Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (BME) DEGREE END SEMESTER EXAMINATIONS NOV/DEC 2016

SUBJECT: PATTERN RECOGNITION (BME 421)

(REVISED CREDIT SYSTEM)

Monday 28th November, 2016, 2 to 5 PM

TIME: 3 HOURS **MAX. MARKS: 100**

Instructions to Candidates:

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

1. (a) Write an expression for the Bayesian Theorem when the given "*d*" features are of discrete type. Describe how this theorem helps in the classification of a multi-class problem. **06**

(b) The normal heart rate values of people having age between 35-45 years are noted as 68,69,70,70,72,72,73,73,74,74,75,76,78,79,85,90,98. The other group of people had the heart rate values of 100,106,110,118,119,120,122,123,124,126,128,129,130, 132, 142. Design the classifier based on the histogram, plotted with an interval width of 5. Find the decision boundary and specify the rule for classification. Test the classifier with the inputs given in table 1(b). **08**

Table (1b)

Inputs	HR
H1	95
H2	120

(c) A certain study, on a population suffering from Alzheimer (*Az*) has shown that 7/10 were Aged above 55years and 4/7 are males (let *age=a*, *male=m*). However these fractions are 3/10 and 3/7 respectively, for those without any problems. If the probability of Alzheimer is 0.02 in the overall population, find the posterior probability $P(Az \mid a, m)$, when the age and gender are assumed to be independent. **06**

2. (a) The feature "x" is normally distributed for class-A, with a mean of 8 and a standard deviation of 2. The class-B is uniformly distributed over the interval $2.5 \leq x \leq 4.8$. The prior probabilities are same for both the classes. Draw the nature of classes and find **08**

the decision regions.

(b) What is intra-cluster distance? Find the inter-cluster distance between the following clusters: *Cluster* C_1= {(3, 4), (5, 5)} and *Cluster* C_2= {(1, 2), (2, 2)} **06**

(c) Describe the training of an autoassociative network (with no self-connection) for an input vector $[1 \quad 1 \quad -1]$. Test the network with one missing entry: $[1 \quad 0 \quad -1]$. **06**

3. (a) Describe, "*Complete Linkage"* clustering algorithm for finding three clusters from the "n" samples given. Use "complete linkage rule" and check the most similar two clusters from the following: C1={(1,1),(2,2)}; C2={(5,5),(7,5)}; C3{(15,15)(16,18)} and C4{(25,28),(26,27)}. **10**

(b) Class "A" is normally distributed with the class prior probability P(A) = 0.6. Another class *B* also normally distributed with P(B)=0.4. The parameters of the classes are:

$$classA: \mu_1 = 28, \mu_2 = 87, \sigma_1 = 2, \sigma_2 = 5, \rho_{12} = 0.6$$
$$classB: \mu_1 = 15, \mu_2 = 61, \sigma_1 = 3, \sigma_2 = 8, \rho_{12} = 0.5$$

10

Given test input vector $X = [30 \quad 70]^T$, find $P(A|X)$ using matrix method.

4. (a) The feature vector details for seven patterns are given in the Table-4(a). Use K-Means algorithm to discover the clusters with an initially selected seed points: (2.2, 3.0), (5.5, 6.0) and (9.0, 9.2) (). Finally find the distance between the resulted clusters.

Table-4(a)

Patterns	*x*	*y*
1	2.0	2.1
2	2.2	3.0
3	4.5	4.8
4	5.5	6.0
5	8.0	8.0
6	9.0	9.2
7	9.8	10.0

08

(b) With a neat flow chart, explain the training algorithm of a perceptron network. **06**

(c) Train a perceptron neuron with an initial weight as zero. Update the weights using perceptron rule, for the following training inputs: **06**

- $(1 \quad -1 \quad 1)$ & $(1 \quad 1 \quad 1)$ are members of class having target value 1
- $(-1 \quad -1 \quad 1)$ & $(-1 \quad -1 \quad -1)$ are not members of class has target value -1

5. **(a)** The data provided in Table-5(a) are the results obtained from a screening test for HIV, that was performed on a group of 2,00,000 people. From the given actual and test results find the following: a) True positive rate, b) True negative rate, and c) False positive rate. **06**

Table-5(a)

		Test results	
		+ve	**-ve**
Actual status	**+ve**	750 TP	150 FN
	-ve	9950FP	1,89,150 TN

(b) What is anatomical biometric? Draw a neat block diagram of a biometric verification system, and explain. **08**

(c) Realize the NAND function using Mc-Culloch Pitts neuron model for testing the data [1 0]. Draw a neat labelled diagram of the neuron. **06**

6 **(a)** Why do we consider the "classifier design & development" is a cyclic process? Apply this principle to the design of an ***ECG-classifier***. **10**

(b) Draw the architecture of a multilayered network. Explain the training of a back propagation network until convergence of output response and target happens, along with the rules for updating the weights. **10**