JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATIONS-2022

M. Tech. -I Semester (CSE: Data Science)

COURSE CODE (CREDITS): 22M11MA111 (3) MAX. MARKS: 15

COURSE NAME: MATHEMATICAL FOUNDATION FOR DATA SCIENCE

COURSE INSTRUCTORS: SST MAX. TIME: 1 Hour

Note: *All questions are compulsory. Marks are indicated against each question in square brackets. Use of scientific calculator is allowed.*

Q1. Consider the function defined by $g(x,y,z) = 3e^x \cos(yz)$.

a) Find the directional derivative of $g(x,y,z)$ at the point (1,1,1) along the direction $2i + j - 2k$.

b) Find the direction in which the function $g(x,y,z)$ increase and decrease most rapidly at the point (1,1,1).

c) Find the maximum value of the directional derivative. **(CO1)[1+1+1]**

Q2. Find the maximum value of the function $f(x,y) = 49 - x^2 - y^2$ on the line $x + 3y = 10$ using the method of Lagrange's multipliers. **(CO1)[3]**

Q3. Obtain the singular value decomposition of the 2 × 2 matrix with the elements:

$a_{11} = 4, a_{12} = 0, a_{21} = 3, a_{22} = -5.$ **(CO2)[4]**

Q4. Which of the following sets is a vector space?

a) $(\mathbb{R}, \mathbb{R}, \oplus, \otimes)$, where $x \oplus y = x + y + 1$, $\alpha \otimes x = \alpha x + \alpha$.

b) $(\mathcal{M}_{2\times2}, \mathbb{R}, +, .)$, where $\mathcal{M}_{2\times2} = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$, $+$ is the standard matrix addition and . is the standard scalar multiplication. **(CO2)[1.5+1.5]**

Q5. Find the projection of the vector (1,-1, 2, 3, 2, 1) onto the vector (1, 1, 1, 0, 0, 1) in $\mathbb{R}^6$. **(CO2)[2]**
