

**First Semester FYUGP Degree (Reg/Sup) 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. Differentiate $\sin(x^2 + e^x)$ with respect to x .

2. Find the derivative of $y = \frac{\cos x}{1 - \sin x}$ w.r.t. x .

3. Find the transpose of

$$\begin{bmatrix} 1 & 5 & 6 & 3 \\ 2 & 5 & 7 & 8 \\ 5 & 9 & 2 & 4 \end{bmatrix}.$$

4. Determine the rank of the matrix

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

5. Calculate the rank of the matrix

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

6. Find the value of $\sin^{-1}\left(\frac{-1}{2}\right)$.

7. Simplify the expression $e^{\ln(x^2+y^2)}$.

8. Calculate $\lim_{x \rightarrow 0} \frac{x^2 - 4}{x^2 + 3x + 2}$.

Section B

Answer any 4 questions. Each carry 6 marks.

9. If A is a square matrix, verify that $A + A'$ is symmetric and $A - A'$ is skew-symmetric, 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. Determine the rank of the matrix

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

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

13. Compute the value of the limit $\lim_{u \rightarrow 1} \frac{u^4 - 1}{u^3 - 1}$.

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

Section C

Answer any 2 questions. Each carry 14 marks.

15. (a) Evaluate $\int_0^1 \frac{x^5}{1+x^{12}} dx$.

(b) Evaluate $\int \csc x dx$.

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

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

17. 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) $\frac{d}{dx}(uv)$

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

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