K25U 3366

Reg. No. : ....

Name : ....

First Semester B.Sc. Degree (CBCSS – OBE – Supplementary) Examination, November 2025
(2019 to 2023 Admissions)
COMPLEMENTARY ELECTIVE COURSE IN MATHEMATICS
1C01 MAT – PH : Mathematics for Physics – I

Time : 3 Hours | Max. Marks : 40

PART – A

Answer **any four** questions from among the questions **1** to **5**. **Each** question carries **one** mark.

1. State Leibnitz's theorem for the n^{th} derivative of the product of two functions.

2. Evaluate $\lim\limits_{x \to c} \dfrac{\log x}{\cot x}$.

3. If A is orthogonal, prove that $|A| = \pm 1$.

4. Are the vectors $x_1 = (3, 2, 7)$, $x_2 = (2, 4, 1)$ and $x_3 = (1, -2, 6)$ linearly dependent. If so, find the relation between them.

5. Replace the polar equation $r = \dfrac{5}{\sin\theta - 2\cos\theta}$ with equivalent Cartesian equation and describe the graph. **(4×1=4)**

PART – B

Answer **any seven** questions from among the questions **6** to **16**. **Each** question carries **two** marks.

6. If $y = e^{ax} \sin bx$, prove that $y_2 - 2ay_1 + (a^2 + b^2)y = 0$.

7. If $x = 2 \cos t - \cos 2t$, $y = 2 \sin t - \sin 2t$, find the value of $\dfrac{d^2y}{dy^2}$ when $t = \dfrac{\pi}{2}$.

P.T.O.

8. If $y = x \log \frac{x-1}{x+1}$, show that $y_n = (-1)^{n-2}(n-2)! \left[\frac{x-n}{(x-1)^n} - \frac{x+n}{(x+1)^n}\right]$.

9. Verify Lagrange's mean value theorem for $f(x) = e^x$ in the interval [0,1].

10. If $f(x) = \log(1 + x)$, $x > 0$, using Maclaurin's theorem, show that
$\log(1 + x) = x - \frac{x^2}{2} + \frac{x^3}{3(1+\theta x)^3}$, where $0 < \theta < 1$.

11. Expand $e^{a \sin^{-1} x}$ in ascending powers of x.

12. Evaluate $\lim_{x \to 0}\left(\frac{1}{x} - \frac{1}{e^x - 1}\right)$.

13. Determine the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$.

14. Using the partition method, find the inverse of $A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}$.

15. Find the values of a, b, c if $A = \begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$ is orthogonal.

16. Find the polar equation for the circle $x^2 + (y - 3)^2 = 9$. **(7×2=14)**

PART – C

Answer **any four** questions from among the questions **17** to **23. Each** question carries **three** marks.

17. If $ax^2 + 2hxy + by^2 = 1$, prove that $\frac{d^2y}{dx^2} = \frac{h^2 - ab}{(hx+by)^3}$.

18. Find the n^{th} derivative of $e^x(2x + 3)^3$.

19. Expand e^x in powers of (x – 1) up to four terms.

20. For the matrix $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & -1 & -1 \end{bmatrix}$, find non-singular matrices such P and Q such that PAQ is in the normal form. Hence find the rank of A.

21. Solve the equations $3x + y + 2z = 3$, $2x - 3y - z = -3$, $x + 2y + z = 4$ by matrix inversion method.

22. Find $\frac{ds}{d\theta}$ for the curve $r = a(1 - \cos\theta)$.

23. Find the radius of curvature at any point $(at^2, 2at)$ of the parabola $y^2 = 4ax$.

(4×3=12)

PART – D

Answer **any two** questions from among the questions **24** to **27**. **Each** question carries **five** marks.

24. If $y = e^{a \sin^{-1}x}$, prove that $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - (n^2 + a^2)y_n = 0$. Hence find the value of y_n when $x = 0$.

25. By forming a differential equation show that

$$(\sin^{-1} x)^2 = 2.\frac{x^2}{2!} + 2.2^2.\frac{x^4}{4!} + 2.2^2.4^2.\frac{x^6}{6!} + \ldots$$

26. Investigate the values of λ and μ so that the equations $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$ have
    i) No solution
    ii) A unique solution and
    iii) An infinite number of solutions.

27. Find the co-ordinates of the center of curvature at any point of the cycloid $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$.

(2×5=10)