

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: IMSC
BRANCH: MATHS & COMP.

SEMESTER : I
SESSION : MO/2025

SUBJECT: MA101 CALCULUS - I

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

- | | | CO | BL |
|---|-----|----|-----|
| Q.1(a) Find the n th derivative of $y = x^{n-1} \log x$ at $x = \frac{1}{2}$. | [2] | 1 | 2 |
| Q.1(b) Show that the curve $y = (1 - x)/(1 + x^2)$ has three points of inflexion which lie on a straight line. | [3] | 1 | 1.5 |
| Q.2(a) Find the asymptotes of $(x^2 - a^2)y^2 = x^2(x^2 - 4a^2)$ | [2] | 2 | 2 |
| Q.2(b) Find the radius of curvature at any point of the cycloid $x = a(t + \sin t)$ and $y = a(1 - \cos t)$ | [3] | 2 | 2 |
| Q.3(a) Find the radius of curvature at any point (x, y) on the rectangular hyperbola with equation $xy = c^2$ | [2] | 2 | 2.6 |
| Q.3(b) Find Maclaurian series expansion of $\sin x$ | [3] | 1 | 1.4 |
| Q.4 If $u = x^2 + y^2 + z^2$, show that | [5] | 3 | 2 |
| $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 2u.$ | | | |
| Q.5(a) Show that $f(x, y) = \frac{xy}{\sqrt{x^2+y^2}}$ when $(x, y) \neq (0, 0)$
$= 0$ when $(x, y) = (0, 0)$
is continuous at $(0, 0)$ | [2] | 3 | 2 |
| Q.5(b) Find the points of inflexion and the intervals of convexity and concavity of the curve $y = e^{-x^2}$ | [3] | 22 | 2 |

:::13/10/2025:::M