Code No.: MA101BS

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CMR ENGINEERING COLLEGE: : HYDERABAD
UGC AUTONOMOUS
I–B.TECH–I–Semester End Examinations (Supply) - December- 2025
LINEAR ALGEBRA AND CALCULUS
(Common for all)

[Time: 3 Hours] **[Max. Marks: 70]**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 20 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A **(20 Marks)**

1. a) Define Rank of a matrix. [2M]

b) Find the rank of the Matrix [2M]

$$\begin{bmatrix} -1 & 0 & 6 \\ 3 & 6 & 1 \\ -5 & 1 & 3 \end{bmatrix}.$$

c) State Cayley-Hamilton theorem. [2M]

d) Define Symmetric Matrix and Skew Symmetric matrix. [2M]

e) Explain P –test and give example. [2M]

f) Explain about Convergent and Divergent of the series. [2M]

g) State Lagrange's mean value theorem. [2M]

h) Define Beta function. [2M]

i) If $u = \frac{y}{z} + \frac{z}{x}$, find $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}$. [2M]

j) Define Functional dependence. [2M]

PART-B **(50 Marks)**

2. Discuss for what values of λ and μ the equations x+y+z=6,x+2y+3z=10, x+2y+ λ z= μ have (i) no solution (ii) a unique solution (iii) an infinite number of solutions. [10M]

OR

3. For the Matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ find the inverse of the matrix by elementary row operations (Gauss Jordan method). [10M]

4. Using Cayley-Hamilton theorem and find the inverse of the matrix $\begin{bmatrix} 1 & 1 & 2 \\ 0 & -2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$. [10M]

OR

5. Reduce the quadratic form $3x^2 + 5y^2 + 3z^2 - 2yz + 2zx - 2xy$ to the Canonical form by Orthogonal reduction and find the nature of quadratic form. [10M]

6. Explain Comparison test with example and test the convergence of $\sum \sqrt{n^4+1} - \sqrt{n^4-1}$. [10M]

OR

7. Write about Ratio test and test the convergence $1 + \frac{2x}{2!} + \frac{3^2}{3!}x^2 + \frac{4^3}{4!}x^3 + - - - - - -$. [10M]

8. Write the geometrical representation of Rolle's theorem and Verify Rolle's theorem for $f(x) = \frac{\sin x}{e^x}$ in $[0,\pi]$. [10M]

OR

9. Derive the relationship between Beta and Gamma functions. [10M]

10. If $u = log(x^3 + y^3 + z^3 - 3xyz)$. Show that $\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 u = \frac{-9}{(x+y+z)^2}$. [10M]

OR

11. Examine the function $x^3 + y^3 - 3axy$ for maxima and minima. [10M]

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