**OPEN ELECTIVE OTHER THAN PARTICULAR PROGRAM (OE)**

# Industry orientated Open Elective:AIDSML

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Second Year (Sem – III) B. Tech. Information Technology | | | | |
| IOE3311:Open Elective I Foundations of AI, Data Science, and Data Engineering | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Lectures | 03 Hrs/week | | ISE | 50 |
| Tutorials | 00 Hrs/week | | ESE | 50 |
| Total Credits | 03 | | Duration of ESE | As applicable |
| | | | | |

**Prerequisite :** Mathematics, Programming for problem solving

**Course Outcomes (CO):** Students will be able to

| | |
|---|---|
| **CO1** | Understand foundational concepts of AI and Data Science. |
| **CO2** | Apply programming skills in Python for data manipulation. |
| **CO3** | Demonstrate proficiency in mathematical foundations for AI and ML applications. |
| **CO4** | Utilize various techniques for data wrangling, cleaning, visualization, inferential statistics, regression analysis, and SQL database management. |

| | Course Contents | CO | Hours |
|---|---|---|---|
| **Unit 1** | **Introduction to AI & Data Science:** Overview of AI and Data Science, The data science workflow, AI applications across various industries,Ethical considerations in AI and data science | **CO1** | **(05)** |
| **Unit 2** | **Programming Fundamentals for AI & Data Science** Python for data manipulation, Libraries: NumPy and Pandas for data science, Data visualization with Matplotlib, Introduction to Scikit-learn for AI,Introduction to TensorFlow and PyTorch | **CO2** | **(08)** |
| **Unit 3** | **Mathematical Foundations for AI & ML:** Linear algebra basics: vectors, matrices, and operations, Calculus essentials: derivatives and integrals, Probability and statistics for data science. | **CO3** | **(08)** |
| **Unit 4** | **Data Wrangling & Cleaning:** Techniques for handling missing values, Addressing outliers and inconsistencies in data Data transformation and normalization. | **CO4** | **(06)** |
| **Unit 5** | **Data Visualization and Inferential Statistics:** Data exploration and visualization techniques, Understanding data distributions, Inferential statistics: hypothesis testing, confidence intervals, and statistical tests for comparisons. | **CO4** | **(08)** |
| **Unit 6** | **Regression Analysis and SQL Database Management:** Linear regression concepts, Time series analysis, Model building, evaluation, and interpretation,SQL for database management, Data analysis with SQL, ETL processes (Extract, Transform, Load). | **CO4** | **(07)** |

**Text Books**


1. **Wes McKinney** - "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" - O'Reilly Media (2017)
2. Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani - "Introduction to Statistical Learning: with Applications in R" - Springer (2017)
3. Sanjeev J. Wagh , Manisha S. Bhende, Anuradha D. Thakare “Fundamentals of Data Science, Tayler &Fransic CRC press 2021
4. **Alan Beaulieu** - "Learning SQL: Generate, Manipulate, and Retrieve Data" - O'Reilly Media (2009)


**Reference Books**


1. Joel Grus - "Data Science from Scratch: First Principles with Python" - O'Reilly Media (2015)
2. **Aurélien Géron** - "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" - O'Reilly Media (2019)


**Useful Links**

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
3. https://nptel.ac.in/courses/106106226/

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 1 | 3 | - | - | - | 2 | 2 | - | 1 |
| **CO 2** | 2 | 2 | 2 | 2 | 3 | - | - | - | 2 | 1 | - | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 1 | 2 | - | 2 | 1 | - | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 1 | 3 |

: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

## Assessment Pattern(with revised Bloom's Taxonomy)

| Knowledge Level | ISE | ESE |
|---|---|---|
| Remember | 5 | 5 |
| Understand | 5 | 5 |
| Apply | 15 | 15 |
| Analyse | 10 | 10 |
| Evaluate | 15 | 15 |
| Create | - | - |
| TOTAL | 50 | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| **Second Year (Sem – III) B. Tech. Information Technology** | | | | |
| **IOE3312: Open Elective -01 Lab- "Foundations of AI, Data Science, and Data EngineeringLab** | | | | |
| **Laboratory Scheme:** | | | **Examination Scheme:** | |
| Practical | 02 Hrs/week | | ISE | 25 |
| Total Credits | 01 | | ESE | 25 |

**Prerequisite :** Mathematics, Programming for problem solving

**Course Outcomes (CO):** Students will be able to

| | |
|---|---|
| **CO1** | Understand the fundamental principles of data science, AI applications, and Python scripting. |
| **CO2** | Apply Python programming skills to perform data manipulation, analysis, and visualization |
| **CO3** | Demonstrate proficiency in linear algebraic computations and implement basic machine learning models. |
| **CO4** | Utilize advanced data handling techniques and SQL database management. |

| **Course Contents** | | **CO** |
|---|---|---|
| **Implementation of following concepts** | | |
| **Experiment 1** | **Data Science Workflow:** Implement a basic data science workflow using a sample dataset. | **CO1** |
| **Experiment 2** | **AI Applications**: Case study analysis of AI applications in healthcare, finance, and retail. | **CO1** |
| **Experiment 3** | **Python Basics**: Write Python scripts for basic data operations (CRUD - Create, Read, Update, Delete). | **CO2** |
| **Experiment 4** | **NumPy:** Perform array operations and linear algebraic computations using NumPy. | **CO2** |
| **Experiment 5** | **Pandas:** Data manipulation and analysis using Pandas (e.g., merging, grouping, and aggregating data). | **CO2** |
| **Experiment 6** | **Matplotlib**: Create various types of plots (line, bar, scatter) using Matplotlib. | **CO2** |
| **Experiment 7** | **Scikit-learn Basics**: Implement simple machine learning models like linear regression and k-means clustering. | **CO3** |
| **Experiment 8** | **Linear Algebra**: Implement matrix operations, eigenvalues, and eigenvectors using Python. | **CO3** |
| **Experiment 9** | **Handling Missing Values**: Techniques to handle missing data (e.g., imputation, deletion). | **CO4** |
| **Experiment 10** | **Exploratory Data Analysis (EDA):** Perform EDA on a dataset to summarize its main characteristics. | **CO4** |
| **Experiment 11** | **Visualization:** Create histograms, box plots, and pair plots to visualize data distributions. | **CO4** |
| **Experiment 12** | **SQL Basics:** Write SQL queries to create, read, update, and delete data in a database. | **CO4** |

**List of Submission:**

Minimum number of Experiments : 10

**Mapping of COs and POs**

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | 2 |
| CO 2 | 2 | 2 | 2 | 2 | 3 | 2 | - | - | 2 | 2 | 2 | 2 |
| CO 3 | 3 | 3 | 3 | 3 | 3 | - | 1 | 2 | 1 | 2 | 3 | 2 |
| CO 4 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 |

1: Slight(Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern:**

| Skill Level (as per CAS Sheet) | Exp 1 | Exp 2 | Exp 3 | Exp 4 | Exp 5 | Exp 6 | Exp 7 | Exp 8 | Exp 9 | Exp 10 | Avg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Task I | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Task II | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Task III | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| ISE | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

| Government College of Engineering, Karad | | |
|---|---|---|
| **Second Year (Sem – IV) B. Tech. Information Technology** | | |
| **IOE3413:Open Elective II Advanced AI Integration** | | |
| **Teaching Scheme** | | **Examination Scheme** |

| | | | | |
|---|---|---|---|---|
| Lectures | 02 Hrs/week | | ISE | 50 |
| Tutorials | 00 Hrs/week | | ESE | 50 |
| Total Credits | 02 | | Duration of ESE | As applicable |
| | | | | |

**Prerequisite :** Foundations of AI, Data Science, and Data Engineering

**Course Outcomes (CO):** Students will be able to

| | |
|---|---|
| **CO1** | Implement supervised and unsupervised algorithms using Scikit-learn. |
| **CO2** | Enhance model performance through feature engineering and model selection. |
| **CO3** | Develop and apply CNNs and RNNs for deep learning and NLP tasks. |
| **CO4** | Utilize advanced data mining techniques and big data platforms for analytics. |

| | Course Contents | CO | Hours |
|---|---|---|---|
| **Unit 1** | **Introduction to Machine Learning:** **Supervised Learning**: Definition, examples, and common algorithms (e.g., linear regression, decision trees, SVM).. **Unsupervised Learning**: Definition, examples, and common algorithms (e.g., k-means clustering, hierarchical clustering, PCA)., **Common Algorithms**: Overview and implementation basics of various machine learning algorithms. | **CO1** | **(05)** |
| **Unit 2** | **Machine Learning with Python:** Introduction to Scikit-learn library., **Implementing Supervised Learning Algorithms**: Implementation of algorithms like linear regression, logistic regression, decision trees, and SVM using Scikit-learn.,**Implementing Unsupervised Learning Algorithms**: Implementation of algorithms like k-means clustering, hierarchical clustering using Scikit-learn. | **CO1** | **(05)** |
| **Unit 3** | **Feature Engineering & Model Selection:** **Feature Extraction**: Techniques for extracting features from raw data., **Feature Transformation**: Techniques for transforming features to improve model performance., **Model Selection**: Strategies for selecting the best model, cross-validation, and hyperparameter tuning. | **CO2** | **(05)** |
| **Unit 4** | **Deep Learning Fundamentals:** Basics of neural networks, activation functions, and architectures., **Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs)**: Structure, applications, and implementation basics | **CO3** | **(04)** |
| **Unit 5** | **Natural Language Processing (NLP) and Computer Vision:** Text processing, sentiment analysis, and building chatbots., **Computer Vision Fundamentals**: Image processing techniques, object detection, and recognition. | **CO3** | **(05)** |
| **Unit 6** | **Big Data Fundamentals and Advanced Data Mining Techniques:** Introduction to big data, its importance, and challenges., Overview of frameworks like Hadoop., Introduction to platforms like AWS, Azure for big data analytics., **Advanced Data Mining Techniques**: Association rule learning, clustering, time series analysis, and forecasting. | **CO4** | **(06)** |

**Text Books**


| | |
|---|---|
| **1.** | ***Ethem Alpaydin*** *- "Introduction to Machine Learning" - MIT Press (2020)* |
| **2.** | **Aurélien Géron** - "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" - O'Reilly Media (2019) |
| **3.** | **Richard Szeliski** - "Computer Vision: Algorithms and Applications" - Springer (2010) |
| **4** | ***Nathan Marz and James Warren*** *- "Big Data: Principles and Best Practices of Scalable Realtime Data Systems" - Manning Publications (2015)* |


**Reference Books**


| | |
|---|---|
| **1.** | **Jiawei Han, Micheline Kamber, and Jian Pei** - "Data Mining: Concepts and Techniques" - Morgan Kaufmann (2011) |
| **2.** | **Alice Zheng and Amanda Casari** - "Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists" - O'Reilly Media (2018) |
| **3.** | S. J. Wagh , Manisha S. Bhende, Anuradha D. Thakare “Fundamentals of Data Science, Tayler &Fransic CRC press 2021 |


**Useful Links**

| | |
|---|---|
| **1.** | https://nptel.ac.in/courses/106102220/ |
| **2.** | https://nptel.ac.in/courses/106106145/ |
| **3.** | https://nptel.ac.in/courses/106106212/ |
| **4.** | https://nptel.ac.in/courses/106105152/ |

## Mapping of COs and POs

**Mapping Table:**

| PO→ CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | 3 | 3 | 2 | - | - | - | 1 | - | 3 |
| **CO 2** | 2 | 3 | 2 | 3 | 3 | 1 | - | - | - | 2 | - | 2 |
| **CO 3** | 2 | 2 | 3 | 2 | 3 | 2 | 1 | - | 2 | - | 1 | 3 |
| **CO 4** | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 3 | 1 | 3 |

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

## Assessment Pattern

| Knowledge Level | ISE | ESE |
|---|---|---|
| Remember | 5 | 5 |
| Understand | 5 | 5 |
| Apply | 15 | 15 |
| Analyse | 15 | 15 |
| Evaluate | 10 | 10 |
| Create | - | - |
| TOTAL | 50 | 50 |

| Government College of Engineering, Karad | | | | |
|---|---|---|---|---|
| Third Year (Sem – V) B. Tech. Information Technology | | | | |
| IOE3514:Open Elective III AI Applications and Emerging Technologies | | | | |
| **Teaching Scheme** | | | **Examination Scheme** | |
| Lectures | 02 Hrs/week | | ISE | 50 |
| Tutorials | 00 Hrs/week | | ESE | 50 |

| Total Credits | 02 | | Duration of ESE | As applicable |
|---|---|---|---|---|
| | | | | |

**Prerequisite :** Advanced AI Integration

**Course Outcomes (CO):** Students will be able to

| | |
|---|---|
| **CO1** | Implement reinforcement learning algorithms and apply them in autonomous systems. |
| **CO2** | Utilize GANs for generating creative content and explore advanced techniques like conditional GANs. |
| **CO3** | Ensure AI models are interpretable and address ethical issues, including bias and fairness. |
| **CO4** | Deploy AI on edge devices and integrate with IoT for applications in smart cities, industry, and healthcare. |

| | Course Contents | CO | Hours |
|---|---|---|---|
| **Unit 1** | **Reinforcement Learning and Autonomous Systems:** Introduction to reinforcement learning principles, Applications of reinforcement learning in autonomous systems, Deep dive into algorithms such as Q-learning and deep Q-networks, Case studies on robotics, gaming, and control systems. | **CO1** | **(04)** |
| **Unit 2** | **Generative Adversarial Networks (GANs) and Creative AI:** Understanding the concept of GANs and their architecture, Applications of GANs in generating realistic images, videos, and creative content, Exploring conditional GANs and style transfer techniques, Case studies in art, design, and content creation. | **CO2** | **(05)** |
| **Unit 3** | **Explainable AI (XAI) and Ethical AI:** Techniques for making AI models interpretable and transparent, Addressing bias, fairness, and accountability in AI systems, Ethical considerations in AI development and deployment, Responsible AI practices and guidelines. | **CO3** | **(05)** |
| **Unit 4** | **Edge AI and Internet of Things (IoT) Integration:** Deploying AI algorithms on edge devices for real-time processing, Integration of AI with IoT ecosystems for smart applications, Use cases in smart cities, industrial IoT, and healthcare monitoring, Challenges and opportunities in edge AI and IoT convergence. | **CO4** | **(05)** |
| **Unit 5** | **Quantum Machine Learning and Quantum Computing:** Fundamentals of quantum computing and quantum machine learning, Quantum algorithms for optimization and pattern recognition tasks, Potential applications of quantum computing in AI and data science, Implications of quantum computing for future AI advancements. | **CO1** | **(05)** |
| **Unit 6** | **AI for Healthcare and Biomedical Applications:** Role of AI in medical imaging analysis and diagnosis, AI-driven drug discovery and personalized medicine, Patient care management using AI-based solutions, Ethical considerations and regulatory challenges in AI-driven healthcare. | **CO4** | **(05)** |

**Text Books**


| | |
|---|---|
| **1.** | **Maxim Lapan** - "Deep Reinforcement Learning Hands-On" - Packt Publishing (2018) |
| **2.** | **David Foster** - "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" - O'Reilly Media (2019) |
| **3.** | Perry Lea ¸IoT and Edge Computing for Architects - Second Edition Paperback – Import, 6 March 2020 |


**Reference Books**


| | |
|---|---|
| **1.** | **Peter Wittek** - "Quantum Machine Learning: What Quantum Computing Means to Data Mining" - Academic Press (2016) |
| **2.** | S. Kevin Zhou, Hayit Greenspan, Dinggang Shen - "Deep Learning for Medical Image Analysis" - Academic Press (2017) |
| **3.** | Pete Warden and Daniel Situnayake - "TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers" - O'Reilly Media (2020) |


**Useful Links**

| | |
|---|---|
| **1.** | https://nptel.ac.in/courses/106106139/ |
| **2.** | https://nptel.ac.in/courses/106105215/ |
| **2.** | https://nptel.ac.in/courses/106106143/ |
| **3.** | https://nptel.ac.in/courses/106105158/ |
| **4.** | https://nptel.ac.in/courses/106106213/ |

## Mapping of COs and POs

| PO → CO ↓ | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 3 | 3 | 3 | 3 | - | - | 2 | 2 | 1 | 3 |
| **CO 2** | 2 | 3 | 1 | 2 | 3 | - | - | - | 3 | - | 3 | 2 |
| **CO 3** | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 2 | 3 | 3 | 3 | - | - | 1 | 2 | 3 | 3 | 3 |

1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)

**Assessment Pattern(with revised Bloom's Taxonomy)**

| Knowledge Level | ISE | ESE |
|---|---|---|
| Remember | | |
| Understand | 5 | 5 |
| Apply | 15 | 15 |
| Analyse | 15 | 15 |
| Evaluate | 15 | 15 |
| Create | - | - |
| TOTAL | 50 | 50 |