	2	3	3	3	3	2	3
CO3	3	2	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	2	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Simple Regression Analysis: Introduction to a linear and nonlinear model. Ordinary Least Square methods. Simple linear regression model, using simple regression to describe a linear relationship. Fitting a linear trend to time series data, Validating simple regression model using t, F and p test. Developing confidence interval. Precautions in interpreting regression results.	9	CO1
2	MODULE-II Multiple Regression Analysis: Concept of Multiple regression model to describe a linear relationship, Assessing the fit of the regression line, inferences from multiple regression analysis, problem of overfitting of a model, comparing two regression model, prediction with multiple regression equation.	9	CO2
3	MODULE-III Fitting Curves and Model Adequacy Checking: Introduction, fitting curvilinear relationship, residual analysis, PRESS statistics, detection and treatment of outliers, lack of fit of the regression model, test of lack of fit, Problem of autocorrelation and heteroscedasticity. Estimation of pure errors from near neighbors.	9	CO3
4	MODULE-IV Transformation techniques: Introduction, variance stabilizing transformations, transformations to linearize the model, Box-Cox methods, transformations on the repressors variables, Generalized and weighted least squares, Some practical applications.	9	CO4
5	MODULE-V Multi collinearity: Introduction, sources of multi collinearity, effects of multi collinearity. Multi collinearity diagnostics: examination of correlation matrix, variance Inflation factors (VIF), Eigen system analysis of X1X. Methods of dealing with Multi collinearity: collecting additional data, model re-specification, and ridge regression.	9	CO5

TEXT BOOKS:

1. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, Third Ed., Wiley India Pvt. Ltd., 2016.
2. Norman R. Draper, Harry Smith; Applied Regression Analysis, WILEY India Pvt. Ltd. New Delhi; Third Edition, 2015.

REFERENCE BOOKS:

1. Johnson, R A., Wichern, D. W., Applied Multivariate Statistical Analysis, Sixth Ed., PHI learning Pvt., Ltd., 2013.
2. Iain Pardoe, Applied Regression Modeling, John Wiley and Sons, Inc, 2012.

E-REFERENCES:

1. <https://www.statisticshowto.com/probability-and-statistics/regression-analysis/linear-regression/>
2. <https://towardsdatascience.com/outlier-detection-techniques-in-python-f8093fbd25a0>

DISCIPLINE SPECIFIC ELECTIVE III

Course Title: (B) PROBABILITY AND DISTRIBUTION MODELS

Course Code: 2569211(B)	Credits : 03
L:T:P:S : 3:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES:

- *To incorporate the concepts of probability theory and its applications as the core material in building theoretical ideas along with the practical notion.*
- *To integrate the intrinsic ideas of preliminary and advanced distributions to correlate with the real-world scenarios.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Develop problem-solving techniques needed to calculate probability and conditional probability
CO2	Derive the expectation and conditional expectation, and describe their properties.
CO3	Understand various types of generating functions used in statistics.
CO4	Describe commonly used univariate discrete continuous probability distributions
CO5	Describe commonly used univariate discrete continuous probability distributions

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	3	2	3	2	3	2	3
CO2	3	3	2	3	3	3	3	3	3	3	3
CO3	2	3	3	3	2	3	2	3	3	2	2
CO4	3	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Probability and Random variables: Introduction – Random Experiments, Empirical basis of probability, Algebra of events, laws of probability; Conditional Probability, Independence, Bayes theorem. One-dimensional Random variable - Discrete and Continuous; Distribution functions and its properties; Bivariate Random Variables - Joint Probability functions, marginal distributions, conditional distribution functions	9	CO1
2	MODULE-II Mathematical Expectation: Expectation, Variance, and Covariance of random variables; Conditional expectation and conditional variance; Markov, Holder, Jensen and Chebyshev's Inequality; Kolmogorov theorem; Central Limit Theorem.	9	CO2
3	MODULE-III Generating Functions: Probability generating function (p.g.f.), moment generating function (m.g.f.), characteristic function (c.f.); Properties and Applications. Probability distributions of functions of random variables: one and two dimensions.	9	CO3
4	MODULE-IV Discrete Distributions: Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Negative Binomial, Multinomial distributions and Discrete Uniform distribution - definition, properties and applications with numerical problems.	9	CO4
5	MODULE-V Continuous Distributions: Uniform, Normal distribution function, Exponential, Gamma, Beta distributions (First and Second kind), Weibull, Cauchy and Laplace distributions, lognormal, logistic, Pareto and Rayleigh distribution functions - definition, properties and applications; concept of truncated distributions.	9	CO5

TEXT BOOKS:

1. Sheldon Ross; A First Course in Probability, Pearson, 2014.
2. Parimal Mukhopadhyay; An Introduction to the Theory of Probability, World scientific, 2012.

REFERENCE BOOKS:

1. FetsjeBijma, Marianne Jonker and Aad van der Vaart; Introduction to Mathematical Statistics, Amsterdam University Press, 2018.
2. Krishnamoorthy, K., Handbook of Statistical Distributions with Applications, Chapman & Hall/CRC, 2006.

E- REFERENCES:

1. <https://www.statlect.com/fundamentals-of-probability/conditional-probability>
2. <https://www.statlect.com/fundamentals-of-probability/characteristic-functions>

DISCIPLINE SPECIFIC ELECTIVE III

Course Title: (C) DESIGN AND ANALYSIS OF EXPERIMENTS

Course Code: 2569211(C)	Credits 03
L:T:P:S : 3:1:0:0	CIA Marks :50
Exam Hours : 03	ESE Marks :100

LEARNING OBJECTIVES

- Describe how to design experiments, carry them out, and analyses the data they yield.
- Construct appropriate experimental designs for given problems: sample size determination, choice of levels of variables, designs with restrictions on randomization, utility functions for measuring design objectives, use of simulation to characterize properties of designs.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Describe the purpose of robust construction and how it is applied in experimental design.
CO2	To formulate and validate the experimental designs in agricultural, medical, biomedical projects.
CO3	Avails them to fetch the background concepts of Model formulation and validation
CO4	To accomplish research-oriented concepts given for Factorial techniques required for experimental designs
CO5	To accomplish research-oriented concepts given for BIBD techniques required for experimental designs.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	2	3
CO4	3	2	3	3	2	3	3	2	3	2	2
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No.	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Basic Principles of Experimental design: Strategy of Experimentation - Applications of Experimental Design – Basic Principles – Guidelines for designing experiments.	9	CO1
2	MODULE-II Basic Designs: Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD).	9	CO2
3	MODULE-III Analysis of Co-variance: Multiple Comparisons – Multiple Range Tests - Analysis of Covariance – Construction of Orthogonal Latin Square.	9	CO3
4	MODULE-IV Factorial experiments: Factorial experiments - 2 ² , 2 ³ and 2 ³ , 3 ² experiments and their analysis - Fractional replication in Factorial Experiments. Necessity of confounding, Types of confounding, complete and partial confounding (Concept Only).	9	CO4
5	MODULE-V Balanced Incomplete Block design: Balanced Incomplete Block Design (BIBD) – Types of BIBD – Simple construction methods – Concept of connectedness and balancing – Intra Block analysis of BIBD.	9	CO5

TEXT BOOK:

1. Douglas C. Montgomery, Design and Analysis of Experiments, 9th Edition, John Wiley and Sons, 2017.

REFERENCE BOOKS:

1. Das M.N. and Giri N.C., Design and Analysis of Experiments, 3rd Edition, New Age International (P) Ltd., 2017.
2. John Lawson, Design and Analysis of Experiments with R, 1st Edition, CRC Press, 2015.

E-REFERENCES:

1. <https://www.statisticshowto.com/design-of-experiments/>
2. <https://www.statisticshowto.com/balanced-incomplete-block-design/>

DISCIPLINE SPECIFIC ELECTIVE IV

Course Title: (A) CYBER SECURITY

Course Code : 2569212(A)	Credits : 03
L:T:P:S : 3:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES:

- *Understand the fundamental principles of Cyber Security, including key concepts, terminology, and the importance of protecting information assets.*

Course outcome: the end of course, the student will be able to

CO1	Understand the fundamentals of Cyber Security
CO2	Identify various types of cyber threats and vulnerabilities.
CO3	Implement security measures and best practices.
CO4	Analyze and respond to security incidents.
CO5	Identify the internet crimes and Network Security Fundamentals

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	2	3	3	2	3
CO3	3	3	3	2	3	3	3	3	3	2	3
CO4	3	3	3	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction, Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography. Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. Network Vulnerabilities: Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit.	9	CO1
2	MODULE-II Network Defence Tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding. VPN: the basic of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System.	9	CO2
3	MODULE-III Web Application Tools: Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel. Application Inspection tools – Zed Attack Proxy, Sqlmap, DVWA, Webgoat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, Pwdump, HTC-Hydra.	9	CO3
4	MODULE-IV Introduction to Cyber Crime, law and Investigation Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world.	9	CO4
5	MODULE-V Internet crime: Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data. Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Worms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks.	9	CO5

TEXT BOOKS:

1. "Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, and Philip Craig
2. "The Web Application Hacker's Handbook" by Dafydd Stuttard and Marcus Pinto
3. "Computer Security: Principles and Practice" by William Stallings and Lawrie Brown

REFERENCE BOOKS:

1. NIST Special Publications.
2. "The Art of Deception" by Kevin D. Mitnick.
3. "Cybersecurity for Dummies" by Joseph Steinberg.

E-REFERENCE:

1. MODULE 1 CYBER SECURITY NOTES | PDF | Security | Computer Security Cyber Security Tutorial | GeeksforGeeks

DISCIPLINE SPECIFIC ELECTIVE IV

Course Title: (B) DIGITAL FORENSICS

Course Code : 2569212(B)	Credits : 03
L:T:P:S : 3:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
- To understand how to examine digital evidences such as the data acquisition, identification analysis.

Course outcomes: At the end of course, the student will be able to

CO1	Understand the core principles of digital forensics, including key terminology, concepts, and the importance of evidence handling.
CO2	To demonstrate proficiency in using digital forensics tools and software for data recovery, analysis, and reporting.
CO3	Understand the legal and ethical implications of digital forensics, including relevant laws, regulations, and best practices for evidence collection and preservation.
CO4	Develop the ability to produce clear, concise forensic reports that can be understood by both technical and non-technical audiences.
CO5	Analyze real-world case studies to apply theoretical knowledge to practical scenarios, enhancing their critical thinking and problem solving skills.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	3	2	3	2	3	2	3
CO2	3	2	2	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	2	3	2	3
CO4	3	2	3	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.	9	CO1
2	MODULE-II Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.	9	CO2
3	MODULE-III Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.	9	CO3
4	MODULE-IV Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.	9	CO4
5	MODULE-V Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.	9	CO5

TEXT BOOKS:

1. Warren G. Kruse II and Jay G. Heiser, “Computer Forensics: Incident Response Essentials”, Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., “Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

REFERENCE BOOK:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

E- REFERENCES:

1. Introduction of Computer Forensics | GeeksforGeeks
2. Data Acquisition System | GeeksforGeeks

DISCIPLINE SPECIFIC ELECTIVE IV

Course Title: (C) BIG DATA SECURITY

Course Code : 2569212(C)	Credits 03
L:T:P:S : 3:1:0:0	CIA Marks :50
Exam Hours : 03	ESE Marks :100

LEARNING OBJECTIVES

- *Understand the Fundamentals of Big Data and Its Impact on Modern Analytics.*
- *Explore Security, Compliance, and Intellectual Property Challenges in Big Data.*
- *Learn Strategies for Integrating Big Data Analytics into Enterprise Systems.*
- *Acquire Expertise in Security Analytics Techniques and Applications.*

Course Outcome: At the end of course, the student will be able to

CO1	Gain a comprehensive understanding of the significance of big data in contemporary analytics, the evolving nature of data, and the key obstacles organizations face in harnessing its full potential.
CO2	Explore pragmatic approaches to securing big data, including effective data classification, safeguarding analytics processes, navigating compliance requirements, and addressing intellectual property challenges in a big data context.
CO3	Learn strategic methodologies for adopting big data technologies within organizations, standardizing practices, ensuring scalability, promoting data reuse, and establishing robust governance frameworks for effective integration into enterprise ecosystems.
CO4	Develop a foundational understanding of security analytics, encompassing various analytical techniques, real-world applications, and the challenges associated with intrusion detection and incident response.
CO5	Delve into advanced methods for analyzing log files and implementing simulation processes to enhance security protocols, fostering a proactive approach to identifying and mitigating security threats within big data environments.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	2	3	3	3	3	3	3	3	2	3
CO4	2	3	2	3	3	3	3	2	2	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I INTRODUCTION TO BIG DATA Arrival of analytics - Big Data Reaches Deep - Obstacles Remain - Data Continue to Evolve - Realizing Value - The Case for Big Data - The Rise of Big Data Options - Beyond Hadoop - Big Data Sources Growing	9	CO1
2	MODULE-II SECURITY, COMPLIANCE, AUDITING & PROTECTION Pragmatic Steps to Securing Big Data - Classifying Data - Protecting Big Data Analytics - Big Data and Compliance - The Intellectual Property Challenge - Big Data: The Modern Era - Today, Tomorrow, and the Next Day - Changing Algorithms	9	CO2
3	MODULE-III INTEGRATING BIG DATA ANALYTICS INTO THE ENTERPRISE The Strategic Plan for Technology Adoption - Standardize Practices for Soliciting Business User Expectations - Acceptability for Adoption: Clarify Go/No-Go Criteria - Prepare the Data Environment for Massive Scalability - Promote Data Reuse - Institute Proper Levels of Oversight and Governance - Provide a Governed Process for Mainstreaming Technology Considerations for Enterprise Integration	9	CO3
4	MODULE-IV SECURITY ANALYTICS I Introduction to Security Analytics – Techniques in Analytics – Analysis in everyday life – Challenges in Intrusion and Incident Identification – Analysis of Log file – Simulation and Security Process.	9	CO4
5	MODULE-V SECURITY ANALYTICS II Access Analytics – Security Analysis with Text Mining – Security Intelligence – Security Breaches	9	CO5

TEXT BOOKS:

1. "Data Science from Scratch: First Principles with Python" by Joel Grus, 2nd Edition, 2019.
2. "An Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, 2nd Edition, 2021.

REFERENCE BOOKS:

1. "Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python" by Peter Bruce and Andrew Bruce, 1st Edition, 2017.
2. "Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy" by Cathy O'Neil, 1st Edition, 2016.

E- REFERENCE:

1. <https://www.geeksforgeeks.org/computer-networks/data-security/>

CORE PRACTICAL III

Course Title: NoSQL DATABASE MANAGEMENT LAB

Course Code : 2569213	Credits 03
L:T:P:S : 0:1:4:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- *Provide students with practical experience in installing, configuring, and managing various NoSQL databases (e.g., MongoDB, Cassandra, Redis).*
- *Enable students to design and implement appropriate data models for different NoSQL database types, including key-value, document, column-family, and graph databases.*
- *Teach students how to create and manage indexes in NoSQL databases and optimize queries for performance and efficiency.*

Course Outcome: At the end of course, the student will be able to

CO1	Install, configure, and initialize MongoDB on a Windows environment.
CO2	Perform basic database operations such as create, insert, update, and delete in MongoDB.
CO3	Create and manage collections dynamically or with options, including dropping collections
CO4	Execute complex queries using criteria, projections, sorting, limits, and pagination in MongoDB.
CO5	Demonstrate the ability to implement and manage indexing in MongoDB for performance optimization.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	2	2	3	3	3	2	3
CO2	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	2	2	2
CO4	3	2	3	2	2	3	3	2	3	3	3
CO5	3	3	3	2	3	2	2	3	2	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MongoDB Installation and Configuration on Windows	12	CO1
2	Create, Insert, Update, and Drop a Database in MongoDB, a. Insert a single document and multiple documents into MongoDB Collection b. Update a document using update() and save() method c. Delete a document using remove() and save () method	12	CO2
3	Collection Creation and Management in MongoDB a. Creating Collections on the Fly in MongoDB b. Creating Collections with options and Dropping it	12	CO3
4	Query Optimization and Result Filtering in MongoDB a. Implementing Field Projection in MongoDB Queries b. Apply limit(), skip(), and sort() Methods in MongoDB Queries	12	CO4
5	Indexing and Data Management in MongoDB Collections a. Create Indexes in MongoDB Collections b. Find Existing Indexes in a MongoDB Collection c. Remove All Documents from a Collection	12	CO5

REFERENCE BOOKS:

1. MongoDB: The Definitive Guide by Kristina Chodorow
2. MongoDB in Action by Kyle Banker
3. Learning MongoDB by Saurabh Badhwar

CORE PRACTICAL IV

Course Title: DESCRIPTIVE AND DISCOVERY ANALYTICS LAB

Course Code : 2569214	Credits 03
L:T:P:S : 0:1:4:0	CIA Marks :50
Exam Hours : 03	ESE Marks :100

LEARNING OBJECTIVES

- Students will learn to articulate the concept of descriptive analytics, its purpose, and its significance in summarizing historical data to identify patterns and trends.
- Acquire skills in data cleaning techniques to handle missing values, outliers, and inconsistencies in datasets.

Course Outcome: At the end of course, the student will be able to

CO1	Import, export, and preprocess data from various formats.
CO2	Apply statistical and data manipulation functions using Pandas
CO3	Perform data summarization and statistical tests like ANOVA and correlation.
CO4	Build and evaluate regression models with visualization techniques.
CO5	Assess model performance using metrics like R-squared and MSE.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	3	2	3	3	3	2	3
CO2	2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	2	3
CO4	3	2	3	3	2	3	3	2	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	Data Handling and Pre processing <ol style="list-style-type: none"> a. Import/export different data formats b. Apply functions on Pandas objects c. Identify and handle missing data d. Data normalization e. Convert common data formats 	12	CO1
2	Data Summarization and Statistical Analysis <ol style="list-style-type: none"> a. Summarize data b. Implement ANOVA c. Implement Correlation Analysis 	12	CO2
3	Data Manipulation Using SQL Operations in Pandas <ol style="list-style-type: none"> a. Perform SQL operations using Pandas 	12	CO3
4	Model Building and Evaluation Using Visualization <ol style="list-style-type: none"> a. Model evaluation using visualization b. Simple Linear Regression c. Multiple Linear Regression 	12	CO4
5	Model Performance Metrics and Comprehensive Evaluation <ol style="list-style-type: none"> a. Calculate R-squared and MSE for in-sample evaluation b. Perform overall model evaluation 	12	CO5

REFERENCE BOOKS:

1. Python for Data Analysis by Wes McKinney — O'Reilly
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron — O'Reilly
3. Practical Statistics for Data Scientists by Peter Bruce & Andrew Bruce — O'Reilly

*******End of Second Semester*******

THIRD SEMESTER

CORE - VII

Course Title: PREDICTIVE ANALYTICS

Course Code : 2569315	Credits 04
L:T:P:S : 4:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- *On taking this course, students will develop proficiency in analyzing large datasets to identify patterns and trends, gain a solid understanding of statistical methods and models used in predictive analytics, and learn to build and validate predictive models using techniques such as regression analysis, decision trees, and machine learning.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Able to collect, clean, and preprocess large datasets for analysis.
CO2	Demonstrate the ability to build and evaluate various predictive models, including regression, classification, and time series forecasting.
CO3	Students will apply statistical techniques to analyze data and interpret results, including understanding concepts like correlation, causation, and significance.
CO4	Statistical techniques to analyze data and interpret results, including understanding concepts like correlation, causation, and significance.
CO5	Gain proficiency in using analytical tools and programming languages (such as R, Python, or specialized software) for data analysis and model development.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	3	2	3	2	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	2	3	3	3	2	3	2	3
CO4	3	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Predictive Analytics and Data Preprocessing Overview of Predictive Analytics: Scope, Applications, and Importance; Types of Predictive Models: Classification, Regression, Forecasting; Data Collection Methods; Data Cleaning and Handling Missing Values; Data Transformation and Normalization; Feature Engineering and Selection Techniques.	9	CO1
2	MODULE II Statistical Foundations for Predictive Analytics Descriptive Statistics and Exploratory Data Analysis (EDA); Probability Distributions and Sampling Techniques; Hypothesis Testing and Confidence Intervals; Correlation vs. Causation Statistical Significance and p-values.	9	CO2
3	MODULE-III Regression Models Simple and Multiple Linear Regression; Logistic Regression for Classification; Assumptions of Regression Models; Model Diagnostics and Evaluation Metrics (R^2 , Adjusted R^2 , RMSE, AIC/BIC); Regularization Techniques: Ridge and Lasso Regression.	9	CO3
4	MODULE-IV Machine Learning Models for Prediction Decision Trees and Random Forests; Support Vector Machines; k-Nearest Neighbors; Ensemble Methods: Bagging, Boosting, Gradient Boosting; Model Evaluation: Confusion Matrix, ROC-AUC, Precision, Recall, F1-Score; Cross-Validation and Hyperparameter Tuning	9	CO4
5	MODULE-V Time Series and Tools for Predictive Analytics Introduction to Time Series Forecasting; Components of Time Series: Trend, Seasonality, Noise; ARIMA and Exponential Smoothing Methods; Evaluation Metrics for Forecasting Models; Tools and Platforms: Python (pandas, scikit-learn, statsmodels), R, Excel, and Other Analytical Software; Case Studies and Applications in Business and Industry	9	CO5

TEXT BOOKS:

1. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning* (2nd edition), Springer, ISBN 978-1071614174.
2. Kuhn, M., & Johnson, K. (2013). *Applied Predictive Modeling* (1st edition), Springer, ISBN 978-1461468486.
3. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd edition), O'Reilly Media, ISBN 978-1492032649.

REFERENCE BOOKS:

1. Han, J., Kamber, M., & Pei, J. (2011). *Data Mining: Concepts and Techniques* (3rd edition), Morgan Kaufmann, ISBN 978-0123814791.
2. Provost, F., & Fawcett, T. (2013). *Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking*, O'Reilly Media, ISBN 978-1449361327.

E- REFERENCES:

1. <https://nptel.ac.in/courses/106106139> – NPTEL Course on Applied Predictive Analytics
2. <https://www.coursera.org/learn/predictive-analytics> – Coursera: Predictive Analytics for Business

CORE - VIII

Course Title: **EXPLORATORY DATA ANALYSIS**

Course Code : 2569316	Credits 04
L:T:P:S : 4:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- *This course aims to provide students with a strong foundation in the principles, techniques, and goals of Exploratory Data Analysis (EDA).*
- *Students will develop the skills to clean, preprocess, and transform raw data into a structured, analysis-ready format.*
- *Additionally, they will learn to uncover meaningful patterns, relationships, and trends through the application of statistical methods and effective data visualization techniques.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Explain the role of EDA in the broader context of data science and its importance in making data-driven decisions.
CO2	Use statistical and visualization techniques to summarize and gain insights from raw datasets..
CO3	Detect, handle, and treat missing or inconsistent data during preprocessing.
CO4	Analyze datasets of varying sizes and complexities using Python or R, leveraging libraries such as Pandas, NumPy, Matplotlib, and ggplot2.
CO5	Apply EDA techniques to solve real-world problems and effectively communicate insights through reports, dashboards, and presentations.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2	2	3	2	2	2	2
CO2	3	3	3	2	3	3	1	3	3	3	2
CO3	3	2	3	3	2	2	2	3	2	3	2
CO4	2	3	2	2	2	2	2	2	2	2	3
CO5	3	3	2	2	3	2	2	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Exploratory Data Analysis Overview of EDA: Definition, purpose, and scope in the data science pipeline Differentiating EDA from confirmatory data analysis. Types of data: Categorical, numerical, ordinal, and time-series data. Tools and environments for EDA: Introduction to Python and R for data analysis	12	CO1
2	MODULE-II Data Cleaning and Preprocessing Handling missing data: Identifying missing values and patterns. Techniques: Imputation (mean, median, mode), interpolation, and deletion. Data transformations: Normalization, standardization, and log transformations. Encoding categorical variables: One-hot encoding, label encoding. Outlier detection and handling: Z-score, IQR method, and robust scaling techniques.	12	CO2
3	MODULE-III Data Visualization Principles of effective data visualization: Choosing the right chart types based on data. Avoiding visualization pitfalls (misleading graphs, over plotting). Univariate visualization: Histograms, boxplots, and density plots. Bivariate visualization: Scatter plots, line charts, bar charts, and heat maps. Multivariate visualization: Pair plots, 3D visualizations, and parallel coordinate plots.	12	CO3
4	MODULE-IV Statistical Analysis in EDA Descriptive statistics: Measures of central tendency: Mean, median, mode. Measures of dispersion: Range, variance, standard deviation, IQR. Correlation and association: Correlation coefficients, covariance, and association measures for categorical data (e.g., Chi square test). Hypothesis testing: Null and alternative hypotheses, p-values, and confidence intervals..	12	CO4
5	MODULE-V Applications and Case Studies in EDA Domain-specific applications: Healthcare: Analyzing patient data for trends and anomalies. Finance: Fraud detection and customer segmentation. Marketing: Customer behavior analysis and campaign performance. Social media: Sentiment analysis and engagement trends.	12	CO5

TEXT BOOKS:

1. Bruce, P., Bruce, A., & Gedeck, P. (2020). *Practical Statistics for Data Scientists* (2nd edition), O'Reilly Media, ISBN 978-1492072942.
2. Dasgupta, A. (2021). *Exploratory Data Analysis with R*, CRC Press, ISBN 978-0367332666.

REFERENCE BOOKS:

1. McKinney, W. (2022). *Python for Data Analysis* (3rd edition), O'Reilly Media, ISBN 978-1098104030.
2. Boehmke, B., & Greenwell, B. M. (2020). *Hands-On Machine Learning with R*, CRC Press, ISBN 978-0367135595.

E- REFERENCES:

1. <https://nptel.ac.in/courses/111104100> – NPTEL: Introduction to Exploratory Data Analysis
2. <https://seaborn.pydata.org/tutorial.html> – Seaborn: Statistical Data Visualization in Python

CORE - IX

Course Title: **BLOCK CHAIN & CRYPTO CURRENCY FUNDAMENTALS**

Course Code : 2569317	Credits 04
L:T:P:S : 4:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES:

- *This course aims to provide students with a comprehensive understanding of blockchain technology by breaking down its fundamental components and exploring how they integrate to support decentralization.*
- *Students will gain insights into the workings of cryptocurrency, tracing the lifecycle of a transaction from initiation to its inclusion in the blockchain.*
- *Additionally, the course will cover the core components of Ethereum and introduce students to the programming languages and tools used for developing decentralized applications on the Ethereum platform.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the technology components of Blockchain and how it works behind – the scenes.
CO2	Be aware of different approaches to developing decentralized applications.
CO3	Understand the Bitcoin and its limitations by comparing with other alternative coins
CO4	Establish deep understanding of the Ethereum model, its consensus model and code execution.
CO5	Understand the architectural components of a Hyperledger and its development

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	3	2	2	2	2
CO2	3	3	2	2	3	3	3	3	3	3	2
CO3	3	2	3	3	3	2	2	3	2	3	3
CO4	2	3	2	3	3	3	3	3	3	2	3
CO5	3	2	3	3	3	2	3	2	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Block chain History of Block chain – Types of Block chain – Consensus – Decentralization using Block chain – Block chain and Full Ecosystem Decentralization – Platforms for Decentralization.	12	CO1
2	MODULE- II Introduction to Cryptocurrency Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Z cash – Smart Contracts – Ri cardian Contracts	12	CO2
3	MODULE-III Ethereum The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.	12	CO3
4	MODULE-IV Web And Hyperledger Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda	12	CO4
5	MODULE-V Alternative Blockchains And Next Emerging Trends Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.	12	CO5

TEXT BOOKS:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Arshdeep Bahga, Vijay Madiseti, “Block chain Applications: A Hands On Approach”, 2017.
3. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly, 2014.

REFERENCE BOOKS:

1. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing, 2016.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.

E- REFERENCES:

1. <https://ethereum.org/en/developers/docs/>–OfficialEthereum Developer Documentation(Covers: *Blockchain fundamentals, Ethereum ecosystem, smart contracts, Solidity programming*<http://www.tutorialspoint.com/csharp>)
2. <https://hyperledger-fabric.readthedocs.io/en/latest/>– Hyperledger Fabric Official Documentation(Covers: *Distributed ledger technology, Hyperledger architecture, enterprise blockchain use cases*)

MULTIPLE DISCIPLINE ELECTIVE / OPEN ELECTIVE -I

Course Title: (A) BIO-INFORMATICS

Course Code : 2569318(A)	Credits 03
L:T:P:S : 2:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES:

- *Understand bioinformatics and its relation to data science. Apply data science techniques to analyze biological data. Use bioinformatics tools for data analysis and visualization.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the structure of Biological Data.
CO2	Analyze biological data using data science techniques (cleaning, visualizing, and interpreting).
CO3	Use machine learning for genomic data analysis (classification, clustering).
CO4	Work with bioinformatics databases and tools to analyze DNA, RNA, and protein data.
CO5	Use sequence alignment and assembly methods to study genomes.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	3	2	1	2	3	2	2
CO2	3	2	2	2	3	2	1	2	2	2	3
CO3	2	3	1	3	3	2	2	2	2	1	2
CO4	2	3	3	3	2	2	2	2	2	2	2
CO5	2	3	3	3	3	1	2	3	3	3	2

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Bioinformatics and Data Science What is bioinformatics? How it connects to data science. Biological data: DNA, RNA, and proteins. Cleaning and organizing biological data. Introduction to key biological databases (GenBank, UniProt, PDB). Basic statistical analysis for biological data (e.g., hypothesis testing, p-values).	9	CO1
2	MODULE-II Machine Learning and Data Mining in Bioinformatics Introduction to machine learning for bioinformatics. Supervised learning: Classification techniques (e.g., SVM, Random Forest). Unsupervised learning: Clustering methods (e.g., K-means). Reducing data complexity (e.g., PCA). Finding patterns in biological data.	9	CO2
3	MODULE-III Sequence Analysis and Genome Informatics Sequence alignment: BLAST, FASTA. Multiple sequence alignment: ClustalW, MAFFT. Genome-wide studies for diseases (GWAS). Gene annotation using bioinformatics tools.	9	CO3
4	MODULE-IV Structural Bioinformatics and Applications Protein structures: primary, secondary, tertiary. Understanding protein folding and molecular docking. Visualizing protein structures (e.g., PyMOL, Chimera). Using bioinformatics for drug discovery and biological research.	9	CO4
5	MODULE-V Functional Genomics and Multi-Omics Analysis Gene expression analysis using RNA-seq and microarrays. Analyzing genes and pathways (Gene Ontology). Combining genomics, transcriptomics, and proteomics data. Using bioinformatics tools like Galaxy and Bioconductor	9	CO5,

TEXT BOOKS:

1. Pevzner, P. A. (2014). *Bioinformatics: Algorithms and Applications* (2nd ed.). Springer.
2. Lesk, A. M. (2019). *Introduction to Bioinformatics* (5th ed.). Oxford University Press.
3. Xia, Y., & Li, Y. (2015). *Bioinformatics: A Machine Learning Approach*. Springer.

REFERENCE BOOKS:

1. Mount, D. W. (2004). *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbor Laboratory Press.
2. Baxevanis, A. D., & Ouellette, B. F. F. (2005). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins* (2nd ed.). Wiley-Liss.

E-REFERENCES:

1. <https://www.geeksforgeeks.org/bioinformaticsapplication/>
2. <https://www.tpointtech.com/bioinformatics-definition>

MULTIPLE DISCIPLINE ELECTIVE / OPENELECTIVE I

Course Title: (B) GENETIC ENGINEERING

Course Code : 2569318(B)	Credits 03
L:T:P:S : 2:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- Explain the principles of genetic engineering, including DNA manipulation, cloning vectors, and gene expression techniques.
- Apply recombinant DNA technology and genome editing tools like CRISPR-Cas9 in biotechnology, medicine, and agriculture.
- Analyze the ethical, legal, and biosafety regulations associated with genetic engineering and its societal impact.

Course outcomes: At the end of course, the student will be able

CO1	Understand the fundamental principles of genetic engineering, including DNA manipulation techniques.
CO2	Explain the role of cloning vectors and expression systems in recombinant DNA technology.
CO3	Apply various genome editing techniques such as CRISPR-Cas9 for genetic modifications.
CO4	Analyze the applications of genetic engineering in medicine, agriculture, and forensic science.
CO5	Evaluate the ethical, legal, and biosafety concerns associated with genetic engineering.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	3	2	1	2	2	2	2
CO2	3	3	2	2	3	2	2	2	2	1	2
CO3	2	3	3	3	2	1	3	2	2	3	3
CO4	2	3	3	3	3	2	2	2	2	2	2
CO5	2	3	3	3	2	1	2	3	3	3	2

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Genetic Engineering: Basics of DNA, RNA, and Proteins, Tools of Genetic Engineering: Restriction Enzymes, Ligases ,Vectors- Gene Cloning Principles and Applications	9	CO1
2	MODULE-II Gene Cloning and Expression Systems: Cloning Vectors: Plasmids, Phages, BACs, YACs-Expression of Recombinant Proteins in Bacteria and Eukaryotes-Polymerase Chain Reaction (PCR) and Its Applications	9	CO2
3	MODULE-III Genome Editing Techniques: Gene Transfer Methods: Microinjection, Electroporation- CRISPR-Cas9 and Other Genome Editing Tools-RNA Interference and Gene Silencing	9	CO3
4	MODULE-IV Applications of Genetic Engineering: Genetically Modified Organisms (GMOs)-Gene Therapy and Biopharmaceuticals-DNA Fingerprinting in Forensic Science	9	CO4
5	MODULE-V Ethical and Regulatory Aspects: Biosafety and Bioethics in Genetic Engineering-Intellectual Property Rights (IPR) and Patents- Future Prospects in Genetic Engineering	9	CO5

TEXT BOOKS:

1. Desmond S T Nicholl, An Introduction to Genetic Engineering , 4th Edition , Cambridge University Press , May 2023, ISBN 9781009180603
2. S.B. Primrose & R.M. Twyman “*Principles of Gene Manipulation and Genomics*“ publisher Wiley-Blackwell 3 June 2013 ISBN-13 978-1405135443

REFERENCE BOOK :

1. Jane K. Setlow “Genetic Engineering: Principles and Methods “1st ed, November 2012, Springer-Verlag New York Inc

E-REFERENCES:

1. https://en.wikipedia.org/wiki/Genetic_engineering
2. <https://www.yourgenome.org/theme/what-is-genetic-engineering/>
3. <https://www.slideshare.net/slideshow/biosafety-and-bioethics/81558094>

MULTI – DISCIPLINE ELECTIVE/OPEN ELECTIVE I

Course Title: (C) BIOETHICS AND DIVERSITY

Course Code : 2569318(C)	Credits 03
L:T:P:S : 2:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

COURSE OBJECTIVES:

- *This course attempts to define the critical interplay of theory, experience, science, social science, law, and community that have influenced and defined bioethics as a field of study.*
- *The course continues with an examination of the central philosophical approaches that inform bioethics and assess their core assumptions and underpinnings, beginning with an exploration of the nature and meaning of moral inquiry as applied to the life sciences.*
- *It looks into the basic notions on human dignity such as autonomy, privacy etc and throws light on the development and relevance of these value precepts.*

Course outcomes: At the end of course, the student will be able

CO1	To understand the major principles underlying bioethics.
CO2	To analyse the basic underpinnings behind the field of bioethics and its relevance
CO3	To create solutions to the existing challenges posed by advancement in scientific research
CO4	Analyze the applications of bioethics in medicine, agriculture, and forensic science.
CO5	Evaluate the ethical, legal, and biosafety concerns associated with genetic engineering.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	3	2	2	3	2
CO2	3	3	2	3	3	3	3	3	3	2	2
CO3	3	2	2	3	2	2	3	2	3	3	3
CO4	2	3	2	2	3	3	3	2	3	2	2
CO5	3	3	2	3	3	3	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Introduction to Bio-ethics Jurisprudential Basis of Bioethics- development of bioethics- understanding law- ethics and bioethics - human dignity and human rights - Principles of benefit and harm- Bioethics: an interdisciplinary domain	9	CO1
2	MODULE-II Autonomy, Consent and Privacy Autonomy and individual responsibility, Consent, Persons without the capacity to consent, Respect for human vulnerability and personal integrity, Privacy and confidentiality	9	CO2
3	MODULE-III Justice, Diversity and Co-operation Equality, justice and equity, Nondiscrimination and non-stigmatization, Respect for cultural diversity and pluralism, Solidarity and cooperation	9	CO3
4	MODULE-IV Ethics in Different Realms Application in different fields of Investigations- relevance- research ethics- ethics in scientific investigations and research- Publication ethics- forms -medical ethics- environmental ethics media ethics-legal and ethical guidelines	9	CO4
5	MODULE-V Health and Responsibility Social responsibility and health, Sharing of benefits, Protecting future generations, Protection of the environment, the biosphere and biodiversity	9	CO5

TEXT BOOKS:

1. Barilan, YechielM Human Dignity, Human Rights, and Responsibility - The New Language of Global Bioethics and Biolaw, U.S.A.: MIT. (2014)
2. Kuhse, H. and Singer, P. Bioethics: An Anthology, 2nd Ed. Blackwell. (2008)
3. Singer, Peter A. and Viens, A. M. The Cambridge Textbook of Bioethics, Cambridge: Cambridge University Press. (2008)

REFERENCE BOOK:

1. Jane K. Setlow "Genetic Engineering: Principles and Methods "1st ed, November 2012, Springer-Verlag New York Inc

E-REFERENCES:

1. https://en.wikipedia.org/wiki/Genetic_engineering
2. <https://www.yourgenome.org/theme/what-is-genetic-engineering/>
3. <https://www.slideshare.net/slideshow/biosafety-and-bioethics/81558094>

CORE PRACTICAL V

Course Title: PREDICTIVE ANALYTICS LAB

Course Code : 2569319	Credits 03
L:T:P:S : 0:1:4:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- *This course is designed to equip students with the ability to build, train, and validate a range of predictive models using suitable algorithms such as regression, classification, and time series analysis.*
- *Students will be encouraged to apply Exploratory Data Analysis (EDA) techniques to visualize data and uncover meaningful insights prior to modeling.*
- *The course also aims to develop competency in evaluating model performance using key metrics such as accuracy, precision, recall, and ROC curves, while enabling students to interpret and communicate the results effectively.*

Course Outcome: At the end students will be able to

CO1	Import, preprocess, and transform real-world datasets, including handling missing values, encoding categorical data, and scaling features for machine learning.
CO2	Perform exploratory data analysis (EDA) using visualization tools like Matplotlib and Seaborn to extract meaningful insights from data.
CO3	Implement and interpret simple and multiple linear regression models to analyze relationships between variables and evaluate model performance
CO4	Build and evaluate classification models including Logistic Regression, Decision Tree, Random Forest, and K-Nearest Neighbors, optimizing parameters and comparing model accuracy.
CO5	Apply time series forecasting techniques such as ARIMA, SARIMA, and Prophet, and evaluate classification models using metrics like confusion matrix, precision, recall, F1-score, and ROC-AUC

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	3	2	2	3	2
CO2	3	3	2	3	3	3	3	3	3	2	2
CO3	3	2	2	3	2	2	3	2	3	3	3
CO4	2	3	2	2	3	3	3	2	3	2	2
CO5	3	3	2	3	3	3	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	Import and preprocess a real-world dataset	12	CO1
2	Perform Exploratory Data Analysis (EDA) with visualization	12	CO2
3	Linear Regression Modelling and Performance Evaluation a. Implement Simple Linear Regression on a dataset and interpret model output. b. Perform Multiple Linear Regression and evaluate model performance.	12	CO3
4	Supervised Classification Techniques and Model Evaluation a. Build a Logistic Regression model for binary classification. b. Apply Decision Tree Classifier and visualize the tree structure. c. Use Random Forest Classifier and compare performance with Decision Tree. d. Perform K-Nearest Neighbors (KNN) classification and tune K-value.	12	CO4
5	Advanced Forecasting Methods and Classification Model Evaluation a. Implement Time Series Forecasting using ARIMA model. b. Use Prophet or SARIMA to forecast seasonal data. c. Evaluate classification models using confusion matrix, precision, recall, F1-score. d. Plot and interpret ROC curves and AUC values for multiple models.	12	CO5

REFERENCE BOOKS:

1. Introduction to Statistical Learning, James et al.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow , Aurlien Gron (Practical ML with Python)
3. Pattern Recognition and Machine Learning, Christopher Bishop
4. Time Series Analysis and Its Applications, Shumway & Stoffer
5. Forecasting: Principles and Practice, Hyndman & Athanasopoulos

CORE PRACTICAL VI

Course Title: - EXPLORATORY DATA ANALYSIS LAB

Course Code : 2569320	Credits 03
L:T:P:S : 0:1:4:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES:

- *This course is designed to equip students with the skills necessary to perform thorough exploratory data analysis using real-world datasets.*
- *Students will learn to create and manipulate DataFrames, clean and preprocess data, identify and handle missing values, and integrate data from various sources.*
- *The course also emphasizes data transformation techniques, outlier detection and treatment, data visualization for pattern recognition, and basic classification and clustering methods essential for effective data mining.*

Course Outcome: At the end students will be able to

CO1	Perform data preprocessing, integration, and transformation using libraries like Pandas and NumPy.
CO2	Apply normalization techniques such as Min-Max, Z-score, and Log transformation to prepare data for analysis.
CO3	Detect and handle outliers using statistical methods including boxplots, Z-score, and IQR.
CO4	Implement association rule mining algorithms like Apriori and FP-Growth to discover patterns in datasets.
CO5	Develop and apply machine learning algorithms for classification (Naïve Bayes, Decision Tree), clustering (K-Means, Agglomerative), and perform basic image processing tasks using OpenCV or PIL.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	3	2	2	3	2
CO2	3	3	2	3	3	3	3	3	3	2	2
CO3	3	2	2	3	2	2	3	2	3	3	3
CO4	2	3	2	2	3	3	3	2	3	2	2
CO5	3	3	2	3	3	3	3	3	3	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	Data Preprocessing and Data Integration using Pandas and NumPy	12	CO1
2	Programs for Data Normalization (Min-Max, Z-score, Log Transformation)	12	CO2
3	Outlier Detection and Removal using Boxplots, Z-score, and IQR methods	12	CO3
4	Association Rule Mining using Apriori and FP-Growth Algorithms	12	CO4
5	<p>Machine Learning Techniques and Image Processing Fundamentals</p> <p>a. Classification using Naïve Bayes, Decision Tree; Clustering using K-Means and Agglomerative Methods</p> <p>b. Image Reading, Writing, Sharpening, Smoothing, and Segmentation using OpenCV or PIL</p>	12	CO5

REFERENCE BOOKS:

1. Python for Data Analysis, Wes McKinney
2. Data Mining: Concepts and Techniques, Han, Kamber & Pei
3. Pattern Recognition and Machine Learning, Bishop
4. Learning OpenCV 4, Kaehler & Bradski
5. Digital Image Processing, Gonzalez & Woods

DISCIPLINE SPECIFIC I

SKILL ENHANCEMENT COURSE - I

Course Title: QUANTITATIVE APTITUDE

Course Code : 2569322	Credits 03
L:T:P:S : 2:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES:

- *To strengthen fundamental concepts in mathematics relevant to problem-solving.*
- *Develop logical reasoning and analytical thinking skills. Improve speed and accuracy in solving aptitude-based problems.*
- *Prepare students for competitive exams and research-level numerical reasoning. Apply mathematical concepts to real-life problem scenarios.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Recall and apply the fundamental concepts of arithmetic and number systems
CO2	Solve algebraic expressions and equations, and analyze geometrical and mensuration problems involving real-world scenarios.
CO3	Demonstrate logical steps to solve problems related to time, speed, distance, and work using appropriate strategies and techniques.
CO4	Interpret and evaluate data presented in tables, charts, and graphs for quick and accurate decision-making.
CO5	Construct solutions using reasoning techniques such as syllogisms, puzzles, and number series to solve analytical reasoning questions.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	3	2	2	2	2
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	2	2	3	3	2	2	3	3	3	2
CO4	2	3	2	3	3	3	3	3	3	2	3
CO5	3	3	2	3	3	2	3	2	2	2	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Number Systems & Arithmetic :Divisibility rules, LCM & HCF- Simplification and approximation-Average, Percentage, Ratio & Proportion- Profit & Loss, Simple & Compound Interest	9	CO1
2	MODULE-II Algebra & Geometry : Algebraic expressions and identities -Linear and quadratic equations-Mensuration: Area, Volume, Surface Area - Geometry: Lines, angles, triangles, circles	9	CO2
3	MODULE-III Time, Work & Distance: Time and work - Pipes and cisterns- Time, speed, and distance - Boats and streams- Problems on trains	9	CO3
4	MODULE-IV Data Interpretation & Analysis : Bar graphs, line graphs, pie charts - Tabular data interpretation	9	CO4
5	MODULE-V Logical & Analytical Reasoning : Coding-decoding - Number series, Alphabet series- Blood relations, Directions, Puzzles- Syllogisms, Venn diagrams- Data sufficiency and statement conclusions	9	CO5,

TEXT BOOK:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", S. Chand Publishing, Revised Edition, 2022.

REFERENCE BOOKS

1. Arun Sharma, "How to Prepare for Quantitative Aptitude for CAT", McGraw-Hill Education, 9th Edition, 2022.
2. Abhijit Guha, "Quantitative Aptitude for Competitive Examinations", Tata McGraw Hill, 5th Edition, 2021.
3. Dinesh Khattar, "Quantitative Aptitude for All Competitive Examinations", Pearson, 2020.

E REFERENCE:

1. RS Aggarwal Practice Tests – Gradeup

*****End of Third Semester*****

FOURTH SEMESTER

Course Title: **PROJECT & VIVA-VOCE**

Course Code : 2569423	Credits 05
L:T:P:S : 0:7:20:0	CIA Marks : 50
Exam Hours : 03	ESE Marks : 100

LEARNING OBJECTIVES

- *On taking the course, the students will be able to Implement the solution for the chosen problem using the concepts and the techniques learnt in the curriculum, Identify, formulate and implement computing solutions,*
- *Design and conduct experiments, analyze and interpret data, Record the result, demonstrate skills to use modern tools, software and equipment's to analyze the chosen problem.*

PROCEDURE

- The final semester will be entirely assigned for the student to carry out their project work.
- The Head of the Department will assign an Internal Guide for each student.
- The students should submit the contact details of the organization to their guide.
- During regular intervals, student should report his/her progress of the project work.
- After the submission of the final report, an external examiner will evaluate the project document and conduct the viva-voce Examination.

DISCIPLINE SPECIFIC II

SKILL ENHANCEMENT COURSE -II

Course Title: LOGICAL REASONING

Course Code : 2569424	Credits 03
L:T:P:S : 2:1:0:0	CIA Marks : 50
Exam Hours : 03	ESE Marks :100

LEARNING OBJECTIVES:

- A course in logical reasoning should impart to the students the necessary skills to engage in reasoning through real world cases.
- With this aim in mind, the course will introduce the models of correct reasoning, both deductive and ampliative, and also dwell on their respective strengths and shortcomings.
- It will supplement this with an overview of commonly encountered fallacies and biases.
- The skills developed during the course will be put to use to evaluate real world cases of public reasoning, including diagnosing fake news and echo chambers.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the concepts and solve problems expressed in words.
CO2	Verbal reasoning tests helps in extraction of information and implications in a sentence
CO3	Puzzle includes seating arrangement or arranging people/days/months/places, etc. in different formats
CO4	Non-verbal reasoning test increases the ability of deduction and induction of logic of information and implications in a problem
CO5	Apply the concepts and solve problems expressed in numbers/letters/figures in combination with words.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	2	3	2	2	2	3
CO2	3	3	2	3	3	3	3	3	3	3	2
CO3	3	3	2	3	2	3	2	3	2	2	2
CO4	2	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3	3

3-Strong Correlation 2- Medium Correlation 1- Low Correlation

S.No.	CONTENTS OF MODULE	Hrs	COs
1	MODULE-I Basic concepts: Epistemology-arguments- truth- validity- soundness- strength. Language: words and meanings- intension and extension of terms- definitional techniques	9	CO1
2	MODULE-II Deductive reasoning: propositional logic- categorical Reasoning-Inductive reasoning: generalization- analogies- inference to the best explanation; Fallacies: formal- informal- biases.	9	CO2
3	MODULE-III Philosophy and critical thinking: moral reasoning- public reasoning- epistemology of fake news and echo chambers. Input-Output Arrangements: Grouping-Puzzles -Family Relationships, Sequencing and Arrangements -Linear- Circular and Matrix Arrangements	9	CO3
4	MODULE-IV Coding and Decoding- Cubes- Selection Criteria, Input Output- Directions- Syllogism- Comparatives- Series and more.	9	CO4
5	MODULE-V Venn diagram : Syllogisms-Course of action-Statement & assumption-Strong/ weak arguments-Verbal logic	9	CO5

TEXT BOOK:

1. L. Vaughn, The Power of Critical Thinking, Oxford: Oxford University Press, 2021

REFERENCE BOOKS:

1. C. Howson and P. Urbach, Scientific Reasoning, Open Court, 2006
2. I. M. Copi, Symbolic Logic, Prentice-Hall of India, 2012
3. P. Lipton, Inference to the Best Explanation, Routledge, 2004

E-REFERENCES:

1. https://www.iitg.ac.in/hss/page_syllabus_details.php?sno=RUKxMmVEZHhpQINSMkZrV00wdX13UT09
2. <https://byjus.com/govt-exams/logical-reasoning/>
3. <https://prepinsta.com/learn-logical-reasoning/>

*****End of Fourth Semester*****

APPENDICES

APPENDIX – A

OUTCOME-BASED EDUCATION (OBE)

Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation.

Program Educational Objectives (PEOs)

The Programme Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation

Programme Outcomes (POs)

Program outcomes are finer statements that designate what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

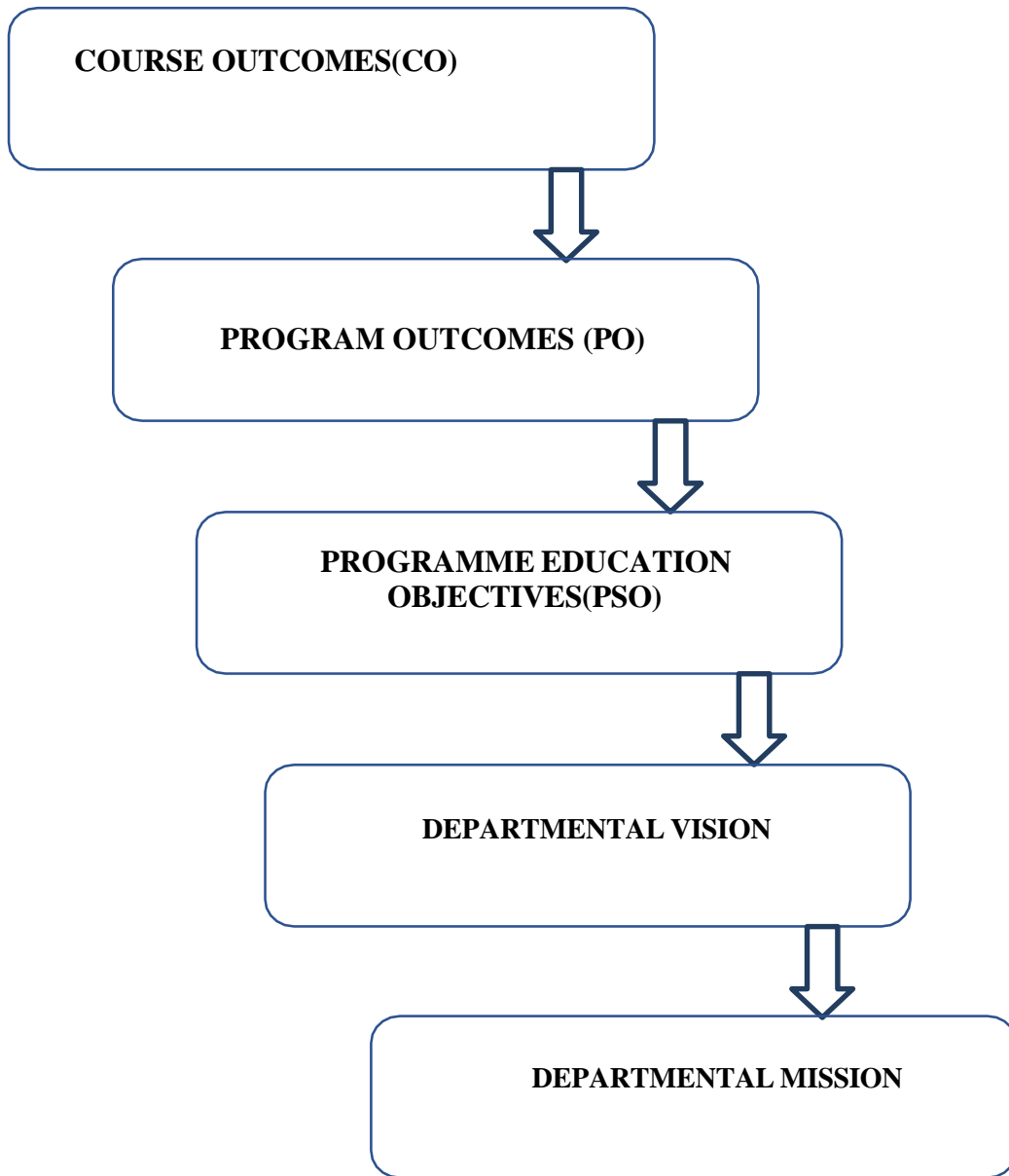
Programme Specific Outcomes (PSO)

Programme Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline.

Course Outcome (CO)

Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course

MAPPING OF OUTCOMES



APPENDIX - B

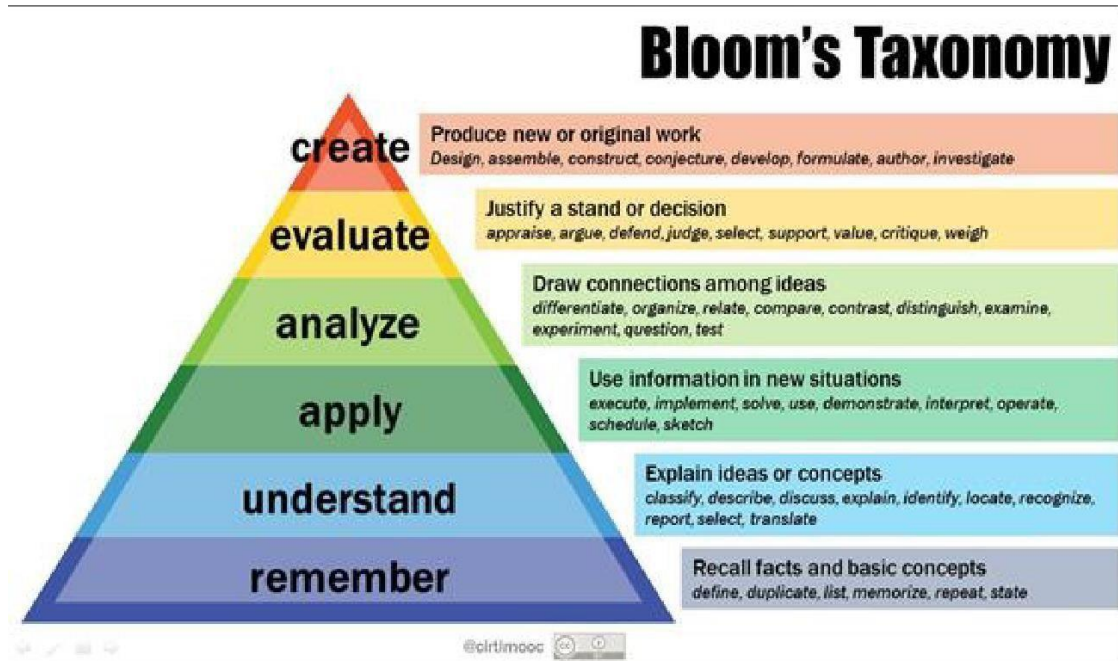
PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES

S.No	Graduate Attributes	Description
1	Knowledge	Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of a graduate programme of study.
2	Critical Thinking	Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
3	Problem Solving	Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
4	Usage of Modern Tools	Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
5	Communication	Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself;
6	Life-Long Learning	Ability to acquire knowledge and skills, including learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
7	Ethical Practices and Social Responsibility	Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work.
8	Independent and Reflective Learning	Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.

APPENDIX - C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (MODULEs, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. [eduglosarry.org]



Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

Level	Parameter	Description
K1	Remember	It is the ability to remember the previously learned material/information
K2	Understand	It is the ability to grasp the meaning of material
K3	Apply	It is the ability to use learned material in new and concrete situations
K4	Analyze	It is the ability to break down material/concept into its component parts/subsections so that its organizational structure may be understood
K5	Evaluate	It is the ability to put parts/subsections together to form a new whole material/idea/concept/information
K6	Create	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.