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FIRST SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(CUFYUGP)

MAT1MN102 - CACULUS OF A SINGLE VARIABLE

2024 Admission onwards

Maximum Time :2 Hours	**Maximum Marks :70**

Section A

All Question can be answered. Each Question carries 3 marks (Ceiling : 24 Marks)

1	Determine whether the statement "If $f(a) = L$, then $\lim_{x\to a} f(x) = L$" is true or false. Explain your answer.
2	Find $f(2)$, $\lim_{x\to 2^+} f(x)$ and $\lim_{x\to 2^-} f(x)$, if $f(x) = \begin{cases} x-5 & \text{if } x \le 2 \\ x^2 & \text{if } x > 2 \end{cases}$
3	Define tangent line to the curve $y = f(x)$ at the point $P(x_0, f(x_0))$
4	Show that $\frac{d}{dx}[cf(x)] = c\frac{d}{dx}[f(x)]$; where c is a constant
5	Find an equation of the tangent line to the graph of $y = f(x)$ at $x = -3$ if $f(-3) = 2$ and $f'(-3) = 5$.
6	Find $\frac{d^2y}{dx^2}$ for $\sin y = x$
7	Find $\frac{dy}{dx}$ if $y = \log_{(\ln x)} e$
8	Explain the term inflection points of a function
9	Show that the function $f(x) = x^2 - 4x + 3$ is concave up on the interval $(-\infty, \infty)$.
10	Write a short note on First Derivative Test.

Section B

All Question can be answered. Each Question carries 6 marks (Ceiling : 36 Marks))

11	Evaluate $\lim_{x\to+\infty} \frac{\sqrt{x^2+2}}{3x-6}$
12	If $\lim_{x\to3} \frac{f(x)+4}{x-3} = 2$, then find $\lim_{x\to3} f(x)$
13	Find the area of the triangle formed from the coordinate axes and the tangent line to the curve $y = 5x^{-1} - 15x$ at the point (5, 0).
14	Find $f'(x)$, if $f = \frac{\sin x + \cos x}{\sin x - \tan x}$
15	Verify that $y = -\ln(e^2 - x)$ satisfies $\frac{dy}{dx} = e^y$, with $y = -2$ when $x = 0$.
16	Evaluate $\lim_{x\to0} \frac{x^2 - \sin^2 x}{x^4}$
17	Find the intervals on which $f(x) = x^2 - 4x + 3$ is increasing and the intervals on which it is decreasing.
18	Find the inflection points of the function $f(x) = xe^{x^2}$

Section C

Answer any ONE. Each Question carries 10 marks (1x10=10 Marks))

19	Find values of the constants k and m, if possible, that will make the function f continuous everywhere. $$f(x) = \begin{cases} x^2+5 & \text{if } x > 2 \\ m(x+1)+k & \text{if } -1 < x \le 2 \\ 2x^3+x+7 & \text{if } x \le -1 \end{cases}$$
20	Let h and g have relative maxima at x_0 . Prove or disprove: 1. $h+g$ has a relative maximum at x_0 2. $h-g$ has a relative maximum at x_0 .