

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

SUMMER SEMESTER, 2017-2018

DURATION: 1 Hour 30 Minutes

FULL MARKS: 75

CSE 4835: Pattern Recognition

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

1. a) Define Pattern Recognition. Briefly describe the design cycle of a pattern recognition system with appropriate figures. 1+13
 b) Compare between the different types of learning methods with examples. 6
 c) What is a class model? How is the class model related to the class decision? 1+4

2. a) Devise the decision rule for the Bayes classifier with minimum risk for a two-class problem. When can this classifier ensure minimum error? Prove it. 4+4
 b) Consider the following decision rule for a two-class one dimensional problem: 7
 Decide ω_1 if $x > \theta$; otherwise decide ω_2 .
 Show that the probability of error for this rule is given by:

$$P(\text{error}) = P(\omega_1) \int_{-\infty}^{\theta} p(x | \omega_1) dx + P(\omega_2) \int_{\theta}^{\infty} p(x | \omega_2) dx$$

 c) Find the weight vector w and bias w_0 for the discriminant function $g(x)$ of Bayes classifier with minimum error rate. Assume that the likelihood probability follows a multivariate normal density function. What conditions are required for this classifier to behave same as a distance classifier? 8+2

3. a) Why is Whitening Transform essential? How do you perform it? 2+3
 b) When is the Mahalanobis distance measure better than the Euclidean distance? Explain with an example scenario. 5
 c) What is a phi-function? How does this function map a non-linear discriminant function into a linear discriminant function? Design a phi function of your own when the original feature space is three dimensional. 2+4
 d) There are generally three ways to devise multicategory classifiers employing linear discriminant functions. Describe each of such designs along with their pros and cons. Use necessary illustrations. 9

4. a) You are given the following sample points in a 2-class problem: 5
 $S_1: (1,1), (1,-1), (2,3)$
 $S_2: (2,1), (0,1), (2,1)$
 Plot these samples (use graph paper) and determine by inspection whether they are separable with a linear decision boundary.
 b) Find the equation of a decision boundary which can correctly classify all the samples in Question 4.(a). Show all calculations required with the Gradient-Descent technique. Choose any criterion function. Assume any values for necessary variables. 20