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# Third Semester FYUGP Degree Examination NOVEMBER 2025

# KU3DSCMAT216 - TRANSFORMS, LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS

2024 Admission onwards

Time : 2 hours Maximum Marks : 70

## Section A

**Answer any 6 questions. Each carry 3 marks.**

1. Define partial differential equation.
2. What makes a PDE linear.
3. Find inverse Laplace transform of $\frac{1}{s+a}$.
4. Write Laplace transform of $f'(t)$.
5. If $F(s) = \mathcal{L}\{f(t)\}$. then what is $\mathcal{L}\left\{\int_0^t f(\tau)\,d\tau\right\}$
6. If $\det(A) = 0$, can $A^{-1}$ exist? Justify.
7. What is the necessary condition for a system of linear equations $AX = B$ to have a unique solution?
8. Find the eigenvalue of the matrix

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

## Section B

**Answer any 4 questions. Each carry 6 marks.**

9. Find Laplace transform of $t^n$ using definition.
10. Determine Laplace transform of $\sin(bt)$ using definition.
11. Derive Laplace transform of $\cos \omega t$ using its derivatives.
12. Find minor and cofactors of the matrix

$$A = \begin{bmatrix} 1 & 3 & 0 \\ 2 & 6 & 4 \\ -1 & 0 & 2 \end{bmatrix}.$$

13. Show that the matrix

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & -1 & 2 \end{bmatrix}$$

has eigenvalues $2 + \sqrt{2}$, $2$, $2 - \sqrt{2}$.

14. Find the eigenvalues of the following matrices

$$A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}, \quad B = \begin{bmatrix} 0.8 & -0.6 \\ 0.6 & 0.8 \end{bmatrix}$$

## Section C

**Answer any 2 questions. Each carry 14 marks.**

15. Expand $f(x) = \begin{cases} x & : 0 < x < 1 \\ 2 - x & : 1 < x < 2 \end{cases}$ in a half range sine series

16. Show that the Fourier series of the function $f(x) = \left(\frac{\pi - x}{2}\right)^2$ in $0 < x < 2\pi$ is

$$f(x) = \frac{\pi^2}{12} + \sum_{n=1}^{\infty} \frac{\cos nx}{n^2}.$$

17. Find the temperature in a laterally insulated bar of length $L$ whose ends are kept at temperature 0, assuming that the initial temperature is

$$f(x) = \begin{cases} x & \text{if } 0 \leq x < \frac{L}{2} \\ L - x & \text{if } \frac{L}{2} < x < L \end{cases}.$$