JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2025

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

COURSE CODE (CREDITS): 24BS1MA411 MAX. MARKS: 15

COURSE NAME: OPTIMIZATION FOR DATA SCIENCE

COURSE INSTRUCTORS: Saurabh Srivastava MAX. TIME: 1 Hour

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	Find the directional derivative of the function $\sqrt{x_1^2 + 2x_2^2 - 4x_3^2}$ at the point $(-1,2,1)$ in the direction of $(-1,3,2)^T$.	1	2
Q2	Find the Jacobian of the following transformation $x = r\cos\theta\sin\varphi, y = r\sin\theta\sin\varphi, z = r\cos\varphi$ at the point $\left(1, \frac{\pi}{4}, \frac{\pi}{2}\right)$. How Jacobian is useful in data science?	1	3
Q3	Write the Hessian matrix for the function $-9x^2 + 6xy - 2y^2 - 2xz - 2z^2$. Find its discriminant at the origin and comment on your result.	1	3
Q4	Write the Taylor's series expansion in vector form up to second degree terms. Also, find the second order Taylor's approximation of the function $e^x log(1+x)$.	1	4
Q5	Estimate the value of y at $x = 5$ by fitting a quadratic curve to the following data: x: 2, 4, 6, 8 y: 1.1, 1.4, 1.5, 1.8 Also, construct the scatter plot for the given data.	1	3