

Reg No:.....  
Name :.....

K24FY 1474 (B)

**First Semester FYUGP Mathematics Examination**  
**NOVEMBER 2024 (2024 Admission onwards)**  
**KU1DSCMAT113 (FUNCTIONS, CALCULUS AND**  
**MATRICES)**

(DATE OF EXAM: 4-12-2024)

Time : 120 min

Maximum Marks : 70

**Part A (Answer any 6 questions. Each carries 3 marks)**

1. Use the laws of exponents to simplify the following expressions:

(a)  $2^{\sqrt{3}} \cdot 7^{\sqrt{3}}$

(b)  $\left(\frac{2}{\sqrt{2}}\right)^2$

3

2. Find the inverse of  $y = \frac{\pi}{2} + 1$ .

3

3. Evaluate  $\lim_{x \rightarrow 0} \frac{1 + x + \sin x}{3 \cos x}$ .

3

4. Evaluate  $\int a^{2x} dx$ .

3

5. Evaluate  $\int_0^{\frac{\pi}{4}} \sec^2 x dx$ .

3

6. Find the transpose of

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

3

7. Define elementary matrices.

3

8. Find the rank of the matrix

$$A = \begin{bmatrix} 1 & 3 \\ 0 & -1 \end{bmatrix}$$

3

**Part B (Answer any 4 questions. Each carries 6 marks)**

9. Express the following logarithms in terms of  $\ln 5$  and  $\ln 7$

(a)  $\ln(1/125)$     (b)  $\ln(9.8)$     (c)  $\ln(7\sqrt{7})$ .

6

10. If  $\sqrt{5 - 2x^2} \leq f(x) \leq \sqrt{5 - x^2}$  for  $-1 \leq x \leq 1$ , find  $\lim_{x \rightarrow 0} f(x)$ , using the Sandwich Theorem.

6

11. If  $2 - x^2 \leq g(x) \leq 2 \cos x$  for all  $x$ , find  $\lim_{x \rightarrow 0} g(x)$ , using the Sandwich Theorem.

6

12. Express the matrix  $A$  as the sum of a symmetric and a skew-symmetric matrix where

$$A = \begin{bmatrix} 4 & 2 & -3 \\ 1 & 3 & -6 \\ -5 & 0 & -7 \end{bmatrix}.$$

6

13. Express the matrix  $A$  as the sum of a symmetric and a skew-symmetric matrix where

$$A = \begin{bmatrix} a & a & b \\ c & b & b \\ c & a & c \end{bmatrix}.$$

6

14. Find the rank of the matrix

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

6

**Part C (Answer any 2 question(s). Each carries 14 marks)**

15. a) Suppose  $u$  and  $v$  are functions of  $x$  that are differentiable at  $x = 0$  and that  $u(0) = 5, v'(0) = -3, v(0) = -1, v'(0) = 2$ . 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  $\frac{d}{dx}(\cos^{-1}(x^2))$ .

14

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

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

14

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

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

14