

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.

- Express the cylindrical unit vectors in terms of cartesian unit vectors
- Find the formulas for cylindrical coordinates in terms of cartesian coordinate system
- Explain the meaning of direct product of two matrices by taking the case of two 2×2 matrices
- What is the characteristic equation of a matrix?
- What is Cayley Hamilton theorem and state its importance
- Write the standard form of a Bernoulli differential equation.
- State the condition for a differential equation $M(x,y)dx + N(x,y)dy = 0$ to be exact.
- Define a second-order linear differential equation. Write its general form

Section B

Answer any 4 questions. Each carry 6 marks.

- Solve the system of linear equations using the matrix method , $x+3y=2$
 $2x+y=3$
- Find the inverse of a matrix $A = \begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix}$.
- Verify Cayley Hamilton theorem for

$$A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

- Solve the differential equation: $y' + x = \frac{y}{x}$.
- Solve $y'' + 6y' + 13y = 0$, for $y(0) = 2$ and $y'(0) = 1$.

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- 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.

- Check the divergence theorem using the function $\vec{V} = y^2 \hat{x} + (2xy + z) \hat{y} + 2yz \hat{z}$, for a unit cube situated at the origin
- Write down the three fundamental theorems of vector calculus: the Gradient Theorem, the Divergence Theorem, and Stokes' Theorem. For each theorem, provide its mathematical statement and explain its physical interpretation with simple examples.
- Explain cylindrical coordinate system and write down the coordinates in it and its unit vectors in terms of cartesian coordinate system. Write down the gradient, divergence and curl in cylindrical coordinate system.