Jaypee University of Information Technology, Waknaghat

TEST-1 Examination - February 2025

B.Sc. IV Semester (Mathematics and Computing)

Course Code/Credits: 24BS1MA412/3 Max. Marks: 15
Course Title: Multivariable Calculus in Machine Learning
Course Instructors: RAD Max. Time: 1 Hour

Note: (a) ALL questions are compulsory.

(b) The candidate is allowed to make suitable numeric assumptions wherever required.

Q.No	Question	CO	Marks
Q1	Consider $f(x,y) = x\ln(y^2-x)$. (a) Descrbe the set of all level curves. (b) Find the domain and sketch its graph.	CO-1	3
Q2	Evaluate $\lim_{(x,y)\to(0,0)} \frac{x^3}{x^2+y^2}$ to analyse risk behaviour near origin, where x is interest rate fluctuation and y is the market volatility.	CO-1	3
Q3	Answer the following questions: (a) Consider $y^5+3x^2y^2+5x^4=12$. Find slope $\frac{dy}{dx}$ of the curve. (b) For $xyz=\cos(x+y+z)$, determine the partial derivative $\frac{\partial z}{\partial x}$.	CO-1	3
Q4	A *mechanical system* is modeled by the function: $\mathtt{f}(x,y) = y^2-4x^2$ where x and y represent design parameters in the system. However, these parameters must satisfy the constraint $\mathrm{g}(x,y)=x^2+2y^2=4$. (a) Solve $\nabla\mathtt{f} = \lambda\nabla\mathrm{g}$, where λ is the Lagrange Multiplier. (b) Determine the extreme values of $\mathtt{f}(x,y)$ under $\mathrm{g}(x,y)=4$.	CO-1	3
Q5	For the terrain mapping and robotics path planning, a UG student considers an hypothetical hilly terrain whose *elevation* is given by $h(x,y) = 500-2x^2-3y^2$ where $h(x,y)$, represents the height, and x and y are in meters. (a) Find the *gradient* $\nabla h(x,y)$ and interpret its meaning. (b) A *hiker* is at the point $(3,2)$. In which direction should he walk to climb the hill most *steeply*?	CO-1	3