25U114S (Pages: 2) Name: ....

Reg.No: ....

FIRST SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2025

(CBCSS - UG)

CC19UMTS1C01 / CC20UMTS1C01 - MATHEMATICS - I

(Mathematics - Complementary Course)

(2019 to 2023 Admissions - Supplementary)

Time : 2.00 Hours Maximum : 60 Marks

Credit : 3

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 2 marks.

1. Find $\lim_{x\to -5} \dfrac{x^2+x-20}{x^2+6x+5}$.
2. A train has position $x = 3t^2 + 2 - \dfrac{1}{\sqrt{t}}$ at time t. Find the velocity of the train at $t = 2$.
3. Let $f(x) = 4x^5 - 13x$ and $g(x) = x^3 + 2x - 1$. Find derivative of $\dfrac{g(x)}{f(x)}$.
4. Differentiate $\sqrt{x^3-5}$.
5. If $x^4 + y^2 + y - 3 = 0$, compute $\dfrac{dy}{dx}$ using implicit differentiation.
6. Find $\displaystyle\int \sqrt{3x+2}\,dx$.
7. Let $f(x)$ be the absolute value function: $f(x) = |x|$; that is $f(x) = \begin{cases} x & \text{if } x \geq 0, \\ -x & \text{if } x < 0, \end{cases}$

   Show that f is continuous at $x_0 = 0$.
8. Determine whether $f(x) = x^4 + x + 5$is increasing or decreasing at $x_0 = 0$ by using first derivative test.
9. Use the second derivative test to analyze the critical points of the function $f(x) = 3x^2 + 2$.
10. Suppose that f is a differentiable function such that $f(0) = 0$ and $f(1) = 1$. Using Horserace theorem show that $f'(x_0) = 2x_0$ for some $x_0 \in (0,1)$.
11. Find the sum $1 + 2 + ... + 25$.
12. An object moving in a straight line has velocity $v = 6t^4 + 3t^2$at time t. How far does the object travel between $t = 1$ and $t = 10$?

(Ceiling: 20 Marks)

Part B (Short essay questions - Paragraph)

Answer ***all*** questions. Each question carries 5 marks.

13. Show that $f(x) = 1 + |x|$ has no derivative at $x = 0$, yet is continuous.

14. Using linear approximation calculate an approximate value for $\dfrac{1}{(1.99)^2 + (1.99)^4}$.

15. Find the equation of the line tangent to the parametric curve $x = t^2 + 1, y = \dfrac{1}{t^4 + 1}$ at $t = 2$.

16. Find the dimensions of a rectangular box of minimum cost if the manufacturing costs are 10 cents per square meter on the bottom, 5 cents per square meter on the sides, and 7 cents per square meter on the top. The volume is to be 2 cubic meters and the height is to be 1 meter.

17. Evaluate (a) $\lim\limits_{x \to 0} \left(\dfrac{x + \sin 2x}{2x + \sin 3x} \right)$ (b) $\lim\limits_{x \to 5^+} \left(\dfrac{\sqrt{x^2 - 25}}{x - 5} \right)$

18. Write $\displaystyle\int_0^1 x^3 dx$ as a limit of sums.

19. Find the area of the region between the graphs of x and $x^2 + 1$ between $x = -2$ and $x = 2$.

(Ceiling: 30 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

20. (a) A Reservoir contains $10^8 - 10^4 t - 80t^2 - 10t^3 + 5t^5$ liters of water at time t, where t is the time in hours from when the gates are opened. How many liters per hour are leaving the reservoir after one hour?

    (b) Find the velocity and acceleration of a moving particle at $t = 0$ if the position is given by $y = 10 - 2t - 0.01t^4$.

21. The region under the graph of x^2 on $0 \leq x \leq 1$ is revolved about the x axis.Using disk method find its volume.

(1 × 10 = 10 Marks)

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