

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2025

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

COURSE CODE (CREDITS): 24BS1MA411(3)

MAX. MARKS: 25

COURSE NAME: OPTIMIZATION FOR DATA SCIENCE

COURSE INSTRUCTORS: Saurabh Srivastava

MAX. TIME: 1 Hour 30 Min

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	Compute the Hessian matrix for the function $f(x, y) = 3x^2y + 4x^3y^4 - 7x^9y^4$ at the point $(1, 1)$. Find its discriminant.	1	5
Q2	Solve graphically the LPP: $\text{Max } Z = 3x_1 - 2x_2 \text{ s.t. } x_1 + x_2 \leq 1, 2x_1 + 2x_2 \geq 4, x_1 \geq 0, x_2 \geq 0$ Comment on your result. Plot the graph in your answer script.	2	3
Q3	Show that, $C = \{(x_1, x_2): 3x_1 + 5x_2 = 9\} \subset \mathbb{R}^2$, is a convex set.	2	3
Q4	Solve the following LPP using simplex method: $\text{Max } Z = 3x_1 + 2x_2 + 5x_3$ s.t. $\begin{aligned} x_1 + 2x_2 + x_3 &\leq 430, \\ 3x_1 + 2x_3 &\leq 460, \\ x_1 + 4x_2 &\leq 420, \\ x_1 \geq 0, x_2 \geq 0, x_3 &\geq 0 \end{aligned}$	2	5
Q5	Verify the necessary KKT conditions at the point $(1, 1)$, for the following non-linear programming problem: $\text{Min } Z = (x_1 - 2)^2 + (x_2 - 1)^2$ s.t. $\begin{aligned} -x_1^2 + x_2 &\geq 0, \\ -x_1 - x_2 + 2 &\geq 0, \\ x_1 \geq 0, x_2 &\geq 0 \end{aligned}$	2	4

Q6	To minimize $f(x) = \frac{1}{2}x^T Hx + c^T x + 13$, where $H = \begin{pmatrix} 10 & -9 \\ -9 & 10 \end{pmatrix}$ and $c = \begin{pmatrix} 4 \\ -15 \end{pmatrix}$. Implement the steepest descent algorithm on this problem for only two iterations, using the starting point $x_0 = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ and learning rate 0.2.	3	5
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JUNE TEST 2 EXAMINATION - April 2023