K26U 0852

Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree (C.B.C.S.S.-OBE – Supplementary) Examination, April 2026
(2020 to 2023 Admissions)
COMPLEMENTARY ELECTIVE COURSE IN MATHEMATICS
2C02 MAT-CH : Mathematics for Chemistry – II

Time : 3 Hours

Max. Marks : 40

UNIT – I

Short answer type. (Answer **any 4** questions.)

1. Find $\frac{\partial z}{\partial x}$ if $z = x \cos xy$.
2. State Fubini's theorem (First form).
3. Evaluate $\int_0^{\frac{\pi}{6}} \sin^6 3x \, dx$.
4. Evaluate $\int_{-2}^{2} (x^4 - 4x^2 + 6) \, dx$.
5. Write the characteristic polynomial of the matrix : $A = \begin{bmatrix} 2 & 0 \\ 1 & 2 \end{bmatrix}$. **(4×1=4)**

UNIT – II

Short essay type. (Answer **any 7** questions.)

6. Evaluate $\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \cot\theta \operatorname{cosec}^2 \theta \, d\theta$.
7. Change the Cartesian integral $\int_{-a}^{a} \int_{-\sqrt{a^2-y^2}}^{\sqrt{a^2-y^2}} dydx$ into an equivalent polar integral and evaluate the integral.
8. Find the first and second partial derivatives of $z = x^3 + y^3 - 5xy$.

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9. Evaluate $\int_0^{\pi} \int_0^{\sin y} y \, dy dx$.
10. Graph the set of points whose polar coordinates satisfy the conditions : $1 \le r \le 2$ and $0 \le \theta \le \frac{\pi}{2}$.
11. Evaluate $\int_0^{\frac{\pi}{2}} \sin^6 x \cos^8 dx$.
12. Find the sum of the eigen values of the matrix $\begin{bmatrix} 1 & 3 & -2 \\ 1 & 2 & 0 \\ 4 & 1 & -5 \end{bmatrix}$
13. Find the characteristic values of the matrix $\begin{bmatrix} 2 & 0 \\ 3 & 4 \end{bmatrix}$
14. If $z = \sin(x - ct)$, prove that $\frac{\partial^2 z}{\partial t^2} = c^2 \frac{\partial^2 z}{\partial x^2}$.
15. Define similar matrices.
16. Show that the function $\left[\frac{x-y}{x+y}\right]$ is discontinuous at the origin. **(7×2=14)**

UNIT – III

Essay type. (Answer **any 4** questions.)

17. If z is a homogeneous function of degree n in x and y, show that $x^2 \frac{\partial^2 z}{\partial x^2} + y^2 \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} = n(n-1) z$.
18. If $\frac{x^2}{a^2+u} + \frac{y^2}{b^2+u} + \frac{z^2}{c^2+u} = 1$, prove that $\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial y}\right)^2 + \left(\frac{\partial u}{\partial z}\right)^2 = 2\left(x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}\right)$.
19. Find the area of the region enclosed by the parabola $y = x^2$ and the line $y = x + 2$.

20. Evaluate $\int \frac{1}{\sqrt{\cos^3 x \sin^5 x}} dx$.
21. Find the area of the region cut from the first quadrant by the curve $r = 2(2 - \sin 2\theta)^{1/2}$.
22. Find the area of the region enclosed by the parabola $y = 2 - x^2$ and the line $y = -6$.
23. Prove that the eigen values of an idempotent matrix are either zero or unity.
24. Verify Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ and find its inverse. **(4×3=12)**

UNIT – IV

Long essay type. (Answer **any 2** questions.)

25. If $u = \frac{x^3 y^3 z^3}{x + y^3 + z^3} + \log\left[\frac{xy + yz + zx}{x^2 + y^2 + z^2}\right]$, find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}$.
26. Find the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$
27. Evaluate $\int_0^{a} (a^2 + x^2)^{5/2} dx$.
28. Find the area of the region that lie inside the circle $r = 1$ and outside the cardioid $r = 1 - \cos\theta$. **(2×5=10)**