Q. Code:944763

Reg. No. | | | | | | | | | | | | | |

M.E./M.TECH DEGREE EXAMINATIONS, MAY 2024

Second Semester

CU22202 – STATISTICAL SIGNAL PROCESSING AND MACHINE LEARNING

(Communication System)

(Regulation 2022)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Interpret and communicate the outcomes of estimation and hypothesis tests in the context of a problem	**3**
CO 2	Learn the various approaches to identify the patterns	**2**
CO 3	Applying the appropriate techniques to real-time application development	**3**
CO 4	Understand the linear model techniques	**2**
CO 5	Perform the optimization techniques for various Machine Learning models	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	How do you interpret the accuracy of a forecast?	**1**	**2**
2.	Differentiate between moving average and exponential smoothing.	**1**	**2**
3.	List the benefits and drawbacks of quantitative forecasting.	**1**	**2**
4.	Obtain a formula to illustrate a model of exponential growth.	**1**	**3**
5.	Compare the K-Nearest Neighbours and K-Means algorithms.	**2**	**2**
6.	Compare statistical and structural approaches to pattern recognition.	**2**	**2**
7.	Define joint and conditional probability. Relate them suitably.	**2**	**2**
8.	Differentiate parametric and non-parametric estimation	**2**	**2**
9.	Summarise the pros and cons of using Naive Bayes.	**3**	**2**
10.	Summarise the challenges of unsupervised learning.	**3**	**3**
11.	Explain some common association rules for learning.	**3**	**2**
12.	Explain the curse of dimensionality in machine learning.	**3**	**2**
13.	Explain the factors that contribute to the popularity of logistic regression.	**4**	**2**
14.	Can we solve the multiclass classification problems using logistic regression? If yes, then how?	**4**	**3**
15.	Outline the problems that are best suited for logistic regression.	**4**	**2**
16.	Explain the kernel in SVM. Why do we use kernels in SVM?	**4**	**2**
17.	Explain the significance of convex optimisation.	**5**	**2**
18.	List out the limitations of gradient descent.	**5**	**2**

19.	Give one example of the constrained optimisation problem.	**5**	**2**	
20.	Explain the elements of bio-inspired design.	**5**	**2**	

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21.(a)	Examine the various growth models and provide appropriate examples.	**(10)**	**1**	**3**
	(OR)			
(b)	Compute the forecasting errors MAE, MSE, RMSE, and MAPE as well as the three-year single exponential smoothing forecast.	**(10)**	**1**	**3**

year	1	2	3	4	5	6	7	8	9	10
Sales	30	25	35	25	20	30	35	40	30	45

22.(a)	**(i)**	Analyse on the Parzen Windows non parametric density estimation technique.	**(6)**	**2**	**3**
	(ii)	Three persons A, B and C have applied for a job in a private company. The chance of their selections is in the ratio 1 : 2 : 4. The probabilities that A, B and C can introduce changes to improve the profits of the company are 0.8, 0.5 and 0.3, respectively. If the change does not take place, find the probability that it is due to the appointment of C and give your inference.	**(4)**	**2**	**3**
		(OR)			
(b)		Apply K nearest neighbor classifier to predict the diabetic patient with the given features BMI, Age. If the training examples are,	**(10)**	**2**	**3**

BMI	Age	Sugar
33.6	50	1
26.6	30	0
23.4	40	0
43.1	67	0
35.3	23	1

35.9	67	1
36.7	45	1
25.7	46	0
23.3	29	0
31	56	1

assume K=3,

test example BMI=43.6, Age=40, Sugar=?

23. (a) Apply the Bayes decision theory for a fish-packing plant that needs to be automated the process of sorting incoming fish according to species with suitable example. **(10) 4 3**

(OR)

(b) Cluster the following eight points (with (x, y) representing locations) into three clusters: **(10) 4 3**

A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2),
A8(4, 9)

Initial cluster centres are: A1(2, 10), A4(5, 8) and A7(1, 2).

The distance function between two points a = (x1, y1) and b = (x2, y2) is defined as-P(a, b) = |x2 – x1| + |y2 – y1|

Use K-Means algorithm to find the three cluster centres after the second iteration.

24. (a) Using the SVM algorithm, find the SVM classifier for the following data. **(10) 4 3**

Example number	X1	X2	class
1	2	1	+1
2	4	3	-1

(OR)

(b) Compute the principal component of following data using PCA algorithm. **(10) 4 3**

CLASS 1

X = 2, 3, 4

Y = 1, 5, 3

CLASS 2

X = 5, 6, 7

Y = 6 , 7 , 8

		Marks	CO	RBT LEVEL
25. (a)	Analyze the gradients of scalar functions with multi-variate inputs. Also, discuss the gradient properties.	**(10)**	**5**	**3**
	(OR)			
(b)	Analyze the lagrange multiplier method for solving constrained optimization problems.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	Write a short note on the steepest ascent method. For the function $f(x)=x\,y^2$ use the gradient to evaluate the path of the steepest ascent at (2, 2).	**(10)**	**5**	**3**