COMSATS University Islamabad
Terminal, Spring 22

Programs: BSE,BCS, BCT, BAI, BDS (II) Max Marks: 50
Subject: **Calculus and Analytical Geometry** **(MTH:104)** Date: July 06, 2022
Time : 3 hours

Instructions for attempting paper:

1. Carrying of digital diaries and mobile phones are not allowed in the examination hall.
2. Sharing of anything is forbidden.
3. Unnecessary detail may lead to negative marking.

1. Plot the function $f(x) = x^2 + 2x - 1$. Is there translation along any axis, if yes mention it by units. Also calculate $f(0)$. [2] [2]

2. Consider the functions

$$f(x) = \begin{cases} 3x & if\ x \leq -2 \\ x^2 - 1 & if\ -2 < x < 2 \\ 3 & if\ x \geq 2 \end{cases}$$

Discuss continuity at $x = 2$ [4]

3. For the function $f(x) = x^4 - 5x^3 + 9x^2$
   Find:
   a) the intervals on which f is increasing,
   b) the intervals on which f is decreasing,
   c) the open intervals on which f is concave up,
   d) the open intervals on which f is concave down.
   e) Points of inflection.

4. Find the volume of the solid whose base is the region bounded between the curve $y = x^2$ and the $x - axis$ from $x = 0$ to $x = 2$ and whose cross sections taken perpendicular to the x-axis are squares. [6]

5. Verify that the hypotheses of the Mean-Value Theorem are satisfied for the function $f(x) = x - \frac{1}{x}$ on the interval $[3, 4]$, and find all values of c in that interval that satisfy the conclusion of the theorem. [2]

6. Find arc length of the following parametric curve [6]

$$x(t) = e^t(cost + sint),\ \ y(t) = e^t(cost - sint),\ \ 1 \leq t \leq 4$$