Roll No:
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# St. Claret College

## Autonomous, Bengaluru

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**UG END SEMESTER EXAMINATION-MAY 2026**
**BSc IV SEM**
**MT425: MATHEMATICS-IV**

25

**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]**

1. Aryabhata contributed to the value of
   A) e B) π C) i D) log
2. A homomorphism preserves
   A) Order relation B) Operation C) Topology D) Distance
3. If H is a normal subgroup of G, then we can form
   A) Product group B) Quotient group C) Cyclic group D) Infinite group
4. Order of differential equation $d^2y/dx^2 + y = 0$ is
   A) 1 B) 2 C) 3 D) 0
5. The complementary function comes from
   A) Homogeneous equation B) Particular solution C) Matrix equation D) Algebraic equation
6. Laplace transform of 1 is
   A) 1 B) s C) 1/s D) 0
7. Inverse Laplace transform converts
   A) Algebra to calculus B) Frequency to time domain C) Matrix to determinant D) Vector to scalar
8. Heaviside function is also called
   A) Step function B) Constant function C) Polynomial D) Trigonometric function
9. Fourier series of an even function contains only
   A) Sine terms B) Cosine terms C) Both sine and cosine D) Log terms
10. Fourier transform is widely used in
    A) Signal processing B) Cooking C) Painting D) Literature

## PART-B

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

11. What is the condition for homomorphism of a group G?
12. Define a normal sub group.
13. Give an example of a non- abelian group, all of whose subgroups are normal.
14. What is centre of a group?
15. Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = 0$.
16. Solve $(D^3+D^2+D+1)y = e^{3x+4}$.
17. Explain first shifting property of Laplace-Transforms.
18. Find the Laplace transform of $t^3 + 4t^2 - 3t + 5$.
19. State Convolution theorem.
20. Give an example of a function with period $2\pi$.
21. Define even and odd functions.
22. Find the Fourier sine transform of $f(x) = \frac{1}{x}$, $x > 0$ .

## PART-C

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

23. Mention the contributions of Aryabhata in the field of Mathematics.
24. Solve $y'' - 4y' + 13y = \sin 2x$.
25. Find the Laplace transform of the following function: L{sin t sin 2t sin 3t}.
26. Find the inverse Laplace transform of $\frac{a^2}{s(s+a)^2}$.
27. Find the half range sine Fourier series of $f(x) = x^2$ in $0 < x < \pi$.
28. Find the Fourier series of $f(x) = x$ over the interval $(0, 2\pi)$.

## PART-D

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

29. (i) If G={1, -1, i, -i}is a group under multiplication and H = {1, -1} be a subgroup of G. Verify that H is a normal subgroup of G. **4 marks**
    (ii) A subgroup H of a group G is normal if and only if every right coset of H in G is a left coset of H in G. **6 marks**
30. (i) Solve $y'' - 4y' + 4y = 8(e^{2x} + \sin 2x + x^2)$. **6 marks**
    (ii) Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = -3 \sin hx$ **4 marks**
31. (i) Solve the Cauchy Euler Equation $x^2y'' - xy' + 2y = x \log x$ **5 marks**
    (ii) Solve $x^2y'' + xy' - 9y = 0$ given that $y = x^3$ is a part of the complimentary function. **5 marks**
32. (i) Use Convolution theorem to obtain the inverse Laplace transform of the function $\frac{1}{s(s+1)^3}$. **5 marks**
    (ii) If $f(t) = t^2$, $0 < t < 2$ and $f(t+2) = f(t)$ for $t>2$. Find L{f(t)}. **5 marks**
33. Obtain the Fourier expansion of the function $f(x) = |x|$ in $(-\pi, \pi)$ and hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$

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