



22/1/24

K23U 4072

Reg. No. :

Name :

I Semester B.Sc. Degree (CBCSS – OBE-Regular/Supplementary/
Improvement) Examination, November 2023
(2019 Admission Onwards)

COMPLEMENTARY ELECTIVE COURSE IN MATHEMATICS
1C01 MAT-PH : Mathematics for Physics – I

Time : 3 Hours

Max. Marks : 40

Answer **any 4** out of 5 questions. **Each** question carries **1** mark.

(4×1=4)

1. Find the n^{th} derivative of e^{mx} .
2. State Taylor's theorem.
3. Define rank of a matrix.
4. Find $\lim_{x \rightarrow 0} \frac{\sin x}{x}$.
5. Find the polar coordinates of (1, 1).

Answer **any 7** questions out of 11 questions. **Each** question carries **2** marks. (7×2=14)

6. $x = 2 \cos t$, $y = 2 \sin t$. Find $\frac{d^2y}{dx^2}$.
7. State Rolle's theorem.
8. Evaluate $\lim_{x \rightarrow 0} \left(\frac{xe^x - \log(1+x)}{x^2} \right)$.
9. Evaluate $\lim_{x \rightarrow 0} \left(\frac{\log x}{\cot x} \right)$.

P.T.O.



10. Determine the rank of

$$\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$$

11. Define linearly independent vectors.

12. Solve the equations

$$x + 2y + 3z = 0$$

$$3x + 4y + 4z = 0$$

$$7x + 10y + 12z = 0.$$

13. Write elementary transformations of a matrix.

14. If A is orthogonal then prove that $|A| = \pm 1$.

15. Find the radius of curvature at the origin for the curve $y - x = x^2 + 2xy + y^2$.

16. Replace the polar equation $r \cos \theta = -4$ in to cartesian form.

Answer **any 4** questions out of 7 questions. **Each** question carries 3 marks.

(4x3=12)

17. If $x = a(\cos t + \sin t)$, $y = a(\sin t - t \cos t)$ then find $\frac{d^2y}{dx^2}$.

18. Verify Rolle's theorem for $\frac{\sin x}{e^x}$ in $(0, \pi)$.

19. Using Maclaurin series expand $\tan x$ up to the term containing x^5 .

20. Show that the transformation

$$y_1 = 2x_1 + x_2 + x_3$$

$$y_2 = x_1 + x_2 + 2x_3$$

$y_3 = x_1 - 2x_3$ is regular. Write down the inverse transformation.

21. Find the value of k for which the system of equations,

$$(3k - 8)x + 3y + 3z = 0$$

$$3x + (3k - 8)y + 3z = 0$$

$3x + 3y + (3k - 8)z = 0$ has non trivial solution.



22. Solve the equations,
 $3x + y + 2z = 3$
 $2x - 3y - z = -3$
 $x + 2y + z = 4$ using Cramer's rule.

23. Find a spherical coordinate equation for the sphere $x^2 + y^2 + (z - 1)^2 = 1$.

Answer any 2 questions out of 4 questions. Each question carries 5 marks. (2x5=10)

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

25. Prove that (if, $0 < a < b < 1$), $\frac{b-a}{1+b^2} < \tan^{-1} b - \tan^{-1} a < \frac{b-a}{1+a^2}$. Hence show that $\frac{\pi}{4} + \frac{3}{25} < \tan^{-1} \frac{4}{3} < \frac{\pi}{4} + \frac{1}{6}$.

26. If the following system,

$$ax + by + cz = 0$$

$$bx + cy + az = 0$$

$cx + ay + bz = 0$ has non trivial solution then prove that $a + b + c = 0$ or $a = b = c$.

27. Find the volume of the ice cream cone D cut from the solid sphere $\rho \leq 1$ by the cone $\phi = \frac{\pi}{3}$.

