K25FY3155 Pages: 2 Reg No:.....
Name:.....

Third Semester FYUGP Degree (Reg) Examination
NOVEMBER 2025
KU3DSCPHY201 - BASIC MATHEMATICAL PHYSICS
2024 Admission onwards

Time : 2 hours Maximum Marks : 70

Section A

Answer any 6 questions. Each carry 3 marks.

1. Find the volume of the parallelepiped whose edges are given by the vectors 2i-3j +4k, i+2j -k ,3i-j +2k

2. Prove that [Ax(BxC)]+[Bx(CxA)]+[Cx(AxB)]=0

3. Express the cylindrical unit vectors in terms of cartesian unit vectors

4. How do we represent the gradient in spherical polar coordinate system.

5. How do we represent the divergence in cylindrical coordinate system

6. What is an ordinary differential equation (ODE)? Distinguish it from a partial differential equation (PDE)

7. What is the order of a differential equation? Give one example each of first-order and second-order ODEs.

8. Define partial differential equation. give one example.

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Section B

Answer any 4 questions. Each carry 6 marks.

9. Explain spherical polar coordinate system and write down the coordinates in it and their relation with the cartesian coordinate system

10. How do we represent the displacement vector,area vector and volume element in cylindrical coordinate system

11. (a) Derive the expression for the gradient of a scalar field $f(r, \theta, \phi)$, in spherical polar coordinates.
(b)Find the gradient of $f(r, \theta) = r^2 \cos\theta$ in spherical polar coordinate system.

12. Classify (order and degree; homogeneous or nonhomogeneous; linear or nonlinear) the following differential equations: (a) $(\ell + y^2)y'' + xy' + x = e^x$ (2) $\frac{d^2\theta}{dt^2} + \frac{g \sin\theta}{\ell} = 0$ (3) $y'' + (y')^2 + xy = 0$ (4) $y' + xy^2 = 0$ (5) $y'' + (y')^{(1/2)} + xy = 0$.

13. By use of the method of successive integration, solve $y'' - 2y' + y = 2\cos x$.

14. By the use of direct integration, solve

$$\frac{\partial^2 u(x,y)}{\partial x\,\partial y} = x^2 y,$$

$$u(x,0) = x^2,$$

$$u(1,y) = \cos y.$$

Section C

Answer any 2 questions. Each carry 14 marks.

15. Obtain rotation matrix R_3 of the cartesian coordinate system about z axis for rotation through an arbitrary angle θ. Show that this matrix is orthogonal and also find its determinant and its inverse.

16. Illustrate the following properties of Pauli's spin matrices. a) Hermition, Orthogonal ,Unitary, unimodular, Commutation .

17. Suppose $\vec{V} = (2xz + 3y^2)\hat{y} + 4yz^2\hat{z}$, check stokes theorem for the square surface of unit area.

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