



Reg. No. :

Name :

**III Semester B.Sc. Degree (C.B.C.S.S. – O.B.E. – Regular/Supplementary/
Improvement) Examination, November 2023
(2019 to 2022 Admissions)
COMPLEMENTARY ELECTIVE COURSE IN MATHEMATICS
3C03MAT – PH : Mathematics for Physics – III**

Time : 3 Hours

Max. Marks : 40

PART – A

Answer **any four** questions. **Each** question carries **1** mark.

1. State the first form of Fubini's theorem.
2. Find an equation for the plane through $P(-3, 0, 7)$ perpendicular to $n = 5i + 2j - k$.
3. Find the length of the indicated portion of the curve $r(t) = 2 \cos t i + 2 \sin t j + \sqrt{5}tk$, $0 \leq t \leq \pi$.
4. Find the Laplace transform of $\sinh at$.
5. Find $e^t + e^{-t}$.

PART – B

Answer **any seven** questions. **Each** question carries **2** marks.

6. Evaluate the integral $\int_0^1 \int_0^1 \int_0^1 (x^2 + y^2 + z^2) dz dy dx$.
7. Find the volume of the region bounded by the elliptical paraboloid $z = 10 + x^2 + 3y^2$ and below the rectangle $R : 0 \leq x \leq 1, 0 \leq y \leq 2$.
8. Evaluate $\iint_R e^{x^2+y^2} dA$ where R is the semicircular region bounded by the x -axis and the curve $y = \sqrt{1-x^2}$.

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9. What is meant by TNB frame ?
10. Determine the velocity and acceleration of a particle, at $t = 1$, whose position vector is given by $r(t) = (t + 1)i + (t^2 - 1)j$.
11. Find a vector parallel to the line of intersection of the planes $3x - 6y - 2z = 15$ and $2x + y - 2z = 5$.
12. Are the following functions even or odd or neither even nor odd. Justify your statement.
 - a) $\sinh x$
 - b) e^x
13. Find parametric equations for the line through $(1, 1, 1)$ parallel to the x -axis.
14. Find the fundamental period of $f(x) = \sin x$ and $g(x) = \sin \pi x$.
15. Show that the functions $\cos x$ and $\cos 3x$ are orthogonal on $[-\pi, \pi]$.
16. Find $\mathcal{L}^{-1} \left\{ \frac{-2s+6}{s^2+4} \right\}$.

PART – C

Answer **any four** questions. **Each** question carries **3** marks.

17. Find the average value of $f(x, y) = \sin(x + y)$ over the rectangle $0 \leq x \leq \pi$, $0 \leq y \leq \pi$.
18. Calculate $\iint_R \frac{\sin x}{x} dA$ where R is the triangle in the xy plane bounded by the x -axis, the line $y = x$ and the line $x = 1$.
19. Find the curvature of the helix $r(t) = a \cos t i + a \sin t j + btk$.
20. Find the even periodic extension of the function.

$$f(x) = \begin{cases} \frac{2k}{L}x & \text{if } 0 < x < \frac{L}{2} \\ \frac{2k}{L}(L-x) & \text{if } \frac{L}{2} < x < L \end{cases}$$



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21. Solve $y'' - y = t$, $y(0) = 1$, $y'(0) = 1$.
22. Solve by the Laplace transform $y(t) + \int_0^1 (t - \tau)y(\tau)d\tau = 1$.
23. Using the Laplace transform solve the IVP

$$y_1' = -y_1 + 4y_2$$

$$y_2' = 3y_1 - 2y_2$$

$$y_1(0) = 3, y_2(0) = 4.$$

PART – D

Answer **any two** questions. **Each** question carries **5** marks.

24. Evaluate $\int_0^3 \int_0^4 \int_{x-\frac{y}{2}}^{x-\frac{y}{2}+1} \left(\frac{2x-y}{2} + \frac{z}{3} \right) dx dy dz$ by applying the transformation $u = \frac{2x-y}{2}$, $v = \frac{y}{2}$, $w = \frac{z}{3}$ and integrating over an appropriate region in uvw space.
25. a) Find the distance from the point $P(2, -3, 4)$ to the plane $x + 2y + 2z = 13$.
b) Determine the angle between the planes $3x - 6y - 2z = 15$ and $2x + y - 2z = 5$.
26. Expand $f(x) = \begin{cases} 0 & -\pi < x < 0 \\ \pi - x & 0 \leq x < \pi \end{cases}$ in a Fourier series.
27. Write the following functions using unit step function and find its transform.

$$f(x) = \begin{cases} 2 & \text{if } 0 < t < 1 \\ \frac{1}{2}t^2 & \text{if } 1 \leq t < \frac{\pi}{2} \\ \cos t & \text{if } t > \frac{\pi}{2} \end{cases}$$