

(FOR THE CANDIDATES ADMITTED
DURING THE ACADEMIC YEAR 2025 ONLY)

25UMS102

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI
END-OF-SEMESTER EXAMINATIONS: NOVEMBER-2025
BSc.- MATHEMATICS **MAXIMUM MARKS: 75**
SEMESTER: I **TIME : 3 HOURS**

PART - III
CALCULUS

SECTION – A **(10 X 1 = 10 MARKS)**

ANSWER THE FOLLOWING QUESTIONS.

MULTIPLE CHOICE QUESTIONS.

(K1)

1. The reciprocal of the curvature of a curve at any point is called _____.
(a) Center of curvature (b) radius of curvature (c) Evolute (d) pedal equation

2. The solution of Lagrange's equation is _____.

(a) $\phi(u, v) = 1$ (b) $\phi(u, v) = 0$ (c) $\phi(u, v) = -1$ (d) $\phi(u, v) = 2$

3. $\int_0^2 \int_0^2 (x - 3y^2) dy dx =$ _____

(a) - 12 (b) 12 (c) 21 (d) -21

4. $\Gamma\left(\frac{1}{2}\right) =$ _____

(a) π (b) $\frac{\pi}{2}$ (c) $\sqrt{\pi}$ (d) $\frac{\sqrt{\pi}}{2}$

5. $L^{-1}\left[\frac{1}{(s+a)^2}\right] =$ _____ (if $s > 0$).

(a) $e^{at} t$ (b) $e^{-at} t$ (c) $e^{at} t^2$ (d) $e^{2at} t$

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES.

(K2)

6. Solve $(D^2 - 5D + 4)y = 0$ where $D = \frac{d}{dx}$

7. Find the general integral of the equation $p + q = x + y$.

8. Find the value of $\int_0^a \int_0^a \int_0^a dx dy dz$

9. If $x = r \cos \theta$ and $y = r \sin \theta$, then find $\frac{\partial(x, y)}{\partial(r, \theta)}$

10. Find $L[\sin^3 2t]$.

SECTION – B

(5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11. a) Prove that the radius of curvature at any point of the cycloid $x = a(\theta + \sin \theta)$ and

$$y = a(1 - \cos \theta) \text{ is } 4a \cos \frac{\theta}{2}$$

(OR)

b) Solve $(D^2 + 5D + 6)y = e^x$ where $D = \frac{d}{dx}$

(CONTD.....2)

12.a) Eliminate f and ϕ from the relation $z = f(x+ay) + \Phi(x-ay)$

(OR)

b) Find the solution of the equation $q = xp + p^2$

13.a) Evaluate $\iint xy \, dx \, dy$ taken over the positive quadrant of the circle $x^2+y^2=a^2$.

(OR)

b) By transforming into polar coordinates, evaluate $\iint \frac{x^2 y^2}{x^2 + y^2} dx \, dy$ over the annular region between the circles $x^2 + y^2 = a^2$ and $x^2 + y^2 = b^2$ ($b > a$)

14.a) Find the curvilinear quadrilateral bounded by the four parabolas

$$y^2 = ax, \quad y^2 = bx, \quad x^2 = cy, \quad x^2 = dy$$

(OR)

b) Prove that $\beta(m,n) = \beta(m)\beta(n)$.

15.a) Evaluate $L^{-1}\left[\frac{s-3}{s^2+4s+13}\right]$

(OR)

b) Evaluate $L^{-1}\left[\frac{s}{(s+2)^2}\right]$

SECTION – C

(5 X 8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K4 (Or) K5)

16. a) Evaluate the radius of curvature at any point of the curve $x = a \cos^3 \theta, y = a \sin^3 \theta$

(OR)

b) Solve $(D^2 - 4D + 3)y = \sin 3x \cos 2x$

17.a) Solve $p^2 + q^2 = npq$.

(OR)

b) Solve : $(y+z)p + (z+x)q = x+y$.

18. a) Evaluate $\iiint xyz \, dx \, dy \, dz$ taken through the position octant of the sphere $x^2+y^2+z^2=a^2$ by transforming into spherical co-ordinates.

(OR)

b) Evaluate the centroid of a loop of the lemniscuses $r^2 = a^2 \cos 2\theta$

19.a) Evaluate $\iiint xyz \, dx \, dy \, dz$ taken through the position octant of the sphere $x^2+y^2+z^2=a^2$ by transforming into spherical co-ordinates.

(OR)

b) Prove that $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$

20.a) Using Laplace transform, Solve $\frac{d^2 y}{dx^2} + 2\frac{dy}{dx} - 3y = \sin t$, given that $y = \frac{dy}{dt} = 0$ where $t=0$

(OR)

b) Using the basic concepts, evaluate (i) $L\{e^{-t} \cos^2 t\}$ (ii) $L\{e^{-t} \sin^2 t\}$ (iii) $L\{e^t \sin^2 t\}$ (iv) $L\{e^t \cos^2 t\}$ and (v) $L\{e^{at} \cos bt\}$
