

FIRST SEMESTER B.Sc. FYUGP EXAMINATION, NOVEMBER 2025

(Regular/Improvement/Supplementary)

MATHEMATICS

MAJOR

MAT1CJ101: DIFFERENTIAL CALCULUS

Time: 2 Hours

Maximum Marks: 70

M: Mark

BL: Bloom's Taxonomy Level (1 to 6)

CO: Course Outcome

Section A				
Answer all questions. Each carries 3 marks. (Ceiling: 24 Marks)				
No.	Question	M	BL	CO
1.	Find $\lim_{x \rightarrow 0^+} \frac{1}{x^{2/3}}$, $\lim_{x \rightarrow 0^-} \frac{1}{x^{2/3}}$ and $\lim_{x \rightarrow 0} \frac{1}{x^{2/3}}$.	3	3	CO1
2.	Show that $y = \sin(1/x)$ has no limit as x approaches zero from either side.	3	4	CO1
3.	State the Intermediate Value Property of derivatives.	3	2	CO1
4.	Define $g(4)$ in a way that extends $g(x) = \frac{x^2 - 16}{x^2 - 3x - 4}$ to be continuous at $x = 4$.	3	4	CO1
5.	Find the derivative of $y = \frac{t^2 - 1}{t^2 + 1}$.	3	3	CO1
6.	Define increasing function. Give an example.	3	1	CO2
7.	Find the function whose derivative is $\sin x$ and whose graph passes through the point $(0, 2)$.	3	3	CO2
8.	Define point of inflection. Give an example.	3	1	CO3
9.	Write the second derivative test for concavity.	3	2	CO3
10.	Show that $\lim_{x \rightarrow -\infty} \frac{1}{x} = 0$.	3	2	CO3
Section B				
Answer all questions. Each carries 6 marks. (Ceiling: 36 marks)				
No.	Question	M	BL	CO
11.	Find the center and radius of the circle $x^2 + y^2 - 3y - 4 = 0$.	6	3	CO1
12.	Graph the parabola $y = -\frac{1}{2}x^2 - x + 4$. Label the vertex, axis and intercepts.	6	4	CO1
13.	Evaluate $\lim_{x \rightarrow 1^+} \frac{\sqrt{2x(x-1)}}{ x-1 }$ and $\lim_{x \rightarrow 1^-} \frac{\sqrt{2x(x-1)}}{ x-1 }$	6	5	CO1
14.	Using the definition calculate the derivative of the function $f(x) = 2x + 3$.	6	3	CO1
15.	Find the value of c that satisfy Mean Value Theorem for the function: $f(x) = x^2$ on $[0, 2]$	6	4	CO2
16.	If $f'(x) = g'(x)$ at each point of an interval I , prove that there exists a constant C such that $f'(x) = g'(x) + C$ for all x in I .	6	5	CO2
(PTO)				

17.	Let $f(x) = (x - 7)(x + 1)(x + 5)$. a) What are the critical points of f ? b) On what intervals is f increasing or decreasing? c) At what points, if any, does f assume local extreme values?	6	6	CO2
18.	Let $y' = x(x - 3)^2$. Identify the intervals on which the function is concave up and concave down. Find the point of inflection, if any.	6	4	CO3

Section C

Answer any one question. Each carries 10 marks. (1x10=10 marks)

No.	Question	M	BL	CO
19.	(a) State and prove the sum rule for sums of more than two functions, using the method of mathematical induction. (b) If $y = x^3 + \frac{4}{3}x^2 - 5x + 1$, then find $\frac{dy}{dx}$.	10	3	CO1
20.	Graph the function $y = \frac{x^3 + 1}{x}$ with asymptotes and dominant terms.	10	6	CO3