Important Note
Show all work.
Use of programmable calculator is not allowed.
Mobiles and paging devices should not be carried during examination.

Instructor: F. D. Zaman
**Q1**) Change to Cartesian coordinates and identify the curve giving a sketch. (4)

(a) Parametric equations of the curve are \( x = t^2 + 1, y = 3 - t \).

(b) Polar equation of the curve is \( r = \sin \theta + 2 \cos \theta \).
Q2) Set up integrals (Do not evaluate) (4)

(a) Integral giving arc length of
\[ x = 2\sqrt{1+t}, \quad y = t^2 + 3; \quad 0 \leq t \leq 2. \]

(b) Integral giving surface area of surface determined by rotating curve about \( x \)-axis
\[ x = \cos^2 t, \quad y = \sin 2t; \quad 0 \leq t \leq \pi / 4. \]
Q3) (a) Find an equation of tangent line to the polar curve \( r = 1 + \cos \theta \) at \( \theta = \frac{\pi}{6} \). (4)

(b) Find area inside the polar curve \( r = 1 + \sin \theta \). (4)
Q4) Given the vectors $a, b, c$ below, find volume of the parallelepiped formed by these vectors

$$a = \mathbf{i} - \mathbf{j} - \mathbf{k}, \quad b = 2\mathbf{i} + 3\mathbf{j} - \mathbf{k}, \quad c = \mathbf{i} + \mathbf{k}. \quad (8)$$
Q5) (a) Find parametric equations of line through $P(1, 2, -1)$ and $Q(3, 4, 2)$. (5)
Q5(b) Find an equation of the plane that contains the line in part (a) above and passes through the origin.
Q6) Show that the planes given below are parallel. Find distance between them.

\[ 2x - 4y - 6z = 1 \]

\[ 3x - 6y - 9z = 4. \]