K26FY0112 Pages: 2 Reg No:.....
Name:.....

First Semester FYUGP Degree (Reg) Examination November 2025

KU1DSCMAT113 - FUNCTIONS, CALCULUS AND MATRICES

2024 Admission onwards

Time : 2 hours Maximum Marks : 70

Section A

Answer any 6 questions. Each carry 3 marks.

1. Evaluate $\int a^{2x}\,dx$.
2. Obtain $\int \sqrt[3]{x^2}\,dx$.
3. Define transpose of a matrix.
4. Define rank of a matrix.
5. Determine the rank of the matrix
$$A = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}.$$
6. Simplify the expression for $e^{-\ln x^2}$.
7. Use horizontal test to show that the function $y = x^2$ is not one-to-one.
8. Find $\lim\limits_{y\to 0} \dfrac{y^2}{y^3+6}$.

Section B

Answer any 4 questions. Each carry 6 marks.

9. If $A = \begin{bmatrix} 1 & 2 & -1 \\ 3 & 0 & 2 \\ 4 & 5 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}$, verify that $(AB)' = B'A'$, where A' is the transpose of A.
10. Find the matrix A if
$$\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} -2 & 4 \\ 3 & -1 \end{bmatrix}.$$

11. Find the rank of the matrix

$$\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}.$$

12. If $f(x) = \dfrac{x+3}{x-2}$, find $f^{-1}(x)$ and identify the domain and range of $f^{-1}(x)$.

13. Compute the value of the limit $\lim\limits_{u \to 1} \dfrac{u^4 - 1}{u^3 - 1}$.

14. Simplify: $\ln(\cosh x + \sinh x) + \ln(\cosh x - \sinh x)$.

Section C

Answer any 2 questions. Each carry 14 marks.

15. a) Suppose u and v are functions of x that are differentiable at $x = 0$ and that $u(0) = 5, u'(0) = -3, v(0) = -1, v'(0) = 2$. Find the values of the following derivatives at $x = 0$.

(i) $\dfrac{d}{dx}(uv)$

(ii) $\dfrac{d}{dx}(7v - 2u)$.

b) Calculate the derivative $\dfrac{d}{dx}(\cos^{-1}(x^2))$.

16. (a) Find the first and second derivative of the function $y = \dfrac{(x^2+x)(x^2-x+1)}{x^4}$.

(b) Evaluate $\dfrac{d}{dx}(\ln \sin x)$.

17. (a) Evaluate $\displaystyle\int \frac{(x+1)(x+\log x)^2}{2x}\,dx$.

(b) Evaluate $\displaystyle\int \sin^3 x\,dx$.