

Third Semester FYUGP Degree (Reg) Examination November 2025

**KU3DSCMAT202 - COORDINATE SYSTEMS AND
MULTIPLE INTEGRALS**

2024 Admission onwards

Time : 2 hours

Maximum Marks : 70

Section A

Answer any 6 questions. Each carry 3 marks.

1. Evaluate the double integral $\iint_R \left(\frac{\sqrt{x}}{y^2} \right) dA$ over the region $R : 0 \leq x \leq 4, 1 \leq y \leq 2$.
2. Evaluate $\int_0^1 \int_0^1 \frac{y}{1+xy} dx dy$
3. Find the equation of the sphere whose center is $(1, 2, 3)$ and radius is $\sqrt{14}$.
4. Evaluate $\int_{-1}^1 \int_0^1 \int_0^2 (x+y+z) dy dx dz$
5. Evaluate $\int_0^1 \int_0^1 \int_0^1 xyz dx dy dz$
6. Write down the equations relating Cartesian coordinates and cylindrical coordinates.
7. Find the spherical coordinates of the point $(1, \sqrt{3}, 2)$.
8. Find the Jacobian $J(r, \theta, z)$ of the transformation $x = r \cos \theta, y = r \sin \theta, z = z$.

Section B

Answer any 4 questions. Each carry 6 marks.

9. Describe the sets of points in space whose coordinates satisfy the given inequalities
 - (a) $x \geq 0, y \geq 0, z = 0$
 - (b) $x \geq 0, y \leq 0, z = 0$
10. Find the center and radius of the sphere $x^2 + y^2 + z^2 - 6y + 8z = 0$.
11. Evaluate $\int_0^3 \int_0^{\sqrt{9-x^2}} \int_0^{\sqrt{9-x^2}} dz dy dx$

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12. Evaluate $\int_0^{2\pi} \int_0^1 \int_{-1/2}^{1/2} (r^2 \sin^2 \theta + z^2) dz dr d\theta$.

13. Solve the system $u = x - y, v = 2x + y$ for x and y in terms of u and v . Then find the value of the Jacobian $\partial(x, y)/\partial(u, v)$.
14. Evaluate the appropriate determinant to show that the Jacobian of the transformation from Cartesian $\rho\phi\theta$ -space to Cartesian xyz -space is $\rho^2 \sin \phi$.

Section C

Answer any 2 questions. Each carry 14 marks.

15. Identify the symmetries and graph the lemniscate $r^2 = \sin 2\theta$.
16. Identify the symmetries and graph the curve $r^2 = 4 \cos \theta$.
17. (a) State Fubini's Theorem (Stronger form)
(b) Sketch the region of integration for the integral $\int_0^2 \int_{x^2}^{2x} (4x+2) dy dx$ and write an equivalent integral with the order of integration reversed and evaluate both integrals.