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**PRESIDENCY UNIVERSITY  
BENGALURU**

**SCHOOL OF ENGINEERING  
SUMMER TERM END TERM EXAMINATION AUGUST 2024**

**Semester:** Summer Term  
**Course Code:** MAT1001  
**Course Name:** Calculus and Linear Algebra  
**Program:** B. Tech.

**Date:** 05/08/2024  
**Time:** 1:00 pm to 4:00 pm  
**Max Marks:** 100  
**Weightage:** 50%

**Instructions:**

- (i) Read all the questions carefully and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) Scientific and Non-programmable calculators are permitted
- (iv) Do not write any information on the question paper other than Roll Number.

**Part A [Memory Recall Questions]**

**Answer any FIVE questions**

**5Q x 4M = 20M**

1. Find the sum and product of the Eigenvalues of  $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ . (CO1) [Knowledge]
2. Obtain the characteristic equation of the matrix  $\begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$ . (CO1) [Knowledge]
3. If  $u = \frac{x^3 + y^3}{\sqrt{x+y}}$ , prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{5}{2}u$ . (CO2) [Knowledge]
4. If  $x = r \cos \theta, y = r \sin \theta$ , show that  $\frac{\partial(x, y)}{\partial(r, \theta)} = r$ . (CO2) [Knowledge]
5. Evaluate  $\int_0^{\infty} x^{3/2} e^{-x} dx$ . (CO3) [Knowledge]
6. Evaluate  $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y dx dy$ . (CO3) [Knowledge]
7. What is the complementary function of  $(D^2 - 6D + 9)y = 0$ . (CO4) [Knowledge]

### Part B [Thought Provoking Questions]

Answer any FIVE questions

5Q x 10M = 50M

8. Find the Eigenvalues and Eigenvectors of the matrix  $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ . (CO1) [Comprehension]
9. If  $u = x \log xy$ , where  $x^3 + y^3 + 3xy = 1$  find  $\frac{du}{dx}$ . (CO2) [Comprehension]
10. Expand  $x^2y + 3y - 2$  in power of  $x - 1$  and  $y + 2$  using Taylor's theorem up to terms of second degree. (CO2) [Comprehension]
11. Evaluate  $\int_{x=0}^a \int_{y=0}^x \int_{z=0}^{x+y} e^{x+y+z} dz dy dx$  (CO3) [Comprehension]
12. Solve  $y'' + 5y' + 6y = 2e^{-x}$ . (CO4) [Comprehension]
13. Solve  $(D^2 + 4)y = \cos 3x$ . (CO4) [Comprehension]

### Part C [Problem Solving Questions]

Answer any TWO questions

2Q x 15M = 30M

14. Find the characteristic equation of the matrix  $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$  and hence compute  $A^{-1}$ . Also, find the matrix represented by  $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$ . (CO1) [Application]
15. Find the extreme values of the function  $f(x, y) = x^3 + y^3 - 3x - 12y + 20$ . (CO2) [Application]
16. Solve  $(D^2 - 2D + 5)y = e^{2x} \sin x$ . (CO4) [Application]