NATIONAL INSTITUTE OF TECHNOLOGY
ROURKELA – 769 008

Department: Electronics and Communication Engineering (ECE Dept.)
Name of the Examination: M. Tech, 2nd Semester End-Sem Examination, 2021
Subject ID: EC 6604 Subject: Machine Intelligence
Full Marks: 50 Time: 2 hours

This question paper contains two pages

Instructions:

1. This question paper contains 5 questions (Q1 to Q5). Figures in right hand side indicate the marks. Each question carries **ten** marks.
2. Answer **ALL** questions. All parts of a question should be answered in single continuous space.
3. Scan the answers of all the questions as one .pdf file and upload as assignment.
4. Due credit will be awarded for neatness in drawing and labeling of figures.

Q. No.		Questions	Marks
1.	(a)	How do you classify two different patterns using Bayes Decision theory? From Bayes decision theory, derive the condition for minimum risk classifier for two- category classification.	2+3
	(b)	Consider following two dimensional data for two-class (class ω_1 and class ω_2) classification problem. $\{[2, 6]^T, [3, 4]^T, [3, 8]^T, [4, 6]^T\} \in$ class ω_1 ; $\{[3, 0]^T, [1, -2]^T, [3, -4]^T, [5, -2]^T\} \in$ class ω_2 A prior probability is given as follows: $P(\omega_1) = P(\omega_2) = 0.5$. Determine and draw the decision boundary that can separate the two classes i.e. class ω_1 and class ω_2.	5
2.	(a)	Derive the expressions of the discriminant function and decision surface for this normal density function when covariance matrix is fixed and same for all the classes.	5
	(b)	Let $\boldsymbol{X}$ be the *d*-dimensional binary vector with a multi-variate Bernoulli distribution $p(\mathrm{X}\vert\theta) = \prod_{i=1}^{d} \theta_i^{x_i} (1-\theta_i)^{(1-x_i)}$ where $\theta = (\theta_1, \theta_2, ..., \theta_d)^t$ is an unknown parameter vector, θ_i being the probability that $x_i = 1$. Calculate maximum-likely estimate for θ.	5
3.	(a)	Assume the features are independent and binary, write the expression for (i) likelihood ratio (ii) discriminant function. With the help of this discriminant function, how do you classify the patterns for binary features? Write in detail.	5
	(b)	Derive and determine the *maximum-likelihood* (ML) estimated parameters for mixture of two one-dimensional *Gaussian* density functions. Write also the ML estimated parameters in the form of an iterative optimization procedure.	5

4.	(a)	What is non-parametric estimation? How do you estimate density using Parzen window technique?	2+3
	(b)	Describe in detail about Fisher discriminator. How will use Fisher discriminator as classifier?	3+2
5.	(a)	How do you use Kernel function in SVM classifier? With the help of expressions, write the different inner-product Kernels that generally used in SVM classifier.	5
	(b)	What is the relation between input size, output size and filter size of a convolution layer in CNN? Assume, a 3-dimensional data of size for width, Height and Depth as 227, 227 and 3 respectively is applied at input of convolution layer in CNN, we have decided to apply filters of width size=11, Height size=11 and Depth size=3, also assume that 96 such filters with stride = 4 but NO padding will be applied. What is output size in terms of width, height and depth?	2+3