JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Sc. (Hons.)-IV Semester (Mathematics and Computing)

COURSE CODE (CREDITS): **24BS1MA411 (3)** MAX. MARKS: 35

COURSE NAME: **OPTIMIZATION FOR DATA SCIENCE**

COURSE INSTRUCTOR: **SST** MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems

(c) Use of scientific calculator is allowed.

Q. No.	Question	CO	Marks
Q1	The following data show the advertising expenses (expressed as a percentage of total expenses) and the net operating profits (expressed as a percentage of total sales) in a random sample of six drugstores: **Advertising Expenses** 1.5 1.0 2.8 0.4 1.3 2.0 **Net Operating Profits** 3.6 2.8 5.4 1.9 2.9 4.3 Fit a least-squares line to predict net operating profits in terms of advertising expenses.	1	5
Q2	Obtain the dual of the linear programming problem: $Min\ Z = 8x_1 + 4x_2,$ $s.t.$ $2x_1 + x_2 \geq 3$ $3x_1 + x_2 \geq 5$ $x_1, x_2 \geq 0$ Solve the dual using the simplex method and hence obtain the optimal solution for the primal.	2	5
Q3	a) State the update rule in the Levenberg-Marquardt Algorithm. b) How does its convergence rate and stability performance differ from the Gradient Descent algorithm and the Gauss-Newton method? c) What is the role of the damping parameter?	3	3+1+1
Q4	Calculate the weight and bias for epoch 1, using the Adagrad parameter update for the following inputs: ***Initial parameters:*** $w = 0.0, b = 0.0, \eta = 0.1, \epsilon = 10^{-8}, g_w = -30, g_b = -10.$	4	5

Q5	Write update rules for the RMSProp and ADAM optimizers by explaining the meaning and role of key terms involved.	4	2+3
Q6	The dual using Lagrange's multipliers for solving the linear support vector machine is as follows: $$Max_{\alpha} \sum_{i=1}^{N} \alpha_i - \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} \alpha_i\alpha_j y_i y_j \langle x_i, x_j\rangle$$ $s.t.$ $$\alpha_i \geq 0 \text{ for all } i$$ $$\sum_{i=1}^{N} \alpha_i y_i = 0$$ For the data set, x_1 x_2 Class 3 2 -1 4 5 +1 6 4 +1 Determine the equation of the maximal margin hyperplane.	5	5
Q7	a) Explain how kernels help support vector machines perform classification in non-linearly separable data. b) Show how the Gaussian Radial Basis Function (RBF) and polynomial kernels compute similarity between two points.	5	1+2+2