GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY,
EAST DELHI CAMPUS,
SURAJMAL VIHAR-110092

DETAILED SYLLABUS
(FOURTH YEAR)

for

BACHELOR OF TECHNOLOGY

for

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

INDUSTRIAL INTERNET OF THINGS

under the aegis of University School of Automation and Robotics offered at Affiliated Institutions of the University

from A.S. 2021-22 onwards

University School of Automation and Robotics

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY,
EAST DELHI CAMPUS, SURAJMAL VIHAR-110092

Semester: 7th			
Paper code: AIDS401/AIML401/IOT401	**L**	**T/P**	**Credits**
Subject: Principles of Management for Engineers	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:

1.	To introduce students to the principles and functions of management in engineering environments.
2.	To develop the skills and knowledge required for effective decision-making in engineering contexts.
3.	To understand the dynamics of organizational behavior and its impact on engineering teams and projects.
4.	To equip students with project management skills for successful execution of engineering projects.

Course Outcomes:

CO1	Understand the fundamental principles of management, its evolution, and the roles of managers in engineering contexts.
CO2	Apply various decision-making models and techniques to solve engineering problems and make effective decisions.
CO3	Analyze individual and group behavior, motivation, leadership, and communication in engineering organizations.
CO4	Acquire project management skills and techniques to plan, execute, monitor, and control engineering projects effectively.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	-	-	2	2	2	-	1	1	-	-	1	1
CO2	-	-	2	2	2	-	1	-	-	-	1	1
CO3	-	-	2	2	2	-	1	-	-	-	1	1
CO4	1	1	3	2	2	1	1	1	1	1	1	1

Course Overview:
Principles of Management for Engineers is an essential course providing a comprehensive understanding of management principles, leadership, decision-making, and organizational behavior in engineering contexts.

Unit I **[8]**
Definition of management: Science or art, manager vs entrepreneur; Types of managers managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

Unit II **[8]**
Nature and purpose of Planning: types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Unit III **[8]**
Organizational Behavior: Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

Unit IV **[8]**
Controlling, system and process of controlling : Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Textbooks:
1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY,
EAST DELHI CAMPUS,
SURAJMAL VIHAR-110092

Detailed SYLLABUS
(4th Year)
Seventh Semester

for

BACHELOR OF TECHNOLOGY

for

Artificial Intelligence and Data Science

Applicable from Batch Admitted in Academic Session 2021-2022 Onwards

Semester: 7th			
Paper code: AIDS403T	**L**	**T/P**	**Credits**
Subject: Digital and Social Media Analytics	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	Understand the fundamental concepts and principles of digital and social media analytics.
2.	Apply data analytics techniques to analyze and interpret digital and social media data.
3.	Develop skills in using tools and software for digital and social media analytics.
4.	Apply digital and social media analytics techniques to solve real-world business problems

Course Outcomes:	
CO1	Apply data analytics techniques to analyze digital and social media data and derive meaningful insights.
CO2	Utilize digital and social media analytics tools and software effectively.
CO3	Design and implement digital and social media analytics strategies for business decision-making.
CO4	Communicate the results of digital and social media analytics effectively to stakeholders.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	1	2	-	-	1	-	-	-	-	1	-
CO2	2	1	2	1	3	1	-	1	1	1	1	1
CO3	2	1	2	1	-	1	-	1	-	1	1	-
CO4	2	1	2	1	2	2	1	1	1	1	1	1

Course Overview:

This course provides an in-depth understanding of digital and social media analytics, focusing on the application of data analytics techniques to analyze and derive insights from digital and social media data. Students will learn various concepts, tools, and methodologies used in digital and social media analytics and develop skills to apply these techniques to real-world scenarios.

Unit I **[8]**

Introduction to Digital and Social Media Analytics: Introduction to digital and social media analytics, Role and significance of digital and social media analytics in business, Types of data in digital and social media analytics, Ethical considerations in digital and social media analytics. Predictive Versus Descriptive: Predictive Analytics, Descriptive Analytics

Unit II **[8]**

Data Collection and Preprocessing for Digital and Social Media Analytics: Data collection methods for digital and social media analytics, Data preprocessing techniques for digital and social media data, Text mining and sentiment analysis in digital and social media analytics, Handling missing data and outliers in digital and social media analytics

Unit III **[8]**

Analyzing Digital and Social Media Data: Exploratory data analysis techniques for digital and social media data, Predictive modeling for digital and social media analytics, Social network analysis and community detection in social media data, Recommender systems in digital and social media analytics

Unit IV **[8]**

Applying Digital and Social Media Analytics: Marketing analytics using digital and social media data, Customer segmentation and targeting using digital and social media analytics, Brand monitoring and reputation management in social media, Case studies and practical applications of digital and social media analytics.

Textbooks:

1. "Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media" by Matthew Ganis (2018).
2. "Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World" by Chuck Hemann and Ken Burbary (2018).
3. "Data Mining for Business Analytics: Concepts, Techniques, and Applications with JMP Pro" by Galit Shmueli, Peter C. Bruce, Mia L. Stephens, and Nitin R. Patel (2020).

Reference Books:

1. "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Instagram, GitHub, and More" by Matthew A. Russell and Mikhail Klassen (2019).
2. "Social Media Mining: An Introduction" by Reza Zafarani, Mohammad Ali Abbasi, and Huan Liu (2014).
3. "Web and Network Data Science: Modeling Techniques in Predictive Analytics" by Thomas W. Miller (2018).

Semester: 7th			
Paper code: AIDS403P	**L**	**T/P**	**Credits**
Subject: Digital and Social Media Analytics Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	Gain hands-on experience in collecting, processing, and analyzing digital and social media data using appropriate tools and techniques.
2.	Apply analytical methods to derive meaningful insights and make data-driven decisions in the context of digital and social media analytics.

Course Outcomes:

CO1	Understand the principles and techniques of digital and social media analytics and their applications in real-world scenarios.
CO2	Develop proficiency in using relevant tools and technologies for analyzing and interpreting digital and social media data.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	3	1	-	1	-	1	1	-
CO2	2	2	2	2	3	2	1	1	1	1	1	1

List of Experiments:

1. To perform sentiment analysis on Twitter data using Python (libraries: Tweepy, NLTK, TextBlob) to understand the sentiment and opinion of users towards specific topics or brands.
2. To extract data from social media platforms using web scraping techniques in Python (libraries: BeautifulSoup, Selenium) for further analysis and insights.
3. To analyze the network structure and relationships within social media data using Gephi or Python (libraries: NetworkX) to identify key influencers, communities, and patterns of information flow.
4. To apply topic modeling techniques in Python (libraries: Gensim, LDA, LSA) to uncover latent topics and themes within online discussions on social media platforms.
5. To visualize and present social media data through interactive dashboards using tools like Tableau or Python (libraries: Matplotlib, Seaborn) to gain insights and facilitate data-driven

decision-making.

6. To identify influential users and opinion leaders in social media networks using Python (libraries: NetworkX, centrality measures) to understand their impact and reach.
7. To develop predictive models using Python (libraries: scikit-learn, XGBoost) to forecast and optimize social media engagement based on historical data and relevant features.
8. To classify and categorize social media posts using Python (libraries: NLTK, scikit-learn) to automatically assign labels or tags based on the content and context of the posts.
9. To analyze and optimize social media campaigns using Python (libraries: pandas, NumPy) by examining key metrics, identifying trends, and making data-driven recommendations for improved campaign performance.
10. To apply NLP techniques in Python (libraries: NLTK, spaCy) to extract insights, perform sentiment analysis, entity recognition, and other advanced text analysis tasks on social media data.

Semester: 7th			
Paper code: AIDS405T	**L**	**T/P**	**Credits**
Subject: Spatial Data Analysis	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

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2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	Gain a comprehensive understanding of spatial data analysis theories and methodologies.
2.	Acquire proficiency in using GIS software and tools for spatial data visualization and analysis.
3.	Apply spatial data analysis techniques to address spatial problems and generate insights.
4.	Develop critical thinking and problem-solving skills in the context of spatial data analysis.

Course Outcomes:	
CO1	Understand the fundamental concepts and techniques of spatial data analysis.
CO2	Develop skills in using GIS tools and software for spatial data visualization and analysis.
CO3	Apply spatial data analysis methods to solve real-world problems in various domains.
CO4	Demonstrate the ability to interpret and communicate spatial data analysis results effectively.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	2	1	-	-	2	-	-	-
CO3	1	2	3	2	3	1	-	-	-	-	-	-
CO4	2	2	3	2	3	2	-	-	-	3	-	-

Course Overview:

This course provides an introduction to spatial data analysis, covering topics such as spatial data models, visualization techniques, clustering, interpolation, geostatistics, spatial regression, and GIS tools. Students will develop skills in analyzing and interpreting spatial data, with applications in environmental sciences, urban planning, epidemiology, and business.

Unit I **[8]**

Introduction to Spatial Data Analysis: Overview of spatial data and its characteristics, Introduction to spatial data models and formats, spatial data visualization techniques, spatial data preprocessing and cleaning.

Unit II **[8]**

Spatial Data Analysis Techniques: Spatial clustering and pattern analysis: Spatial interpolation and prediction methods, Geostatistics and spatial autocorrelation analysis, Spatial regression and modeling, Spatial data mining and machine learning algorithms

Unit III **[8]**

Spatial Data Visualization and GIS Tools: Geographic Information Systems (GIS) concepts and applications, Spatial data visualization using GIS software, GIS tools for spatial analysis and query, Web-based mapping and interactive visualization

Unit IV **[8]**

Applications of Spatial Data Analysis: Spatial data analysis in environmental sciences, Urban planning and transportation analysis, Spatial epidemiology and health-related studies, Spatial analysis in business and marketing

Textbooks:

1. "GIS Fundamentals: A First Text on Geographic Information Systems" by Paul Bolstad
2. "Spatial Data Analysis: Theory and Practice" by Robert Haining

Reference Books:

1. "Geospatial Analysis: A Comprehensive Guide" by Michael J. de Smith, Michael F. Goodchild, and Paul A. Longley
2. "Spatial Statistics and Geostatistics: Theory and Applications for Geographic Information Science and Technology" by Yongwan Chun and Daniel A. Griffith
3. "GIS and Spatial Analysis for the Social Sciences: Coding, Mapping, and Modeling" by Robert Nash Parker and Emily K. Asencio

Semester: 7th			
Paper code: AIDS405P	**L**	**T/P**	**Credits**
Subject: Spatial Data Analysis Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

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2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	Develop proficiency in utilizing GIS software and spatial analysis tools for visualizing and analyzing spatial data.
2.	Apply spatial data analysis techniques and methodologies to solve complex spatial problems and derive meaningful insights from spatial datasets.

Course Outcomes:

CO1	Understand the fundamental concepts and techniques of spatial data analysis through hands-on practical applications.
CO2	Develop skills in using GIS software and spatial analysis tools to analyze and interpret spatial data for real-world problems in various domains.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	1	-	-	2	1	-	-	2	-	-	-
CO2	1	2	3	2	3	1	-	-	-	-	-	-

List of Experiments:

1. To visualize spatial data using GIS software (ArcGIS or QGIS) to effectively represent and communicate spatial patterns and relationships.
2. To apply spatial clustering and hotspot analysis techniques using R (libraries: sp, spdep, cluster) to identify spatial clusters and hotspots of interest in the dataset.
3. To utilize Python (libraries: arcpy, GeoPandas) to perform spatial interpolation techniques for estimating values at unobserved locations based on the values of surrounding known locations.
4. To conduct geostatistical analysis and kriging using R (libraries: gstat, automap) to model and predict spatial phenomena based on statistical properties and spatial relationships.
5. To analyze and optimize network-based spatial data using ArcGIS Network Analyst or osmnx (Python) for efficient routing and analysis of transportation networks.

6. To perform spatial regression modeling using R (libraries: spdep, spreg) to explore the relationship between spatially referenced variables and predict outcomes based on spatial dependencies.
7. To create interactive web maps and visualizations using tools like Leaflet.js, Mapbox, or ArcGIS Online to effectively present and explore spatial data on web platforms.
8. To analyze point patterns and measure spatial autocorrelation using R (libraries: spatstat, spdep) to understand the spatial distribution and clustering of point features.
9. To apply spatial data mining techniques and machine learning algorithms using Python (libraries: scikit-learn, PySAL) for discovering patterns and making predictions in spatial datasets.
10. To assess the environmental impact of spatial phenomena using spatial analysis techniques in ArcGIS or QGIS, enabling effective decision-making and mitigation strategies.

Semester: 7th			
Paper code: AIDS407T	**L**	**T/P**	**Credits**
Subject: Data Visualization	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:

1.	To introduce students to the fundamental concepts and principles of data visualization.
2.	To develop practical skills in using popular data visualization libraries and tools.
3.	To enable students to create interactive and dynamic visualizations for effective data exploration and analysis.
4.	To explore advanced topics in data visualization, including multidimensional visualization, network visualization, and visualizing large datasets.

Course Outcomes:

CO1	Understand the principles and importance of data visualization in data analysis and decision-making processes.
CO2	Develop skills in using various data visualization tools and techniques to effectively present and communicate complex data.
CO3	Apply interactive visualization methods to explore and analyze data, enabling user interaction and exploration.
CO4	Gain knowledge of advanced data visualization techniques and their applications for visualizing complex and large datasets.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	2	2	3	2	3
CO2	1	2	3	2	3	2	1	2	2	3	2	3
CO3	1	2	3	2	3	2	1	2	2	3	2	3
CO4	1	2	2	2	3	2	1	2	2	3	2	3

Course Overview:
This course introduces students to the principles, techniques, and tools of data visualization. Students will learn to effectively present and communicate data using popular libraries and tools. Topics include exploratory data analysis, interactive visualization, advanced techniques, and visualizing complex and large datasets.

Unit I **[8]**
Introduction to Data Visualization: Importance and principles of data visualization, Data types and data visualization techniques, Exploratory data analysis and storytelling through data visualization

Unit II **[8]**
Data Visualization Tools and Techniques: Introduction to data visualization libraries and tools (e.g., Matplotlib, Seaborn, Tableau), Basic plotting techniques: line plots, bar plots, scatter plots, and histograms, Advanced visualization techniques: heatmaps, treemaps, parallel coordinates, and geospatial visualization

Unit III **[8]**
Interactive Data Visualization: Introduction to interactive visualization tools (e.g., D3.js, Plotly), Creating interactive plots and dashboards, Animation and dynamic visualization techniques

Unit IV **[8]**
Advanced Topics in Data Visualization: Multidimensional visualization: dimensionality reduction techniques (e.g., PCA, t-SNE), Network visualization and graph analysis, Visualizing large datasets: sampling, aggregation, and data reduction techniques

Textbooks:
1. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney
2. "Interactive Data Visualization for the Web: An Introduction to Designing with D3" by Scott Murray
3. "Data Visualization: A Practical Introduction" by Kieran Healy

Reference Books:
1. "The Visual Display of Quantitative Information" by Edward R. Tufte
2. "Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic
3. "Information Visualization: Perception for Design" by Colin Ware.

Semester: 7th			
Paper code: AIDS407P	**L**	**T/P**	**Credits**
Subject: Data Visualization Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	To gain hands-on experience in using different data visualization tools and libraries.
2.	To apply appropriate data visualization techniques for different types of data and analysis tasks.

Course Outcomes:

CO1	Understand the principles and importance of data visualization in data analysis and decision-making processes.
CO2	Develop skills in using various data visualization tools and techniques to effectively present and communicate complex data.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	1	2	3	2	3	2	1	2	2	3	2	3
CO2	1	2	3	2	3	2	1	2	2	3	2	3

List of Experiments:

1. To familiarize with the basic principles and concepts of data visualization using Matplotlib library in Python.
2. To create interactive and dynamic visualizations using Plotly library, emphasizing user interaction and exploration of data.
3. To introduce with geographic data visualization techniques using Folium library, allowing them to create maps and explore spatial patterns in data.
4. To develop an understanding of network visualization concepts and techniques using NetworkX library, enabling students to analyze and visualize complex network structures.
5. To provide skills to effectively visualize and analyze time series data using Seaborn library, focusing on identifying patterns and trends.
6. To explore the realm of 3D data visualization using Mayavi library, to visualize and interpret complex three-dimensional datasets.

7. Introduce students to visualizing large-scale datasets using Apache Spark, emphasizing the handling and visualization of big data for analysis and insights.
8. Enable students to design and create interactive dashboards using Tableau, emphasizing the effective communication of data-driven insights.
9. Familiarize students with D3.js library and its capabilities to create interactive and dynamic web-based visualizations, enhancing their skills in web-based data presentation.
10. Enable students to visualize machine learning models and their results using Python libraries like scikit-learn and matplotlib, enhancing their understanding of model performance and interpretation.

Semester: 7th			
Paper code: AIDS409T	**L**	**T/P**	**Credits**
Subject: Business Intelligence & Analytics	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:

1.	Gain a comprehensive understanding of Business Intelligence and Analytics concepts, techniques, and tools.
2.	Develop skills to analyze and interpret data, perform statistical analysis, and visualize data effectively.
3.	Acquire knowledge of machine learning algorithms and their applications in business analytics.
4.	Stay updated with emerging trends and technologies in the field of Business Intelligence and Analytics.

Course Outcomes:

CO1	Understand the fundamental concepts of Business Intelligence and Analytics and their application in AI and Data Science.
CO2	Analyze and interpret data using various statistical techniques and develop actionable insights for business decision-making.
CO3	Apply machine learning algorithms for business analytics, including regression, classification, clustering, and recommendation systems.
CO4	Explore emerging trends in Business Intelligence and Analytics, such as Big Data Analytics, real-time analytics, and streaming data.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	-	-	2
CO2	3	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	1	2
CO4	3	3	3	3	3	-	-	-	-	-	2	3

Course Overview:
This course provides an in-depth understanding of Business Intelligence (BI) and Analytics concepts, techniques, and tools, with a focus on their application in the field of Artificial Intelligence (AI) and Data Science. Students will learn to analyze and interpret data, develop BI solutions, and apply analytics to make informed business decisions.

Unit I **[8]**
Introduction to Business Intelligence and Analytics: Introduction to Business Intelligence and Analytics, Data Warehousing and Data Mining, Data Extraction, Transformation, and Loading (ETL), Introduction to Analytics: Descriptive, Predictive, and Prescriptive Analytics.

Unit II **[8]**
Data Analysis and Visualization: Exploratory Data Analysis (EDA), Statistical Analysis for Business Intelligence, Data Visualization Techniques and Tools, Interactive Dashboards and Reports

Unit III **[8]**
Machine Learning for Business Analytics: Supervised and Unsupervised Learning Algorithms, Regression and Classification Models, Clustering Techniques for Customer Segmentation, Recommendation Systems

Unit IV **[8]**
Big Data Analytics and Emerging Trends: Introduction to Big Data Analytics, Hadoop and Map Reduce, Real-time Analytics and Streaming Data, Emerging Trends in Business Intelligence and Analytics

Textbooks:
1. "Business Intelligence: A Managerial Perspective on Analytics" by Ramesh Sharda, Dursun Delen, Efraim Turban
2. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost, Tom Fawcett
3. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney

Reference Books:
1. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" by Ralph Kimball, Margy Ross
2. "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel
3. "Big Data Analytics: Methods and Applications" by Chang Liu, Quan Z. Sheng, Jian Yu, Yongrui Qin

Semester: 7th			
Paper code: AIDS409P	**L**	**T/P**	**Credits**
Subject: Business Intelligence and Analytics Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	Understand the fundamental concepts and techniques of business intelligence and analytics.
2.	Gain hands-on experience in applying business intelligence and analytics methods to real-world datasets and interpret the results.

Course Outcomes:

CO1	Apply business intelligence and analytics techniques to solve real-world problems in various domains.
CO2	Develop skills in using tools and technologies for data cleaning, analysis, modeling, and visualization in the context of business intelligence and analytics.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	1	1	-	-	-	-	1	1	1
CO2	2	2	2	1	1	-	-	-	-	1	1	1

List of Experiments:

1. To provide students with hands-on experience in applying data cleaning and preprocessing techniques for business analytics.
2. To develop skills in exploring and analyzing data using exploratory data analysis methods for market research.
3. To understand and apply predictive modeling techniques, such as regression analysis, for business analytics.
4. To segment customers and perform cluster analysis to gain insights for targeted marketing strategies.
5. To forecast future sales using time series analysis and evaluate the accuracy of the predictions.

6. To mine association rules from transactional data for market basket analysis and cross-selling opportunities.
7. To analyze customer sentiment from text data and derive insights for improving products and services.
8. To build decision tree and random forest models for predicting customer churn and identify factors influencing it.
9. To implement recommender systems for personalized product recommendations based on user preferences.
10. To create interactive dashboards and reports using Power BI for effective communication and decision-making in business intelligence.

Semester: 7th			
Paper code: AIDS411T	**L**	**T/P**	**Credits**
Subject: Advances in Data Science	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:

1.	Gain a comprehensive understanding of deep learning architectures, training techniques, and advanced topics.
2.	Develop skills in NLP for text analysis, classification, and language modeling.
3.	Learn the principles and techniques of big data analytics, including distributed computing and scalable machine learning.
4.	Understand the ethical implications of data science and implement techniques for model interpretability, fairness, and privacy.

Course Outcomes:

CO1	Apply advanced techniques in deep learning and neural networks for solving complex data analysis problems.
CO2	Develop expertise in natural language processing (NLP) and apply it to text-based data for tasks such as sentiment analysis, named entity recognition, and language generation.
CO3	Analyze and process big data using distributed computing frameworks like Hadoop and Spark, and apply machine learning algorithms to large-scale datasets.
CO4	Understand the importance of explainable AI and ethical considerations in data science, and apply techniques to address model interpretability, bias, fairness, privacy, and security.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	1	2	-	3	-	-	1	-	-	-	-
CO2	2	2	2	3	-	-	-	-	1	-	-	-
CO3	2	-		2	3	-	1	-	-	1	-	-
CO4	2	2		3	3	-	-	-	-		1	2

Course Overview:
This course explores advanced topics in data science, including deep learning, natural language processing, big data analytics, and ethical considerations. Students will gain practical skills in applying these techniques to solve complex problems, analyze large-scale datasets, and address interpretability, fairness, privacy, and security in AI applications.

Unit I **[8]**
Deep Learning and Neural Networks: Introduction to deep learning, Neural network architectures: CNNs, RNNs, and Transformers, Training deep learning models, Transfer learning and fine-tuning, Advanced topics in deep learning: Generative models, GANs, and reinforcement learning.

Unit II **[8]**
Natural Language Processing (NLP): Basics of NLP: Tokenization, POS tagging, and parsing Text classification and sentiment analysis, Named Entity Recognition (NER) and entity linking, Word embedding's and language modeling, Neural machine translation and language generation.

Unit III **[8]**
Big Data Analytics: Introduction to big data analytics, Distributed computing and storage: Hadoop and Spark, Processing big data: MapReduce and Spark programming, Machine learning on big data: Scalable algorithms and frameworks, Stream processing and real-time analytics

Unit IV **[8]**
Explainable AI and Ethical Considerations: Interpretable machine learning models, Model explainability and feature importance, Bias, fairness, and accountability in AI, Privacy and security in data science, Ethical guidelines and responsible AI practices

Textbooks:
1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
2. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper
3. "Big Data: A Revolution That Will Transform How We Live, Work, and Think" by Viktor Mayer-Schönberger and Kenneth Cukier

Reference Books:
1. "Interpretable Machine Learning: A Guide for Making Black Box Models Explainable" by Christoph Molnar
2. "Fairness and Machine Learning: Limitations and Opportunities" edited by Solon Barocas, Moritz Hardt, and Arvind Narayanan
3. "Privacy and Big Data: The Players, Regulators, and Stakeholders" by Terence Craig and Mary Ludloff

Semester: 7th			
Paper code: AIDS411P	**L**	**T/P**	**Credits**
Subject: Advances in Data Science Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:	
1.	Gain hands-on experience in building and training deep learning models and applying them to various domains.
2.	Understand the challenges and considerations in natural language processing tasks and analyze the performance of NLP algorithms.
Course Outcomes:	
CO1	Develop practical skills in advanced data science techniques such as deep learning, NLP, and distributed computing for real-world applications.
CO2	Analyze and interpret the behavior of complex machine learning models, address issues of fairness and bias, and apply privacy-preserving methods to ensure ethical data science practices

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	1	-	-	-	-	-	-	1
CO2	2	2	2	2	1	1	1	1	1	1	1	2

List of Experiments:

1. To implement and train deep learning models (e.g., CNN, RNN) on real-world datasets for various applications.
2. To perform text classification tasks using NLP techniques and compare different algorithms for accuracy and efficiency.
3. To process large-scale datasets using Spark's distributed computing capabilities and run machine learning algorithms on them.
4. To build and train GAN models for generating realistic images and evaluate the quality of the generated samples.
5. To implement and train sequence-to-sequence models for language translation tasks using attention mechanisms.

6. To apply various anomaly detection techniques on time series data and evaluate their effectiveness.
7. To assess and mitigate bias in machine learning models using fairness indicators and AIF360.
8. To interpret and explain the predictions of complex machine learning models using LIME and SHAP techniques.
9. To design and train reinforcement learning agents to play games and achieve high scores.
10. To apply differential privacy techniques to protect sensitive information while performing data analysis.

Semester: 7th			
Paper code: AIDS413T	**L**	**T/P**	**Credits**
Subject: Data Science for Complex Systems	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:

1.	Understand the fundamental concepts and challenges of analyzing complex systems using data science techniques.
2.	Develop skills in applying network analysis to study complex system structures and identify key components.
3.	Apply time series analysis to analyze temporal data in complex systems and make predictions.
4.	Use simulation methods to model complex phenomena and evaluate system behavior under different scenarios.

Course Outcomes:

CO1	Analyze and model complex systems using network analysis, time series analysis, and simulation techniques.
CO2	Apply data science methodologies to make data-driven decisions and predictions in complex system contexts.
CO3	Utilize optimization and recommendation techniques for efficient resource allocation and personalized recommendations.
CO4	Interpret and visualize data from complex systems to gain insights into their behavior and dynamics.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	1	1	1	2	-	-	-	2	1	2	1
CO2	3	1	1	1	2	1	1	1	2	1	2	2
CO3	3	1	1	1	2	1	1	1	2	1	2	2
CO4	3	1	1	1	2	1	1	1	2	1	2	2

Course Overview:
This course introduces students to data science techniques for analyzing complex systems, such as social networks, IoT networks, and financial systems. Students will learn network analysis, time series analysis, and simulation methods to gain insights into complex system behavior and make data-driven decisions.

Unit I **[8]**
Introduction to Complex Systems and Network Analysis: Introduction to complex systems, characteristics, and challenges, Network theory and representation of complex systems as graphs, Network analysis metrics: centrality, connectivity, and community detection.

Unit II **[8]**
Time Series Analysis in Complex Systems: Time series data representation and pre-processing, Time series forecasting techniques: ARIMA, Exponential Smoothing, and LSTM, Detecting anomalies and patterns in time series data.

Unit III **[8]**
Simulation Methods for Complex Systems: Simulation modeling and techniques (e.g., Monte Carlo simulation, agent-based modeling), Analyzing epidemic spread, traffic flow, and other complex phenomena using simulations, Evaluating system behavior under different scenarios and parameter settings

Unit IV **[8]**
Data-Driven Decision Making in Complex Systems: Predictive modeling for decision-making in complex systems, Optimization techniques for resource allocation and scheduling, Recommender systems and their applications in personalized recommendations

Textbooks:
1. "Network Science" by Albert-Laszlo Barabasi
2. "Time Series Analysis and Its Applications: With R Examples" by Robert H. Shumway and David S. Stoffer
3. "Simulation Modeling and Analysis" by Averill M. Law and W. David Kelton

Reference Books:
1. "Complex Networks: Structure, Robustness, and Function" by Ernesto Estrada and Philip A. Knight
2. "Forecasting: Principles and Practice" by Rob J Hyndman and George Athanasopoulos
3. "Agent-Based and Individual-Based Modeling: A Practical Introduction" by Steven F. Railsback and Volker Grimm

Semester: 7th			
Paper code: AIDS413P	**L**	**T/P**	**Credits**
Subject: Data Science for Complex Systems Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
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3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:	
1.	Gain hands-on experience in analyzing and modeling complex systems using network analysis, time series analysis, and simulation techniques. Understand the challenges and approaches for handling big data in complex systems and apply machine learning algorithms for predictions and decision-making.
2.	Explore the application of data science techniques in interdisciplinary fields to address complex challenges in today's interconnected world.
Course Outcomes:	
CO1	Develop practical skills in data science techniques for analyzing complex systems and understanding their behavior.
CO2	Apply data science methodologies to solve real-world problems in various domains, such as social networks, finance, and healthcare, and gain insights into complex system dynamics.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	1	-	-	-	-	-	-	1
CO2	2	2	2	2	1	1	1	1	1	1	1	2

List of Experiments:

1. To analyze and visualize social media data as a network to understand user interactions and identify key influencers.
2. To build predictive models using machine learning algorithms to forecast stock market prices and evaluate their performance.
3. To simulate the spread of an epidemic in complex networks and analyze the impact of different parameters on the spread.
4. To perform sentiment analysis on textual data (e.g., product reviews, tweets) and classify sentiments as positive, negative, or neutral.

5. To apply clustering algorithms to detect communities in networks and analyze their structure.
6. To analyze time series data from IoT sensors, perform forecasting, and identify patterns and anomalies.
7. To use optimization techniques to allocate resources efficiently in complex systems, such as workforce scheduling or supply chain management.
8. To build collaborative filtering-based recommender systems to suggest movies based on user preferences.
9. To apply anomaly detection algorithms on network traffic data and identify abnormal behavior indicative of cyber-attacks.
10. To simulate game theory scenarios and analyze decision-making strategies in complex systems.

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY,
EAST DELHI CAMPUS,
SURAJMAL VIHAR-110092

Detailed SYLLABUS
(4th Year)
Seventh Semester

for

BACHELOR OF TECHNOLOGY

for

Artificial Intelligence and Machine Learning

Applicable from Batch Admitted in Academic Session 2021-2022 Onwards

Detailed SYLLABUS
(4th Year)

Open Area Basket

Seventh Semester

for

BACHELOR OF TECHNOLOGY

for

Artificial Intelligence and Data Science
Artificial Intelligence and Machine Learning
Industrial Internet of Things

Applicable from Batch Admitted in Academic Session 2021-2022 Onwards

Semester: 7th			
Paper code: OAE403T	**L**	**T/P**	**Credits**
Subject: Computer Vision	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To introduce students the major ideas, methods and techniques of computer vision and pattern recognition.
2.	Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.
3.	Perform shape analysis and extract features form Images and do analysis of Images
4.	Get an exposure to advanced concepts, including state of the art deep learning architectures, in all aspects of computer vision.

Course Outcomes:	
CO1	Describe different image representation, their mathematical representation and different data structures used.
CO2	Classify different segmentation algorithm for given input.
CO3	Detect a moving object in video using the concept of motion analysis.
CO4	Recognize the object using the concept of computer vision

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	3	2	-	-	1	1	1	1	1	1	2
CO2	2	2	-	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	3	-	1	-	1	-	-	-
CO4	2	2	-	3	3	-	-	-	-	-	1	-

Course Overview:

Computer Vision introduces B.Tech students to the fascinating world of visual perception through machines. This course explores algorithms and techniques that enable computers to understand and interpret images and videos. Students will delve into image processing, feature

extraction, object recognition, and deep learning models for computer vision tasks. Practical applications such as facial recognition, autonomous vehicles, and medical imaging will be discussed, preparing students for exciting opportunities in AI-driven visual systems.

UNIT I **[8]**

Digital Image Formation and low, level processing: Overview and State of the art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing. Depth estimation and Multi camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry, Homography, Rectification, DLT, RANSAC, 3D reconstruction framework, Auto calibration.

UNIT II **[8]**

Feature Extraction: Edges , Canny, LOG, DOG, Line detectors (Hough Transform), Corners , Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale, Space Analysis, Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph, Cut, Mean, Shift, MRFs, Texture Segmentation, Object detection.

UNIT III **[8]**

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio, Temporal Analysis, Dynamic Stereo, Motion parameter estimation. Shape from X: Light at Surfaces, Phong Model, Reflectance Map, Albedo estimation, Photometric Stereo, Use of Surface Smoothness Constraint, and Shape from Texture, color, motion and edges.

UNIT IV **[8]**

Miscellaneous: Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing, Modern trends, super-resolution, GPU, Augmented Reality, cognitive models, fusion and SR&CS.

Text Books:

1. Szeliski, R., Computer Vision: Algorithms and Applications, Springer, Verlag London .
2. Forsyth, A., D. and Ponce, J., Computer Vision: A Modern Approach, Pearson Education.

Reference Books:

1. Hartley, R. and Zisserman, A., Multiple View Geometry in Computer Vision Cambridge University Press.
2. Fukunaga, K., Introduction to Statistical Pattern Recognition, Academic Press, Morgan Kaufmann.

Semester: 7th			
Paper code: OAE403P	**L**	**T/P**	**Credits**
Subject: Computer Vision Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	Understand the fundamentals of computer vision algorithms and their use cases.
2.	Develop practical skills in using popular computer vision tools and frameworks to solve real-world problems.

Course Outcomes:

CO1	Gain expertise in computer vision techniques and applications, including object detection, segmentation, and facial recognition.
CO2	Acquire hands-on experience in building computer vision models and deploying them on edge devices for real-world applications.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	3	1	-	1	-	1	1	-
CO2	2	2	2	2	3	2	1	1	1	1	1	1

List of Experiments:

1. Learn to preprocess images by applying techniques such as resizing, filtering, and histogram equalization.
2. To implement object detection algorithms to identify and localize objects in images and video streams.
3. To use semantic segmentation models to segment objects in an image and understand pixel-level classification.
4. To build a facial recognition system to detect and recognize faces in images and video.
5. To implement OCR techniques to recognize text from images and scanned documents
6. To apply neural style transfer to blend the style of one image onto the content of another image.
7. To use pose estimation models to detect and track human body keypoints in images and videos.
8. To implement super-resolution algorithms to upscale low-resolution images.

9. To fine-tune pre-trained models like VGG, ResNet, or MobileNet for image classification tasks.
10. To develop an image captioning system to generate textual descriptions of images.
11. To combine computer vision and natural language processing to create a model that answers questions about images.
12. To optimize object detection models for deployment on edge devices with real-time performance.

Semester: 7th			
Paper code: OAE405T	**L**	**T/P**	**Credits**
Subject: Software Verification, Validation and Testing	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	Explain the importance of software verification and validation in the context of AI, ML, IoT, and Data Science.
2.	Apply different testing techniques and methodologies to identify and resolve software defects effectively.
3.	Implement automated testing and utilize test automation tools for efficient and continuous testing.
4.	Evaluate and validate AI/ML models and perform data validation in Data Science projects.
Course Outcomes:	
CO1	Understand the concepts of software verification, validation, and testing and their significance in AI, ML, IoT, and Data Science applications.
CO2	Develop expertise in applying various testing methodologies, automated testing, and test automation tools to ensure software quality and reliability.
CO3	Demonstrate the ability to use test management and bug tracking tools effectively to plan, monitor, and manage the testing process.
CO4	Assess the trade-offs between different testing approaches and make informed decisions to ensure comprehensive software testing.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	2	1	-	-	2	-	-	-
CO3	1	2	3	2	3	1	-	-	-	-	-	-
CO4	2	2	3	2	3	2	-	-	-	3	-	-

Course Overview:
This course introduces students to the principles and techniques of software verification, validation, and testing. It covers the various testing methodologies, tools, and best practices used to ensure the quality and reliability of software in the context of Artificial Intelligence, Machine Learning, Industrial Internet of Things, and Data Science applications.

UNIT I **[8]**

Introduction: Terminology, evolving nature of area, Errors, Faults and Failures, Correctness and reliability, Testing and debugging, Static and dynamic testing, Exhaustive testing: Theoretical foundations: impracticality of testing all data, impracticality of testing all paths, no absolute proof of correctness.

UNIT II **[8]**

Software Verification and Validation Approaches and their Applicability: Software technical reviews; Software testing: levels of testing - module, integration, system, regression; Testing techniques and their applicability-functional testing and analysis, structural testing and analysis, error-oriented testing and analysis, hybrid approaches, integration strategies, transaction flow analysis, stress analysis, failure analysis, concurrency analysis, performance analysis; Proof of correctness; simulation and prototyping; Requirement tracing.

UNIT III **[8]**

Test Generation: Test generations from requirements, Test generation pats, Data flow analysis, Finite State Machines models for flow analysis, Regular expressions based testing, Test Selection, Minimizations and Prioritization, Regression Testing.

UNIT IV **[8]**

Mutation and mutants: Introduction, Mutation and mutants, Mutation operators, Equivalent mutants, Fault detection using mutants, Types of mutants, Mutation operators for C and Java.

Text Books:

1. Software Verification and Validation: An Engineering and Scientific Approach, Marcus S. Fisher, Springer, 2007
2. Foundations of Software Testing, Aditya P. Mathur,Pearson Education, 2008
3. Software Testing: Principles and Practices,SrinivasanDesikan, Gopalaswamy Ramesh, Pearson Education India,2006

Reference Books:

1. "Software Testing: Principles, Techniques, and Tools" by K. K. Aggarwal and Yogesh Singh
2. "Software Testing" by Ron Patton
3. "Testing Computer Software" by Cem Kaner, Jack Falk, and Hung Q. Nguyen

4. "The Art of Software Testing" by Glenford J. Myers, Corey Sandler, and Tom Badgett

Semester: 7th			
Paper code: OAE405P	**L**	**T/P**	**Credits**
Subject Software Verification, Validation and Testing Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	To familiarize students with different types of software testing and verification methods.
2.	To provide hands-on experience with industry-standard testing tools and practices.

Course Outcomes:

CO1	Understand the principles and techniques of software testing and validation.
CO2	Develop proficiency in using various software testing tools for different testing scenarios.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	1	-	-	2	1	-	-	2	-	-	-
CO2	1	2	3	2	3	1	-	-	-	-	-	-

List of Experiments:

1. To understand the importance of static code analysis and utilize SonarQube to identify code quality issues, bugs, and vulnerabilities in software projects.
2. To learn the fundamentals of unit testing and practice writing and executing JUnit test cases to ensure individual units of code function correctly.
3. To explore the concepts of integration testing and use Selenium to automate browser-based testing, ensuring seamless interactions between components.
4. To familiarize students with test case management using TestRail and learn to design, execute, and track test cases effectively.
5. To gain hands-on experience in performance testing with JMeter, measuring system responsiveness, scalability, and stability under varying workloads.
6. To understand the significance of security testing and utilize OWASP ZAP to identify and address security vulnerabilities in web applications.
7. To learn model-based testing techniques with Spec Explorer and generate effective test cases from models, improving test coverage.

8. To explore usability testing concepts and use UserTesting to evaluate the user-friendliness and user experience of software applications.
9. To understand mutation testing principles and utilize PIT to assess the effectiveness of test suites in detecting code mutations.
10. To experience load testing with LoadRunner, simulating real-world user loads to assess application performance under stress.
11. To learn to measure code coverage using JaCoCo and assess the effectiveness of test suites in covering code paths.
12. To utilize Postman to automate the testing of APIs, ensuring their functionality, reliability, and compatibility.

Semester: 7th			
Paper code: OAE407T	**L**	**T/P**	**Credits**
Subject: Metaverse and its Applications	**4**	**0**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To Understand the social and cultural implications of the metaverse, including issues related to identity, representation, and community-building.
2.	To analyze and evaluate the opportunities and limitations of the metaverse in various domains, such as gaming, social interaction, business, and education.
3.	To Stay updated with the latest developments and emerging trends in the field of the metaverse and its applications.
4.	To Apply critical thinking and problem-solving skills to address real-world scenarios and challenges in the context of the metaverse.
Course Outcomes:	
CO1	To Understand the social and cultural implications of the metaverse, including issues related to identity, representation, and community-building.
CO2	Identify and analyze the technologies enabling the metaverse, such as virtual reality, augmented reality, and blockchain.
CO3	Examine the economic aspects of the metaverse, including virtual economies, digital assets, and monetization strategies.
CO4	Apply critical thinking and problem-solving skills to address real-world scenarios and challenges in the context of the metaverse.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	3	2	-	-	-	-	-	1	1	1	2
CO2	2	2	-	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	3	-	-	-	1	-	-	-
CO4	2	2	-	3	3	-	-	-	-	-	1	-

Course Overview:
This course provides an in-depth exploration of the concept, technologies, and applications of the metaverse. The metaverse refers to a virtual universe where individuals can interact with digital environments and each other in real or simulated time.

UNIT I **[10]**

Introduction: definition of Metaverse applications, design dimensions, Metaverse application ecology and economy, design and development process

Immersive Techniques and Functionality: SDKs, tools, and services for augmented reality, virtual reality, extended reality (XR), human computer interactions, devices and internet of things, and digital twins.

UNIT II **[10]**

UIUX: SDKs, tools, and services for avatar systems, spatial user interface, multimodal user interface, locomotion, UI prototyping, and accessible and inclusive UX design

UNIT III **[10]**

Metaverse Privacy Security and Ethics: SDKs, tools, and services for cyberspace encryption, blockchain, and federated learning.

Metaverse Intelligence: SDKs, tools, and services for nature language processing, machine learning, data mining, and recommendation systems.

UNIT IV **[10]**

Meat Entertainment: Metaverse prototypes for entertainment, including multiplayer VR gaming, social VR, live performance in Metaverse.

Metaverse in Web Learning: Metaverse prototypes for education, including avatar-mediated teaching and learning, immersive learning, experiential learning, collaborative learning, etc.

Metaverse in Healthcare: Metaverse prototypes for healthcare and mental well-being, including teletherapy, teleoperation, rehabilitation.

Text Books:

1. LaViola Jr, J. J., Kruijff, E., McMahan, R. P., Bowman, D., & Poupyrev, I. P. (2017). 3D user interfaces: theory and practice. Addison-Wesley Professional.
2. LaValle, M. (2019). Virtual reality. Cambridge University Press.

Reference Books:

1. Metaverse Roadmap (2007) https://www.metaverseroadmap.org/overview/

Semester: 7th			
Paper code: OAE409T	**L**	**T/P**	**Credits**
Subject: Web Intelligence	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To introduce students to the fundamental concepts and challenges of Web Mining, Recommendation Systems, NLP, and Semantic Web.
2.	To familiarize students with various techniques and algorithms used in Web Intelligence applications.
3.	To enable students to develop AI-driven web-based applications using intelligent techniques.
4.	To encourage students to critically analyze and evaluate the performance of Web Intelligence solutions for real-world scenarios.

Course Outcomes:	
CO1	Understand the core concepts and principles of web mining, recommendation systems, NLP, and semantic web technologies, and their significance in web-based applications.
CO2	Apply various intelligent techniques, algorithms, and models to analyze web data, build recommendation systems, and process natural language in web-related tasks.
CO3	Design and develop AI-driven web applications using web mining, recommendation systems, NLP, and semantic web technologies to improve user experience and personalization.
CO4	Evaluate and compare different web intelligence approaches, models, and algorithms to make informed decisions for building efficient and effective web-based solutions.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	-	-	-	-	2
CO2	3	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	1	2
CO4	3	3	3	3	3	-	-	-	-	-	2	3

Course Overview:
Web Intelligence is an advanced course for B.Tech AI, ML, IIoT, and Data Science students to explore the integration of AI and intelligent techniques in web-related applications. The syllabus covers web mining, recommendation systems, natural language processing, and semantic web technologies.

UNIT I **[8]**
Introduction to Web Mining: History of web mining, state-of-art for web mining, web scraping, Web Databases, Knowledge Discovery in Databases, Similarity search in textual data, Text processing, Similarity functions: Jaccard, Euclidean, Cosine

UNIT II **[8]**
Key Components: Benchmarking, Click, Conversion, Direct Traffic, Filter, Funnel, Goal, Impression, Keyword, Landing Page, Organic Traffic, Paid Traffic, Types of Visitors, Tracking Code, Time on Site.

UNIT III **[8]**
Web Mining Essentials: Automated Reporting, Actionable Reporting, Web Testing, Dashboards, Segmentation, Classification and Regression for web mining, Ensemble learning for web data analytics.

UNIT IV **[8]**
Web Data Analytics: Significance of Web Mining, Web Analytics Process, Web Document Ranking: Graph Analysis with PageRank. Google Analytics: Acquisition analysis, Behavior Analysis, conversation Analysis

Textbooks:
1. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, 1st Edition, Avinash Kaushik
2. Google Analytics: Understanding Visitor Behavior 1st Edition, Justin Cutroni

Reference Books:
1. Google Analytics Breakthrough: From Zero to Business Impact 1st Edition, Feras Alhlou, Shiraz Asif, Eric Fettman

Semester: 7th			
Paper code: OAE409P	**L**	**T/P**	**Credits**
Subject: Web Intelligence Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	To understand elements of web intelligence and scraping
2.	To provide knowledge on tools and techniques involved in web data analytics

Course Outcomes:

CO1	Understand the elements of web intelligence
CO2	Gain knowledge about web analytics techniques

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	1	1	-	-	-	-	1	1	1
CO2	2	2	2	1	1	-	-	-	-	1	1	1

List of Experiments:

1. To gain insights into web traffic patterns, user behavior, and popular content on a live website using web analytics tools.
2. To understand the presence and impact of Adwords on a website, and explore their relevance for marketing and revenue generation.
3. To learn to set up and configure Google Analytics for tracking website performance and user interactions.
4. To explore various open-source features of Google Analytics and utilize them to analyze website traffic and user engagement.
5. To apply advanced data mining techniques to extract valuable insights and patterns from web data, aiding decision-making and business intelligence.
6. To implement algorithms to rank web documents based on relevance and importance, improving search engine efficiency.
7. To apply knowledge discovery techniques to uncover valuable patterns and trends from web databases in practical applications.

8. To understand the Jaccard Similarity measure and implement it to compare sets, useful in various data analysis tasks.
9. To implement the Euclidean Similarity measure to quantify the similarity between data points, valuable in clustering and classification tasks.
10. To implement the Cosine Similarity measure to determine the similarity between documents and vectors, essential for text analysis and information retrieval.

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Semester: 7th			
Paper code: OAE411T	**L**	**T/P**	**Credits**
Subject: Intelligent and Expert Systems	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To introduce students to the core concepts and principles of intelligent systems and expert systems.
2.	To equip students with the knowledge and skills to design and develop rule-based expert systems.
3.	To enable students to apply intelligent systems in different domains and understand their practical applications.
4.	To create awareness among students about the ethical considerations and future trends in the field of intelligent systems.

Course Outcomes:	
CO1	Understand the Basics of Artificial Intelligence and Expert Systems
CO2	Analyze the programming Logic in Artificial Intelligence
CO3	Evaluate various search methods in Artificial Intelligence
CO4	Gain Knowledge about the Expert Systems and the latest developments in Knowledge

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	3	1	1	-	1	1	-	-	2
CO2	2	2	3	3	1	1	-	1	1	-	-	2
CO3	2	2	3	3	1	1	-	1	2	-	-	2
CO4	2	2	3	3	2	1	1	1	2	-	-	2

Course Overview:

Intelligent and Expert Systems is an advanced course for B.Tech AI, ML, IIoT, and Data Science students, covering the principles and applications of AI-based intelligent systems and expert

systems. Topics include knowledge representation, reasoning, rule-based systems, and applications in various domains.

Unit I **[8]**

Introduction: Expert systems and their history, Expert systems in daily life, Case study of expert systems. Emulation of human cognitive process, knowledge search trade-off, stored knowledge, semantic nets. An abstract view of modeling, elementary knowledge. Computational logic, analysis of compound statements using simple logic connectives, predicate logic, knowledge organization and manipulation, and knowledge acquisition.

Unit II **[8]**

Search methods and knowledge representation: Introduction to Fuzzy logic with examples, Bayesian probabilistic inference, possible world, representation, Structure knowledge: Graph, frames, and related structures. Object-oriented, representation- object classes, messages, and methods. Search and control strategies - Concepts, search problems, searching AND – OR graphs.

Unit III **[8]**

Knowledge organization and communication in expert systems: Knowledge organization-Indexing and retrieval techniques, integration of knowledge in memory organization systems, Perception and communication in expert systems. Overview of Linguistics, Basic passim techniques, semantic analysis and representation structures, natural language generation, and system.

Unit IV **[8]**

Pattern recognition and learning techniques: Pattern recognition system- understanding speech recognition, Image transformation, low-level processing, medium and high-level processing, vision system architecture, Rule-based system architecture, knowledge acquisition and validation, knowledge system building tools

Textbooks:

1. Russel (Stuart), 'Artificial Intelligence- Modern approach, Pearson Education series in AI', 3rd Edition, 2009.
2. Dan W Patterson, 'Introduction to Artificial intelligence and Expert systems', Prentice Hall of India Pvt. Ltd,2001

Reference Books:

1. Eugene Charniak, Drew Mc Dermot, 'Introduction to Artificial intelligence', Addison Wesley Longman Inc.,2009
2. George. F, William. A. Stubblefield, 'Artificial intelligence and the design of expert systems', The Benjamin Cummins Publishing Co., Inc 2nd Edition, 1992.

Semester: 7th			
Paper code: OAE411P	**L**	**T/P**	**Credits**
Subject: Intelligent and Expert Systems Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:	
1.	To understand elements of Expert Systems.
2.	To gain knowledge on techniques and tools involved in developing expert systems

Course Outcomes:	
CO1	Understand the Basics of Artificial Intelligence and Expert Systems
CO2	Gain Knowledge about the Expert Systems and the latest developments in Knowledge

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	1	-	-	-	-	-	-	1
CO2	2	2	2	2	1	1	1	1	1	1	1	2

List of Experiments:

1. To familiarize students with installing and configuring essential Python libraries for data analysis, visualization, and scientific computing.
2. To develop practical applications that simulates human cognitive processes using artificial intelligence techniques to solve real-world problems.
3. To introduce students to fuzzy sets theory and its application in decision-making and pattern recognition tasks using Python libraries.
4. To create knowledge graphs to represent complex relationships between entities and enable effective data representation and analysis.
5. To enable students to visualize and analyze network graphs using Python libraries for understanding network structures and properties.
6. To apply pattern recognition techniques on textual data for tasks like sentiment analysis, topic modeling, and text classification.
7. To apply pattern recognition techniques on numerical datasets for tasks like anomaly detection, clustering, and regression.
8. To apply pattern recognition algorithms on medical datasets to assist in diagnosis, treatment planning, and medical research.

Faculties can motivate students to make a project on real life expert systems.

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Semester: 7th			
Paper code: OAE413T	**L**	**T/P**	**Credits**
Subject: Audio and Speech Processing	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To introduce students to the basics of audio and speech signals and their pre-processing.
2.	To provide insights into speech recognition and the techniques involved in automatic speech recognition systems.
3.	To familiarize students with speech synthesis methods and the process of converting text to speech.
4.	To enable students to apply audio feature extraction techniques for various audio processing tasks.

Course Outcomes:	
CO1	Understand the fundamentals of audio and speech signals, their characteristics, and the challenges in processing and analyzing them.
CO2	Learn the techniques for building automatic speech recognition systems and comprehend their real-world applications and limitations.
CO3	Gain the knowledge of developing text-to-speech synthesis systems using different approaches and evaluate their quality.
CO4	Apply various audio feature extraction techniques for classification, music information retrieval, and audio event detection in AI-based systems.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	-	-	1	1	1	1	1	1	2
CO2	2	2	-	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	3	-	1	-	1	-	-	-
CO4	2	2	-	3	3	-	-	-	-	-	1	-

Course Overview:
Audio and Speech Processing is an advanced course for B.Tech AI, ML, IIoT, and Data Science students to explore the principles and techniques for analyzing and processing audio and speech data. The syllabus covers speech recognition, synthesis, audio feature extraction, and applications in AI-based systems.

UNIT I **[8]**

Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT II **[8]**

Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT III **[8]**

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV **[8]**

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – ngrams, context dependent sub-word units; Applications and present status.
Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody.

Text Books:

1. Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Ben gold and Nelson Morgan, “Speech and audio signal processing”, processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education.

Reference Books:

1. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education.
3. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons.

Semester: 7th			
Paper code: OAE413P	**L**	**T/P**	**Credits**
Subject: Audio and Speech Processing Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	To provide hands-on experience in audio data handling, preprocessing, and feature extraction.
2.	To enable students to apply machine learning and signal processing techniques to real-world speech-related problems and evaluate their performance.

Course Outcomes:

CO1	Gain practical experience in processing and analyzing audio signals for various applications, including speech recognition and emotion analysis.
CO2	Develop skills in implementing machine learning models for audio and speech-related tasks, and understanding their limitations and challenges.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	2	1	-	-	-	-	-	-	1
CO2	2	2	2	2	1	1	1	1	1	1	1	2

List of Experiments:

1. To visualize audio signals in the time and frequency domains, understanding the characteristics of audio data.
2. To preprocess audio data, remove noise, and apply techniques like normalization and filtering.
3. To extract relevant features (e.g., MFCC, Mel spectrogram) from audio data for speech recognition tasks.
4. To implement a basic speech recognition system using HMM and observe its performance.
5. To identify speakers from a dataset using methods like Gaussian Mixture Models (GMM) or Support Vector Machines (SVM).
6. To classify the emotional state of speakers from audio data using machine learning techniques.

7. To compress audio files using MPEG audio compression standards and analyze the trade-offs between size and quality.
8. To convert text into speech using TTS systems and evaluate the synthesized speech quality.
9. To automatically segment an audio recording and identify distinct speakers present in it.
10. To develop a deep learning model for detecting specific keywords or commands in an audio stream.
11. To optimize a speech emotion recognition model for running on edge devices like Raspberry Pi or Arduino.
12. To apply deep learning techniques to enhance the quality of noisy speech signals.

Semester: 7th			
Paper code: OAE415T	**L**	**T/P**	**Credits**
Subject: Cyber Forensics and Cyber Crime Investigation	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	Compare and contrast the differences between digital evidence and traditional evidence
2.	Discuss the ways in which digital evidence is authenticated
3.	Describe and critique digital forensics process models
4.	Critically evaluate standards and good practices for digital evidence and digital forensics
Course Outcomes:	
CO1	Understand the fundamentals of cybercrime and issues.
CO2	Analyze different investigation tools for cybercrime.
CO3	Understand basics of Forensic Technology and Practices.
CO4	Apply different laws, ethics and evidence handling procedures to design AI based modules and Technologies.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	3	2	-	-	1	1	1	1	1	1	2
CO2	2	2	-	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	3	-	1	-	1	-	-	-
CO4	2	2	-	3	3	-	-	-	-	-	1	-

Course Overview:

Cyber Forensics and Cyber Crime Investigation is an essential course for B.Tech AI, ML, IIoT, and Data Science students to understand the principles, techniques, and legal aspects of investigating cybercrimes. The syllabus covers digital evidence acquisition, analysis, and cybercrime investigation methodologies.

UNIT I **[10]**

Cybercrimes and related offences and penalties: Introduction to Cybercrimes, Classification of cybercrimes, Distinction between cyber crime and conventional crimes, Reasons for commission of cyber crime, Kinds of cyber crimes – cyber stalking; cyber pornography; forgery and fraud; crime related to IPRs; Cyber terrorism; Spamming, Phishing, Privacy and National Security in Cyberspace, Cyber Defamation and hate speech, computer vandalism etc.

UNIT II **[10]**

Digital Forensics: Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.

UNIT III **[10]**

Cyber Crime Investigation: Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNIT IV **[10]**

Cyber Laws: Provisions in Indian Laws in dealing with Cyber Crimes and its critical analysis, Information Technology Act, 2000, Penalties under IT Act, Offences under IT Act, Offences and Analysis related with Digital Signature and Electronic Signature under IT Act, Statutory Provisions, Establishment of Authorities under IT Act and their functions, powers. Cyber crimes under IPC.

Text Books:

1. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009.
2. Kevin Mandia, Chris Prosise, Matt Pepe, “Incident Response and Computer Forensics “, Tata McGraw -Hill, New Delhi, 2006.

Reference Books:

1. Robert M Slade,” Software Forensics”, Tata McGraw - Hill, New Delhi, 2005.
2. Bernadette H Schell, Clemens Martin, “Cybercrime”, ABC – CLIO Inc, California, 2004.
3. “Understanding Forensics in IT “, NIIT Ltd, 2005.

Semester: 7th			
Paper code: OAE417T	**L**	**T/P**	**Credits**
Subject: Advanced Java Programming	**3**	**0**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:

1.	To provide students with a strong foundation in advanced Java programming concepts and their practical applications.
2.	To enable students to design and implement multithreaded applications and handle exceptions effectively.
3.	To equip students with networking and database connectivity skills for building networked applications with database interaction.
4.	To introduce students to GUI development using JavaFX and explore web development concepts with Java Servlets, JSP, and Spring.

Course Outcomes:

CO1	Develop expertise in advanced Java concepts, including multithreading, networking, database connectivity, and GUI development.
CO2	Apply advanced Java knowledge to create real-world applications involving networking, database interaction, and graphical user interfaces.
CO3	Utilize design patterns and principles to solve complex programming challenges and optimize application performance.
CO4	Gain an understanding of web development concepts with an introduction to Java Servlets, JSP, and the Spring Framework.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	1	2	3	3	1	1	-	1	1	-	-	2
CO2	2	2	3	3	1	1	-	1	1	-	-	2
CO3	2	2	3	3	1	1	-	1	2	-	-	2
CO4	2	2	3	3	2	1	1	1	2	-	-	2

Course Overview:
Advanced Java Programming is designed for B.Tech AI, ML, IIoT, and Data Science students to enhance their Java skills, focusing on advanced topics like multithreading, networking, database connectivity, and GUI development. The syllabus covers Java's latest features and applications in real-world scenarios.

UNIT I **[8]**

JDBC Architecture: JDBC Architecture, a Relational Database Overview, Processing SQL Statements with JDBC Establishing a Connection, Connecting with DataSource Objects, Handling SQLExceptions, Retrieving and Modifying Values from Result Sets, Using Prepared Statements, Using Transactions, Using RowSet Objects

UNIT II **[8]**

Generics & Collection Framework APIs: Introduction to Design Patterns: the Factory Design Pattern, the Singleton Design Pattern.

UNIT III **[8]**

Why use Servlets & JSPs: an introduction to web servers & clients, HTML, HTTP Protocol, HTTP GET and POST requests, HTTP responses. Web App Architecture: high-level overview. A ModelView-Controller (MVC) overview and example, life cycle of a servlet, request & response objects, Init Parameters and ServletConfig, JSP init parameters, Context init parameters, attributes and listeners, session management.

UNIT IV **[8]**

Scriptless JSP: Create a simple JSP using “out” and a page directive, JSP expressions, variables, and declarations, implicit objects, The Lifecycle and initialization of a JSP, other directives. Standard actions, Expression Language, The EL implicit objects & EL functions, using JSTL.

Text Books:

1. Dietel & Deitel, Java How to Program, Pearson Education, 10th Ed., 2015.
2. Bryan Basham, Kathy Sierra, Bert Bates, Head First Servlets & JSPs , O’REILLY, 2nd Ed., 2008.

Reference Books:

1. Eric Freeman , Elisabeth Freeman, Kathy Sierra and Bert Bates, Head First Design Patterns, O’REILLY, 1st Ed., 2004.

Semester: 7th			
Paper code: OAE417P	**L**	**T/P**	**Credits**
Subject: Advanced Java Programming Lab	**0**	**2**	**1**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End term Examination: As per university examination norms from time to time

INSTRUCTIONS TO EVALUATORS: Maximum Marks: As per university norms

1. This is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under the intimation to the office of the HOD/ Institution in which they appear is being offered from the list of practicals below.
3. Instructors can add any other additional experiments over and above the mentioned in the experiment list which they think is important.
4. At least 8 experiments must be performed by the students.

Course Objectives:

1.	Develop a deep understanding of advanced Java concepts, such as multi-threading, networking, and database connectivity, to build robust and efficient applications
2.	Gain practical experience by working on real-world Java projects, which involve solving complex problems and implementing solutions using advanced Java features.

Course Outcomes:

CO1	Achieve proficiency in utilizing advanced Java features, including multithreading, socket programming, JDBC, and JavaFX, to develop high-performance applications.
CO2	Be capable of designing and building robust, scalable, and secure applications that leverage advanced Java programming techniques for real-world use cases.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping

(Scale 1: Low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	2	3	3	-	1	-	1	-	-	2
CO2	2	2	-	3	3	-	-	-	-	-	1	1

List of Experiments:

1. Write a java program of thread synchronization, inter-thread communication, and thread pooling.
2. Implement a client-server application using Java's networking APIs.
3. Design a calculator, a simple text editor, or a graphical game with user interaction and visual components. Explore event handling, layout managers, and UI design principles.
4. Implement functionalities like data retrieval, insertion, deletion, and updating records. Explore concepts like JDBC, SQL queries, and database transactions.
5. Utilize third-party libraries or frameworks in Java programming. Choose a popular library (e.g., Apache Commons, Gson, Log4j) and develop programs that showcase its features and functionality.
6. Write a java program to writes objects to a file in a serialized format and then reads and reconstructs the objects from the file.

7. Write a java program that uses reflection to inspect and modify the behavior of objects based on user input or external configuration.
8. Implement generic methods to perform operations like sorting, searching, or filtering on generic collections.
9. Design custom annotations and use them in a Java program to provide additional metadata and define behavior.
10. Write a java program to Integrate Java with native code by using the JNI (with native libraries written in C/C++).
11. Implement functional programming concepts and solve problems related to data manipulation, filtering, or mapping.

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Semester: 7th			
Paper code: OAE419T	**L**	**T/P**	**Credits**
Subject: Bioinformatics	**4**	**0**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To provide exposure to the Data Science and Machine Learning within the context of its importance in biology.
2.	To learn various methodologies and techniques in biology using Data Science.
3.	To learn various tools for bioinformatics data analytics.
4.	To learn deep learning approaches for bioinformatics applications.
Course Outcomes:	
CO1	To understand the importance of Data Science and machine learning in biology
CO2	To acquire knowledge of different data science and machine learning techniques in biology.
CO3	Apply various tools for bioinformatics data analytics.
CO4	Learn and applying deep learning approaches for bioinformatics applications.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	-	-	1	1	1	1	1	1	2
CO2	2	2	-	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	3	-	1	-	1	-	-	-
CO4	2	2	-	3	3	-	-	-	-	-	1	-

Course Overview:

Bioinformatics is designed for B.Tech AI, ML, IIoT, and Data Science students to explore the application of computational methods in analyzing biological data. The syllabus covers biological databases, sequence analysis, protein structure prediction, and gene expression analysis using bioinformatics tools and algorithms.

UNIT I **[10]**

Introduction to Bioinformatics: Definition, scope, and applications of bioinformatics, Role of bioinformatics, computational methods and tools used in bioinformatics.

Biological Databases and Data Retrieval: biological databases (e.g., GenBank, UniProt, NCBI), Data types and formats in bioinformatics, Database search and retrieval techniques, Need for Data Science in Biology and Healthcare, Visualization tools for biological and bioinformatics datasets, data handling, transformations of data.

UNIT II **[10]**

AI and Data Science in Sequence Analysis and Genomics: Introduction, Sequence alignment using machine learning algorithms, DNA and protein sequence classification and clustering, Data Science in genomics, from genetics to genomes, Alignment, and phylogenetic trees.

UNIT III **[10]**

Prediction and Design: Structural bioinformatics, Storage in Protein Data Bank, 1D, 2D, 3D Structure Prediction, Secondary Structure Prediction, Proteomics, Protein structure prediction, integrative structural modeling, and structure-based drug design.

UNIT IV **[10]**

Bioinformatics System: AI algorithms, statistical tools, graph algorithms for bioinformatics data analytics. Deep learning algorithms in perspective of bioinformatics applications, contact prediction, GANs for biological applications, Whole-cell modeling approaches.

Text Books:

1. Arthur M. Lesk, “Introduction to Bioinformatics”, Oxford University Press) (Fifth Edition)
2. Jeil Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media Inc. (Second Edition,)

Reference Books:

1. Vince Buffalo, “Bioinformatics Data skills”, O’Reilly Media Inc.
2. Neil C. Jones and Pavel A. Pevzner, “An introduction to Bioinformatics Algorithms”, The MIT Press.

Semester: 7th			
Paper code: OAE421T	**L**	**T/P**	**Credits**
Subject: Digital & Smart Cities	**4**	**0**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: As per university examination norms from time to time
2. End Term Theory Examination: As per university examination norms from time to time

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per university norms

1. There should be 9 questions in the end term examination question paper.
2. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions.
3. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, students may be asked to attempt only 1 question from each unit.
4. The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
5. The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required.

Course Objectives:	
1.	To familiarize students with the fundamental concepts and components of smart cities.
2.	To explore the role of AI, ML, and IoT in building innovative smart city solutions.
3.	To provide insights into the challenges and opportunities in the digital infrastructure of smart cities.
4.	To promote an understanding of the social, ethical, and governance aspects of smart city development.
Course Outcomes:	
CO1	Acquire a comprehensive understanding of the concepts, technologies, and challenges associated with smart cities.
CO2	Develop the ability to apply AI and IoT technologies in designing smart city solutions and addressing urban challenges.
CO3	Gain knowledge of digital infrastructure components necessary for building smart cities, including data management and cybersecurity.
CO4	Appreciate the importance of sustainable and inclusive development principles in smart city planning and implementation.

Course Outcomes (CO) to Programme Outcomes (PO)

Mapping (Scale 1: Low, 2: Medium, 3: High

CO/ PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	3	2	-	-	1	1	1	1	1	1	2
CO2	2	2	-	3	3	-	-	-	-	-	-	2
CO3	2	2	2	3	3	-	1	-	1	-	-	-
CO4	2	2	-	3	3	-	-	-	-	-	1	-

Course Overview:

This course provides students with an in-depth understanding of digital and smart cities. It covers the fundamental concepts of smart cities, the role of AI, ML, and IoT in enabling smart solutions, and the importance of digital infrastructure and governance. Through case studies and real-world examples, students will gain insights into the challenges and opportunities in building sustainable and inclusive smart cities in the context of Indian and global scenarios.

UNIT I **[10]**

Unit 1: Introduction to Smart Cities: Introduction to smart cities: Concepts, components, and characteristics, Role of AI, ML, and IoT in enabling smart city solutions. Case studies of successful smart city implementations in India and worldwide.

UNIT II **[10]**

Digital Infrastructure for Smart Cities: Urban sensing and data collection technologies. Cloud computing, edge computing, and data centers in smart cities. Cybersecurity and privacy challenges in smart city infrastructures.

UNIT III **[10]**

AI and IoT Applications in Smart Cities: Smart transportation systems and traffic management. Energy-efficient buildings and smart grids. Healthcare and public safety solutions. Waste management and environmental monitoring.

UNIT IV **[10]**

Smart Governance and Citizen Engagement: E-governance and digital services for citizens. Open data initiatives and data-driven decision-making. Community engagement and participatory platforms. Social and ethical considerations in smart city development.

Text Books:

1. "Smart Cities: Digital Transformations, Smart Urban Infrastructures and Digital Innovation" by Matteo Zignani, Vincenzo Mighali, and Raffaele Giaffreda.
2. "Smart Cities: Foundations, Principles, and Applications" by Hossam Gabbar.

Reference Books:

1. "Smart Cities: Big Data Prediction Methods and Applications" by Robert J. Howlett and Lakhmi C. Jain.
2. "Internet of Things for Smart Cities: Technologies, Big Data and Security" by Fadi Al-Turjman.
3. "Artificial Intelligence and IoT for Smart Cities: Applications and Security" by Fahim Ahmed Shaikh.