JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2024

B.Tech-VII Semester (ECE)

COURSE CODE (CREDITS): 19B1WEC732 (3) MAX. MARKS: 15

COURSE NAME: Pattern Analysis in Machine Intelligence

COURSE INSTRUCTORS: Dr. Vikas Baghel MAX. TIME: 1 Hour

Note: *(a) All questions are compulsory.*

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems.

Q1. **a)** Explain what pattern recognition is and describe its importance in the field of machine learning and artificial intelligence. **[2]** **[CO1]**

b) List and briefly describe the typical stages of a pattern recognition process. **[1]**

c) What are the key differences between statistical and structural pattern recognition? **[1]**

d) Describe the key steps involved in feature engineering for a pattern recognition task. Explain how each step contributes to improving the performance of a machine learning model. **[2]**

Q2. **a)** Discuss the concept of dimensionality reduction' in pattern recognition. Describe the mathematical foundation of PCA. How are the principal components derived? **[3]** **[CO2]**

b) Assume you have the following dataset: **[3]**

$$x = \begin{pmatrix} 4 & 6 \\ 2 & 8 \\ 3 & 7 \end{pmatrix}$$

Determine whether ICA can potentially be used to separate the sources or not.

c) Given two classes, C_1 and C_2, with the following means and covariance matrices: **[3]**

$$\mu_1 = \begin{pmatrix} 2 \\ 3 \end{pmatrix}, \quad \mu_2 = \begin{pmatrix} 4 \\ 6 \end{pmatrix}$$

$$\Sigma_1 = \begin{pmatrix} 1 & 0.5 \\ 0.5 & 2 \end{pmatrix}, \quad \Sigma_2 = \begin{pmatrix} 1.5 & 0.4 \\ 0.4 & 1.8 \end{pmatrix}$$

Assuming equal priors for both classes and the within-class scatter matrices are the same, compute the optimal weight (projection) vector $\boldsymbol{w}$.