K25FY3387 Pages: 2 Reg No:................

Name:................

Third Semester FYUGP Degree Examination NOVEMBER 2025

KU3DSCMAT212 - BASIC MATHEMATICAL METHODS

2024 Admission onwards

Time : 2 hours Maximum Marks : 70

Section A

Answer any 6 questions. Each carry 3 marks.

1. Write $\int_0^{\pi} \sin x\, dx$ by Simpson's 1/3-rule, taking $n = 2$.
2. Evaluate $\int_0^1 \frac{dx}{3+2x}$ by trapezoidal rule, taking $n = 1$.
3. State two necessary conditions on a linear system in order to apply Cramer's rule.
4. Find the characteristics equation of the matrix $\begin{bmatrix} 3 & 1 \\ -1 & 1 \end{bmatrix}$.
5. Write the inverse of the matrix $\begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 \\ 0 & 0 & 5 & 0 \\ 0 & 0 & 0 & 10 \end{bmatrix}$.
6. State the order of the ordinary differential equation $y' - 2y = 4(x+1)^2$.
7. Solve the ODE: $\frac{dy}{dx} = \frac{1}{1+x^2}$ by integration.
8. Check whether the functions $\ln x$ and $\ln x^2$ are linearly dependent or not. Justify.

Section B

Answer any 4 questions. Each carry 6 marks.

9. Any system of linear equations can have either no solution or exactly one solution or many solutions. Give an example for each of them.
10. Give a geometric interpretation of the existence and uniqueness of solutions of a system of two linear equations in two variables.
11. Define singular and nonsingular matrices. Give an example of each.
12. Solve the IVP: $y' \cosh^2 x = \sin^2 y$, $y(0) = \frac{\pi}{2}$.

13. By reducing to first order, solve the second order differential equation $xy'' = 2y'$.

14. Verify that $y_1 = e^x$ and $y_2 = e^{-x}$ are solutions of the ODE: $y'' - y = 0$ and then solve the initial value problem $y'' - y = 0$, $y(0) = 6$, $y'(0) = -2$

Section C

Answer any 2 questions. Each carry 14 marks.

15. Find the Fourier series of $f(x)$ given by

$$f(x) = \begin{cases} 1, & \text{if } -\pi/2 < x < \pi/2 \\ -1, & \text{if } \pi/2 < x < 3\pi/2 \end{cases}$$

and $f(x + 2\pi) = f(x)$.

16. Find Fourier series of the function $f(x)$ with period 4, where

$$f(x) = \begin{cases} 0: & -2 < x < -1 \\ k: & -1 < x < 1 \\ 0: & 1 < x < 2 \end{cases}$$

17. Solve the initial value problem $y' = x(y - x)$, $y(2) = 3$, in the interval $[2, 2.4]$, using the classical Runge-Kutta method, with step size $h = 0.2$.