

D 12646

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Name.....

Reg. No.....

**FIRST SEMESTER (CBCSS—UG) DEGREE EXAMINATION
NOVEMBER 2021**

Mathematics

MTS 1C 01—MATHEMATICS—I

(2021 Admissions)

Time : Two Hours

Maximum : 60 Marks

Section A*Answer at least **eight** questions.**Each question carries 3 marks.**All questions can be attended.**Overall Ceiling 24.*

1. Calculate the slope of the tangent line to the graph of $f(x) = x^2 + 1$ when $x = -1$.
2. Find $\lim_{x \rightarrow 1} \frac{x^2 + x - 2}{x^2 - x}$.
3. Find the derivative of $y = \sqrt{x}$ for $x > 0$.
4. Find $\frac{d}{dx} \left[\cos(\sqrt{1 + \cos x}) \right]$.
5. Find the linearization of $f(x) = \cos x$ at $x = \pi/2$.
6. Show that there is a number c such that $c^3 - c^2 = 10$.
7. Find $\lim_{t \rightarrow 0} \cos \left(\frac{x}{\sqrt{19 - 3 \sec 2t}} \right)$.
8. Suppose that f is differentiable on the whole real line and that $f'(x)$ is constant. Prove that f is linear.

Turn over

9. Find the critical points of $f(x) = 3x^4 - 8x^3 + 6x^2 - 1$.
10. Find the inflection points of $f(x) = x^2 + (1/x)$.
11. Using limits of Riemann sums, establish the equation $\int_a^b c \, dx = c(b - a)$, where c is a constant.
12. Find $\int_0^2 \left(\frac{t^2}{4} - 7t + 5 \right) dt$.

(8 × 3 = 24 marks)

Section B*Answer at least five questions.**Each question carries 5 marks.**All questions can be attended.**Overall Ceiling 25.*

13. Find $\lim_{h \rightarrow 0} \frac{\sqrt{2+h} - \sqrt{2}}{h}$.
14. Show that the line $y = mx + b$ is its own tangent at any point $(x, mx + b)$ on the line.
15. Assume that oil spilled from a ruptured tanker spreads in a circular pattern whose radius increases at a constant rate of 1 ft/s. How fast is the area of the spill increasing when the radius of the spill is 20 ft?
16. Use implicit differentiation to find d^2y/dx^2 if $5x^3 - 7y^2 = 10$.
17. Find the maximum and minimum points and values for the function $f(x) = (x^2 - 8x + 12)^4$ on the interval $[-10, 10]$.
18. Use l'Hôpital's Rule to find $\lim_{x \rightarrow 0} \frac{\sin x - x}{x^3}$.

19. Find the area of the region between the x -axis and the graph of $f(x) = x^3 - x^2 - 2x$, $-1 \leq x \leq 2$.

(5 × 5 = 25 marks)

Section C

Answer any **one** question.
The question carries 11 marks.

20. (a) Find the area of the region in the first quadrant that is bounded above by $y = \sqrt{x}$ and below by the x -axis and the line $y = x - 2$.

(b) Find $\frac{dy}{dx}$ if $y = \int_1^{x^2} \cos t \, dt$.

21. (a) Find the absolute extrema of $h(x) = x^{2/3}$ on $[-2, 3]$.

- (b) Find the volume of the solid generated by the revolution about the x -axis of the loop of the

curve $y^2 = x^2 \frac{3a - x}{a + x}$.

(c) Evaluate $\lim_{x \rightarrow 0} \left(\frac{1}{x^2} - \frac{1}{\sin^2 x} \right)$.

(1 × 11 = 11 marks)