MANIPAL INSTITUTE OF TECHNOLOGY
(A constituent unit of MAHE, Manipal 576104)

VII SEM B.Tech (BME) DEGREE END SEMESTER EXAMINATIONS NOVEMBER 2019

SUBJECT: PATTERN RECOGNITION (BME 4008)

(REVISED CREDIT SYSTEM)

Thursday 28th November 2019: 2 to 5 PM, 2019

TIME: 3 HOURS   **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer FIVE full questions.**
2. **Draw labeled diagram wherever necessary**

1A. State the Bayesian Theorem for a three class problem, with nine discrete features. Explain significance of the theorem. (4)

1B. The values of feature x for the class-P samples are: 68, 70, 70, 73, 73, 74, 75, 76, 77, 77, 78, 80, 82, 84. The samples from class-Q had x values of 78, 84, 93, 90,100, 103, 104, 108, 110, 111, 118. Draw histogram with a step size of four. Find a decision boundary between classes and test the following samples: 85 and 89. (3)

1C. A feature "x" is normally distributed for class-A and class-B. Their prior probabilities are P (A) and P (B) respectively. If the classes are described as:

$class\text{-}A : \mu_A = 112$ and $\sigma_A = 3$, with P(A) = 0.65

$class\text{-}B: \mu_B = 62$ and $\sigma_B = 4$, with P(B)=0.35

Find the equation of the optimal decision boundary between the two classes. (3)

2A. The feature is normally distributed for class A, with a mean of 10 and a standard deviation of 3. The class-2 is also seen uniformly distributed between15 to 20. Assume P(A)=0.6 and P(B)=0.4. Plot the probability density function of each class. Find the decision boundary between the classes and represent class regions in the plot. Calculate the value of likelihood ratio for x=14 and interpret the value. (5)

2B. Divide the following samples into 3 clusters. The samples represented with three features are: (2,4,5), (3,4,6), (5,7,8), (8,9,8), (10,10,11). (5)

3A. Explain the general algorithm for bottom up clustering considering the average cluster distance. (4)

3B. What is confusion matrix? Describe its significance. (3)

3C. What is importance of estimation of True positive rate. Draw the ROC and explain the curve in association with a classifier. (3)

4A. How supervised learning is different than reinforcement learning? Explain artificial neuron as a binary classifier with a McCulloch-Pitts neuron model. (5)

4B. How biometric recognition system is different from a verification system. Describe elements of a biometric verification system considering anatomical pattern as the input. (5)

5A. Identify four features for classifying breast cancer using a multilayered neural network deigned to classify images into two classes. Draw the diagram of the neural network for the given inputs with 7 hidden nodes in the hidden layer. (4)

5B. Describe the training algorithm of Back Propagation Neural Network (BPNN) to minimize the error in response. (3)

5C. A series of nine samples and their feature values are given in table1. Find the prior probabilities associated with *class-A*, *class-B,* and *class*-C. Estimate the probability that the test sample $X = [1 \quad 0]^T$ came from class C. (3)

Table1

Samples	CLASS Name	Feature x	Feature y
1	A	0	1
2	A	1	0
3	A	0	1
4	B	0	1
5	B	1	0
6	A	0	1
7	B	1	1
8	C	1	0
9	C	0	1