



## P.B. SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, Vijayawada – 520 010

Reaccredited at 'A+' level by NAAC

Autonomous&ISO 9001:2015 Certified

**Title of the Course: MATRIX THEORY**

**Semester : III**

Course Code	22OE3MA1	Course Delivery Method	Blended Mode
Credits	3	CIA Marks	30
No. of Lecture Hours / Week	3	Semester End Exam Marks	70
Total Number of Lecture Hours	45	Total Marks	100
Year of Introduction : 2023-24	Year of offering : 2023-24	Year of Revision:-----	Percentage of Revision :--

**Course Objectives:** The objective of this course is to teach the basic concepts of linear algebra and its applications to non-mathematics post graduate students.

**Course Outcomes:** After successful completion of this course, students will be able to

CO1: understand the basics of matrix theory. (PO1)

CO2: find the Echelon form of matrices. (PO1)

CO3: solve system of linear equations using various methods. (PO5)

CO4: find Eigen values and Eigen vectors of matrices. (PO5)

CO5: study applications of Cayley Hamilton theorem. (PO3)

### UNIT-I

**Linear system of Equations :** Introduction, Fundamentals of Matrices, Rank of Matrix.

(Sections 1.0, 1.1, 1.2 of units 1 of Text book 1)

### UNIT-II

**Linear system of Equations :** Echelon Form, Normal Form of a Matrix, Finding inverse by row operations.

(Sections 1.3, 1.4, of unit 1 of Text book 1 and concepts from Text book 2)

### **UNIT-III**

**Linear system of Equations :** Solution of a System of Linear Equations, Gauss-Elimination Method, Inverse Method, Cramer's Rule.

(Sections 1.5, 1.6, of unit 1 of Text book 1 and concepts from Text book 2)

### **UNIT -IV**

**Eigen Values-Eigen Vectors:** Introduction, Basic concepts, Eigen Values and Eigen Vectors. (Sections 2.0, 2.1, 2.2 of unit 2 of Text book 1 )

### **UNIT –V**

**Eigen Values-Eigen Vectors:** Cayley Hamilton Theorem with proof, and its applications. (Sections 2.4 of unit 2 of Text book 1 ).

### **PRESCRIPTED TEXT BOOK:**

[1] “A text book of Engineering Mathematics-III” , N.P Bali & Dr.K.L. Sai Prasad. First edition 2018, University science press, New Delhi.

[2] “ Higher Engineering Mathematics”, B. S. Grewal, 40<sup>th</sup> Edition, 2007, Khanna Publishers, New Delhi.

### **REFERENCE BOOKS:**

**Course has Focus on :** Foundation (Elective Paper)

**Websites of Interest :** 1. [www.nptel.ac.in](http://www.nptel.ac.in)

2. [www.epgp.inflibnet.ac.in](http://www.epgp.inflibnet.ac.in)

3. [www.ocw.mit.edu](http://www.ocw.mit.edu)

**P B SIDDHARTHA COLLEGE OF ARTS AND SCIENCE::VIJAYAWADA**  
(An Autonomous College in the Jurisdiction of Krishna University)

**M.Sc. Mathematics**  
**Fourth Semester**

**Open elective**  
**MATRIX THEORY – 22OE3MA1**

**Time:3 hours**

**Max. Marks: 70**

**SECTION A**

**Answer all questions.**

**(5x4=20)**

1 a) Prove that  $A^3 - 4A^2 - 3A + 11I = 0$ , where  $A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix}$  (CO1, L2)

(OR)

b) Determine the rank of the matrix  $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$  (CO1, L2)

2 a) Find the inverse of the matrix  $A = \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$  (CO2, L3)

(OR)

b) For the matrix  $A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & -1 & -1 \end{bmatrix}$ , find non-singular matrices P and Q such that PAQ is in the normal form. (CO2, L3)

3 a) Solve the equations  $x+2y+3z=0$ ,  $3x+4y+4z=0$ ,  $7x+10y+12z=0$ . (CO3, L3)

(OR)

b) Find the values of  $\mu$  and  $\lambda$  so that the equations  $2x+3y+5z=9$ ,  $7x+3y-2z=8$ ,  $2x+3y+\lambda z=\mu$  have no solution. (CO3, L3)

4 a) Find the eigen values and eigen vectors of the matrix  $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$  (CO4, L4)

(OR)

b) Find the characteristic equation of the matrix  $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$  (CO4, L4)

5 a) Verify Cayley Hamilton theorem for the matrix  $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ . (CO5, L2)

(OR)

b) Using Cayley Hamilton theorem find the inverse of  $A = \begin{bmatrix} 5 & 3 \\ 3 & 2 \end{bmatrix}$  (CO5, L2)

## SECTION B

**Answer the following questions.** (5X10=50)

6 a) Find the solutions of the system of equations

$$x_1 - x_2 + 2x_3 = 1,$$

$$2x_1 + 2x_3 = 1,$$

$$x_1 - 3x_2 + 4x_3 = 2 \text{ and describe explicitly all solutions.}$$

(CO1, L2)

(OR)

b) Find the rank of the matrix  $A = \begin{bmatrix} 1 & 2 & -3 \\ 2 & 1 & 0 \\ -2 & -1 & 3 \\ -1 & 4 & -2 \end{bmatrix}$  (CO1, L2)

7 a) Reduce the matrix  $A = \begin{bmatrix} 6 & 3 & -4 \\ -4 & 1 & -6 \\ 1 & 2 & -5 \end{bmatrix}$  into row reduced echelon form. (CO2, L3)

(OR)

b) Reduce the matrix  $A = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & -2 & 4 & 0 \\ 0 & 3 & -1 & 0 \\ 0 & 1 & -2 & 1 \end{bmatrix}$  into normal form. (CO2, L2)

8 a) Solve the system of equations  $x + y - 2z = 0$ ,  $2x - 3y + z = 0$ ,  $x - 4y + 2z = 0$ . (CO3, L3)

(OR)

b) Solve the system of equations  $x + y + 2z = 9$ ,  $2x + 4y - 3z = 1$ ,  $3x + 6y - 5z = 0$  using Gauss elimination method. (CO3, L3)

9 a) Find the eigen values and eigen vectors of the matrix  $A = \begin{bmatrix} 1 & 2 & -1 \\ 1 & 0 & 1 \\ 4 & -4 & 5 \end{bmatrix}$  (CO4, L3)

(OR)

b) Find the eigen values and eigen vectors of the matrix  $A = \begin{bmatrix} 0 & 1/2 \\ 1/2 & 0 \end{bmatrix}$  (CO4, L3)

10 a) State and prove the Cayley-Hamilton theorem.  
(OR)

(CO5, L3)

b) Using Cayley Hamilton theorem find the inverse of  $A = \begin{bmatrix} 7 & -1 & 3 \\ 6 & 1 & 4 \\ 2 & 4 & 8 \end{bmatrix}$ . (CO5, L3)

\*\*\*