

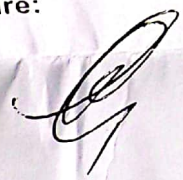


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Student ID: _____

Air University
Mid Semester Examinations: Spring 2025

Subject: Multivariable Calculus
Class: BSCYS-IV
Section(s): A,B
Course Code: MA-105

Time Allowed: 120 Minutes
Max Marks: 50
FM's Name: Dr. Tanzeela Shaheen
FM's Signature: 

INSTRUCTIONS

- Attempt responses on the answer book only.
- Nothing is to be written on the question paper.
- Rough work or writing on question paper will be considered as use of unfair means.
- Calculators are allowed.

CLO-1

Q1. (a) Describe the graph of the equation

(7)

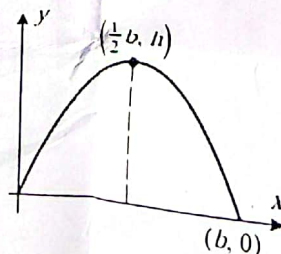
$$x^2 - y^2 - 4x + 8y - 21 = 0$$

(b) Find equation of the sphere that has $(1, -2, 4)$ and $(3, 4, -12)$ as endpoints of a diameter. (3)

CLO-2

Q2. (a) A firewall monitoring system detects a surge in cyber threats over a period of time. The number of detected threats follows a parabolic pattern, where the maximum number of threats h occurs at the midpoint of the observation period $\frac{1}{2}b$, and the number of threats drops to zero at the beginning ($x = 0$) and end ($x = b$) of the period. (7)

1. Derive an equation modeling the number of threats as a function of time, assuming a parabolic distribution.
2. Compute the total number of threats detected over the entire observation period by finding the area under the curve.



(b) Find two-unit vectors in 3-space that are perpendicular to the line $y = -5x + 1$. (3)

CLO-5

- Q3. (a) Show that the lines L_1 and L_2 intersect and find their point of intersection. (7)

$$L_1: x + 1 = 4t, \quad y - 3 = t, \quad z - 1 = 0$$

$$L_2: x + 13 = 12t, \quad y - 1 = 6t, \quad z - 2 = 3t$$

- (b) Find the work done by a force $F = -3j$ pounds applied to a point that moves on a line from $(1,3)$ to $(4,7)$. Assume that distance is measured in feet. (3)

CLO-1

- Q4. (a) Find an equation of the plane through the points $P_1(1,2,-1)$, $P_2(2,3,1)$, and $P_3(3,-1,2)$. (7)

- (b) Convert $(2, \frac{3\pi}{2}, \frac{\pi}{2})$ from spherical to rectangular coordinates. (3)

CLO-1

- Q5. Identify and sketch the quadric surface with proper labelling. (10)

$$9z^2 - 4y^2 - 9x^2 = 36$$

(GOOD LUCK)