QUESTION 2

Problem 2 :

Choose any time-series dataset (e.g., Airline Passengers or Stock Prices) and:

● Implement an LSTM model to predict future values of the series like number of passengers for future months or closing price of a stock in future days based on historical data.

● Evaluate the model using Mean Absolute Error (MAE) and Mean Squared Error (MSE).

● Plot the predicted vs actual values and analyze the model's performance.

Short Explanation of the Approach

1. **Load and Preprocess Data**
    - The Airline Passengers dataset (monthly passenger totals) is normalized using MinMaxScaler to scale the values between 0 and 1, ensuring faster convergence during training.
    - A **sliding window approach** is used to create sequences: for each 12-month sequence (input), the model predicts the next month's value (output).

2. **Model Architecture**
    - An **LSTM model** is implemented with two LSTM layers (to capture temporal dependencies) followed by a Dense layer for predicting a single output value.
    - ReLU activation is used in LSTM layers, and the model is trained with the **Adam optimizer** and **MSE loss**.
3. **Training and Testing**
    - The dataset is split into **training (80%)** and **testing (20%)** subsets.
    - The model is trained for 50 epochs, with validation on the test set to monitor overfitting.
4. **Evaluation**
    - Predictions are compared with the actual test values using **Mean Absolute Error (MAE)** and **Mean Squared Error (MSE)**.
    - The predictions are inverse-transformed to their original scale for meaningful interpretation.
5. **Visualization**
    - **Predicted vs Actual Values**: A time-series plot shows how well the model captures the trend in test data.
    - **Loss Curves**: Training and validation loss plots highlight the model's convergence behavior.

This pipeline ensures an end-to-end implementation for time-series forecasting while emphasizing both model performance and interpretability.