Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

II SEMESTER M.Tech. (BME) DEGREE MAKE UP EXAMINATIONS, 2017
SUBJECT: PATTERN RECOGNITION (BME 5237)
(REVISED CREDIT SYSTEM)
Tuesday, 13th June 2017, 9 AM to 12 NOON

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

Instructions to Candidates:

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

1.	(a)	Consider the set of feature vectors for two classes $C_1 = \begin{bmatrix} 1 & 1 & 2 & 1 & 3 \\ 0 & 1 & 2 & 2 & 2 \end{bmatrix}$ and $C_2 = \begin{bmatrix} 2 & 2 & 3 & 4 & 4 \\ 0 & 1 & 1 & 1 & 2 \end{bmatrix}$. The density function defined on these samples is given by $$p(x\|\theta) = \theta x^{(\theta-1)}$$ Estimate the parameter θ associated with each class using the Maximum Likelihood method. Plot the posterior densities pertaining to $C_1$and C_2, and the decision surface when $P(C_1) = P(C_2) = 0.5$. List the number of misclassification.	**(10)**
	(b)	Explain the Pattern Recognition System with a neat block diagram.	**(10)**
2.	(a)	Consider the set of feature vectors for two classes $C_1 = \begin{bmatrix} 1 & 2 & 1 & 3 \\ 0 & 2 & 2 & 2 \end{bmatrix}$ and $C_2 = \begin{bmatrix} 2 & 2 & 3 & 4 \\ 0 & 1 & 1 & 1 \end{bmatrix}$. Calculate the optimum direction $\boldsymbol{v}$ to project classes using Fisher Linear Discriminant Analysis. Illustrate this procedure on a scatter plot. Are these projected classes well separated? Explain.	**(10)**
	(b)	Consider a two class problem having three independent binary features with known feature probabilities: $p_1 = p_2 = 0.7$, $p_3 = q_1 = q_2 = q_3 = 0.7$. Find the Bayesian decision rule and find the classes if $P(C_1) = P(C_2)$. Justify this decision (explain how each feature contributes towards right decision). Provide a graphical representation of these classes along with the decision surface.	**(10)**
3.	(a)	Design the decision surface between the three classes ω_1, ω_2 and ω_3 having the corresponding linear discriminant functions as: $g_1(X) = -2x_1 - 0.75x_2 + 10.25$,	**(10)**

		$g_1(X) = 2x_1 - 0.75x_2 + 10.25$ *and* $g_1(X) = 0.75x_2 + 2.25$. Plot and identify the regions pertaining to these classes. Classify the unknown sample $x' = \begin{bmatrix} 5 \\ 4.5 \end{bmatrix}$.	
	(b)	Construct a single output perceptron with updated weights for the given inputs $[x_1\ x_2]$ and the desired outputs y as shown in Table 1. Use $\eta = 0.2$, $W(0) = \begin{bmatrix} -1.2 \\ -0.3 \\ 0.7 \end{bmatrix}$. Draw the scatter plot along with the decision surface. Table 1 x_1: 1 2 2 3 x_2: 2 1 3 2 y: 1 0 1 0	**(10)**
4.	(a)	Consider two classes with set of feature vectors as: $C_1 = \begin{bmatrix} 1 & 6 & 8 & 11 \\ 8 & 7 & 5 & 4 \end{bmatrix}$ *and* $C_2 = \begin{bmatrix} 2 & 3 & 6 & 11 \\ 4 & 3 & 2 & 1 \end{bmatrix}$. Design the decision surface using Perceptron criteria, with $\eta = 0.2$, and $W(0) = \begin{bmatrix} -9.98 \\ 0.52 \\ 1.15 \end{bmatrix}$. Draw the scatter plot with decision surface classifying these classes.	**(10)**
	(b)	Consider two classes C_1 *and* C_2, if class conditional densities are normally distributed with covariance matrices $\sum_i = \sum$ (Arbitrary but same covariance), for $i = 1,2$. Derive and explain the discriminant function for minimum error rate classification.	**(10)**
5.	(a)	Consider the set of feature samples A B C D E F G H 0 0.5 2 3 4 5 7 9 0 0.5 2 2 3 -1 1 1 Explain the Batchelor and Wilkin's clustering Algorithm. Identify three clusters for given set of feature samples by taking vector A as one of the cluster center.	**(10)**
	(b)	Explain Graph based clustering using the Minimal Spanning Tree algorithm for the feature samples from question 5(a) and extract three clusters by taking 'A' t be the root node.	**(10)**