**Chapter 1: SUBJECT OVERVIEW**

**Topic – 1: Data Preprocessing**

**Raw Data Preparation**

* Cleaning
* Normalization
* Transformation

**Topic – 2: Supervised Learning**

**Regression**

* Linear regression
* Decision trees

**Classification**

* Logistic regression
* Decision trees (**again**)
* Classification

**Topic – 3: Unsupervised Learning**

**Clustering**

* K-means
* Hierarchical clustering

**Dimensionality Reduction**

* PCA
* t-SNE

**Topic – 4: Reinforcement Learning**

**Reward Based Learning**

* Agents
* States
* Actions
* Rewards
* Policies

**Topic – 5: Model Evaluation & Validation**

**Assessment Techniques**

* Cross-validation
* Confusion matrix
* Precision
* Recall
* F1-score
* ROC-AUC

**Topic – 6: Feature Engineering**

**Definition**

* Process of **creating new features** from existing data.
* Improving model’s performance.

**Topic – 7: Overfitting & Underfitting**

**Definition**

* Solving problems like model being **too complex** or **too simple**.

**Techniques**

* Regularization (L1, L2)
* Dropout
* Pruning

**Topic – 8: Optimization Algorithms**

**Model Training Methods**

* Gradient descent
* Stochastic gradient descent (SGD)
* Adam
* RMSprop

**Topic – 9: Bias-Variance Tradeoff**

**Definition**

* Balancing **model’s complexity** and **errors**
* Caused due to **bias** & **variance**.

**Topic – 10: Neural Networks & Deep Learning**

**Neural Networks**

* Forward propagation
* Backward propagation
* Activation functions
* CNNs
* RNNs
* Transformers

**Topic – 11: Hyperparameter Tuning**

**Optimizing Model Performance**

* Adjusting parameters
* Grid search
* Random search

**Topic – 12: Deployment & Production**

**Objectives**

* Deploying models into production
* Monitoring performance
* Managing lifecycles
* CI/CD pipeling

**Topic – 13: Feature Selection & Extraction**

**Definition**

* **Identifying** most relevant features.
* **Reducing dimensionality** to improve model performance.

**Techniques**

* Lasso regression
* Recursive feature elimination (RFE)

**Topic – 14: Advanced Algorithms & Techniques**

**Ensemble Methods**

* Random forest
* Gradient boosting
* XGBoost

**Deep Learning Architectures**

* LSTM
* GARNs
* BERT

**Topic – 15: Model Interpretability & Explainability**

**Definition**

* Techniques to understand and explain model.

**Techniques**

* SHAP values
* LIME
* Model-agnostic methods

**Topic – 16: Advanced Hyperparameter Optimization**

**Techniques**

* Bayesian optimization
* Hyperband
* Genetic algorithms