

**Second Semester M. Tech Degree Examination**

**Stream: Signal Processing (2013 Scheme)**

**TSE 2006 : PATTERN RECOGNITION AND MACHINE LEARNING**

Time: 3 hours

Max. Marks: 60

Instructions: *Answer any 2 questions from each module (Each Carries 10 Marks)*

**Module I**

1. (a) Suppose that we have three colored boxes r (red), b (blue), and g (green). Box r contains 3 apples, 4 oranges and 3 limes, Box b contains 1 apple, 1 orange and 0 limes and Box g contains 3 apples, 3 oranges and 4 limes. If a box is chosen at random with probability  $p(r) = 0.2$ ,  $p(b) = 0.2$  and  $p(g) = 0.6$  and piece of fruit is removed from the box (with equal probability of selecting any of the items in the box), then what is the probability of selecting an apple? If we observe that the selected fruit is in fact an orange, what is the probability that it came from the green box?  
(6 marks)
- (b) Explain how the misclassification rate be minimized in Decision theory. (4 marks)
2. Explain Curse of dimensionality. Why is it important when designing a classifier?
3. Consider a  $D$ -dimensional Gaussian random variable  $\mathbf{x}$  with distribution  $N(\mathbf{x}|\boldsymbol{\mu}, \boldsymbol{\sigma})$  in which the variance  $\boldsymbol{\sigma}^2$  is known and for which we wish to infer the mean  $\boldsymbol{\mu}$  from a set of observations  $\mathbf{X} = \{\mathbf{x}_1, \dots, \mathbf{x}_N\}$ . Given a prior distribution  $p(\boldsymbol{\mu}) = N(\boldsymbol{\mu}|\boldsymbol{\mu}_0, \boldsymbol{\sigma}_0)$ , find the corresponding posterior distribution  $p(\boldsymbol{\mu}|\mathbf{X})$ .

**Module II**

4. What are the three basic problems of HMM? Explain forward and backward algorithms.
5. (a) Explain k –nearest neighbor method for density estimation. (5 marks)
- (b) Consider six points namely (1,1,1), (2,1,2) and (2,1,3) of Class 1 and (2,5,6), (1,6,5) and (2,7,5) of Class 2. Find the direction of projection vector  $\mathbf{V}$  and within class structure  $\mathbf{W}$ . Assumed the mapping is from a 3-dimension to one dimension. (5 marks)

6. Explain how decision tree is constructed using the following data.

Cook	Mood	Cuisine	Tasty
Sita	bad	Indian	Yes
Sita	good	Continental	Yes
Asha	bad	Indian	No
Asha	good	Indian	Yes
Usha	bad	Indian	Yes
Usha	bad	Continental	No
Asha	bad	Continental	No
Asha	good	Continental	Yes
Sita	good	Indian	Yes
Sita	good	Continental	No
Usha	good	Indian	Yes
Usha	bad	Continental	Yes

### **Module III**

7. Explain (a) Support Vector Machine classifier and its properties  
(b) Perceptron convergence theorem.

8. Explain Criterion function for clustering

9. Use the k means algorithms and Euclidian distance to cluster the following 8 examples into 3 clusters ;(2,10),(2,5),(8,4),(5,8),(7,5),(6,4),(1,2),(4,9).