National University of Computer & Emerging Sciences, Karachi
Fall-2023 FAST School of Computing
Mid-Term - II Exam
7th November 2023, 10:00 AM - 11:00 AM

Course Code: MT-1003	Course Name: Calculus and Analytical Geometry
Instructors Name: Ms. Urooj / Ms. Alishba Tariq / Ms.Fareeha sultan / Mr. Nadeem Khan / Mr. Mairaj Ahmed	
Student Roll No:	Section No:

Instructions:

- Attempt all questions. There are **03 Questions and 02 pages**.
- Solve the paper according to the sequence given in the question paper.
- Graphical Calculator is not allowed.
- Return the question paper with the answer copy.

Time: 60 minutes **Max Marks: 30**

Question 01: [CLO-4] [5]

Answer the following.

a. Rolle's Theorem is used to find the zeros of a function. (True/False)

b. $\lim_{x\to 0^+} sinxlnx$

I) 0 II) $+\infty$ III) -1 IV) $\frac{\pi}{2}$ V) 2

c. For which value of x the function $f(x) = x^3 - 8$ on $[3,7]$ satisfies the conditions of mean value theorem.

I) 4.509 II) 3.512 III) 8.888 IV) 5.132 V) 6.285

d. $\lim_{t\to 0} \frac{te^t}{1-e^t}$

I) 0 II) $-\infty$ III) -1 IV) $\frac{-1}{e}$ V) $-e$

e. The rational function $f'(x) = \frac{3-x^2}{x^3}$, has

I) a stationary point at $x = 1$

II) a stationary point at $x = -1$

III) two stationary points at approximately $x = -1.723$ and $x = 1.723$

IV) three stationary points at approximately $x = 0$, $x = -1.723$ and $x = 1.723$

V) no stationary points

Question 02: [CLO-3] [5+5]

Evaluate the following integrals:

a. $\int_1^4 \frac{\ln(x)}{\sqrt{x}} dx$

b. $\int \frac{\sqrt{1+4x^2}}{x} dx$

Question 03: **[CLO-4]** **[5+5+5]**

a. Use the definition of area under the curve with x_k^* as the midpoint of the subinterval to find the area under the curve $y = 4x - x^2$ over the interval $[0, 4]$.

b. If $f(x) = \frac{1}{2}x^{\frac{4}{3}} - 2x^{\frac{1}{3}}$, Find:

   I. All critical points.

   II. Intervals in which function is increasing and decreasing.

   III. Relative extrema.

c. A pulley is on the edge of a dock, 8 *ft* above the water level. (See the figure below.) A rope is being used to pull a boat. The rope is attached to the boat at water level. The rope is being pulled at the rate of 1 *ft* per second. Find the rate at which the boat is approaching the dock at the instant the boat is 4 *ft* from the dock.