Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

VII SEMESTER B.TECH. (BME) DEGREE END SEMESTER EXAMINATIONS NOV-DEC 2018

SUBJECT: PATTERN RECOGNITION (BME 4008)

(REVISED CREDIT SYSTEM)

Saturday, 1st December: 2 PM to 5 PM

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

Instructions to Candidates:

1. **Answer ALL questions.**
2. **Draw labeled diagram wherever necessary**

1A. Write expressions for the Bayesian Theorem for a "K" class problem in the following cases:

i) "d" features of continuous type

ii) "d" features of continuous, independent within each class. (4)

Describe the likelihood method based classification.

1B. The feature - *x* is normally distributed for ***class-1***, with a mean of 3 and a standard deviation of 2. The ***class-2*** is also seen normally distributed with mean of 7 and standard deviation of 1. Plot the probability density function of each class. Find the decision boundary between the classes and represent class regions in the plot. (3)

1C. In a hospital during the blood test it is observed that about 50 B+ve groups of blood samples are arriving to the blood bank on average per day. Find the probability that exactly 10 people with B+ve group come for the day. (3)

2A. Given the series of 5 samples and their feature values as described in Table1. Find *P(A|x=1, y=1)* and $P(B|\, x=1, y=1)$ using Bayesian theorem. (3)

Table1

CLASS Name	***Feature*** *x*	***Feature*** *y*
A	1	1
A	1	0
A	1	1
B	1	1
B	0	1

2B. Derive the discriminating boundary equation between two classes when classes are normally distributed with their prior probabilities are equal. (3)

2C. During the screening of 100 subjects for cardiac disorder, identified 80% of subjects as the normal (N) class and is also seen as a bivariate normal. Remaining 20% subjects are noticed with higher heart rate and represented by *class-P*. The *class-P* is also normally distributed. The extracted class features are x_1 and x_2, the other details of the classes are:

$$class-N: \mu_1 = 72, \mu_2 = 35, \sigma_1 = 2, \sigma_2 = 3, \rho_{12} = 0.6$$

$$class-P: \mu_1 = 120, \mu_2 = 55, \sigma_1 = 3, \sigma_2 = 2, \rho_{12} = 0.3$$

(4)

Given test input vector $X = [70 \quad 45]^T$, find $P(N|X)$.

3A. Find the complete linkage cluster distance between following clusters:
C1= {(30,35), (32, 38), (41, 45)}
C2= {(20,25), (27,29)}
C3= {(10,11), (12,15)}
Note: For the estimation of the sample distance use city clock distance (3)

3B. How top-down approach for clustering is advantageous compared to bottom-up approach? Describe Forgy's method for portioning cluster C1 in Q3A into two. (4)

3C. Given the sample space consists of 4 samples (7,8), (9,9) (11,15) and (12,17). Write the rule for determining *single linkage cluster* distance and find the three clusters. (3)

4A. Design the architecture of McCulloch Pitts neuro for realizing a 3 input AND function, and suggest a decision rule for classification. (3)

4B. For a perceptron net initially set all the weights to zero, and then train the network using following training patterns:
$(1 \quad 1 \quad -1), (1 \quad 1 \quad 1)$ 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".
Test the network with an input vector, $X = (1 \quad -1 \quad 1)$ (3)

4C. Describe the following stages of training algorithm of a multilayered Back Propagation Neural Network (BPNN): (4)
i. Feedforward ii. Error estimation

5A. What are dynamic signature patterns? Explain the elements of a dynamic signature identification system. Identify the four features that helps in the classification of a dynamic signature. (4)

5B. Describe the major challenges in the design of a statistical classifier that categories a random ECG sample as class "Normal" and "Tachycardia". (3)

5C. Explain the analysis of a classifier performance with the following:
a. Sensitivity b. ROC (3)