King Fahd University of Petroleum and Minerals  
Department of Mathematics and Statistics  

Exam-I  Math 201, Calculus III  Summer 103  

Time allowed  120 Minutes  

Name: ------------------------------------ ID: ---------------  

Section:-----------------  

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Q1. The equation of a sphere is given by

\[ 3x^2 + 3y^2 + 3z^2 - 5x + 3y - 2z = 0 \]

a) Find the center and radius of the sphere. (13 points)

b) Find the midpoint of the line joining the center and the origin. (2 points)
Q2.

a) Find the equation of a plane \( \varphi \) passing through three points \( A(2, -1, 3), B(0, 1, -2) \) and \( C(4, -2, -2) \) (10 points)

b) Find the area of the triangle ABC (2 points)

c) Find the projection of \( \overrightarrow{AB} \) on \( \overrightarrow{AC} \) (3 points)
Q3. Given two planes

\[ \phi_1 : \quad x - 3y - z - 1 = 0 \]
\[ \phi_2 : \quad 2x + y + z - 3 = 0 \]

a) Find the parametric equations for the line of intersection of the planes \( \phi_1 \) and \( \phi_2 \) (10 points)

b) Find the angle between the planes \( \phi_1 \) and \( \phi_2 \) (5 points)
Q4. Let \( C : \ r = f(\theta) = 4\cos \theta \) be a polar curve.

a) Find the equation of the tangent line to \( C \) when \( \theta = \pi / 6 \) (13 points)

b) Show it graphically (2 points)
Q5. Let \( C: r = f(\theta) = 1 - \sin \theta \) be a polar curve.

a) Plot the graph of \( C \) (5 points)
b) Find the arc length of \( C \) (10 points)
c) Find the area enclosed by \( C \) (5 points)
Q6. Let
\[ C_1 : \quad r = f(\theta) = 4 \cos \theta \]
\[ C_2 : \quad r = g(\theta) = 2 \]
be two curves.

a) Shade the region inside \( C_1 \) and outside \( C_2 \) \hspace{1cm} (5 points)

b) Find the above shaded area \hspace{1cm} (15 points)