



K25U 3082

Reg. No. :

Name :

**III Semester B.Sc. Honours in Mathematics Degree (CBCSS – OBE –
Supplementary/Improvement) Examination, November 2025
(2021 to 2023 Admissions)
3B10 BMH : CALCULUS – III**

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **any four** questions out of **five** questions. **Each** question carries **one** mark.

1. Evaluate $\int_0^1 \int_1^2 dy dx$.
2. State Divergence Theorem.
3. Define average value of a function of two variables on a Rectangle R.
4. Plot the point with cylindrical co-ordinate $(2, 2\pi/3, 1)$.
5. Give an example of a one-sided surface. **(4×1=4)**

SECTION – B

Answer **any 6** questions out of **9** questions. **Each** question carries **2** marks.

6. Evaluate $\int_0^{\pi/2} \int_0^{\pi/2} \sin x \cos y \, dA$.
7. Find the area enclosed by one loop for closed leaved rose $r = \cos 2\theta$.
8. Find the polar moment of inertia of a homogeneous disk D with density ρ , center at origin and radius a.
9. Describe the Surface whose equation in cylindrical co-ordinate is $z = r$.

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10. The point $\left(2, \frac{\pi}{3}, \frac{\pi}{4}\right)$ is given in spherical co-ordinates. Find the rectangular co-ordinates of the point.
11. Find the Gradient of $F(x, y, z) = x^2yzi + xyj + z^2k$.
12. Evaluate, $\int_C y \sin z \, ds$ where C is the circular Helix given by the equation $x = \cos t, y = \sin t, z = t, 0 \leq t \leq 22\pi$.
13. If f is a function of two variable that has continuous second order partial derivatives then show that $\text{curl}(\nabla f) = 0$.
14. Identify the Surface with the Vector equation $r(u, v) = 2\cos u \, i + v \, j + 2\sin u \, k$.
(6×2=12)

SECTION – C

Answer **any 8** questions out of **12** questions. **Each** question carries **4** marks.

15. Use the mid point rule with $m = n = 2$, to estimate the value of the integral $\int_{x=0}^2 \int_{y=1}^2 (x - 3y^2) \, dy \, dx$.
16. Find the Volume of the solid that is bounded by the elliptic paraboloid $x^2 + 2y^2 + z = 16$, the planes $x = 2$ and $y = 2$ and the three coordinate planes.
17. Evaluate $\iint_D xy \, dA$ where D is the region bounded by the line $y = x - 1$ and the parabola $y^2 = 2x + 6$.
18. Evaluate $\iiint_E z \, dV$, where E is the solid tetrahedron bounded by the four planes $x = 0, y = 0, z = 0$ and $x + y + z = 1$.
19. Use the change of variables $x = u^2 - v^2, y = 2uv$, to evaluate the integral $\iint_R y \, dA$, where R is the region bounded by the x -axis and the parabolas $y^2 = 4 - 4x, y^2 = 4 + 4x, y \geq 0$.



20. Evaluate $\int_C 2x \, ds$, where c consist of the arc c_1 of the parabola $y = x^2$, from $(0, 0)$ to $(1, 1)$, followed by the vertical line segment c_2 from $(1, 1)$ to $(1, 2)$.
21. Evaluate $\oint_C y^2 dx - 3xy \, dy$, where C is the boundary of a semi annular region D in the upper half plane between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 4$.
22. Find the tangent plane to the Surface with parametric equation $x = u^2, y = v^2, z = u + 2v$ at $(1, 1, 3)$.
23. Compute the surface integral $\iint_S x^2 \, dS$, where S is the unit Sphere.
24. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F} = -y^2 \mathbf{i} + x \mathbf{j} + z^2 \mathbf{k}$ and C is the curve of intersection of the plane $y + z = 2$. and the cylinder $x^2 + y^2 = 1$.
25. Find the outward flux of the Vector Field $\mathbf{F}(x, y, z) = z\mathbf{k}$, across the sphere $x^2 + y^2 + z^2 = a^2$.
26. Find the area of the part of the paraboloid $z = x^2 + y^2$, that lies under the plane $z = 9$. (8×4=32)

SECTION – D

Answer **any 2** questions out of **4** questions. **Each** question carries **6** marks.

27. The joint density function of X and Y is given as

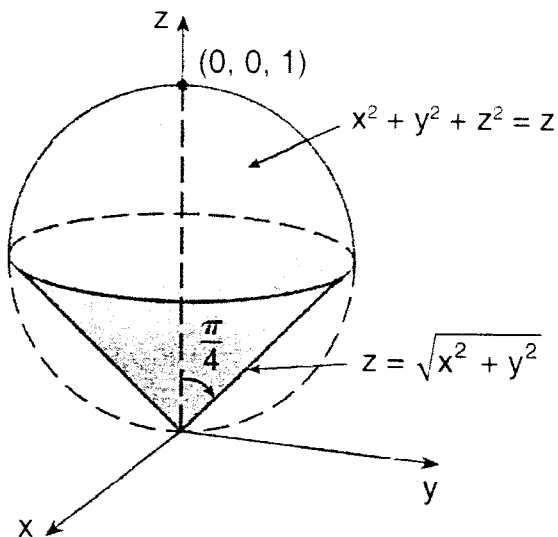
$$f(x, y) = \begin{cases} C(x+2y), & \text{if } 0 \leq x \leq 10, 0 \leq y \leq 10 \\ 0 & \text{otherwise} \end{cases}$$

Find the value of constant C .

Then find $P(X \leq 7, Y \geq 2)$.



28. Find the volume of the solid that lies above the cone $z = \sqrt{x^2 + y^2}$ and below the sphere $x^2 + y^2 + z^2 = z$.



29. A) Show that $F(x, y, z) = y^2z^3 \mathbf{i} + 2xyz^3 \mathbf{j} + 3xy^2z^2 \mathbf{k}$ is a conservative Vector Field.

B) Find a function f such that $F = \nabla f$.

30. Using Stokes Theorem evaluate $\oint_C F \cdot d\mathbf{r}$, where $F = 2z\mathbf{i} + 3x\mathbf{j} + 5y\mathbf{k}$, where C is the positively oriented circle $x^2 + y^2 = 4$, that forms the boundary of the surface $z = 4 - x^2 - y^2$, $z \geq 0$, in the xy plane.

(2×6=12)