K25FY3258 Pages: 2 Reg No:.....
Name:.....

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.

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