

B. E. (C.S.E.) 4TH YEAR 2ND SEMESTER EXAMINATION 2025
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 positive identification rate, (iii) false negative identification 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

15	12	10
6	12	15
5	20	10

4. (a) Describe the features extraction process using the Fisher's linear discriminant analysis (FLDA) w.r.t. face recognition. 10
- (b) Describe the different levels of feature extraction process for fingerprint trait. 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 $\mathbf{X} = \{\mathbf{x}_1 = ([5, 2.5, 3, 3.5]^T, 0)$ and $\mathbf{x}_2 = ([2.5, 3, 3.5, 4]^T, 1)\}$. Use Heaviside or threshold activation function. 10+5
- (b) Describe the k -nearest neighbour classifier. 5

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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. 5+ 10
 (b) Describe the competitive learning. 5

7. (a) State the functions of an RBF neural network. Write a training procedure of an RBF neural network with K hidden layer neurons and C output layer neurons using N training samples of p dimension. 5+10
 (b) For the XOR problem, you need to design an RBF neural network with the centers $\mathbf{c}_1 = [1, 0]^T$ and $\mathbf{c}_2 = [0, 1]^T$. Assume the initial weight vector $\mathbf{w} = [2.5, 0.5, 3.0]^T$. Use $\sigma^2 = 10$. Compute the weight vector $\mathbf{w}$ after 1 epoch. 5