Roll No:
Date: __/__/____

St. Claret College

Autonomous, Bengaluru

UG END SEMESTER EXAMINATION-MAY 2026
BSc II SEM
MT224: MATHEMATICS-II

11

TIME: 3 hours **MAX. MARKS: 80**

This paper contains TWO printed pages and FOUR parts

Instructions:
1. **Verify and ensure that the question paper is completely printed.**
2. **Any discrepancies or questions about the exam paper must be reported to the COE within 1 hour after the examination.**
3. **Students must check the course title and course code before answering the questions.**

PART-A

Answer ALL questions. Each answer carries ONE mark. **[1 x 10 = 10]**

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1. A group is a set with
   A) One operation B) Two operations C) Three operations D) No operation
2. Identity element in a group is
   A) Unique B) Multiple C) Infinite D) Negative
3. Order of an element is
   A) Number of operations B) Smallest positive integer n such that $a^n = e$
   C) Largest integer D) Zero
4. Polar coordinates are written as
   A) (x, y) B) (r, θ) C) (a, b) D) (m, n)
5. Pole in polar coordinates means
   A) Origin B) Axis C) Curve D) Angle
6. Rolle's theorem applies to
   A) Continuous functions B) Discontinuous functions C) Random numbers D) Matrices
7. L'Hospital rule is used to evaluate
   A) Simple values B) Indeterminate forms C) Angles D) Sets
8. Order of differential equation depends on
   A) Power of x B) Highest derivative C) Constant term D) Variable only
9. Clairaut's equation is of the form
   A) $y = px + f(p)$ B) $y = x^2$ C) $y = \sin x$ D) y = constant
10. Integrating factor is used to solve
    A) Linear differential equations B) Algebraic equations C) Matrix equations D) Trigonometry

PART-B

Answer any TEN questions. Each answer carries TWO marks. **[2 x 10 = 20]**

11. On Z, a * b = a + b + 5, find the identity element.
12. Mention the postulates of a group.
13. Show that (N, .) is not a group.
14. Find the angle between the radius vector and the tangent for the curve r = $a\sin^3\frac{\theta}{3}$.
15. For the curve r = $a\theta$ show that p = $\frac{r^2}{\sqrt{r^2+a^2}}$.
16. Find the pedal equation of the curve $r^n = a^n \sin n\theta$.
17. Prove that $\lim_{x\to 0}\frac{1}{1-e^{\frac{1}{x}}}$ does not exist.
18. Discuss any two types of discontinuities.
19. State Lagrange's mean value theorem.
20. Test for exactness and solve $\left(3x^2y + \frac{y}{x}\right)$ dx+$(x^3 + \log x)$ dy=0.
21. Find the general and singular solution of Clairaut's equation $y = xp + p^2$.
22. Find the integrating factor of the linear differential equation $\frac{dy}{dx} + \frac{2}{x}y = x^3$.

PART-C

Answer any FOUR questions. Each answer carries FIVE marks. **[5 x 4 = 20]**

23. Prove that the cube roots of unity form an abelian group under multiplication.
24. Show that the following pairs of curves r= a(1 + cosθ), r= b(1 - cosθ) cut orthogonally.
25. Determine the position and nature of the double points of the curve $x^3+ 2x^2+2xy-y^2+5x-2y =0$.
26. Verify Cauchy mean value theorem for f(x)= x^2 and g(x) = x^3 in [1, 2].
27. Evaluate: $\lim_{x\to 0}\frac{e^x - e^{\sin x}}{x - \sin x}$.
28. Solve for p; where p^2+ 2pycot x - $y^2 = 0$.

PART-D

Answer any THREE questions. Each answer carries TEN marks. **[10 x 3 = 30]**

29. (i) Find the order of each element of the multiplicative group {1, -1, i, -i}. **4 marks**
    (ii) Prove that a non-empty subset H of a group G is a sub group of G if and only if
    (i) for every a, b ϵ H $\rightarrow a * b \epsilon H$ (ii) for every a ϵ H $\rightarrow a^{-1}\epsilon H$ **6 marks**
30. Trace the curve Asteroid.
31. (i) State and prove Rolle's theorem. **7 marks**
    (ii) Verify Rolle's theorem for the function f(x) = $x^2 - 6x + 8$ in [2, 4]. **3 marks**

32. (i) Solve for y; where $y = p\sin p + \cos p$ **4 marks**
    (ii) Solve for x; where y= 2px - yp^2. **6 marks**
33. Find the general and singular solution of $(px - y)(x - py) = 2p$ by using the substitution x^2 = u and y^2 = v.

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