AS PER NEP 2020

SHRI VILE PARLE KELAVANI MANDAL's
USHA PRAVIN GANDHI COLLEGE OF ARTS, SCIENCE AND COMMERCE
Bhakti Vedanta Swami Marg, North-South Road No. 1
Juhu Scheme, Vile Parle (West), Mumbai 400 056.
Accreditation by NAAC "A+" Grade with CGPA 3.27

Affiliated to the

UNIVERSITY OF MUMBAI

Program: Master of Science

M. Sc. (Artificial Intelligence and Data Science)

Part I & II

Choice Based Credit System (CBCS) with effect

from the Academic year 2025 - 26

Academic Council No:
Agenda No:

Syllabus for Approval
(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program	**M.Sc.** **(Artificial Intelligence and Data Science)**
2	Eligibility	M.Sc. Artificial Intelligence and Data Science admissions are offered on a merit basis.Eligibility for the Programme: B.Sc. (IT) /B.Sc.(CS) /BCA/ BCS/ BE/B.Sc.(Data Science) /Graduate in any discipline with mathematics/statistics as major subject/Graduate with any discipline where subjects are aligned with Computer Science or Information Technology.
3	Duration of program	**02 years and 04 semesters**
4	Intake Capacity	**20 students**
5	Scheme of Examination	**Semester Pattern (CBCS)**
6	Standards of Passing	**40 %**
7	No. of years/Semesters:	**02 years and 04 semesters**
8	Program Level:	**Semester**
9	Pattern:	**CBCS**
10	Status:	**NEW**
11	To be implemented from Academic Year:	**June 2025- 26**

Preamble

The Master of Science (M.Sc.) in Artificial Intelligence (AI) and Data Science (DS) at Usha Pravin Gandhi College of Arts, Science and Commerce is an advanced graduate program that prepares students to develop mastery in AI algorithms, data analysis, machine learning, and statistical modeling. It empowers students to harness the transformative power of AI and Data Science to develop skills and knowledge to solve complex real-world problems and manage large-scale datasets.

The M.Sc. in AI and Data Science program is designed to align NEP 2020 guidelines with a blend of core and elective courses. Core courses lay the foundation in the subject discipline, ensuring students acquire fundamental concepts and techniques that enables them to solve complex problems. The program encourages to acquire proficiency in programming languages (such as Python and R), utilize cutting- edge algorithm and data visualization to gain insights into data. Concepts of statistical analysis, natural language processing, soft computing, time series analysis and forecasting, and deep neural networks are key highlights of the program. Elective courses empower students to specialize in domains like healthcare analytics, sports analytics, retail marketing analytics, Blockchain technologies, image and video analytics, and social media analytics.

In addition to classroom teaching and lab session, M.Sc. in AI and Data Science programs encompass On Job Training (OJT) and hands-on projects. The OJT experience offers students invaluable exposure to real-world scenarios within IT and IT-related organizations. Students can translate their theoretical knowledge into practical applications and gain first-hand experience and develop the skills that are must in the professional arena. Concurrently, hands-on projects enable students to immerse themselves in practical problem-solving, tackling intricate data challenges and delivering actionable insights to organizations. The Research Methodology Course has been included in the program to nurture a research- oriented mindset, enabling students to make meaningful contributions to the advancement of AI and Data Science.

Upon successful completion of the program, graduates of M.Sc. in AI and Data Science programs have promising career opportunities, across diverse industries. Graduates can take up diverse roles, including data scientists, data analysts, machine learning engineers, data engineers, or data consultants, with potential careers spanning finance, healthcare, e-commerce, marketing, technology, and research institutions. Furthermore, this program also paves the way for engaging themselves into research and academia.

1. Aims and Objectives

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Program Vision: The proposed M.Sc. (AI and Data Science) program aspires to be a pioneering academic venture that prepares students to excel in the interdisciplinary domains of AI and Data Science. This program envisions cultivating analytical, technical, and ethical competencies in students, fostering innovative thinking, and delivering professionals capable of addressing contemporary and future AI and DataScience challenges.

2. Objectives:

a. **Multifaceted AI and Data Science Proficiency:** The primary objective of this program is to provide students with a multidimensional understanding of AI and Data Science. It entails a comprehensive exploration of AI algorithms, machine learning, deep learning, statistical analysis, data mining, data visualization, and data management. Graduates will possess a well-rounded foundation in these disciplines. It involves a comprehensive exploration of AI algorithms, machine learning, deep learning,statistical analysis, data mining, data visualization, and data management. Graduates will possess a well-rounded foundation in these disciplines.

b. **Technical Mastery and Analytical Excellence:** This program is designed to facilitate the acquisition of advanced technical and analytical skills essential for the proficient handling of complex datasets. Graduates will demonstrate competence in data preprocessing, feature engineering, statistical modeling, andstate-of-the-art AI methodologies for data-driven decision-making.

c. **Cultivating an Innovative Mindset:** An overarching goal is to instill an innovation-oriented mindset instudents. Through critical thinking and creative problem-solving, students will develop the capacity toconceive innovative AI and Data Science solutions to real-world challenges, fostering intellectual and practical adaptability.

d. **Promoting Collaborative Excellence:** Collaboration is paramount in AI and Data Science. A fundamental objective is to foster collaborative aptitude, equipping students with the skills to effectivelycommunicate, ideate, and contribute within diverse, multidisciplinary teams, emulating the professionallandscape of these fields.

e. **Alignment with Industry Trends:** The program is committed to staying aligned with dynamic industrytrends and emerging technologies in AI and Data Science. It ensures graduates are industry-ready by offering practical exposure through guest lectures, industry partnerships, and internships.

f. **Holistic Professional Development:** Beyond technical competence, this program emphasizes the development of well-rounded professionals. Leadership, adaptability, and ethical decision-making are nurtured traits, ensuring graduates are not only proficient but also ethical and adaptable contributors inAI and Data Science.

g. **Research and Impact:** Encouraging research and innovation is intrinsic to this program. Students will havethe opportunity to participate in cutting-edge research projects, contributing to the continuo us expansion ofknowledge in AI and Data Science and making meaningful academic and industrial impacts.

3. Learning Outcomes

Upon successful completion of this program, students will exhibit the following learning outcomes:

- **Interdisciplinary Mastery:** Graduates will demonstrate comprehensive interdisciplinary proficiency in both AI and Data Science, with in-depth knowledge spanning AI algorithms, machine learning, deep learning, statistical analysis, data mining, data visualization, and data management.

- **Technical Artistry:** Graduates will possess technical excellence, adeptly utilizing tools such as Python, TensorFlow, PyTorch, and data visualization libraries. They will be proficient in data preprocessing, feature engineering, and employing cutting-edge AI methodologies to transform raw datainto actionable insights.

- **Innovative Problem-Solving:** The program cultivates innovative problem-solving capabilities. Graduates will exhibit the ability to creatively address complex real-world challenges through the application of AI and Data Science principles.

- **Effective Collaboration:** Collaboration skills will be a hallmark of our graduates. They will excel in collaborative teamwork, effectively communicating, ideating, and contributing within multifaceted AI and Data Science projects, in line with industry expectations.

- **Industry Relevance:** Graduates will be poised to make immediate contributions to the AI and Data Science job market, demonstrating competence aligned with industry trends and the ability to adapt to the evolving professional landscape.

- **Ethical Responsibility:** Ethical considerations are paramount. Graduates will exhibit a strong commitment to ethical conduct in all facets of AI and Data Science, addressing privacy, security, and ethical concerns with unwavering dedication.

- **Research and Innovation:** Graduates will be passionate about research and innovation, contributing to groundbreaking research projects and expanding the boundaries of AI and Data Science knowledge.

1. Credit Structure of the Program (Sem I, II, III & IV)

<table>
<tr><th>Year</th><th>Level</th><th>Sem</th><th colspan="4">Major</th><th>RM</th><th>OJT/ FP</th><th>RP</th><th>Cum. Cr.</th><th>Degree</th></tr>
<tr><th></th><th></th><th></th><th colspan="3">Mandatory</th><th>Electives</th><th></th><th></th><th></th><th></th><th></th></tr>
<tr><td rowspan="12">1</td><td rowspan="12">6.0</td><td rowspan="6">Sem I</td><td colspan="3">2*4+2*2 + 2</td><td>4</td><td>4</td><td rowspan="6">-</td><td rowspan="6">-</td><td rowspan="6">22</td><td rowspan="12">PG Diploma (after 3Years Degree)</td></tr>
<tr><td>Fundamental concepts of Artificial Intelligence</td><td>TH</td><td>4</td><td rowspan="5">Human Resource Analytics
2 TH +2PR
(OR)
Retail Marketing Analytics
2 TH + 2 PR
(OR)
Sports Data Analytics
2 TH +2PR</td><td rowspan="5">Research Methodology</td></tr>
<tr><td>Fundamental concepts of Artifical Intelligence Practical</td><td>PR</td><td>2</td></tr>
<tr><td>Data Analysis and Visualization</td><td>TH</td><td>4</td></tr>
<tr><td>Data Analysis and Visualization Practical</td><td>PR</td><td>2</td></tr>
<tr><td>Linear Algebra</td><td>TH</td><td>2</td></tr>
<tr><td rowspan="6">Sem II</td><td colspan="3">2*4+2*2+2</td><td>4</td><td rowspan="6">-</td><td rowspan="6">OJT4</td><td rowspan="6">-</td><td rowspan="6">22</td></tr>
<tr><td>Deep Learning</td><td>TH</td><td>4</td><td rowspan="5">Resilient Data Processing Techniques
2 TH+2PR
(OR)
Public Health care Analytics
2 TH +2PR
(OR)
Social Media Analytics
2 TH +2PR</td></tr>
<tr><td>Deep Learning Practical</td><td>PR</td><td>2</td></tr>
<tr><td>Big data Systems</td><td>TH</td><td>4</td></tr>
<tr><td>Big data Systems Practical</td><td>PR</td><td>2</td></tr>
<tr><td>Time Series Analysis and Forecasting Practical</td><td>PR</td><td>2</td></tr>
<tr><td colspan="3">Cum.Cr. For PG Diploma</td><td colspan="3">28</td><td>8</td><td>4</td><td>4</td><td></td><td>44</td></tr>
<tr><td colspan="12">Exit Option: PG Diploma (44 credits) after Three Year UG Degree</td></tr>
</table>

Year	Level	Sem (2yr)	Major				RM	OJT/ FP	RP	Cum. Cr.	Degree
2	6.5	Sem III	2*4+2*2 + 2			4	-	-	RP 4	22	PG Degree after 3-yr UG
			Quantum Computing	TH	4	Image and Video Analytics 2TH +2PR **(OR)** Risk Analytics in Banking and Financial Markets 4PR **(OR)** Cloud Computing 2TH+2PR					
			Reinforcement Learning Practical	PR	2						
			Natural Language Processing	TH	4						
			Natural Language Processing Practical	PR	2						
			Robotic Processing Automation	TH	2						
		Sem IV	2*4+2*2 + 2			4	-	-	RP 6	22	
			Generative AI	TH	4	Blockchain Technologies 2TH+2PR (OR) Econometrics and Finance 2 TH + 2PR (OR) Developing Data Science Web Applications 4PR					
			Generative AI Practical	PR	2						
			Optimization Methods	TH	4						
			Optimization Methods Practical	PR	2						
Cum. Cr. For 1 Yr.PG Degree			26			8			10	44	
Cum. Cr. For 2 Yr.PG Degree			54			16	4	4	10	88	

Sign of HOD
Prof. Dr. Swapnali Lotlikar

Sign of Principal
Dr. A. Kapoor

Dept. of Artificial Intelligence

1) Credit Structure of the Program (Sem I, II)

Credit Distribution Structure for

PART I (M.Sc. (Artificial Intelligence and Data Science))

SEM I				
Sr. No.	**Name of the Module (Subject)**	**Module Code**	**Module Category (Core, Core Elective, OE,VSC, SEC, AEC,VSC, IKS, CC, FP, OJT, RM, CEP, RP)**	**Total no. of credits**
1	Fundamental Concepts of Artificial Intelligence	UAFCA501	MAJOR	**4**
2	Fundamental Concepts of Artificial Intelligence Practical	UAFCA501P	MAJOR	**2**
3	Data Analysis and Visualization	UADAV502	MAJOR	**4**
4	Data Analysis and Visualization Practical	UADAV502P	MAJOR	**2**
5	Linear Algebra	UALAL503	MAJOR	**2**
6	Human Resource Analytics	UAHRA504	ELECTIVE	**2**
7	Human Resource Analytics Practical	UAHRA504P	ELECTIVE	**2**
8	Retail Marketing Analytics	UARMA505	ELECTIVE	**2**
9	Retail Marketing Analytics Practical	UARMA505P	ELECTIVE	**2**
10	Sports DataAnalytics	UASDA506	ELECTIVE	**2**
11	Sports DataAnalytics Practical	UASDA506P	ELECTIVE	**2**
12	ResearchMethodology	UARME507	RM	**4**

Credit Distribution Structure for

PART II (M.Sc. (Artificial Intelligence and Data Science))

SEM II				
Sr. No.	**Name of the Module (Subject)**	**Module Code**	**Module Category (Core, Core Elective, OE,VSC, SEC, AEC,VSC, IKS, CC, FP, OJT, RM, CEP, RP)**	**Total no. of credits**
1	Deep Learning	UADLE551	MAJOR	**4**
2	Deep Learning Practical	UADLE552P	MAJOR	**2**
3	Big Data Systems	UABDA553	MAJOR	**4**
4	Big data Systems Practical	UABDA553P	MAJOR	**2**
5	Time Series Analysis and Forecasting Practical	UATAF554P	MAJOR	**2**
6	Resilient Data Processing Techniques	UARDP555	ELECTIVE	**2**
7	Resilient Data Processing Techniques Practical	UARDP555P	ELECTIVE	**2**
8	Public Health Care Analytics	UAPHA556	ELECTIVE	**2**
9	Public Health Care Analytics Practical	UAPHA556P	ELECTIVE	**2**
10	Social MediaAnalytics	UASMA557	ELECTIVE	**2**
11	Social MediaAnalytics Practical	UASMA558P	ELECTIVE	**2**
12	OJT	UAOJT559	OJT	**4**

Credit Structure of the Program (Sem III, IV)

Credit Distribution Structure for

PART II (M.Sc. (Artificial Intelligence and Data Science))

SEM III				
Sr. No.	**Name of the Module (Subject)**	**Module Code**	**Module Category (Core, Core Elective, OE,VSC, SEC, AEC,VSC, IKS, CC, FP, OJT, RM, CEP, RP)**	**Total no. of credits**
1	Quantum Computing	UAQCO601	MAJOR	**4**
2	Reinforcement Learning Practical	UARLE602P	MAJOR	**2**
3	Natural Language Processing	UANLP603	MAJOR	**4**
4	Natural Language Processing Practical	UANLP603P	MAJOR	**2**
5	Robotic Processing Automation	UARPA604	MAJOR	**2**
6	Image and Video Analytics	UAIVA605	ELECTIVE	**2**
7	Image and Video Analytics Practical	UAIVA605P	ELECTIVE	**2**
8	Risk Analytics in Banking and Financial Markets Practical	UARAB606P	ELECTIVE	**4**
9	Cloud Computing	UACCO607	ELECTIVE	**2**
10	Cloud Computing Practical	UACCO607P	ELECTIVE	**2**
11	Research Project	UARPR608	RP	**4**

Credit Distribution Structure for

PART II (M.Sc. (Artificial Intelligence and Data Science))

SEM IV				
Sr. No.	**Name of the Module (Subject)**	**Module Code**	**Module Category (Core, Core Elective, OE,VSC, SEC, AEC,VSC, IKS, CC, FP, OJT, RM, CEP, RP)**	**Total no. of credits**
1	Generative AI	UAGAI651	MAJOR	**4**
2	Generative AI Practical	UAGAI651P	MAJOR	**2**
3	Optimization Methods	UAOME652	MAJOR	**4**
4	Optimization Methods Practical	UAOME652P	MAJOR	**2**
5	Blockchain Technologies	UABTE653	ELECTIVE	**2**
6	Blockchain Technologies Practical	UABTE653P	ELECTIVE	**2**
7	Econometrics and Finance	UAEFI654	ELECTIVE	**2**
8	Econometrics and Finance Practical	UAEFI654P	ELECTIVE	**2**
9	Developing Data Science Web Applications Practical	UADDS655P	ELECTIVE	**4**

10	Research Project	UARPR656	RP	**6**

Semester I

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: I	
Course: Fundamental concepts of Artificial Intelligence		**Course Code:** UAFCA501	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE) (Marks- 60 in Question Paper)**
4	4	20+20	60

Learning Objectives:

To enable the students to:

- To understand the Foundations and Evolution of AI and Data Science
- To develop Problem-Solving Skills Using AI Techniques
- To Master Data Analysis and Preprocessing Techniques.
- To understand the principles of machine learning and its capabilities

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Pre requisite: Basic understanding of statistics

Course Outcomes:

Upon completing this course, the student will be able to:

CO1: Comprehensive Understanding of AI and Data Science Principles
CO2: Proficiency in Data Analysis and Statistical Techniques.
CO3: Skills in Data Preprocessing and Visualization
CO4: Application of AI Techniques for Problem Solving
CO5: Applying supervised and unsupervised machine learning techniques

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
Module I	**Introduction to Artificial intelligence and Data Science** **Introduction to AI:** Definitions and scope, Aims and challenges, Historical l Overview, Early concepts and the Turing Test, Significant milestones, Case studies: Deep Blue, AlphaGo, advancements in NLP and computer vision AI, ML. **Overview of Data Science**: Data Science life cycle, key concepts and applications. NOIR (nominal, Ordinal, Interval and Ratio), continuous and discrete numeric data. Types of data analysis, Basics of probability, conditional probability, Bayes' theorem, and probability distributions.	**15**

Module II	**Introduction to Machine Learning:** What is machine learning? Varieties of machine learning, introduction of supervised and unsupervised learning **Supervised Learning** Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes,	**15**
Module III	**Supervised Learning & Ensemble Techniques** Maximum margin classifier – Support vector machine, Decision Tree, Random Forests Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking	
Module IV	**Unsupervised learning**: The Challenge of Unsupervised Learning, Principal Components Analysis, Clustering Methods, K-Means Clustering, Hierarchical Clustering, Anomaly detection and large-scale machine learning.	**15**
	Total	**60**

Reference Books:

- "Practical Statistics for Data Scientists: 50 Essential Concepts" by Peter Bruce and Andrew Bruce, O'Reilly Media, 2020, ISBN-10: 1491952962 ISBN-13: 978- 149195296
- "Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic, Wiley, 2015
- "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett, 2013
- Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
- Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2022
- Introduction to Machine Learning with Python: A Guide for Data Scientists Book by Andreas C. Müller and Sarah Guido. 2022.
- Python Machine Learning Book by Sebastian Raschka, Packt Publishing , 3rd Edition, 2019.

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: I**	
Course: Fundamental concepts of Artificial Intelligence Practical		**Course Code:** UAFCA501P	
Practical			
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE) (Marks- in Question Paper)**
4	2	20	30

Learning Objectives:

To enable the students to:

- To able demonstrate statistical descriptive methods in Python.
- To understand correlation analysis and data wrangling concept.
- To demonstrate univariate, bivariate, multivariate statistics analysis
- To demonstrate python and R libraries

Pre requisite:

Basic computer skills and Basic understanding of elementary Math.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Demonstrate statistical methods using python, R and Excel.

CO2: Implement data wrangling concept and correlation analysis.

CO3: Demonstrate univariate, bivariate, and multivariate statistics using, Python,

CO4: Demonstrate python and R libraries

Outline of Syllabus:

Module	**Description**	**No. of Hours**
PSDSP502	**Essential technologies for AI,ML and Data Science Practical**	
1	Demonstrate statistical descriptive methods using Python or R.	
2	Import a csv or Excel dataset and demonstrate data wrangling, view shape, dimension, column names of the dataset, ways to select data using column number, column names, simple and compound conditional selection, update, and modify dataset.	
3	Perform univariate, bivariate, and multivariate analysis using Visualization techniques in Python	
4	Perform univariate, bivariate, and multivariate analysis using Visualization techniques in R	
5	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6	Write a program to implement Decision Tree and Random Forest with Prediction, Test Score and Confusion Matrix.	

7	For a given set of training data examples stored in a .CSV file implement Least Square Regression algorithm.	
8	For a given set of training data examples stored in a .CSV file implement Logistic Regression algorithm	
9	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set.	
10	Implement K-means clustering with Prediction, Test Score and Confusion Matrix.	
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: I**	
Course: Data Analysis and Visualization		**Course Code:** UADAV502	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE) (Marks- 60 in Question Paper)**
4	4	20+20	60

Learning Objectives:

To enable the students to:

- To understand basics of various types of data
- To apply data cleaning and preprocessing techniques in AI and Data Science
- To apply techniques of statistical and Exploratory Data Analysis (EDA) on data
- To apply data visualization and data analytics techniques to solve real world business problems

Pre requisite:

Basic understanding of data, types of data and visualization

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Students will learn to understand various data formats, data sources, data storage mechanisms and various data repositories such as Data Marts, Data Lakes, ETL

CO2: Students will be able to handle missing data and manage data wrangling and learn manipulation Tools used for Data Cleaning, Data Preparation and Data Transformation

CO3: Students will learn to demonstrate the data visualizations, make interpretations from the visualization, and present the reports

CO4: Students will be able to create a data story using various software tools such as PowerBI

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Unit 1: Introduction to Data Analysis** Data Analysis - Exploratory Data Analysis and AI and Data Science Process - Responsibilities of a Data Analyst - Data Analytics vs. Data Analysis - Types of Data - Understanding Different Types of File Formats - Sources of Data - Languages for Data Professionals - Overview of Data Repositories–Data Warehouse, Data Marts, Data Lakes, and Data Pipelines - Foundations of Big Data - Identifying Data for Analysis	**15**
2	**Unit 2: Data Wrangling** Storage and File Formats - Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, interacting with Web APIs, Interacting with Databases – Data Wrangling - Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting - Tools for Data Wrangling , ETL- Data Cleaning and Preparation - Handling Missing Data, Data Transformation, String Manipulation, Final data loading	**15**

3	**Unit 3: Data Visualization** Introduction to data visualization - Introduction to Visualization and Dashboard Softwares - Visualization Tools as Tableau- Getting started with Desktop – Connecting to the dataset - Creating charts – Creating common visualizations (barcharts, line charts etc.) - Filtering and sorting data - Adding Titles, Labels, anddescriptions - Publish your work to Cloud - Interactivity with text and visualtooltips - Interactivity with actions (filter, highlight, URL) – Assemblingdashboards from multiple charts, example of Importing data, cleaning, summarization, visualization	**15**
4	**Unit 4: Story Telling** Introduction to Power BI - Understanding Desktop - Understanding Power BI Report Designer - Report Canvas, Report Pages: Creation, Renames - Report Visuals, Fields and UI Options - Experimenting Visual Interactions, Advantages - Reports with Multiple Pages and Advantages - Pages with Multiple Visualizations - PUBLISH Options and Report Verification in Cloud - Adding Report Titles. Report Format Options - Introduction to data storytelling - Creating a data story	**15**
	Total	**60**

Reference Books:

1. Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython by McKinney, W., 2nd edition. O'Reilly Media, 2017.
2. Doing Data Science: Straight Talk from the Frontline by O'Neil, C., & Schutt,R, O'Reilly Media, 2013.
3. The Big Book of Dashboards by Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, John Wiley & Sons,2017
4. Practical Tableau by Ryan Sleeper, O'Reilly Media, 2018.
5. Power BI. Book-1, Business Intelligence Clinic: Create and Learn by Roger F Silva, 2018
6. Introducing Microsoft Power BI by Alberto Ferrari and Marco Russo, Microsoft Press, Washington,2016

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: I**	
Course: Data Analysis and Visualization Practical		**Course Code:** UADAV502P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks -)**	**Semester End Examinations (SEE) (Marks- in Question Paper)**
4	2	20	30

Learning Objectives

- Students will learn to understand various data formats, data sources, data storage mechanisms and various data repositories such as Data Marts, Data Lakes, ETL
- Students will be able to handle missing data and manage data wrangling and learn manipulation Tools used for Data Cleaning, Data Preparation and Data Transformation
- Students will learn to demonstrate the data visualizations, make interpretations from the visualization, and present the reports
- Students will be able to create a data story using various software tools such as PowerBI

Pre requisite:
Basic understanding of data, types of data, visualization mechanisms and basic computer skills.

Course Outcomes:
After completion of the course, learners would be able to:
CO1: To understand basics of missing data and manage data wrangling and manipulation of data
CO2: To create data visualization and report making using various software tools
CO3: To demonstrate data visualization techniques and make interpretations of the resultsCO4:
To create data story using various software tools

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
PSDSP504	**Data Analysis and Visualization Practical**	
1	Implement Data Loading, Storage and File Formats. Read data and store them intext format.	
2	Implement the code to interact with Web APIs and to perform web scrapping.	
3	Demonstrate Data Cleaning and Preparation.	
4	Implement Data wrangling on a data set.	
5	Demonstrate the handling of missing data and string manipulation.	
6	Create common charts with title, labels and descriptions using Tableau/PowerBI.	
7	Perform sorting and filtering using power BI/ tableau, create visualizations and publish it on Tableau Cloud.	
8	Perform data visualization using Power BI/Tableau.	
9	Create reports using Power BI/Tableau.	
10	Create a data story in Tableau or power BI/Tableau.	
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: I**	
Course: Linear Algebra		**Course Code:** UALAL503	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- To Understand the foundational concept of matrix rank and apply the Gauss Elimination method to solve systems of linear equations.
- To Understand normed spaces and their properties and explore inner product spaces, emphasizing inner products and orthogonality.
- To Apply the Gram Schmidt Process to construct an orthogonal basis and analyze change of basis and orthogonal complements
- To analyze Orthogonal Diagonalization and its applications. And examine quadratic forms and techniques for diagonalizing them. And understand the principles of Principal Component Analysis.

Pre requisite:

Knowledge of mathematical concepts

Course Outcomes:

After completion of the course, learners would be able to:

CO 1. Students will demonstrate a comprehensive understanding of matrix rank and its application inlinear algebra. They will be proficient in solving systems of linear equations using the Gauss Elimination method.

CO2. Students will grasp normed space principles and effectively apply their properties. They will demonstrate proficiency in understanding and applying inner product spaces, with a focus on inner products and orthogonality.

CO3. Students will apply the Gram-Schmidt Process to construct orthogonal bases, showcasingproblem-solving skills. They will demonstrate proficiency in working with change of basis, orthogonal complements, and subspace projections.

CO4. Students will demonstrate competence in Orthogonal Diagonalization, particularly in the context of quadratic forms. They will apply Principal Component Analysis in various linear algebra applications.

Outline of Syllabus: (per session plan)		
Module	**Description**	**No of Hours**
PSDS505	**Linear Algebra**	
1	**Unit 1: Review of Matrix Algebra** Rank, Solution of system of equations- Gauss Elimination, LU decomposition, Echelon form. Normed spaces, Inner Product Spaces: Inner products – Orthogonality – Orthogonal basis – Gram Schmidt Process – Change of basis, Orthogonal complements – Projection on subspace – Least Square Principle- QR decomposition.	**20**
2	**Unit 2: Multivariate Techniques** Orthogonal Diagonalization, Quadratic Forms, Diagonal zing Quadratic Forms, Principal Component Analysis and Singular Value Decomposition	**10**
	Total	**30**

Reference Books:

- Gupta S. C., Kapoor V. K.: Fundamentals of Mathematical Statistics; Twelveth Edition. SultanChand &Sons. (2017)
- Johnson, R.A., Wichern, D.W.: Applied Multivariate Statistical Analysis, Prentice-Hall, New Jersey, 2015
- Draper, N. R. and Smith, H. (1998), Applied Regression Analysis (John Wiley), Third Edition.2019
- Purohit, S. G. Gore, S.D. and Deshmukh, S.R., Statistics using R, second edition. NarosaPublishing House, New Delhi. 2019 (Reprint version)
- Daniel W. W. Applied Non-Parametric Statistics, First edition Boston-Houghton Mifflin Company. 1990

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: I	
Course: Human Resource Analytics		**Course Code:** UAHRA504	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- develop applied analytical competence, enabling them to effectively utilize HR Analytics models and frameworks. They will gain hands-on experience in interpreting HR metrics and applying analytical tools to solve practical HR challenges.
- acquire practical skills in implementing Human Resource Information Systems (HRIS). They will beable to navigate the development process, conduct needs analysis, design systems, and consider organizational culture, leading to successful HRIS implementation.
- enhance their HR decision-making abilities by applying HR Analytics to specific HR sub-systems, such as staffing, training, and compensation management. They will learn to make data-driven decisions aligned with organizational objectives, contributing to effective human resource management.
- develop critical thinking skills by critically evaluating emerging trends in HR Analytics, including the impact of technology, social media, big data, and predictive analytics.

They will be equipped to anticipate and navigate future challenges, ensuring they remain adaptable and forward-thinking in the dynamic field of human resource management.

Pre requisite:

Tools, methods, approaches, and techniques of HR

Course Outcomes:

After completion of the course, learners would be able to:

CO1: To Analyze problems and issues in HR and the relevance of HR analytics.

CO2: To Logically synthesize the tools, methods, and techniques of HR analytics to understand real world corporate scenario.

CO3: To Identify the application and uses of HR analytics in various HR sub-systems

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
1	**Unit 1: HR Measurement** Need for HR Measurement, Significance and concept of HR Analytics, HR Analytics and business linkages, Prerequisites of HR Analytics; Models and frameworks of HR Analytics; Measuring intellectual capital, need and rationale for HR Accounting & Audit, Approaches, and methods of HR Accounting & Audit **HRIS for HR Analytics**: What is Human Resource Information System; Role of HRIS in analytics; HRIS development and Implementation, the development process- need analysis, systems design, structure, and culture; HRIS Applications- making HRIS work.	**15**
2	**Unit 2: Analytics for HR sub-systems**	**15**

	HR Analytics for Staffing, Training & Development, Performance Management Systems, Career Planning Systems, Rewards and Compensation Management, Employee Relations Systems. **Analytics for HR system:** HR performance frameworks and measurement systems; Measuring HR Climate and People Management Capabilities; Competency Management Frameworks & Competency Mapping, Integration of competency- based HR System. Measuring HR Effectiveness, The HR Scorecard **Trends and Future Challenges:** Technology and changes in HR Analytics, Role of social media, Big Data and Predictive Analytics in HR, Assessing the effectiveness of HR Analytics, Post analysis steps, Review and monitoring, Issues inHR valuation and measurement; Emerging challenges: Global and Indian Experience	
	Total	**60**

Reference Books:

1. Ulrich, D. & Brockbank, W., The HR Value Proposition. Harvard Business School Press 2016
2. How to measure HRM by Jac Fitzenz, 2002
3. Predictive Analytics for Human Resources by Jac Fitz-enz, John Mattox II, Wiley 2014
4. Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and Outcomes. By Jack Phillips, Patricia Pulliam Phillips- 2014

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: I	
Course: Human Resource Analytics Practical		**Course Code:** UAHRA504P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

To enable the students to:

- analyze employee turnover rates, identify contributing factors, and propose recommendations for reducing turnover, showcasing advanced analytical proficiency.
- design and develop a user-friendly HRIS dashboard, integrating HR metrics in real-time using programming languages, demonstrating technical expertise in HR information systems.
- align HR strategies with organizational goals by creating an HR scorecard, identifying key performance indicators, and designing a dashboard for ongoing measurement and analysis.
- use predictive analytics to forecast employee attrition, validate model accuracy, and provide actionable insights to proactively address potential attrition risks, showcasing expertise in data-driven retention strategies.

Pre requisite:

Understanding of R/Python

Course Outcomes:

After completion of the course, learners would be able to:CO1:
Analyze HR analytics.
CO2: Use and understand tools require for HR analytics
CO3: Identify the application and uses of HR analytics in various HR sub-systems

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
	Human Resource Analytics Practical	
1	**Analyze employee turnover rates and identify factors contributing to attrition** • Collect historical employee data, including tenure, performance ratings, salary, and job satisfaction. • Calculate employee turnover rates for different departments and job roles. • Conduct statistical analysis to identify correlations between turnover and variables such as salary, job satisfaction, and performance. • Generate visualizations (e.g., charts, graphs) to present the findings and propose recommendations to reduce turnover.	**6**
2	**Develop a user-friendly HRIS dashboard for monitoring and analyzing HR metrics** • Identify key HR metrics to be displayed on the dashboard (e.g., headcount, recruitment pipeline, training hours). • Design the layout and interface of the HRIS dashboard using appropriate programming languages and tools. • Integrate data from various HR systems and databases to populate the	**6**

	dashboard in real-time. • Implement interactive features, such as drill-down capabilities and data filters, to facilitate data exploration and analysis	
3	**Analyze training effectiveness and identify skill gaps in the organization** • Collect training data, including participant demographics, training modules, pre/post-assessment scores, and performance metrics. • Perform statistical analysis to evaluate the impact of training on employee performance. • Identify areas of improvement and recommend targeted training programsbased on identified skill gaps. • Develop a visualization or report summarizing the training needs analysis results.	**6**
4	**Develop an HR scorecard to measure HR effectiveness and align HRstrategies with organizational goals** • Identify key HR performance indicators aligned with the organization'sstrategic objectives. • Collect relevant data for each HR indicator, such as employee satisfactionsurveys, training investment data, and performance metrics. • Calculate HR metrics and indicators, such as turnover rate, training ROI, and employee engagement index. • Design a dashboard or report to present the HR scorecard and analyze trendsover time.	**6**
5	**Use predictive analytics to forecast employee attrition and develop retention strategies** • Gather historical HR data, including employee demographics, performance metrics, compensation, and employee exit data. • Build a predictive model (e.g., logistic regression, decision tree) to predict employee attrition. • Validate the model's accuracy and evaluate its performance using appropriate evaluation metrics. • Generate actionable insights and recommendations to proactively address potential attrition risks.	**6**
6	**Use predictive analytics to forecast employee attrition and develop retention strategies** • Gather historical HR data, including employee demographics, performance metrics, compensation, and employee exit data. • Build a predictive model (e.g., logistic regression, decision tree) to predictemployee attrition. • Validate the model's accuracy and evaluate its performance using appropriate evaluation metrics. • Generate actionable insights and recommendations to proactively address potential attrition risks.	**6**
7	**Measure and analyze employee engagement levels within the organization** • Collect employee engagement survey data, including responses to survey questions related to job satisfaction, work environment, and organizational culture. • Calculate engagement scores and identify key drivers of engagement. • Conduct a sentiment analysis on employee feedback to understand areas of improvement. • Present the findings & propose strategies to enhance employee engagement	**6**

	based on the analysis.	
8	**Develop a program to automate repetitive HR processes, such as leave management or performance appraisal** • Identify the HR process to be automated and define the required functionalities. • Design and implement a web-based application or script to streamline the process using appropriate programming languages and frameworks. • Integrate the application with relevant HR systems and databases to ensuredata accuracy and consistency. • Test and validate the automated process, considering different scenarios anduser inputs.	**6**
9	**Analyze the effectiveness of the organization's performance managementsystem and provide insights for improvement.** • Collect performance evaluation data, including performance ratings, goal achievement metrics, and feedback. • Analyze the distribution of performance ratings across different departmentsor job roles. • Identify trends and patterns in performance data and assess the fairness and consistency of the evaluation process. • Propose recommendations for enhancing the performance management systembased on the analysis results.	**6**
10	**Analyze the organization's compensation structure and compare it to industry benchmarks.** • Gather salary data for different job roles and levels within the organization. • Perform a salary analysis, including measures like average salary, salary distribution, and salary competitiveness. • Conduct benchmarking by comparing the organization's salary data withindustry standards or competitor data.	**6**
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: I**	
Course: Retail Marketing Analytics		**Course Code:** UARMA505	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- To understand the marketing analytics
- To gain hands-on experience of exploratory data analytics

Pre requisite: Knowledge of statistics and mathematical concepts

Course Outcomes:

Upon completing this course, the student will be able to:

CO1.Understand the importance of marketing analytics for forward looking and systematic allocation of marketing resources

CO2.Know how to use marketing analytics to develop predictive marketing dashboard for organization

CO3.Analyze data and develop insights from it to address strategic marketing challenges

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Unit 1: Introduction to Marketing Analytics and Exploratory Data analytics using R** Course Introduction - Why marketing analytics? Course description and learning objectives Marketing analytics overview - How analytics can assist marketing decision-making, The framework of marketing optimization Tabulate and summarize data - What cleaned data looks like, Simple histogram plot, use histogram and boxplot to inform data distribution Visualize data - Elements of data visualization, Histogram, scatter plot, line plot, bar charts, line fits with the ggplot()function	**15**
2	**Unit 2:Marketing Campaigns - Experiment Design, Customer Lifetime Value (CLV) and Cohort Analysis** Design and Conduct Experiments - Design experiments, examples, Randomization/sample splitting, Conduct experiments	**15**

	Assess Experiment Outcome Using Hypothesis Testing - Why hypothesis testing for experiment outcomes, Terminologies for hypothesis testing, how does hypothesis testing work, Power calculation, Conduct hypothesis testing in r Calculate and predict clv - Calculate clv, Typical frameworks in predicting clv, using linear regression and logistic regression to predict clv Clv analysis and cohort analysis introduction to experiment	
	Total	**30**

Reference Books:

- Hands-on AI and Data Science for Marketing by Yoon Hyup Hwang, Packt Publishing, 2019
- Retail Analytics: The Secret Weapon by Emmett Cox,1st edition , Weily , 2011
- Cutting Edge Marketing Analytics: Real-world Cases and Data Sets for Hands on Learning by Venkatesan Rajkumar,Farris Paul and Ronald Wilcox, Pearson FT Press, 2014
- Marketing Analytics: A Practical Guide to Real Marketing Science by Grigsby Mike, Kogan Page, 2015

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: I	
Course: Retail Marketing Analytics Practical		**Course Code:** UARMA505P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

- To Learn working and analyzing with marketing data
- To develop predictive marketing dashboard for organization
- Understand the concept of hypothesis testing and its role in assessing experiment outcomes

Pre requisite:

Knowledge of statistics and mathematical concepts

Course Outcomes:

After completion of the course, learners would be able to:

CO1.Learn how to tabulate and summarize marketing data using R

CO2.Design and conduct experiments for marketing campaigns

CO3.Understand the concept of hypothesis testing and its role in assessing experiment outcomes

CO4.Calculate, predict, and apply Customer Lifetime Value

CO5.Analyze customer purchasing patterns and build a recommender system based on market basket analysis

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
	Retail Marketing Analytics Practical	
	Note: Being able to approach data using statistical software is one of the essential goalsof this class. You are required to use R for all assignments and projects throughout thiscourse. Completing homework and quizzes using Excel or other program languages is not accepted. Programming knowledge prior to the class is preferred, but not required.As we spend time in- class to familiarize you with the RStudio interface and basic functions in the first few weeks of the class, take this time ask questions and adapt to Ras soon as possible. Download R from http://cran.r-project.org/ Download R Studio from http://www.rstudio.com/products/rstudio/download/	
1	**Learn how to tabulate and summarize marketing data using R.** Clean and preprocess the marketing data. Generate a simple histogram plot to visualize data distribution. Use tabulation and summary functions to gain insights from the data. Interpret the findings and discuss the implications for marketing analysis.	
2	**Gain proficiency in visualizing marketing data using R.** Understand the key elements of data visualization. Create various visualizations such as histograms, scatter plots, line plots, and	

	bar charts using the ggplot() function in R. Apply appropriate visualization techniques to effectively communicatemarketing insights.	
3	**Design and conduct experiments for marketing campaigns.** Learn about experimental design and its application in marketing. Design experiments using examples from marketing scenarios. Implement randomization and sample splitting techniques. Conduct the experiments and collect relevant data for analysis.	
4	**Understand the concept of hypothesis testing and its role in assessingexperiment outcomes.** Explore the purpose of hypothesis testing in analyzing experiment results. Familiarize with key terminologies related to hypothesis testing. Learn the process of hypothesis testing and power calculation. Conduct hypothesis testing using R to evaluate experiment outcomes.	
5	**Calculate and predict Customer Lifetime Value (CLV).** Calculate CLV using different approaches and frameworks. Explore predictive modeling techniques such as linear regression and logistic regression for CLV prediction. Assess the accuracy and reliability of CLV predictions.	
6	**Apply CLV analysis and cohort analysis in marketing analytics.** Analyze CLV data and identify patterns and trends. Perform cohort analysis to segment customers based on their behavior or characteristics. Interpret the results of CLV analysis and cohort analysis to derive actionable insights for marketing strategies.	
7	**Extract data from social media platforms and perform analysis to gain insightsinto customer behavior and preferences.** Utilize Python libraries like Beautiful Soup and requests to scrape data from social media platforms. Clean and preprocess the scraped data. Analyze the data to identify trends, sentiment analysis, or customer engagement metrics. Visualize the findings using appropriate charts or graphs.	
8	**Analyze customer purchasing patterns and build a recommender system basedon market basket analysis.** Use transactional data to identify frequently occurring item sets using associationrule mining algorithms. Calculate support, confidence, and lift for the identified item sets. Build a recommendation engine using collaborative filtering techniques. Evaluate the performance of the recommender system and make recommendations based on customer preferences.	
9	**Analyze customer transaction data to calculate RFM scores** Segment customers into different groups using clustering algorithms such as k-means or hierarchical clustering. Perform descriptive analysis on each customer segment to understand their characteristics. Develop targeted marketing strategies for each segment based on their RFM profiles.	

10	**Design and implement A/B tests for marketing campaigns using randomized assignment** Collect relevant data and perform statistical analysis to compare theperformance of different strategies. Calculate key metrics such as conversion rates, click- through rates, orrevenue. Interpret the results and provide recommendations for optimizing marketing campaigns based on the findings.	

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: I	
Course: Sports Data Analytics		**Course Code:** UASDA506	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- Understand the role and importance of data analytics in sports
- Develop skills in collecting, cleaning, and managing sports data
- Gain proficiency in using statistical analysis techniques to analyze sports data
- Apply data visualization methods to present sports data effectively
- Learn how to apply predictive modeling techniques to sports data
- Explore the use of machine learning algorithms in sports analytics
- Understand ethical considerations and challenges in sports data analytics

Pre requisite:

Basic knowledge of statistics and probability, Familiarity with programming concepts and a programming language (e.g., Python), Background in computer science or related field

Course Outcomes:

Upon completing this course, the student will be able to:

CO1: To understand the role and importance of data analytics in sports
CO2: To develop skills in collecting, cleaning, and managing sports data
CO3: To gain proficiency in using statistical analysis techniques to analyze sports data
CO4: To apply data visualization methods to present sports data effectively
CO5: To learn how to apply predictive modeling techniques to sports data
CO6: To explore the use of machine learning algorithms in sports analytics

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	**Fundamentals of Sports Data Analytics** Introduction to Sports Data Analytics - Overview of sports data analytics, Evolution of analytics in sports, importance, and applications of sports data analytics Data Collection and Preprocessing - Sources of sports data, Data collection methods, Data cleaning and preprocessing techniques, Database management for sports analytics Data Visualization for Sports Analytics- Principles of data visualization, Visualization tools and libraries Creating effective visualizations for sports data, Interactive dashboards for sports analytics Statistical Analysis in Sports - Descriptive statistics for sports data, Hypothesis testing in sports analytics, Regression analysis in sports, Analysis of variance (ANOVA) in sports	**15**

2	**Advanced Techniques in Sports Data Analytics** Predictive Modeling in Sports Analytics - Introduction to predictive modeling, Feature selection and engineering for sports data, Linear regression models for sports prediction, Classification models for sports outcomes Machine Learning in Sports Analytics - Overview of machine learning algorithms, Decision trees and random forests in sports analytics, Support vector machines for sports prediction, Neural networks and deep learning in sports analytics Advanced Topics in Sports Data Analytics - Sports performance analysis, Player tracking and motion analytics, Sports marketing and fan engagement analytics, Sports injury prediction and prevention Sports Business Analytics - Revenue generation and marketing in sports, Fan engagement and customer analytics	**15**
	Total	**30**

Reference Books:

- Sports Analytics: :" A Guide for Coaches, Managers, and Other Decision Makers by Benjamin C," Alamar, Columbia university press, 2013
- Sports Analytics and AI and Data Science: Winning the Game with Methods and Models by Thomas Miller, 1st edition, Pearson FT Press, 2015
- Sports Analytics: Analysis, Visualization and Decision Making in Sports Performance by Ambikesh Jayal, Allistair McRobert, Giles Oatley, Peter O'Donoghue, Taylor and Francis, 1st Edition, 2018
- Cricket Analytics: Analytics and AI and Data Science in Cricket by Tapan Bagchi and S. Raghunathan Machine Learning using Python by Manaranjan Pradhan and U. Dinesh Kumar, Weily ,2020

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: I	
Course: Sports Data Analytics Practical		**Course Code:** UASDA506P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

To enable the students to:

- To understanding of Sports Data Analytics To achieve proficiency in Data Manipulation and Exploratory Data Analysis
- To analyze Player Performance/ Team Performance
- To implement Predictive Modeling, Data Visualization and Reporting.

Pre requisite:

Sports knowledge, Basic statistics, Programming skills, Data cleaning and preprocessing methods

Course Outcomes:

After completion of the course, learners would be able to:

CO1.Understand of Sports Data Analytics

CO2.Get Proficiency in Data Manipulation and Exploratory Data Analysis

CO3.Analyze Player Performance/ Team Performance

CO4.Perform Predictive Modeling

CO5.Prepare comprehensive report

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	**Exploratory Data Analysis** • Perform exploratory data analysis on a cricket dataset, analyzing variables such as number of matches, runs, not outs, wickets, etc. • Visualize the distribution of player performance metrics using histograms, box plots, or scatter plots. • Investigate the relationship between player age and performance metrics using correlation analysis.	
2	**Batting Performance Analysis** • Analyze batting performance in a Cricket dataset, calculating metrics such as batting average, strike rate, and runs scored by players. • Identify top-performing batsmen based on performance metrics and compare their performance against different opponents or in specific conditions.	
3	**Bowling Performance Analysis** • Analyze bowling performance in the Cricket dataset, calculating metrics such as bowling average, economy rate, and wickets taken by players. • Identify top-performing bowlers based on performance metrics and analyze their performance against different teams or in various match situations	

4	**Performance Comparison** • Compare the scoring averages of top-performing batsman in different seasons. • Analyze the runs scoring (strike rate of Batting) of players from various teams in a specific league	
5	**Player Position Analysis** • Calculate position-specific performance metrics and compare players within each position.	
6	**Injury Analysis** • Investigate the relationship between player injuries and their subsequent performance using historical injury and performance data. • Identify patterns and trends in the data to determine the impact of injuries on player performance and team success.	
7	**Team Analysis** • Analyze the impact of toss on a team's overall scoring and winning percentage. • Study the relationship between batting averages of players and their team's win-loss record	
8	**Sports Revenue Analysis** • Analyze revenue generation in sports organizations by examining factors such as ticket sales, merchandise sales, and sponsorship deals. • Identify key drivers of revenue and provide recommendations for maximizing financial performance.	
9	**Predictive Modeling** • Build a regression model to predict the number of runs scored by players based on their historical performance data. • Develop a classification model to predict the outcome of match based on team's statistics.	
10	**Visualization and Reporting: (Mini-Project)** • Prepare a comprehensive report summarizing the findings of the analysis and providing actionable insights for sports teams or organizations.	
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: I**	
Course: Research Methodology		**Course Code:** UARME507	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE) (Marks- 60 in Question Paper)**
4	4	40	60

Learning Objectives:

To enable the students to:

- To Know basics of how research problems are defined, research methods are adopted and/or developed, research is undertaken
- To equip students with various techniques of research design and data collection
- To implement Parametric and non-parametric test
- To learn ANOVA technique how to write scientific report ,

Pre requisite:

Basic programming skills, orientation towards research and conceptual understanding of IT subjects

Course Outcomes:

After completion of the course, learners would be able to:

CO1. Know basics of how research problems are defined, research methods are adopted and/or developed, research is undertaken

CO2. Formulate the questionnaire for data collection

CO3. Parametric and non-parametric test

CO4. Learn ANOVA technique how to write scientific report

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	**Research Methodology and Problem Identification and Formulation:** Meaning and objectives, motivation of research, types of research, research methods v/s methodology, research and scientific methods, research process and stages of research, defining and formulating the research problem, technique involved in defining a problem, importance of literature review in defining a problem, role of literature review,ways to perform literature review, methods to find open problem and research problems,critical literature review, identifying gap areas from literature study, hypothesis building	
2	**Research Design and Data Collection and Analysis:** Need of research design, concepts related to research design, different research designs, research plan, basic principles of experimental design and setup, collection of primary data, observation methods, interview methods, collection of data through questionnaire and schedules, collection of secondary data, selection of appropriate method for data collection, case study method, guidelines for developing questionnaire, successful interview, survey v/s experiment, processing and data analysis, use of statistical packages, measure of asymmetries and other measures. Fieldwork-The Nature of Field Work, Selection and Training of Investigators, Sampling Frame and Sample Selection, Field Operation, Field Administration.	

3	**Sampling and Hypothesis Testing:** Sampling, understanding sampling methods, central limit theorem, confidence interval, definitions and basic concepts of hypothesis testing, procedures of hypothesis testing, flow diagram for hypothesis testing, test of hypothesis, Type I andType II error, important parametric test, hypothesis testing of mean, proportion, tests for equality of mean and variances of two populations, confidence interval, z-test, and X2 test for goodness to fit, limitation of test of hypothesis.	
4	**Analysis of Variance and Covariance:** Basic principle of Analysis of Variance,ANOVA Technique, **Academic Ethics:** Plagiarism, exposure on anti-plagiarism tools.Technical Writing: Academic writing, sources of information, assessment of quality of journals and articles, writing scientific report, structure and component of research report, types of report – technical reports and thesis, SCOPUS Index, citations, search engines beyond google, impact factor, H-Index.	
	Total	**60**

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers' Distributors.
2. Kothari, C.R.,2019, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2023, Research Methodology-A Step-by-Step Guide for Beginners, (4th.ed), Singapore, Pearson Education.
4. Neeraj Pandey, Intellectual Property Rights ,1st Edition, PHI, 2014
5. Shrivastava, Shenoy& Sharma, Quantitative Techniques for Managerial Decisions, Wiley Goode W J &Hatt P K, Methods in social research, Asia Law House, 2017
6. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH), 2015

Semester II

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Deep learning		**Course Code:** UADLE551	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE) (Marks-60 in Question Paper)**
4	4	20 +10 +10	60

Learning Objectives:

- To present the mathematical, statistical, and computational challenges of building neural networks
- To study the concepts of deep learning
- To enable the students to know deep learning techniques to support real-time applications

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Describes basics of mathematical foundation that will help the learner to understand theconcepts of Deep Learning

CO2: Understand and describe model of deep learning

CO3: Design and implement various deep supervised learning architectures for text & imagedata.

CO4: Design and implement various deep learning models and architectures.

CO5: Apply various deep learning techniques to design efficient algorithms for real-world applications.

Outline of Syllabus: (per session plan)

Modules	**Description**	**Duration (Lecture)**
1	Artificial Neural Networks- The Neuron-Expressing Linear Perceptron's as Neurons-Feed-Forward Neural Networks- Linear Neurons and Their Limitations –Sigmoid – Tanh – and ReLU Neurons -Softmax Output Layers – Training Feed-Forward Neural Networks-Gradient Descent- Delta Rule and Learning Rates- Gradient Descent with Sigmoidal Neurons- The Backpropagation Algorithm-Stochastic and Minibatch	**15**
2	The Backpropagation Algorithm-Stochastic and Minibatch GradientDescent – Test Sets – Validation Sets – and Overfitting- Preventing Overfitting in Deep Neural Networks – Implementing Neural Networks in TensorFlow. Local Minima in the Error Surfaces of Deep Networks-Model Identifiability- Spurious Local Minima in Deep Networks- Flat Regions in the Error Surface – Momentum-Based Optimization – Learning Rate Adaptation.	**15**

3	Convolution Neural Network- Introduction to CNN & Applications, Characteristics, Building Blocks of CNN, General Architecture & Components, Training CNN, Popular Architectures-AlexNet, VGG, GoogleNet, ResNet etc. Transfer Learning, Visualizing Learning in Convolutional Networks – Embedding and Representation Learning	**15**
4	Autoencoder: Introduction to Autoencoders, Applications, Architecture, Types of Autorncoders, Objective functiona and Loss functions Recurrent Neural Networks- Introduction to RNN and its applications, General Architecture of RNN, RNN Topologies, Long Short-Term Memory, Gated Recurrent Unit (GRU), Vanishing and Exploding Gradients, Solutions Advanced deep learning techniques deep boltzman machine, deep fake technology, case study on designing deep learning solutions for identifying fake finger prints, fake images and videos	**15**
Total Lectures		**60**

Reference books:

1. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine IntelligenceAlgorithm," O'Reilly, 2022.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, An MIT Press book, 1st Edition(2016)

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: IV	
Course: Deep Learning Practical		**Course Code:** UADLE552P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks -)**	**Semester End Examinations (SEE) (Marks- in Question Paper)**
4	2	20	30

Learning Objectives:

- To understand the principles of deep learning and its capabilities and
- To acquire practical skills to design, implement, and train practical deep learning systems.

Course Outcomes:

After completion of the course, a student should be able to:

CO1: Describes basics of mathematical foundation that will help the learner to understand theconcepts of Deep Learning.

CO2: Understand and describe model of deep learning.

CO3: Design and implement various deep supervised learning architectures for text & imagedata.

CO4: Design and implement various deep learning models and architectures.

CO5: Apply various deep learning techniques to design efficient algorithms for real-world applications.

Outline of Syllabus: (per session plan)

Modules	Topics	Duration (Lecture)
1	Performing matrix multiplication and finding eigen vectors and eigen values using TensorFlow Solving XOR problem using deep feed forward network. Implementing deep neural network for performing binary classification task.	**15**
2	Using deep feed forward network with two hidden layers forperforming multiclass classification and predicting the class. Using a deep feed forward network with two hidden layers forperforming classification and predicting the probability of class. Using a deep feed forward network with two hidden layers forperforming linear regression and predicting values. Evaluating feed forward deep network for regression using K-Foldcross validation. Evaluating feed forward deep network for multiclass Classificationusing KFold cross-validation.	**15**

3	Implementing regularization to avoid overfitting in binary classification. Demonstrate recurrent neural network that learns to perform sequence analysis for stock price. Performing encoding and decoding of images using deep autoencoder.	**15**
4	Implementation of convolutional neural network to predict numbersfrom number images Denoising of images using autoencoder.	**15**
Total Lectures		**60**

Essential readings:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, An MIT Press book, 1st Edition(2016)
2. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine IntelligenceAlgorithm," O'Reilly, 2022.
3. Deep Learning Cookbook by Douwe Osinga, O'Reilly, 1st edition (2018)

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: II**	
Course: Big Data Systems		**Course Code:** UABDA553	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE) (Marks- 60 in Question Paper)**
4	4	40	60

Learning Objectives:

To enable the students:

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems in fordecision support.

Pre requisite:

Fundamental knowledge of Databases

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand Big Data Concepts
CO2: Do Data Collection and Integration
CO3: Develop Data Storage and Management
CO4: Perform Data Preprocessing and Cleaning
CO5: Understand Data Transformation and Feature Engineering
CO6: Perform Exploratory Data Analysis (EDA)
CO7: Use Big Data Analytics Tools

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hrs**
1	Classification of Digital Data, Characteristics of Data, and Big Data, Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Bigdata?, Traditional Business Intelligence versus BigData. Business motivation and drivers for Big Data adoption, marketplace dynamics, business architecture, business process management, information and communication technology, data analytics and data science, Big data storage concepts	**15**
2	Next generation databases- SQL, NoSQL, A Brief History of NoSQL, ACID vs. BASE, CAP Theorem (Brewer's Theorem), NoSQL Advantages and Disadvantages, SQL vs. NoSQL Databases, Categories of NoSQL Databases, MongoDB, jQuery, JSON, Neo4j, Cassandra, and their consistency	**15**

3	Data Product, Building Data Products at Scale with Hadoop, Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, Working with Distributed file system, Working with Distributed Computation, Framework for Python and Hadoop Streaming, Hadoop Streaming, MapReduce with Python, Advanced MapReduce.	**15**
4	Distributed Analysis and Patterns, Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data Ingestion, Importing Relational data with Sqoop, Ingesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher-level APIs.	**15**
	Total	**60**

Reference Books:

1. Big Data and Analytics Subhashini Chellappan Seema Acharya Wiley, First edition 2015
2. Data Analytics with Hadoop an Introduction for Data Scientists, Benjamin Bengfort and Jenny Kim O'Reilly, 2016
3. Big Data and Hadoop, V.K Jain, Khanna Publishing, First edition, 2018
4. Practical MongoDB, Shakuntala Gupta, Edward, Navin Sabharwal, Apress Publisher
5. Beginning JSON, Ben Smith, APress Publisher
6. Beginning jQuery, Jack Franklin, Russ Ferguson, Apress Publisher
7. Next Generation Databases, Guy Harrison, Apress Publisher
8. Big Data Fundamentals Concepts, Drivers& Techniques Thomas Erl, Wajid Khattak, and Paul Buhler

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: II	
Course: Big Data Systems Practical		**Course Code:** UABDA553P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

- To teach the students the implementation of Big data analytic as per the concepts learnt

Pre requisite:

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.

CO2: Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduceand NO SQL in big data analytics.

CO3: Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.

CO4: Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	**MongoDB Basics** a. Write a MongoDB query to create and drop database. b. Write a MongoDB query to create, display and drop collection c. Write a MongoDB query to insert, query, update and delete a document. **Programs on Basic jQuery** a. jQuery Basic, jQuery Events b. jQuery Selectors, jQuery Hide and Show effects c. jQuery fading effects, jQuery Sliding effects	**20**
2	**Create a graph database using Neo4j** a. Querying on above designed Neo4j data b. Graph analytics (Example case study: Social Network Graph – Querying graph data, find the shortest connection between two people, find the most influential people in a network)	**20**

3	**Hadoop installation and Spark programs** a. Install, configure, and run Hadoop and HDFS ad explore HDFS. b. Implement word count / frequency programs using MapReduce and pySpark c. Implement a MapReduce program that processes a weather dataset using pySpark d. Data handling using spark SQL e. Machine learning using with spark MlLib	**20**
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: II	
Course:Time Series Analysis and Forecasting Practical		**Course Code:** UATAF554P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

To enable the student to understand

the time series data and trends, seasonal components of time series data, and forecasting methods of Time series data

Pre requisite:

Time stamp data, data granularity and basic statistics

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the trends and the seasonal components of time series data

CO2: Apply the Moving averages on time series data

CO3: Apply the forecasting models on time series data

CO4: Apply the exponential smoothing on data

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
1	**Introduction to Trend. Trend and Seasonal component** Fitting and plotting of modified exponential curve Fitting and plotting of Gompertz curve. Fitting and plotting of logistic curve. Fitting of trend by Moving Average Method. Seasonal indices Ratio-to-Trend method	**30**
2	**Forecasting Cyclic Component** Measurement of Seasonal Indices Ratio-to-Moving Average method. Measurement of seasonal indices Link Relative method Calculation of variance of random component by variate difference method Forecasting by exponential smoothing,ARIMA,SARIMA	**30**
	Total	**60**

Reference Books:

1. Kendall, M. (1976) Time Series. 2nd Edition, Charles Griffin and Co Ltd., London, and High Wycombe.
2. Chatfield C. . The Analysis of Time Series –An Introduction, 6th Edition, Chapman & Hall,2003.
3. Mukhopadhyay P. (2011). Applied Statistics, 2nd ed. Revised reprint, Books and Allied
4. Shumway, R. H., and Stoffer, D. S. (2006). Time Series Analysis and Its Applications with R Examples, 2 ed.Springer, New York, NY
5. Box, G. E. P., Jenkins, G. M., & Reinsel, G. C,Time Series Analysis: Forecasting and Control. Prentice - Hall,Inc., Upper Saddle River, NJ, 2015

6. Yaffee, R. and McGee, M. (2000). Introduction to Time Series Analysis and Forecasting with Applications of SASand SPSS. Academic Press, Inc., San Diego, CA

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: II	
Course: Resilient Data Processing Techniques		**Course Code:** UARDP555	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- To understand the basics t of resilience in data processing using SPARK Technologies.
- To implement of SPARK Technologies

Pre requisite:

Data mining Techniques. Knowledge of Python for implementation.

Course Outcomes:

After completion of the course, learners would be able to:

Upon completing this course, the student will be able to:

CO1: Understand the concept of SPARK Technologies, RDD and its implementation

CO2: Implement of SPARK SQL, GraphX, Performance Tuning.

CO3: Use Sparks Resilient Distributed Datasets to process and analyze large data sets across many CPUs

CO4: Analyze how the GraphX library helps with network analysis problems

CO5: Understand how Spark SQL lets you work with structured data

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
1	**Introduction to Resilient Data Processing Techniques** Importance of resilience in data processing, Fundamentals of Spark Technology, Components of the Spark unified stack, Features of Spark, Spark Web UI, an introduction to RDDs - Resilient Distributed Datasets, Launching and using Spark's Scala and Python shell, Spark Context, Spark Ecosystem, In-Memory data – Spark, Creating, Loading and Saving RDD, Transformations in RDD, Actions in RDD, Key-Value Pair RDD, Map Reduce and Pair RDD operations RDD Partitions	15
2	**Implementation of SPARK Technologies** Spark Applications vs. Spark Shell, Creating Spark Context, building a Spark Application, Spark, and Hadoop Integration-HDFS, Handling Sequence File, Spark RDD-RDD Lineage, RDD Persistence Overview, Distributed Persistence. Spark Streaming, ML library for Spark, Working with Statistics, SPARK SQL, GraphX, Performance Tuning.	15
	Total	30

Reference Books:

- Learning Spark: Lightning-Fast Data Analytics 2nd Edition, by Jules S. Damji, Brooke Wenig Tathagata Das, Denny Lee, O'Reilly , 2020
- Apache Spark Machine Learning Blueprints 1st Edition, Kindle Edition by Alex Liu, Packt Publishing, 2016
- Apache Spark 2.x Cookbook: Cloud-ready recipes for analytics and AI and Data Science 2nd Edition, by Rishi Yadav, Packt Publishing, 2017

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: II**	
Course: Resilient Data Processing Techniques Practical		**Course Code:** UARDP555P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

To enable the students to:

- Understand the concept of SPARK Technologies and its implementation
- Understand the concept of RDD
- Understand the implementation of SPARK SQL, GraphX, Performance Tuning

Pre requisite: Basic understanding of programming language (python) and Data mining techniques

Course Outcomes:

After completion of the course, learners would be able to:

CO1. Understand the concept of SPARK Technologies and its implementation
CO2. Understand the concept of RDD
CO3. Understand the implementation of SPARK SQL, GraphX, Performance Tuning

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
	SPARK Technologies Practical	
1	Installation of Apache Spark	
2	Spark Basics and RDD interface	
3	Filtering RDDs, and the Minimum Temperature by Location Example	
4	Counting Word Occurrences using flatmap()	
5	Executing SQL commands and SQL-style functions on a Data Frame	
6	Implement Total Spent by Customer with DataFrames	
7	Use Broadcast Variables to Display Movie Names Instead of ID Numbers	
8	Create Similar Movies from One Million Rating	
9	Using Spark ML to Produce Movie Recommendations	
10	Use Windows with Structured Streaming to Track Most-Viewed URLs (Spark Streaming)	
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: II**	
Course: Public Health Analytics		**Course Code:** UAPHA556	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- Discuss the evolving landscape of healthcare services, including the growing importance of value-based healthcare systems and the role of data in enhancing outcomes. Explore the utilization and management of data in electronic health record (EHR) systems. Identify and cite relevant sources of public health data and information.
- Illustrate the various functions performed by data analysis in the field of public health. Apply commonly used graphical and descriptive techniques to summarize public health data effectively.
- Investigate the reliability, accuracy, and comparability of health and genomic data. Examine the integrity of these data sets and their suitability for meaningful comparisons.
- Acquire fundamental skills in using popular software tools for conducting data analyses.
- Develop data models that integrate patient information from multiple origins to create comprehensive and patient-centric perspectives.

Pre requisite:

Basic concepts of data analytics and machine learning

Course Outcomes:

After completion of the course, learners would be able to:

CO1: To Gain proficiency in understanding and managing health data, including storage strategies, benefits,and challenges.

CO2: To Master the components, coding systems, benefits, and challenges of Electronic Health Records(EHR).

CO3: To Acquire statistical analysis skills for healthcare data, covering central tendency, hypothesis testing, and variance analysis.

CO4: To Develop expertise in biomedical image analysis, genomic data analysis, natural language processing, data mining, predictive models, privacy-preserving data methods, and clinical decision support systems in healthcare.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	**Healthcare data management** • What is Health Data Management? Benefits and challenges of health data management, how to store all that data • Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting EHR Challenges • Phenotyping Algorithms • Statistical analysis of healthcare data- Measures of Central Tendency and Dispersion, Confidence Limits and Hypothesis Testing, Statistical Tests for Categorical Data, T-Tests for Related and Unrelated Data, Analysis of Variance	**15**

	• Data Quality and Governance	
2	**Healthcare data Analysis:** • Biomedical Image and Signal Analysis, Genomic Data Analysis for Personalized Medicine • Natural Language Processing and Data Mining for Clinical Text, Mining the Biomedical- Social Media Analytics for Healthcare. • Predictive Models for Integrating Clinical and Genomic Data, Privacy-Preserving Data, Publishing Methods in Healthcare Mobile Imaging and Analytics for Biomedical Data, Data Analytics for Pharmaceutical Discoveries-Clinical Decision Support Systems	**15**
	Total	**30**

Reference Books:

1. Healthcare Business Intelligence + Website - A Guide to Empowering Successful Data Reporting and Analytics Hardcover by LB Madsen (Author),2012
2. Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence (Marketing Science) 1st Edition by Dr. Steven Struhl,2016

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: II**	
Course: Public Health Analytics Practical		**Course Code:** UAPHA556P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:

To enable the students to:

- Should be able to understand, visualize and infer healthcare data.
- Should be able to use linear regression and forecasting methods for predicting growth rates, expenditure or any other numeric variable related to the medical field.
- Should be able to demonstrate descriptive, diagnostic, and inferential statistics using Python, R or Excel
- Perform predictive analysis using machine learning algorithms and deep learning.
- Perform NLP and sentiment analysis.

Pre requisite:

Basic computer skills and Basic understanding of elementary Math.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: To Gain proficiency in modelling and mining Electronic Health Record (EHR) data for effective healthcare analysis.

CO2: To Master exploratory data analysis using tools like Tableau or Power BI, focusing on healthcare data interpretation

CO3: To Acquire skills in predicting medical expenditures and diseases using classification algorithms and time-series analysis

CO4: To Explore diverse applications, including Twitter data sentiment analysis, clinical text categorization, medical image classification, and AI-driven healthcare chatbots.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
PSDSP516b	**Public Health Analytics Practical**	
1	EHR data modeling, data mining, exploratory data analysis using tableau or power BI.	
2	Medical expenditure prediction	
3	A Twitter Healthcare data extraction, processing and sentiment analysis use keywords related to health (e.g., COVID-19 vaccine).	
4	Using classification algorithms in prediction of diseases	
5	Clinical Text Data Categorization and Feature Extraction	
6	Medical Image classification (x-rays)	
7	Image object detection using deep learning.	

8	Health forecasting using time-series.	
9	Heart sound classification using signal processing.	
10	AI conversational chatbot for primary healthcare diagnosis.	
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: II**	
Course: Social Media Analytics		**Course Code:** UASMA557	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

Enable student to:

- To understand and familiarize the learners with the concept of social media.
- Enable the learners to develop skills required for analyzing the effectiveness of social media.
- Familiarize the learner with different visualization techniques for social media decisions.

Pre requisite:

Graph Theory, Data mining Techniques. Knowledge of Python for implementation.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the concept of social media.

CO2: Enable the learners to develop skills required for analyzing the effectiveness of social media.

CO3: Familiarize the learner with different visualization techniques for social media decisions.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	**Social Media Analytics: An Overview** Core Characteristics of social media, Types of social media, social media landscape, Need for Social Media Analytics (SMA), Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Location Analytics - Sources of Location Data, Categories of Location Analytics, Social Information Filtering: Social Sharing and filtering, Automated Recommendation systems, Traditional Vs social Recommendation Systems, understanding social media and Business Alignment, social media KPI, formulating a Social Media Strategy, Managing Social Media Risks **Case Study:** Online Behavior on Twitter	**15**
2	**Social Network Structure, Measures & Visualization** Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust. Network Visualization - Graph Layout, Visualizing Network features, Scale Issues. Capturing Correlations: Triangles, Clustering, and Assortativity. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks, Common Network Terminologies, Network Analytics Tools. **Case Study**: LinkedIn	**15**
	Total	**30**

Reference Books:

1. Seven Layers of Social Media Analytics Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan, 2015
2. Analyzing the Social Web 1st Edition by Jennifer Golbeck, 2013
3. Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other social media, Sites, Matthew A Russell, O'Reilly, 2019
4. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: II	
Course: Social Media Analytics Practical		**Course Code:** UASMA557P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE) (Marks- 30 in Question Paper)**
4	2	20	30

Learning Objectives:
To enable student to understand various social media platforms, related analytics tools, data scrapping, data reporting tools

Pre requisite:
Python, Types of social media

Course Outcomes:
After completion of the course, learners would be able to:
CO1: To understand the fundamental concepts of social media networks.
CO2: To Collect, monitor, store and track social media data
CO3: To analyze and visualize social media data
CO4: To design and develop social media analytics models.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
	Social Media Analytics Practical	
1	Study Various Social Media platforms (Facebook, twitter, YouTube etc.) Social Media analytics tools (Facebook insights, google analytic net lytic etc.) Social Media Analytics techniques and engagement metrics (page level, post level, member level) using Gephi Tool	
2	Scrape an online Social Media Site for Data. Use python to scrape information from twitter. Exploratory Data Analysis andvisualization of Social Media Data	
3	Create sociograms for the persons-by-persons network and the community-by-community network for a given relevant problem. Create a one-mode network and two- node network for the same. Datasets: les-Misérables, Airlines, Internet Core Routers.	
4	Develop Content (text, emoticons, image, audio, video) based social media analytics model for business. (e.g., Content Based Analysis: Topic, Issue, Trend, sentiment/opinion analysis, audio, video, image analytics)	
5	Develop Structure based social media analytics model for any business. (e.g.,Structure Based Models -community detection, influence analysis)	
6	Develop a dashboard and reporting tool based on real time social media dataUsing Power BI	
7	Use Google Visualization Charts to analyze social media data	

8	Analyze social media data Network Analysis with Orange Software	
9	Use Graph Neural Networks on the datasets (Planetoid Cora Dataset)/ Jazz Musicians Network.	
10	Analyze Twitter conversations to identify the most active and influential users using Machine Learning Algorithms with Gephi Tool.	
	Total	**60**

Programme Name: M.Sc. AI and Data Science (Semester-II)	**Course Name: On Job Training** **Course Code** :UAOJT559
Total Credits: 04	**Total Marks: 100**
Continuous assessment: 40	**External assessment: 60**

A. Introduction

- On Job training (OJT) is an integral component of the M.Sc. AI and Data Science program that provides students with a unique opportunity to bridge the gap between theoretical knowledge gained in the classroom and practical application in a real-world environment. This training aims to equip students with both technical and non-technical skills that are essential for success in the industry.
- By participating in OJT, students can apply the concepts and theories learned during their coursework to real-world scenarios. They gain hands-on experience, problem-solving skills, and a deeper understanding of how the industry operates. This practical exposure enhances their competence and confidence, preparing them to tackle the challenges they may encounter in their professional careers.
- From an organizational perspective, hosting OJT programs allows companies to gain insights into the curriculum and content of the M.Sc. AI and Data Science program. They can provide valuable feedback on the relevance of the coursework and industry requirements, enabling academic institutions to continually improve the program's alignment with industry needs. This collaboration between academia and industry fosters a mutually beneficial relationship, ensuring that graduates are well-prepared for the job market.
- Moreover, OJT benefits the faculty members involved in the program. They can gain firsthand exposure to the industry and observe the type of work being performed. This experience enables them to enhance their teaching methodologies and delivery techniques, ensuringthat they remain up-to-date with the latest industry practices. The insights gained from OJT also enable faculty members to provide relevant guidance and mentorship to students, preparing them for successful careers in the field of AI and Data Science.

B. Enhancing Practical Skills through OJT

- The On Job Training (OJT) program spans 4-6 weeks, requiring a minimum of 120 hours of physical presence at the organization.
- Students are expected to find their own OJT placements, although the institution provides support and guidance in securing positions with reputable organizations.
- OJT must be conducted outside the home institution to expose students to real-world work environments.
- OJT covers any subject within the syllabus, allowing students to align their experience with their academic interests.
- In recognition of changing dynamics, some OJT sessions can be conducted online to accommodate virtual work environments.

- OJT will offer students the opportunity to apply classroom learning in a real-world setting, fostering the development of technical and non-technical skills.
- Mutual Benefits: Organizations gain insights into the program's curriculum and industry requirements, enabling them to provide constructive feedback and enhance course relevance.
- OJT bridges the gap between theoretical knowledge and practical application, preparing students for successful careers in AI and Data Science

C. **Interning organization:** Students have the flexibility to pursue their OJT in various types of organizations, including but not limited to:

- Software Development Firms: Gain practical experience in software development and programming.
- Hardware/Manufacturing Firms: Learn about hardware design, manufacturing processes, and quality assurance.
- Small-Scale Industries/Service Providers: Explore opportunities in diverse sectors such as banking, clinics, NGOs, and professional institutions like CA firms or law firms.
- Civic Departments: Engage with local civic departments such as ward offices, post offices, police stations, or panchayats to understand their functioning and contribute to their activities.
- Research Centre's/University Departments/Colleges: Contribute as research assistants or in similar roles for research projects or initiatives, fostering collaboration between academia and industry.

Note: The listed options provide a range of possible OJT placements, offering students valuable exposure to different sectors and professional settings.

D. OJT mentors:

To enhance the learning experience and ensure the quality of the MSc program, each student participating in the OJT will be assigned two mentors: a faculty mentor from the institution and an industry mentor from the organization where the student is interning.

- **Industry Mentor Role:** The industry mentor plays a crucial role in guiding the student during the internship. They ensure that the internee fulfills the requirements of the organization and successfully meets the demands of the assigned project. Through their expertise and experience, industry mentors provide valuable insights into real-world practices and industry expectations.
- **Faculty Mentor Role:** The faculty mentor serves as the overall coordinator of the OJT program. They oversee the entire internship process and evaluate the quality of the OJT in a consistent manner across all students. The faculty mentor ensures that the OJT aligns with the program's objectives and provides valuable learning opportunities. They also facilitate communication between the institution, industry mentor, and student to ensure a fruitful OJT experience.

By having both an industry mentor and a faculty mentor, students benefit from a comprehensive guidance system that combines industry expertise and academic support. This dual mentoring approach ensures a well-rounded and rigorous OJT experience for every student in the program.

E. Submission of documentation for OJT

The student will make two documents as part of the OJT

- **Online diary:** This ensures that the student updates daily activity, which could be accessed by both the mentors. Daily entry can be of 3- 4 sentences giving a very brief account of the learning/activities/interaction taken place. The faculty mentor will be monitoring the entries in the diary regularly as shown in **Appendix-I**
- **OJT report:** A student is expected to make a report based on the OJT he or she has done in an organization. It should contain the following:

- **Certificate:** A certificate in the prescribed Performa (given **in Appendix II** and **Appendix III**) from the organization where the OJT was done.
  - **Title** : A suitable title giving the idea about what work the student has performed during the OJT.
  - **Description of the organization**: A small description of the organization where the student has interned
  - **Description of the activities** done by the section where the intern has worked: A description of the section or cell of the organization where the intern worked. This should give an idea about the type of activity a new employee is expected to do in that section of the organization.
  - **Description of work allotted and done by the intern:** A detailed description of the work allotted, and actual work performed by the intern during the OJT period. It shall be the condensed and structured version of the daily report mentioned in the online diary.
  - **Self-assessment**: A self-assessment by the intern on what he or she has learned during the OJT period. It shall contain both technical as well as interpersonal skills learned in the process.

F. Interaction between mentors:

To ensure the smooth conduct of the OJT a meet-up involving the intern, industry mentor, and the faculty mentor will be scheduled as a mid-term review. The meeting can preferably be online to save time and resources. The meeting ensures the synergy between all stakeholders of the OJT. A typical meeting can be of around 15 minutes where at the initial stage the intern brief about the work and interaction goes for about 10 minutes. This can be followed by the interaction of the mentors in the absence of the intern. This ensures that issues between the intern and the organization, if any, are resolved amicably.

G. OJT workload for the faculty:

Every student is provided with a faculty member as a mentor. So, a faculty mentor will have a few students under him/her. A faculty mentor is the overall in charge of the OJT of the student. He/she constantly monitors the progress of the OJT by regularly overseeing the diary, interacting with the industry mentor, and guiding on the report writing etc. Considering the time and effort involved, a faculty mentor who is in-charge of 20 students shall be provided by a workload of 3 hours.

Evaluation Scheme

Theory courses of 4 credits: Total marks 100. Out of the total, 40% is for internal and 60% is for external evaluation.

A. Internal Evaluation (20m + 10m + 10m = 40 Marks)

The internal assessment marks shall be awarded as follows:

i) 10 marks + 10marks (three tests* for 10 marks each to be conducted at different instants of time amongst which best two out of three will be considered)

ii) 10 marks assignments / projects / presentations etc.

iii) 10 marks research paper

10 marks from every course (Two 4 credits mandatory courses, one 4 credits mandatory course, one 4 credits Research Methodology/Research Project) coming to a total of 40 marks, shall be awarded on publishing of research paper in Journal/Conference with plagiarism less than 15%. The marks can be awarded as per the impact factor of the journal, quality of the paper, importance of the contents published, social value.

Suggested format of Question paper of 10 marks for the written test.

Q1.	Attempt *any two out of three* :	10 marks
a.		
b.		
c.		

B. External Examination: (60 marks) Duration: 2 hours

	All questions are compulsory	
Q1	(Based on Module 1) Attempt *any three* of the following out of four	15 marks
Q2	(Based on Module 2) Attempt *any three* of the following out of four	15 marks
Q3	(Based on Module 3) Attempt *any three* of the following out of four	15 marks
Q4	(Based on Module 4) Attempt *any three* of the following out of four	15 marks

Theory courses of 2 credits: Total marks 50. Out of the total, 40 % is for internal and 60% is for external evaluation.

A. Internal Evaluation (20 Marks)

a. 10 marks (two tests* of 10 marks each to be conducted at different instants of time and average of two will be considered)

b. 10 marks assignments / projects / presentations etc.

Suggested format of Question paper of 10 marks for the written test.

Q1.	Attempt *any two out of three* :	10 marks
a.		
b.		
c.		

B. External Examination: (30 marks) Duration: 1 hour

	All questions are compulsory	
Q1	(Based on Module 1) Attempt *any two out of three* of the following:	10 marks
Q2	(Based on Module 2) Attempt *any two out of three* of the following:	10 marks
Q.3	(Based on Module 1 & 2) Attempt *any two out of three* of the following.	10 marks

Computer Based Test courses for 4 credits: Total marks 100. Out of the total, 40% is for internal and 60% is for external evaluation.

A. Practical Evaluation Internal (40 marks)

1.	Performance during the regular practical sessions	30
2.	Viva Voce	10

B. Computer Based Test - Practical Evaluation External (60 marks)

A Certified copy of hard-bound journal is essential to appear for the practical

examination.

1.	Practical Question **(Computer Based Test)**	40
2.	Journal	10
3.	Viva Voce	10

Computer Based Test courses for 2 credits: Total marks 50. Out of the total, 40% is for internal and 60% is for external evaluation.

A. Practical Evaluation Internal (20 marks)

1.	Performance during the regular practical sessions	15
2.	Viva Voce	5

B. Computer Based Test - Practical Evaluation External (30 marks)

A Certified copy of hard-bound journal is essential to appear for the practical examination.

1.	Practical Question **(Computer Based Test)**	20
2.	Journal	5
3.	Viva Voce	5

Rubrics for Practical for regular practical sessions - Internal Evaluation	
Performance Indicator	**Maximum marks**
Knowledge (Factual /Conceptual/Procedural/cognitive)	
Describe Factual /Conceptual/procedural/cognitive	
Demonstration Factual /Conceptual/procedural/cognitive	
Strategy (Analyze &/or Evaluate) Factual /Conceptual/procedural/cognitive	
Interpret/Develop Factual	

/Conceptual/procedural/cognitive	
Attitude towards learning **(receiving, attending, responding, valuing, organizing,** **Characterization by value)**	
Nonverbal communication skills/Behavior skills (motor skills, hand-eye coordination, speech behavior)	

Evaluation of On Job Training Course (4 Credit Course)

Internal Evaluation	
Online diary	20
Mid-term interaction	20
Total	**40**
External Evaluation	
OJT Report and Documentation	20
Quality & Relevance	20
OJT Viva	20
Total	**60**

Appendix-I

Maintain the weekly online diary for each week in the following format.

	Day	Date	Name of the Topic/Module Completed	Remarks
1st WEEK	MONDAY			
	TUESDAY			
	WEDNESDAY			
	THRUSDAY			
	FRIDAY			
	SATURDAY			

Signature of the Faculty mentor: _____

Seal of the College

Appendix-II

(Proforma for the certificate for internship in official letter head)

This is to certify that Mr. /Ms. ……. worked as an intern as part of his/her M.Sc. course in Information Technology of SVKM's Usha Pravin Gandhi College of Arts, Science and Commerce. The particulars of internship are given below:

Internship starting date: _____

Internship ending date: _____

Actual number of days worked: _____

Tentative number of hours worked:_____Hours

Broad area of work: _____

A small description of work done by the intern during the period:
_____
_____

Supervisor Signature: _____

Name: _____
Designation: _____
Contact:_____
Email: _____

(Seal of the organization)

Appendix-III

(Proforma for the Evaluation of the intern by the industry mentor /to whom the intern was reporting in the organization)

Professional Evaluation of intern

Name of intern:

_____

College/institution: _*[Note: Give a score in the 1 to 5 scale by putting √ in the respective cells]*

No	Particular	Excellent	Very Good	Good	Moderate	Satisfactory
1	Attendance & Punctuality					
2	Ability to work in a team					
3	Written and oral communication skills					
4	Problem solving skills					
5	Ability to grasp new concepts					
6	Technical skill in terms of technology, programming etc					
7	Ability to complete the task					
8	Quality of overall work done					

Comments:

_____

Signature:

_____

Name: _____
Designation: _____
Contact:_____
Email: _____

SEMESTER III

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: III	
Course: Quantum Computing		**Course Code:** UAQCO601	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE)(Marks- 60 in Question Paper)**
4	4	40	60

Learning Objectives:

To enable the students to:

To learn the fundamental concepts behind quantum computation

To study the details of quantum mechanics and the relation to Computer Science

To gain knowledge about the basic hardware and mathematical models of quantum computation

To learn the basics of quantum information and the theory behind it.

Pre requisite: Linear Algebra

Course Outcomes:

Upon completing this course, the student will be able to:

CO1: understand the basics of quantum computing.

CO2: understand the background of Quantum Mechanics

CO3: analyze computation models

CO4: understand the quantum operations

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**Fundamental concepts** Quantum Computation: History & Overview, Quantum Bits, Quantum Algorithms Quantum Information Processing	**15**
Module II	**Quantum mechanics for quantum computation** Quantum Circuits, Universal Quantum Gates, Quantum Circuit Model of Computation – Simulation – Quantum Fourier Transform and Applications – Quantum Search Algorithms – Quantum Computers physical realization.	**15**
Module III	**Quantum information** Quantum Noise and Quantum Operations: Classical Noise and Markov processes – Quantum Operations – Examples – Applications – Distance Measures for Quantum Information – Quantum Error Correction – Entropy Quantum Computing Frameworks – Open Source Programming Framework – Google - Criq, TensorFlow Quantum, IBM Qiskit	**15**

Module IV	**Quantum Programming** Programming using Quantum Computing Frameworks – Open Source Programming Framework – Google - Criq, TensorFlow Quantum, IBM Qiskit Quantum Machine Learning	**15**
	Total	**60**

Reference Books:

- Dancing with Qubits,By Robert S. Sutor,Packt Publishing,2019
- Chris Bernhardt, "Quantum Computing for everyone" The MIT Press Cambridge, Massachusetts London, England,2019
- Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013
- Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
- N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.
- https://quantumai.google/software
- https://www.ibm.com/quantum/qiskit

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: III	
Course: Reinforcement Learning Practical		**Course Code:** UARLE602P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	2	20	30

Learning Objectives:

To enable the students to:

- Gain a comprehensive understanding of the key concepts and principles of reinforcement learning, including agent-environment interaction, state, action, reward, and policy.
- Develop a strong foundation in the mathematical underpinnings of reinforcement learning, including probability theory, linear algebra, optimization, and Markov decision processes.
- Master various reinforcement learning algorithms, from dynamic programming and Monte Carlo methods to temporal difference learning and deep reinforcement learning.
- Acquire hands-on experience in implementing reinforcement learning algorithms using Python and popular libraries such as NumPy, OpenAI Gym, and PyTorch

Pre requisite:

Proficiency in Python programming, including experience with libraries such as NumPy, Pandas, and Matplotlib

Strong foundation in linear algebra

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Clearly explain the fundamental concepts and principles of reinforcement learning and distinguish it from other types of machine learning.

CO2: Apply the mathematical principles underpinning reinforcement learning to analyze and solve problems involving Markov decision processes and dynamic programming.

CO3: Design and implement reinforcement learning solutions to practical problems using Python and relevant libraries, ensuring the ability to handle complex environments and tasks.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**Introduction to Reinforcement Learning and Mathematical Foundation** Installing Python libraries: NumPy, Matplotlib, OpenAI Gym, Basic	**15**

	environment setup using OpenAI Gym, Probability Theory and Markov Processes, implementing basic probability simulations, Linear Algebra and Optimization, Dynamic Programming, applying linear algebra in RL contexts	
Module II	**Markov Decision Processes (MDP), Dynamic Programming, Monte Carlo Methods** Implementing a simple MDP, Visualizing state transitions and rewards, Implementing Policy Evaluation, Implementing Policy Iteration and Value Iteration algorithms, Monte Carlo Prediction and Control, Exploring Starts, First-visit and Every-visit Monte Carlo, Implementing Monte Carlo Prediction, Implementing Monte Carlo Control with Exploring Starts	**15**
Module III	**Temporal Difference Learning, Functional Approximation** Implementing TD(0) for prediction, Implementing SARSA (State-Action-Reward-State-Action), Implementing Q-Learning, Introduction to Function Approximation, Linear Function Approximation, Non-linear Function Approximation (Neural Networks), Implementing Linear Function Approximation, Implementing Q-Learning with Neural Networks	**15**
Module IV	**Deep Reinforcement Learning, Multi-Agent Reinforcement Learning** Understanding Deep Q-Networks (DQN), Experience Replay and Target Networks, Implementing a DQN from scratch, Enhancing DQN with Double and Dueling DQN, Implementing basic Multi-Agent environments, Solving tasks with Multi-Agent RL	**15**
	Total	**60**

Reference Books

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT Press, 2nd Edition, 2018, ISBN: 978-0262039246
2. Csaba Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 1st Edition, 2010, ISBN: 978-1608454921
3. Maxim Lapan, "Deep Reinforcement Learning Hands-On", Packt Publishing, 1st Edition, 2018, ISBN: 978-1788834247
4. Dimitri P. Bertsekas, "Reinforcement Learning and Optimal Control", Athena Scientific, 1st Edition, 2019, ISBN: 978-1886529397
5. Aske Plaat, "Deep Reinforcement Learning", Springer, 1st Edition, 2022, ISBN: 978-3030592393
6. Paul A. Gagniuc, "Markov Chains: From Theory to Implementation and Experimentation", Wiley-IEEE Press, 1st Edition, 2017, ISBN: 978-1119382028

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: III	
Course: Natural Language Processing		**Course Code:** UANLP603	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	4	40	60

Learning Objectives:

To enable the students to:

- Understand and apply basic to advanced NLP concepts
- Develop proficiency in using NLP libraries and frameworks
- Implement NLP algorithms and models to solve real-world problems
- Explore and evaluate current research trends and advancements in NLP

Pre requisite:

- Proficiency in Python programming
- Understanding of basic concepts in machine learning and statistics
- Familiarity with linear algebra and calculus

Course Outcomes:

After completion of the course, learners would be able to:

CO1: apply basic to advanced NLP concepts to solve real world problems

CO2: Develop NLP libraries and frameworks

CO3: Implement NLP algorithms and models to solve real-world problems

CO4: Explore and evaluate current research trends and advancements in NLP

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**NLP Overview, syntax, and Parsing** • **Overview of NLP** and its applications, Basic text processing techniques: Tokenization, Stop word removal, Stemming and Lemmatization; Regular	**15**

	expressions for text processing, Applications of NLP; Basic text preprocessing using NLTK and SpaCy **Syntax and Parsing** • **Part-of-Speech (POS) tagging**: HMM, CRF, Chunking, Named Entity Recognition (NER); **Syntactic parsing**: Dependency parsing, Constituency parsing; Hands-on: Implementing POS tagging and NER using SpaCy	
Module II	**Morphological Analysis and Text Representation** • **Morphological Analysis:** Introduction to Morphology, Types of Morphological Processes, Inflectional and Derivational Morphology, Morphological Parsing, Tools for Morphological Analysis • **Text Representation:** Bag of Words (BoW) and Term Frequency-Inverse Document Frequency (TF-IDF), Word embeddings: Word2Vec, GloVe, FastText, Sentence and document embeddings. Hands-on: Implementing and visualizing word embeddings using Gensim	**15**
Module III	**Text Classification, Sentiment Analysis, and Sequence model** • **Text classification techniques**: Naive Bayes, SVM, neural network-based classifiers; **Sentiment analysis**: Lexicon-based methods, machine learning-based methods ; Implementing text classification and sentiment analysis using scikit-learn and deep learning models **Sequence Models** • **Language models**: n-grams, neural language models, Recurrent Neural Networks (RNNs): LSTM, GRU; **Sequence-to-sequence models** and the attention mechanism; Building RNNs and sequence models using TensorFlow/Keras	**15**
Module IV	**: Transformers and Pre-trained Models** • **Introduction to transformer architecture**: BERT (Bidirectional Encoder Representations from Transformers), GPT (Generative Pre-trained Transformer), RoBERTa, Fine-tuning pre-trained models for NLP tasks, Using Hugging Face Transformers library to fine-tune BERT/GPT • Advanced Topics: Transfer Learning in NLP, Multi-lingual NLP, Zero-shot and Few-shot Learning	**15**
	Total	**60**

Books:

- Speech and Language Processing, Third Edition, Daniel Jurafsky Stanford University, James H. Martin University of Colorado at Boulder, 2nd Edition, Pearson Education India, 2013
- Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper, O'Reilly Media, 2009
- Deep Learning for Natural Language Processing" by Palash Goyal, Sumit Pandey, and Karan Jain, Apsress, 26 June 2018

- Transformers for Natural Language Processing and Computer Vision, Packt Publishing Ltd, 29 Feb 2024
- Hands-On Large Language Models by Jay Alammar, Maarten Grootendorst , September 2024 O'Reilly Media, Inc. ISBN: 9781098150969

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: III**	
Course: Natural Language Processing Practical		**Course Code:** UANLP603P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	2	20	30

Learning Objectives:

To enable the students to:

- Understand and apply basic to advanced NLP concepts
- Develop proficiency in using NLP libraries and frameworks practically
- Implement NLP algorithms and models to solve real-world problems
- Explore and evaluate current research trends and advancements in NLP

Course Outcomes:

After completion of the course, learners would be able to:

CO1: apply basic to advanced NLP concepts to solve real world problems

CO2: Develop NLP libraries and frameworks

CO3: Implement NLP algorithms and models to solve real-world problems

CO4: Explore and evaluate current research trends and advancements in NLP

Outline of Syllabus: (per session plan)

Module	**Module**	**No. of Hours**
	Module I	
1	Write a script to tokenize a given text using NLTK and SpaCy.	**15**
2	Implement stop word removal using NLTK and SpaCy. (Exercise for -Test the effect of stop word removal on a text classification task, such as spam detection. Discuss how stop word removal affects the	

	performance of the model)	
3	Apply stemming and lemmatization on a sample text using NLTK and SpaCy. Compare the results of both techniques on different words (Discuss when to use stemming versus lemmatization in NLP tasks.)	
4	Create a pipeline that performs tokenization, stop word removal, stemming/lemmatization, and regular expression-based text cleaning on a dataset using NLTK and SpaCy.	
5	Perform POS tagging on a sample text using NLTK and SpaCy, Stanford POS tagger etc	
	Module II	
1	Implement POS tagging using Hidden Markov Models (HMM)	**15**
2	Implement chunking (shallow parsing) using NLTK. Create a chunker to identify noun phrases (NPs) in a text. Visualize the chunked phrases and discuss how chunking differs from full parsing.	
3	Create a list of words that exhibit inflectional and derivational morphology. Collect the small group of regular inflectional verbs and nouns. Find the morphemes of those words and display the type of information (e.g.-Number-Singular/plural, Gender-feminine/masculine etc.) Explore existing tools for morphological analysis such as NLTK's morphy (based on WordNet) or SpaCy's lemmatizer.	
4	Implement a Bag of Words model from scratch in Python using a small dataset of text documents.	
	Module III	**15**
1	Implement a simple feedforward neural network-based language model using TensorFlow/Keras. Use an embedding layer followed by Dense layers to predict the next word in a sequence.	
2	Build a sequence-to-sequence (seq2seq) model using TensorFlow/Keras for a simple machine translation task (e.g., translating English sentences to French). Use an LSTM or GRU for both the encoder and decoder.	
3	Build and train a basic RNN model using TensorFlow/Keras for text generation. Use a dataset like Shakespeare's plays to generate new text sequences.	
	Module IV	**15**
1	Load a pre-trained BERT model using the Hugging Face Transformers library and use it for masked language modeling (MLM) to predict missing words in a sentence.	
2	Fine-tune a pre-trained BERT model for a text classification task, such as sentiment analysis on the IMDb movie reviews dataset.	
3	Load a pre-trained RoBERTa model using the Hugging Face Transformers library on a text classification task and compare its performance with BERT	
4	Use a pre-trained multilingual model to perform zero-shot translation between language pairs not directly trained together (e.g., translating from Hindi to Spanish using an English pivot).	

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: III	
Course: Robotic Process Automation		**Course Code:** UARPA604	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
2	2	20	30

Learning Objectives:

To enable the students to:

- To make the students aware about the automation today in the industry.
- To make the students aware about the tools used for automation.
- To help the students automate a complete process

Pre requisite:

-

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the mechanism of business process and can provide the solution in an optimize way

CO2: Use and handle the different events, debugging and managing the errors.

CO3: Automate the complete process

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**Robotic Process Automation:** Scope and techniques of automation, About UiPath **Record and Play:** UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder. **Sequence, Flowchart, and Control Flow:** Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow	**15**

	Data Manipulation: Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example)	
Module II	**Taking Control of the Controls:** Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, when to use OCR, Types of OCR available, how to use OCR, Avoiding typical failure points **Handling User Events and Assistant Bots:** What are assistant bots? Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger, Monitoring image and element triggers, An example of monitoring email, Example of onitoring a copying event and blocking it, Launching an assistant bot on a keyboard event **Exception Handling, Debugging, and Logging:** Exception handling, Common exceptions, and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps, Error reporting	**15**
	Total	**30**

Reference Books:

- Learning Robotic Process Automation by Alok Mani Tripathi, Packt Publisher, 1st Edition (2018)
- Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation by Srikanth Merianda, Createspace Independent Publishing publisher, 1st Edition (2018)
- The Simple Implementation Guide to Robotic Process Automation (Rpa): How to Best Implement Rpa in an Organization by Kelly Wibbenmeyer, iUniverse publisher, 1st Edition (2018)

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: III	
Course: Image and Video Analytics		**Course Code:** UAIVA605	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
2	2	20	30

Learning Objectives:

To enable the students to:

- Master digital image and video processing fundamentals, including acquisition, formats, and representation.
- Utilize image and video processing tools like OpenCV and PIL for practical applications.
- Implement image enhancement, segmentation, and advanced analysis techniques.
- Apply motion analysis and tracking methods to analyze video content dynamically.
- Develop competencies in real-time object detection and multi-object tracking using advanced algorithms.
- Understand and execute event recognition and video summarization techniques effectively.

Pre requisite:

- Basic programming skills in Python.
- Familiarity with mathematical concepts such as linear algebra, probability, and calculus.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Skillfully manipulate and enhance images and videos using advanced processing tools.

CO2: Master feature extraction and object recognition to analyze image content effectively.

CO3: Implement motion analysis and object tracking techniques in dynamic video environments.

CO4: Develop methods to summarize video content, aiding in efficient data interpretation and decision- making.

Outline of Syllabus: (per session plan)		
Module	**Description**	**No. of Hours**
Module I	**Image Analysis** **Introduction to Image Processing:** Overview of Digital Imaging(formats, resolution, and color models), Image Acquisition and Representation, Tools for Image Processing (OpenCV and PIL (Python Imaging Library)) **Image Enhancement Techniques:** Histogram Techniques (Equalization, Matching) for contrast enhancement, Spatial Filtering (Smoothing and sharpening filters, median filters, and their applications), Edge Detection and Image Segmentation (Sobel, Canny, and segmentation algorithms (watershed, k-means clustering)) **Feature Extraction and Description:** Keypoint Detection and Feature Descriptors (SIFT, SURF for keypoint detection; HOG and LBP for texture and shape description), Object Recognition and Classification **Advanced Image Analysis:** Image Transforms, Morphological Operations, Image Composition (stitching, creation of panoramic images, and super-resolution imaging)	**15**
Module II	**Video Analytics** **Introduction to Video Processing:** Basics of Video Technology (rates, resolution, and encoding), differences between video and still image processing, Video Acquisition and Representation, Frameworks and Tools for Video Analytics **Motion Analysis:** Optical Flow, Motion Detection and Tracking, Advanced Motion Analysis **Object Detection and Tracking**: Real-Time Object Detection (YOLO, SSD etc), Multi-Object Tracking (SORT, Deep SORT etc), Challenges in Real-Time Tracking **Video Event and Activity Recognition:** Event and Activity Detection methods, Video Summarization Technique	**15**
	Total	**30**

Text Books:

1. Intelligent Image and Video Analytics, El-Sayed M. El-Alfy, George Bebis, Mengchu Zhou, Routledge, Taylor and Francis Group, CRC, 2023
2. Machine Learning for Audio, Image and Video Analysis:Theory and Applications, Francesco Camastra, Alessandro Vinciarelli, Springer, 2015
3. Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress 2021(UNIT-III,IV and V), Vaibhav Verdhan, 2021

Reference Books:

1. “Image Processing, Analysis, and Machine Vision”, Milan Sonka, Vaclav Hlavac, Roger Boyle, 4th edition, Thomson Learning, 2013.
2. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited,2011.
3. “Video Analytics for Business Intelligence”, Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, Springer, 2012.
4. “Computer Vision: A Modern Approach”, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
5. “Computer & Machine Vision”, E. R. Davies, (2012), Fourth Edition, Academic Press.

Programme Name: M.Sc. – Artificial Intelligence and DataScience (2025 - 26) **Total Credits:** 02	**Course Name:** Image and Video Analytics Practical **Course Code:** UAIVA605P **Total Marks:** 50 **University assessment:** 50

Prerequisite: Basic understanding of computer science principles, familiarity with programming (Python preferred), and introductory knowledge of signal processing or computer vision.

Course Outcome:

- Capture, manipulate, and format images and video frames using OpenCV.
- Implement and evaluate image enhancement and segmentation methods.
- Utilize algorithms to extract and match features between images.
- Apply transformations and morphological operations for complex image analysis.
- Implement motion detection and object tracking in dynamic video scenes.
- Execute face detection and event recognition for video summarization.

.Course Code	Course Title	Credits
	Image and Video Analytics	**02**

Note: - Access to Python and relevant libraries (OpenCV, scikit-image, etc.).

1.	Image Acquisition and Basic Processing: Acquire and manipulate images (resize, crop, format conversion) using OpenCV.
2.	Histogram Equalization: Enhance image contrast by applying histogram equalization techniques.
3.	Image Filtering and Edge Detection: Apply filters and detect edges using Sobel and Canny methods.
4.	Image Segmentation: Segment images using global and adaptive thresholding and k-means clustering.
5.	Feature Extraction and Matching: Extract keypoints and match features between images using SIFT or ORB.
6.	Image Transformation and Morphology: Perform Fourier/Wavelet transforms and apply morphological operations.
7.	Image Stitching and Panorama Creation: Stitch multiple images together to create a panoramic image.
8.	Video Capture and Frame Extraction: Capture video and extract frames at regular intervals using OpenCV.
9.	Motion Detection and Optical Flow: Detect motion and analyze optical flow using background subtraction and optical flow algorithms.
10.	Object Detection in Videos: Detect objects in video sequences using YOLO or SSD models.
11.	Face Detection Using Haar Cascades: Implement face detection in images and videos using Haar cascade classifiers.
12.	Multi-Object Tracking: Track multiple objects in videos using algorithms like SORT or Deep SORT.
13.	Video Event Detection and Summarization: Detect events and create summarized

	videos highlighting key activities.

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: III**	
Course: Risk Analytics in Banking and Financial Markets		**Course Code:** UARAB606P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
8	4	40	60

Learning Objectives:

To enable the students to:

- Understand the scope, evolution, and significance of risk analytics in banking and financial markets.
- Recognize different types of risks (market, credit, operational) and apply analytical tools like VaR, stress testing, and scenario analysis to manage these risks.
- Utilize traditional and advanced credit scoring models, including machine learning and AI techniques, to assess and predict credit risk.
- Understand and apply arbitrage models and pair trading strategies, incorporating statistical and machine learning techniques to identify profitable trading opportunities.

Pre requisite:

- Familiarity with fundamental financial concepts, including risk management principles and financial markets.
- A basic grasp of statistical methods and machine learning algorithms, as these will be applied in credit scoring and trading strategies.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Effectively identify, assess, and manage key financial risks using advanced risk analytics tools and techniques.

CO2: Build and deploy both traditional and AI-driven credit scoring models to predict credit risk with a focus on fairness and ethical considerations.

CO3: Identify and exploit arbitrage opportunities in financial markets through both statistical and machine learning-based pair trading strategies

CO4: Understand the role of risk analytics in regulatory compliance, including key frameworks like Basel Accords and Dodd-Frank, ensuring adherence to financial regulations.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**Importance of Risk Analytics** • Introduction to Risk Analytics: Definition, scope, and evolution in financial markets. • Key risks in banking and financial markets: Market, credit, operational, etc. • Regulatory framework and compliance: Basel Accords, Dodd-Frank, and the role of risk analytics in meeting regulatory requirements. • Risk analytics tools and techniques: VaR, stress testing, scenario analysis, and emerging trends.	**20**
Module II	**Credit Scoring Models using Data Science and AI** • Fundamentals of Credit Scoring: Introduction to credit risk and traditional credit scoring models (Logistic Regression, Decision Trees). • Machine Learning in Credit Scoring: Overview of ML algorithms (SVM, Random Forest, Gradient Boosting), feature engineering, and model selection. • AI and Advanced Credit Scoring Techniques: AI in credit scoring (Neural Networks, Deep Learning), explainability, fairness, and ethical considerations.	**20**
Module III	**Introduction to Arbitrage Models and Detailed Pair Trading in Financial Markets** • Introduction to Arbitrage: Understanding arbitrage opportunities, strategies, and types (pure arbitrage, statistical arbitrage, risk arbitrage). • Introduction to Pair Trading: Basics of pair trading, statistical foundations (cointegration, correlation), and identifying trading pairs. • Advanced Pair Trading Strategies: Defining trading rules, identifying pairs using Machine Learning (ML) techniques, and case studies on implementing pair trading strategies.	**20**
	Total	**60**

Reference Books:

1. John C. Hull, "Risk Management and Financial Institutions", Wiley, 2018 (5th Edition), ISBN: 9781119448112
2. Bart Baesens, Daniel Roesch, and Harald Scheule, "Credit Risk Analytics: Measurement Techniques, Applications, and Examples in SAS", Wiley, 2016, ISBN: 9781119278344

3. Jon Danielsson, "Financial Risk Forecasting: The Theory and Practice of Forecasting Market Risk with Implementation in R and Matlab", Wiley, 2011, ISBN: 9780470669433

4. Marcos López de Prado, "Machine Learning for Asset Managers", Cambridge University Press, 2020, ISBN: 9781108792892

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: III**	
Course: Cloud Computing		**Course Code:** UACCO607	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
2	2	20	30

Learning Objectives:

- To learn how to use Cloud Services.
- To implement Virtualization.
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- Broadly educate to know the impact of engineering on legal and societal issues involved.

Pre requisite:.

- Understanding of fundamental computing concepts and basic networking principles.
- Basic programming skills and familiarity with operating systems and virtualization techniques

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Students will grasp the basics of cloud computing, including virtualization and distributed computing principles.

CO2: Students will learn about cloud architecture, delivery models, deployment models, and essential security mechanisms.

CO3: Students will gain practical knowledge of major platforms like AWS, Google App Engine, and Microsoft Azure.

CO4: Students will develop skills in implementing and managing cloud mechanisms and management systems.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**

Module I	**Introduction to Cloud Computing:** Introduction, Historical developments, Building Cloud Computing Environments, **Principles of Parallel and Distributed Computing:** Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. **Virtualization:** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment **Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges	**15**
Module II	. **Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure. **Specialized Cloud Mechanisms:** Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database. **Cloud Management Mechanisms:** Remote administration system, Resource Management System, SLA Management System, Billing Management System, **Cloud Security** **Mechanisms:** Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images	**15**
	Total	**30**

Reference Books:

1. Mastering Cloud Computing Foundations and Applications Programming by Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, Elsevier, 2013.
2. Cloud Computing Concepts, Technology & Architecture by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Prentice Hall, 2013.
3. Distributed and Cloud Computing, From Parallel Processing to the Internet of Things by Kai Hwang, Jack Dongarra, and Geoffrey Fox, MK Publishers, 2012.

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: III**	
Course: Cloud Computing Practical		**Course Code:** UACCO607P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	2	20	30

Learning Objectives:
This course aims to equip students with practical knowledge and hands-on experience in networking and virtualization technologies. Students will learn to implement various communication models, including TCP, UDP, multicast sockets, and RMI, as well as to deploy and manage virtualized environments using Xen, VMware ESXi, and Windows Hyper-V.

Course Outcomes:
After completion of the course, learners would be able to:
CO 1: set up and manage client-server communications using different protocols
CO 2: deploy applications through RMI
CO 3: implement and manage virtualization technologies

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
Module I	1. Write a program for implementing Client Server communication model using TCP. 2. Write a program for implementing Client Server communication model using UDP. 3. A multicast Socket example. 4. A RMI based application program to display current date and time. 5. Show the implementation of web services. 6. Implement Xen virtualization and manage with Xen Center 7. Implement virtualization using VMWare ESXi Server and managing with vCenter 8. Implement Windows Hyper V virtualization	**60**
	Total	**60**

SEMESTER IV

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Generative AI		**Course Code:** UAGAI651	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE)(Marks- 60 in Question Paper)**
4	4	40	60

Learning Objectives:

To enable the students to:

- Understand the principles and mathematical foundations of generative models.
- Learn different types of generative models, including GANs, VAEs, and others.
- Explore the applications of generative AI in various fields such as art, music, and data augmentation.
- Analyze and address ethical issues related to generative AI.

.

Pre requisite: Linear Algebra

Course Outcomes:

Upon completing this course, the student will be able to:

CO1: Understand the definition, history, and importance of generative models.
CO2: Comprehend mathematical foundations: probability distributions, optimization, and information theory.
CO3: Differentiate between discriminative and generative models, understand GMMs and HMMs.
CO4: Grasp the theory, architecture, and applications of VAEs and GANs.
CO5: Explore advanced models: PixelRNN, PixelCNN, Normalizing Flows, and diffusion models.
CO6: Apply generative models for art, music, data augmentation, and synthetic data, considering ethical issues.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
Module I	**Foundations and Core Models of Generative AI** **Introduction to Generative AI:** Definition and history of generative models, Importance and applications of generative AI, Overview of current state-of-the-art models, Case studies of successful applications; Review of Mathematical Foundations for Gen AI; Types of generative models: explicit vs. implicit models; Comparison	**15**

	between discriminative and generative models; Overview of classic generative models: Gaussian Mixture Models (GMMs), Hidden Markov Models (HMMs) **Variational Autoencoders (VAEs):** Theory and architecture of VAEs; Encoder-decoder; framework; Evidence Lower Bound (ELBO) and Latent Variables, Latent space representation; Training VAEs: loss functions, reparameterization trick; Disentangled Representations and Structured Latent Spaces, Hierarchical VAEs and their Applications, Conditional VAEs for Specific Task Control, Applications of VAEs: image generation, anomaly detection **Generative Adversarial Networks (GANs):** Theory and architecture of GANs; Role of generator and discriminator; Training challenges and solutions (e.g., mode collapse, vanishing gradients); Variants of GANs: Deep Convolutional GANs (DCGANs), From DCGAN to StyleGAN3, Wasserstein GANs and Improved Training Techniques, Conditional GANs (cGANs) for Task-Specific Generation, CycleGANs, Mode Collapse and Solutions, GAN Loss Functions and Metrics	
Module II	**Advanced Generative Architectures and Transformers** **Energy-Based Models (EBMs):** Deep Energy-Based Models for Image and Text Generation, Contrastive Divergence and Maximum Likelihood Estimation, Hybrid Models: Combining EBMs and GANs **Other Generative Models:** Autoregressive models: PixelRNN, PixelCNN; Flow-based models: Normalizing Flows, Real NVP; Diffusion models: Diffusion Models vs. GANs and VAEs, Score-based Generative Models and Denoising Diffusion, Applications in Image and Audio Generation (e.g., DALL-E 2, Latent Diffusion Models) **Transformers for Generative Tasks:** Generative Pre-trained Transformers (GPT-4 and beyond), Autoregressive and Masked Language Models for Generation, Vision Transformers (ViTs) and their Role in Image Generation, Cross-Modal Generative Models (e.g., CLIP, Flamingo), Recent Advancements in Zero-shot and Few-shot Generation using Transformers	**15**
Module III	**Hybrid Models, Diffusion, and Large Language Models (LLMs)** **Diffusion-based Text-to-Image Models:** DALL-E, Imagen, and Stable Diffusion Architectures, Latent Diffusion for High-Resolution Image Generation, Style Transfer **Hybrid Generative Models:** Combining VAE, GAN, and Flow-based Models for Enhanced Generation, Generating High-Fidelity, Diverse Data using Hybrid Architectures, Future Trends in Multi-modal Generation **LLMs for Generative AI:** Core LLM Architectures-BERT and Variants, GPT-2 and GPT-3 architectures, autoregressive modeling for text generation, chatbots, creative writing. T5 and Sequence-to-Sequence Models, Multimodal and Multilingual Models, Hugging Face Transformers Library, Applications of LLMs and Prompt Engineering: Text Generation and Summarization, Machine Translation	**15**

Module IV	**: Applications, Data Augmentation, and Ethical Considerations in Generative AI** **Data Augmentation and Synthetic Data:** Techniques for data augmentation: image transformations, adversarial training; Generating synthetic data for training machine learning models: benefits and challenges; Real-world applications: healthcare, autonomous driving, financial modelling; Evaluation metrics for synthetic data quality **Generative AI in Art and Music:** Creating art with GANs: techniques and examples; AI-Assisted Content Creation (e.g., DALLE-2 for Art and Design , Music generation using VAEs and GANs: methodologies and tools; VAEs and GANs in music generation, tools like OpenAI's Jukebox, Magenta, and MuseNet. Tools for Creative AI (e.g., RunwayML, Artbreeder, DeepDream) **Generative AI for Drug Discovery, Bioinformatics and Business:** Gen AI for Drug Discovery and Bioinformatics applications, Application in Generating Business Content (e.g., Automated Reports, Product Descriptions) **Ethical Issues in Generative AI:** Deepfakes and misinformation: detection and mitigation techniques; Bias and Fairness in LLMs, Privacy concerns: data anonymization, synthetic data generation; Bias and fairness: addressing bias in training data and models; Legal and societal implications: regulations, public perception, Future Trends in Generative AI: Code Generation and Reasoning, multimodal learning	**15**
	Total	**60**

Reference Books:

- "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016
- "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster, **Oreily,** 2019
- Research papers and articles provided throughout the course

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Generative AI Practical		**Course Code:** UAGAI651P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	2	20	30

Learning Objectives:

To enable the students to:

- Understand and implement key generative models for text, images, and music.
- Explore and apply advanced generative model architectures and techniques.
- Utilize generative models in creative and practical applications.
- Analyze model performance and address ethical considerations.
- Fine-tune pre-trained LLMs for specific tasks and datasets.

Pre requisite:

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Construct and train HMMs, VAEs, and GANs for various datasets.
CO2: Compare GAN architectures and analyze generated output quality.
CO3: Generate art, music, and category-specific images using generative models.
CO4: Identify ethical issues and evaluate the quality of generated content.
CO5: Fine-tune LLMs and implement text summarization models for custom applications.

Outline of Syllabus: (per session plan)

		No. of Hours

Module I	1. Create a Hidden Markov Model (HMM) for sequence prediction using a text dataset. 2. Build and train a Variational Autoencoder (VAE) on the MNIST dataset to generate new digit images. 3. Implement a basic GAN and train it on the CIFAR-10 dataset to generate new images.	
Module II	4. Compare the performance of DCGAN and WGAN on the CelebA dataset and analyze the generated images. 5. Implement a PixelCNN model to generate new images pixel by pixel using the MNIST dataset. 6. Build a character-level language model using an RNN and generate new text sequences.	
Module III	7. Develop a Conditional VAE (CVAE) to generate images conditioned on class labels from the MNIST dataset. 8. Implement a Conditional GAN (CGAN) to generate specific category images from the CIFAR-10 dataset. 9. Use a pre-trained GAN to generate art images and explore style transfer techniques.	
Module IV	10. Create a simple music generation model using a VAE trained on a MIDI file dataset. 11. Fine-tune a pre-trained LLM (e.g., GPT-2) on a custom text dataset and generate coherent text samples. 12. Implement a text summarization model using an LLM and evaluate its performance on news articles.	
	Total	**60**

Reference Books

- "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016
- "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster, **Oreily,** 2019
- Research papers and articles provided throughout the course

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Optimization Methods		**Course Code:** UAOME652	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 40)**	**Semester End Examinations (SEE)(Marks- 60 in Question Paper)**
4	4	40	60

Learning Objectives:

Introduction to optimization techniques using both linear and non-linear programming. The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization too. After an adequate introduction to linear algebra and probability theory, students will learn to frame engineering minima maxima problems in the framework of optimization problems.

Pre requisite: Linear Algebra

Course Outcomes:

Upon completing this course, the student will be able to:

CO1: Comprehend the techniques and applications of Engineering optimization.

CO2: Analyze characteristics of a general linear programming problem

CO3: Apply basic concepts of mathematics to formulate an optimization problem

CO4: Analyze various methods of solving the unconstrained minimization problem .

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
Module I	Introduction to optimization Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.	**15**

Module II	Linear Programming Problem Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.	**15**
Module III	Single Variable Optimization Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.	**15**
Module IV	Multivariable and Constrained Optimization Techniques Multi Variable and Constrained Optimization Technique, Optimality criteria, Direct search Method, Simplex search methods, Hooke-Jeeves's pattern search method, Powell's conjugate direction method, Gradient based method, Cauchy's Steepest descent method, Newton's method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method.	**15**
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Optimization Methods Practical		**Course Code:** UAOME652P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	2	20	30

Learning Objectives:

To enable the students to:

- Impart knowledge on theory of optimization and conditions for optimality for unconstraint and constraint optimization problems
- Inculcate modelling skills necessary to describe and formulate optimization problems in design and manufacturing
- Familiarize with the working principle of optimization algorithms used to solve linear and non-linear problems
- Train the students to solve optimization problems using software tools

.

Pre requisite:

Course Outcomes:

1. To cultivate foundation of Optimization fundamentals.
2. To generate mathematical ability to solve optimization problems.
3. To understand various algorithms with their comparative study for the utilization of Optimization problem solution.
4. To analyze a research problem having requirement of optimization techniques.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	1. Find the maximum and minimum values of the function using the first and second derivatives. Use Symbolic Mathematics Toolbox. Study the functions available in the Optimization Toolbox of MATLAB. 2. Find approximately the optimum point of the given linear programming problem graphically. Find the optimum point and optimum function value of a linear programming problem using the standard functions available in the Optimization Toolbox.	
Module II	3. Write a program to minimize a non-linear one-dimensional function with no constraints using Unrestricted Search Method. First take the step size fixed and then take accelerated step size. Also, write a program to minimize a non-linear one-dimensional function with no constraints using Exhaustive Search Method. 4. Write a program to minimize a non-linear one-dimensional function with no constraints using Dichotomous Search Method.	
Module III	5. Write a program to minimize a non-linear one-dimensional function with no constraints using Interval Halving Method. 6. Write a program to minimize a non-linear one-dimensional function with no constraints using Fibonacci Method	
Module IV	7. Write a program to minimize a non-linear one-dimensional function with no constraints using Golden Section Method. 8. Write a program to minimize a non-linear one-dimensional function with no constraints using Quadratic Interpolation Method. Also, write a program to minimize a non-linear onedimensional function with no constraints using Cubic interpolation Method. 9.Write a program to minimize a non-linear one-dimensional function with no constraints using Newton's method, Quasi-Newton Method and Secant Method	
	Total	**60**

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		Semester: IV	
Course: Blockchain Technologies		**Course Code:** UABTE653	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA) (Marks - 20)**	**Semester End Examinations (SEE)(Marks- 30 in Question Paper)**
2	2	20	30

Learning Objectives:

To enable the students to:

- understand the structure of a Blockchain
- learn the fundamentals of Ethereum and Bitcoin

Pre requisite:

Course Outcomes:

Upon completing this course, the student will be able to:

1. provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved.
2. gain the ability to write and deploy basic smart contracts on the Ethereum blockchain using Solidity programming language and tools like Truffle and Remix**.**

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours

Module I	**a)Blockchain** – Introduction, History, Centralized versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases. **b) A Working of Bitcoin:** Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets, Interacting with the Bitcoin Blockchain	**15**
Module II	**a)Ethereum**- Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Ethereum Blockchain, Ethereum Accounts, Advantages of Accounts, Account State, Merkle Patricia Tree, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine. **b)Mining Ether**: Difficulty, Factors Required for Block Validation, How Proof of Work Helps Regulate Block Time, Faster Blocks, How Ethereum Uses Stale Blocks, Forking	**15**
	Total	**30**

Reference Books:

- The NFT Handbook, Matt Fortnow,Terry, Wiley,2022
- Mastering Ethereum, Andreas M. Antonopoulos ,Dr. Gavin Wood, O'Reilly, 2018
- The Blockchain Developer, Elad Elrom, Apress, 2019
- Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal , Gautam Dhameja ,Priyansu Sekhar Panda , Apress,2018
- Introducing Ethereum and Solidity, Chris Dannen, Apress,2017
- Blockchain for dummies, Tiana Laurence, Wiley,2017

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Blockchain Technologies Practical		**Course Code:** UABTE653P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
4	2	20	30

Learning Objectives:

To enable the students to:

a. recognize the importance of blockchain in various industries and its potential to disrupt traditional systems.
b. analyze the structure and functionality of Bitcoin wallets for storing and managing cryptocurrency.
c. introduce the Ethereum Virtual Machine (EVM) as the backend for executing smart contracts.

.

Pre requisite:

Course Outcomes:

After completion of the course, learners would be able to:

CO1. develop a mechanism for generating RSA key pairs, enabling users to securely encrypt and decrypt messages.
CO2. explore the architecture and components of the Bitcoin blockchain, including blocks, transactions.
CO3. demonstrate smart contracts and their deployment in decentralized applications (DApps).

Outline of Syllabus: (per session plan)		
		No. of Hours
1	Develop a secure messaging application where users can exchange messages securely using RSA encryption. Implement a mechanism for generating RSA key pairs and encrypting/decrypting messages.	
2	Allow users to create multiple transactions and display them in an organised format.	
3	Create a Python class named Transaction with attributes for sender, receiver, and amount. Implement a method within the class to transfer money from the sender's account to the receiver's account	
4	Implement a function to add new blocks to the miner and dump the blockchain.	
5	Write a python program to demonstrate mining.	
6	Demonstrate the use of the Bitcoin Core API to interact with a Bitcoin Core node	
7	Demonstrating the process of running a blockchain node on your local machine	
8	Demonstrate mining using geth on your private network	
9	Write a Solidity program that demonstrates various types of functions including regular functions, view functions, pure functions, and the fallback function	
10	Write a Solidity program that demonstrates function overloading, mathematical functions, and cryptographic functions	
11	Write a Solidity program that demonstrates various features including contracts, inheritance, constructors, abstract contracts, interfaces.	
12	Write a Solidity program that demonstrates use of libraries, assembly, events, and error handling	
13	Build a decentralized application (DApp) using Angular for the front end and Truffle along with Ganache CLI for the back end	
	Total	**60**

Reference Books

Online References:

1. NPTEL courses:
   a. Blockchain and its Applications,
   b. Blockchain Architecture Design and Use Cases
2. www.swayam.gov.in/
3. www.coursera.org
4. https://ethereum.org/en/

5. https://www.trufflesuite.com/tutorials
6. https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.h
7. Blockchain demo: https://andersbrownworth.com/blockchain/
8.BlockchainDemo:Public/PrivateKeys&signing:
https://andersbrownworth.com/blockchain/public-private-keys/
9.https://www.javatpoint.com/blockchain-tutorial
10. https://www.tutorialspoint.com/blockchain/index.htm

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Econometrics and Finance		**Course Code:** UAEFI654	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
2	2	20	30

Learning Objectives:

To enable the students to:

- Define and explain econometrics scope, methodology, and types.
- Apply uni-variate and multivariate regression models to real-world data.
- Conduct significance tests and evaluate goodness of fit in econometric models.
- Identify and remedy heteroscedasticity, multicollinearity, and autocorrelation in regression models.
- Design and structure financial models using spreadsheet techniques and best practices.
- Implement auditing, testing, and security measures in financial models.

Pre requisite:

- Understanding of fundamental statistics and proficiency in algebra and calculus.

 Basic knowledge of economics and familiarity with data analysis techniques.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Define, explain, and apply econometrics scope, methodology, uni- and multivariate regression models.

CO2: Test significance, goodness of fit, and address heteroscedasticity, multicollinearity, and autocorrelation issues.

CO3: Analyze and apply dummy variables and variable errors in econometric models.

CO4: Design, build, audit, test financial models using spreadsheets, macros, and ensure security.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**Differential Calculus-** Functions, limit of a function, continuity of a function, Derivative of a function - Rules of Differentiation, Higher order derivatives, differentiation of logarithmic functions, exponential functions and implicit functions. **Econometrics-** Introduction to Econometrics– definitions – scope – methodology – types. Uni-variate regression model, Assumptions, Gauss Markov Theorem. Multivariate regression model and Inferential Analysis. Test of significance of parameter estimates. Test of goodness of fit and correlation Problem and Methods to detect Heteroscedasticity, Multicollinearity and Autocorrelation in the Regression Model, its causes, consequences and Remedial Measures. Dummy variables: Nature of Dummy variables – Use of Dummy Variables – Errors in Variables and its consequences.	**15**
Module II	**Financial Modelling** Introduction to financial modelling; objectives of financial modelling; spreadsheet features, techniques; best practices in spreadsheet design. Desigining models - Model Design and structure; Building business case models; spreadsheet techniques and methods. Auditing and Testing: Essential testing and auditing techniques; Testing financial analysis model with cash flows and ratios; Debugging and checking a financial model. Macros and Security: Writing and auditing and macros; Spreadsheet security, Model Completion: Model review; Documentation; Final audit.	**15**
	Total	**30**

Reference Books:

1. Damodar N. Gujarathi: Basic Econometrics, New Delhi: Tata McGraw Hill.
2. J.Johnston: Econometric Methods, McGraw Hill.
3. John Hull: Futures, Options and Other Derivatives, Prentice Hall.

4. Financial Valuation and Modeling by Sheeba Kapil

Programme Name: M.Sc. – Artificial Intelligence and DataScience (2025 - 26) **Total Credits:** 02	**Course Name:** Econometrics and Finance Practical **Course Code:** UAEFI654 **Total Marks:** 50 **University assessment:** 50
Prerequisite: Basic computer skills and Basic understanding of Ms Excel	
Course Outcome: ● Learners will learn practical application of Econometrics. ● Learners will be able to use Econometrics in financial modelling	

Course Code	Course Title	Credits
	Practical on Econometrics and Finance	**02**
Note: Working on - Micro soft Excel / R Programming / Python		
1.	Uni-variate Regression Model	
2.	Multivariate Regression Model	
3.	Methods to detect hetroscedasticity and remedial measures	
4.	Methods to detect multicollinearity and remedial measures	
5.	Methods to detect auto-correlation and remedial measures.	
6.	Interpreting on Dummy variable	
7.	Financial modelling: best practices in spreadsheet design.	
8.	Model Design and structure	
9.	Auditing and Testing	
10.	Macros and Security	

Program: M.Sc. – Artificial Intelligence and Data Science (2025 - 26)		**Semester: IV**	
Course: Developing Data Science Web Applications		**Course Code:** UADDS655P	
Teaching Scheme		**Evaluation Scheme**	
Lecture (Hours per week)	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
8	4	40	60

Learning Objectives:

To enable the students to:

- Understand the fundamental concepts and architecture of the Shiny package and its role in web application development using R.
- Develop simple Shiny applications with reactive components, including basic UI elements and server logic.
- Design and implement complex user interfaces, utilizing tabs, sidebars, and dynamic UI elements.
- Manage, process, and visualize data within Shiny applications using popular R packages like ggplot2, plotly, and DT.

Pre requisite:

- Familiarity with R syntax, data types, and fundamental programming concepts.
- Understanding of data manipulation, analysis, and visualization using R.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Design and Develop Shiny Applications by leveraging both basic and advanced UI components.

CO2: Integrate interactive plots, data tables, and summaries into Shiny apps, providing users with dynamic data exploration tools.

CO3: Construct well-organized, user-friendly interfaces that enhance the usability and accessibility of Shiny applications.

CO4: Generate dynamic reports and dashboards, complete with data download capabilities, using Shiny and R Markdown.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
Module I	**Introduction to Shiny and Basic UI/Server Structure** Introduction to the Shiny package and its core concepts, basic structure of a Shiny application, including the UI (User Interface) and server components, set up a simple Shiny app with interactive features like reactive expressions and dynamic UI elements, Overview of Shiny and its role in web application development, Setting up the R environment for Shiny applications, Understanding the UI and server architecture, Building a basic Shiny app with reactive outputs, Introduction to input controls (text, sliders, buttons, etc.)	**20**
Module II	**Building Advanced User Interfaces in Shiny** **C**reation of more complex user interfaces for your Shiny apps, advanced UI components like tabs, sidebars, and layouts, build Shiny apps that are well-organized and easy to navigate, Using tabs and sidebars to organize your app, Implementing different layouts to structure your app, Adding dynamic UI elements that respond to	**20**

	user input	
Module III	**Data Handling, Visualization, and Reporting** Integrating data analysis and visualization capabilities into your Shiny applications, handle and process data within Shiny, create interactive plots using popular R packages like ggplot2 and plotly, and generate dynamic reports, build data-driven Shiny apps that can serve as interactive dashboards or reporting tools, Importing, processing, and managing data in Shiny apps, Creating interactive visualizations with ggplot2 and plotly, Building data tables and summaries with DT and summarytools, Generating dynamic reports using R Markdown and Shiny, Implementing download functionality for data and reports	**20**
	Total	**60**

Reference Books:

1. Hadley Wickham, Mastering Shiny, O'Reilly Media, 2021, ISBN: 9781492047387
2. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly Media, 2016, ISBN: 9781491910392,
3. Chris Beeley and Shitalkumar R. Sukhdeve, Shiny in Action, Manning Publications, 2022, ISBN: 9781617298358
4. Winston Chang, R Graphics Cookbook, O'Reilly Media, 2018 (2nd Edition), ISBN: 9781491978606