AI and Application of AI Syllabus

Week 1: Python Basics to Intermediate + Numpy, Pandas, Matplotlib

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| **Day** | **Topic** | **Theory / Concepts** | **Hands-On / Implementation** | **Outcome** |
| 1 | Python Basics | Variables, Data Types, Conditionals, Loops, Functions | Exercises on Python basics, small quizzes | Comfort with syntax, logic building |
| 2 | Data Structures | Lists, Tuples, Sets, Dictionaries, String manipulation | Implement data structure operations | Solid understanding of built-in structures |
| 3 | Functions & Modules | Custom functions,  \*args, \*\*kwargs, importing modules | Write custom functions and modularize code | Code reusability and modularization basics |
| 4 | File Handling & Exception | File I/O, Error handling | Read/write .txt/.csv files, try-except blocks | Handle external data and errors gracefully |
| 5 | Numpy Basics | Arrays, broadcasting, reshaping, indexing | Basic operations and problems with np arrays | Numerical computing foundations |
| 6 | Pandas & Matplotlib | Series, DataFrames, filtering, plotting | Data analysis + visualizations with Matplotlib | Able to read CSV, process and visualize data |

Week 2: Python OOP + EDA + Statistics + Math for ML

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| **Day** | **Topic** | **Theory / Concepts** | **Hands-On / Implementation** | **Outcome** |
| 7 | OOP in Python | Classes, objects, inheritance, polymorphism | Build a simple class-based system like Bank or Student Management | Apply OOP principles |
| 8 | Python Libraries | os, random, math, itertools, collections | Code examples with each library | Tools for scripting and utility building |
| 9 | EDA Basics | Distributions, outliers, skewness, correlations | Use Pandas, Seaborn, Matplotlib on real datasets | Understand the dataset deeply |
| 10 | Descriptive Stats | Mean, median, mode, std, IQR, Z-score | Statistical analysis on numeric features | Understand feature behavior numerically |
| 11 | Probability | Events, Bayes Theorem, Conditional Probability, Distributions | Simulate events and apply probability laws | Basics of uncertainty in data |
| 12 | Linear Algebra | Vectors, matrices, dot products, eigenvectors | Solve with numpy, geometric visualization | Math backbone for ML |

Week 3: Machine Learning Theory & Practice

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| **Day** | **Topic** | **Theory / Concepts** | **Hands-On / Implementation** | **Outcome** |
| 13 | ML Pipeline + Train/Test | ML steps, train-test split, supervised vs unsupervised | Scikit-learn pipeline walkthrough | Understanding end-to-end ML process |
| 14 | Regression (Linear, Lasso) | Cost function, overfitting, regularization (L1/L2) | Build and evaluate regression models on real dataset | Predicting numerical values |
| 15 | Classification Basics | Logistic regression, decision boundaries, metrics | Train classifier on binary and multiclass datasets | Distinguish classes using classifiers |
| 16 | KNN, Naive Bayes | Lazy learning, Euclidean dist, Bayes assumptions | sklearn-based hands-on | Use distance and probabilities in ML |
| 17 | Decision Trees, Random Forest | Entropy, Gini, Bagging, Ensemble theory | sklearn DecisionTree and RandomForest | Tree-based model building |
| 18 | Model Tuning + Evaluation | GridSearchCV, cross-validation,  metrics: accuracy, F1, confusion matrix | Evaluation on validation data | Improving model performance systematically |

Week 4: Deep Learning and Neural Networks

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| **Day** | **Topic** | **Theory / Concepts** | **Hands-On / Implementation** | **Outcome** |
| 19 | Intro to Neural Networks | Neurons, activation functions, loss functions | Basic perceptron using numpy | Neural network intuition |
| 20 | Backpropagation + Gradient | Chain rule, gradients, weight updates | Manual gradient calculations, numpy implementation | Understand how networks learn |
| 21 | PyTorch/TensorFlow Intro | Tensors, computation graph, optimizers | Hello world NN in PyTorch or TensorFlow | Comfort with DL frameworks |
| 22 | MLP with PyTorch/TensorFlow | Build multi-layer NN for classification | Digit classification with MNIST | Multi-class classification |
| 23 | CNN Basics | Filters, convolution, padding, pooling, stride | Implement CNN on CIFAR-10 or  fashion-MNIST | CNN working for image tasks |
| 24 | Transfer Learning | Pretrained models, feature extraction, fine-tuning | Use ResNet/VGG from torchvision or TF Hub | Use SOTA  models for better results |