Artificial Intelligence & Machine Learning Course Curriculum

Module 1: Introduction to AI & Machine Learning

- What is Artificial Intelligence?
- Real-world applications of AI
- History and evolution of Machine Learning
- AI vs ML vs Deep Learning
- Overview of supervised, unsupervised & reinforcement learning

Module 2: Python for AI/ML

- Introduction to Python programming
- Data types, variables, and loops
- Functions, modules, and libraries
- Working with **NumPy**, **Pandas**, and **Matplotlib**
- Data visualization and basic analytics

Module 3: Mathematics for Machine Learning

- Linear Algebra essentials (vectors, matrices, operations)
- Probability & Statistics (mean, variance, distributions)
- Calculus for optimization (gradients, derivatives)
- Basic concepts of optimization (cost function, gradient descent)

Module 4: Data Pre-processing & Feature Engineering

- Data collection and cleaning
- Handling missing data and outliers
- Feature scaling, encoding, and transformation
- Feature selection and dimensionality reduction (PCA)
- Splitting datasets and model validation

Module 5: Supervised Learning

- Linear & Logistic Regression
- Decision Trees & Random Forests
- K-Nearest Neighbors (KNN)
- Support Vector Machines (SVM)
- Model evaluation metrics (accuracy, precision, recall, F1-score)

Module 6: Unsupervised Learning

- Clustering algorithms (K-Means, Hierarchical, DBSCAN)
- Dimensionality reduction (PCA, t-SNE)
- Association rule learning (Apriori, Eclat)
- Anomaly detection

Module 7: Deep Learning

- Introduction to Neural Networks
- Activation functions, loss functions, and backpropagation
- Building models using **TensorFlow** or **PyTorch**
- Convolutional Neural Networks (CNNs) – for image data
- Recurrent Neural Networks (RNNs), LSTM, GRU – for sequence data

Module 8: Natural Language Processing (NLP)

- Text preprocessing (tokenization, stemming, lemmatization)
- Bag of Words, TF-IDF, and Word Embeddings
- Sentiment Analysis and Text Classification
- Language models and Transformers (BERT, GPT overview)

Module 9: Model Deployment & MLOps

- Model saving and versioning
- REST API deployment using Flask or FastAPI
- Introduction to MLOps pipelines (CI/CD for ML)
- Model monitoring and retraining

Module 10: Capstone Projects & Case Studies

- Predictive Analytics (sales, demand, or churn prediction)
- Image Classification using CNNs
- Sentiment Analysis on social media data
- Chatbot using NLP
- Recommendation System (movies, products, or courses)