National Forensic Sciences University

End-Semester Examination (100 Marks)

Course: Artificial Intelligence and Machine Learning

Time Allowed: 3 Hours

SET 1: Question Paper

Section A (Short Questions, 5 × 5 = 25 Marks)

1. Define AI and explain its real-world applications. (5)
2. Differentiate between supervised and unsupervised learning techniques. Provide examples. (5)
3. What are the steps involved in preprocessing data in machine learning? (5)
4. Explain the difference between overfitting and underfitting with suitable examples. (5)
5. Define confusion matrix and describe how it is used to calculate precision, recall, and F1-score. (5)

Section B (Medium-Length Questions, 5 × 10 = 50 Marks)

6. Explain linear regression and logistic regression. Provide their use cases. (10)
7. Implement k-NN classification for the following data, and predict the class for the query point $[40, 50]$ when $k = 3$:

Brightness	Saturation	Class
50	50	Red
60	90	Blue
25	80	Red
40	20	Blue
70	70	Red

(10)

8. What are the challenges in machine learning? How can regularization solve these challenges? (10)

9. Describe the role of dimensionality reduction techniques like PCA and SVD in machine learning. (10)

10. Build a decision tree for hiking habits using the given dataset. Use information gain as the splitting criterion:

Weekend?	Company	Weather	Go Hiking?
No	Friends	Sunny	Yes
Yes	Alone	Rainy	No
Yes	Family	Sunny	Yes
No	Friends	Rainy	No
Yes	Friends	Sunny	Yes

(10)

Section C (Long Questions, $2 \times 12.5 = 25$ Marks)

11. Discuss the biological inspiration and structure of artificial neural networks (ANNs). Explain how backpropagation works. (12.5)

12. Discuss the real-world applications of machine learning in cybersecurity, healthcare, and anomaly detection. Provide examples for each. (12.5)

SET 2: Question Paper

Section A (Short Questions, 5 × 5 = 25 Marks)

1. What is machine learning? Discuss its history and evolution briefly. (5)
2. Explain clustering and differentiate between k-means clustering and hierarchical clustering. (5)
3. Define the terms "activation function" and "hyperparameter tuning" in neural networks. (5)
4. Describe the role of fairness, transparency, and accountability in AI/ML systems. (5)
5. Perform min-max normalization for the dataset: [10, 20, 30, 40, 50]. Normalize between 0 and 1. (5)

Section B (Medium-Length Questions, 5 × 10 = 50 Marks)

6. Use the least squares method to predict the final grade of a student who scores 86 in internal exams, given the following data:

Internal Grade	Final Grade
72	84
50	63
81	77
78	90
90	75

   (10)
7. Explain logistic regression in detail, including its mathematical formulation. How is it used for binary classification? (10)
8. Compare Euclidean, Manhattan, and Minkowski distances. Provide examples for their use in k-NN. (10)
9. Explain the importance of evaluation metrics like accuracy, precision, recall, and F1-score with examples. (10)

10. Solve the following: Given a confusion matrix, find precision, recall, F1-score, and accuracy:

	Predicted No	Predicted Yes
Actual No	50	10
Actual Yes	5	100

(10)

Section C (Long Questions, 2 × 12.5 = 25 Marks)

11. Discuss in detail the applications of AI in anomaly detection and Deepfake technology. Explain the role of ML in solving such challenges. (12.5)

12. What is backpropagation? Explain how loss functions are minimized during training in an ANN. Use relevant equations and diagrams. (12.5)