JADAVPUR UNIVERSITY
B. E. (C.S.E.) 4TH YEAR 2ND SEMESTER EXAMINATION 2024
BIOMETRIC SYSTEMS

Time: 3 Hours Full Marks: 100

[Answer all parts of a question together]

Answer Q1: [25 marks][CO1]

1. Give five examples of biometric traits. What are the characteristics that a biometric trait should have? With a schematic diagram discuss the various steps of a generic biometric system. What does it mean by recognition and verification in biometric systems? 5+5+10+5

Answer Q2: [15 marks][CO3]

2. (a) Define (i) recognition rate, (ii) false non-match rate, (iii) false match rate, (iv) specificity and (v) equal error rate (EER). (5×2)

   (b) How do you compare two biometric systems using their ROC curves? 5

Answer any one from the following Q3-Q4: [20 marks] [CO2]

3. (a) Let there are N number of face images in the training set and each image is of size $H \times W$. There are C classes and each class has $R_c | \sum_{c=1}^{C} R_c = N$, number of images. Now, describe the 2DFLDA method to derive the features: 10

   (b) By showing detailed calculations, generate the LBP feature map from the following image. 10

5	2	10
6	12	15
8	24	20

4. (a) Describe the features extraction process using the Fisher's linear discriminant analysis (FLDA) w.r.t. face recognition. 10

   (b) Describe feature extraction process using G-2DFLD method. 10

Answer any two from Q5 – Q7: [20 marks each] [CO4]

5. (a) Describe the error correcting learning rule with a schematic diagram and then compute the weight vector after 1 epoch for the labeled training set $\boldsymbol{X} = \{\boldsymbol{x_1} = ([5, 2.5, 3, 3.5]^T, 0)$ and $\boldsymbol{x_2} = ([2.5, 3, 3.5, 4]^T, 1\}$. Use Heaviside or threshold activation function. 10+5

   (b) Describe the k-nearest neighbour classifier. 5

6. (a) Let the training set contains T labeled patterns, each one has p features. Design a multilayer perceptron (MLP) with N hidden layer neurons and K output layer neurons using sigmoid function. Write the back-propagation algorithm to train the MLP. 10

   (b) For the XOR problem, you need to design an RBF neural network with the centers $\boldsymbol{c}_1 = [1, 1]^T$ and $\boldsymbol{c}_2 = [0, 0]^T$. Assume the initial weight vector $\boldsymbol{w} = [2.5, 0.5, 3.0]^T$. Use $\sigma^2 = 10$. Compute the weight vector $\boldsymbol{w}$ after 1 epoch. 10

7. (a) Find the margin of separation between the positive and negative samples in a linear SVM. 10

   (b) Describe a computationally efficient method for finding the optimal separating hyperplane (OSH) for a linear SVM. 10