



Reg. No. :

Name :

I Semester B.Sc. Degree CBCSS (OBE) Reg./Sup./Imp.
Examination, November 2020
(2019 Admn. Onwards)



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

Time : 3 Hours

Max. Marks : 40

PART – A
Short Answer

Answer any four questions out of five questions. Each question carries 1 mark :

1. Find the derivative of $2x^5 - x^3 - x$.
2. Write the Maclaurin's series of $\sin \theta$.
3. Find the rank of the matrix $A = \begin{bmatrix} 3 & 0 & 0 \\ 1 & 5 & 0 \\ 2 & 5 & 1 \end{bmatrix}$.
4. Find the polar equation of the Cartesian coordinate $x^2 + y^2 = 1$.
5. Graph the set of points whose polar coordinates satisfy the condition $-3 \leq r \leq 2, \theta = \frac{\pi}{4}$? (4x1=4)

PART – B
Short Essay

Answer any seven questions out of ten questions. Each question carries 2 marks :

6. Find the derivative of $y = \frac{\sin t}{\sin 2t}$.
7. If $x = \sec t$ and $y = \tan t$, then find $\frac{dy}{dx}$.
8. Find $\frac{dy}{dx}$ when $x^3 + y^3 = 3axy$.

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9. Verify Mean value theorem for $f(x) = x^2$ in $[-2, 3]$.
10. Find $\lim_{x \rightarrow 0} \left[\frac{x - \sin x}{x^3} \right]$.
11. For what values of λ the matrix $A = \begin{bmatrix} 2 & 0 & 0 & 1 \\ 0 & 5 & 0 & 0 \\ 1 & 2 & 1 & \lambda \end{bmatrix}$ has rank 3? Give reason for your answer.
12. Using the Gauss-Jordan method, find the inverse of $A = \begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$.
13. Verify that the matrix $A = \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ \sin \theta & 0 & \cos \theta \end{bmatrix}$ is orthogonal.
14. Find $\frac{ds}{dy}$ for the curve $ay^2 = x$, where s is the arc length.
15. Find a spherical coordinate equation for the sphere $x^2 + y^2 + (z - 2)^2 = 4$. **(7×2=14)**

PART - C
Essay

Answer **any four** questions out of seven questions. **Each** question carries **3** marks :

16. Find $\frac{d}{d\theta}(\sin^{-1} \theta)$, where $\theta \in (-1, 1)$.
17. If $y = [x^{\tan x} + (\sin x)^{\cos x}]$, then find $\frac{dy}{dx}$.
18. Find the values of a and b such that $\lim_{x \rightarrow 0} \left[\frac{x(1 + a \cos x) - b \sin x}{x^3} \right] = 1$.
19. Verify Rolle's theorem for $f(x) = \frac{\sin x}{e^x}$ in $[0, \pi]$.
20. Solve the equations $3x + y + 2z = 3$, $2x - 3y - z = -3$, $x + 2y + z = 4$ by matrix method.
21. Are the vectors $x_1 = (1, 1, 1)$, $x_2 = (2, 2, 2)$ and $x_3 = (3, 3, 3)$ linearly dependent? If so express one of these as a linear combination of the others.
22. Prove that the radius of curvature at the point $\left(\frac{3a}{2}, \frac{3a}{2} \right)$ of the Folium $x^3 + y^3 = 3axy$ is $\frac{3a}{8\sqrt{2}}$. **(4×3=12)**



PART - D
Long Essay

Answer **any two** questions out of four questions. **Each** question carries **5** marks :

23. a) If $\sin y = x \sin(a + y)$, then find $\frac{dy}{dx}$.
- b) If $x^y = e^{x-y}$, prove that $\frac{dy}{dx} = \frac{\log x}{(1 + \log x)^2}$.
24. a) Expand $\log(1 + x)$ upto the term containing x^5 .
- b) Expand $\log(1 + \sin^2 x)$ in powers of x as far as the term in x^6 .
25. a) Reduce the matrix $A = \begin{bmatrix} 4 & 8 & 8 & 0 \\ 1 & 3 & 4 & 0 \\ 2 & 2 & 4 & 2 \end{bmatrix}$ into its normal form and hence find its rank.
- b) Test for consistency of the linear system of equations $x + 2y + 4z + w = 5$, $3x + 6y + 12z + 3w = 15$, $4x + 8y + 16z + 4w = 0$, $5x + 10y + 20z + 5w = 0$.
26. a) Show that the radius of curvature at any point of the cycloid $x = a(\theta + \sin \theta)$, $y = a(1 - \cos \theta)$ is $4a \cos \frac{\theta}{2}$.
- b) Find all polar coordinates of the point $\left(2, \frac{\pi}{6} \right)$. **(2×5=10)**