

B A, BSC, BCOM DEGREE END SEMESTER EXAMINATION – MARCH 2026**UGP (HONS.) SEMESTER – 4: – DISCIPLINE SPECIFIC COURSE****COURSE CODE -: 24UEMSDSC207: INTERMEDIATE MATRIX ALGEBRA AND APPLICATIONS***(For Regular 2024 Admission)*

Time: 2 Hours

Max. Marks: 70

PART A*(Maximum marks from this part is 10). Each question carries 2 marks.*

1. Define diagonal matrix. Give an example. (U, CO1)
2. Define the elementary row operations. (R, CO1)
3. Define rank of a matrix. What is the rank of a matrix if all its rows are linearly dependent. (U, CO2)
4. Find the value of x if $\begin{vmatrix} x & 1 & 1 \\ 1 & x & 1 \\ 1 & 1 & x \end{vmatrix} = 2$. (E, CO3)
5. Solve the system by Cramer's rule: $3x - 2y = 4$, $5x + y = 7$. (A, CO3)
6. Briefly explain the inter industry relationship. (R, CO4)
7. What is the importance of technological coefficients? (A, CO4)
8. Obtain the technology matrix for the following input output table (E, CO4)

| Producer Industry | Consumer Industry | | Final Demand |
|-------------------|-------------------|------------|--------------|
| | Industry 1 | Industry 2 | |
| Industry 1 | 30 | 60 | 10 |
| Industry 2 | 40 | 30 | 20 |

PART B*(Maximum marks from this part is 30). Each question carries 5 marks*

9. Define trace of a matrix. Find x if $tr(A) = tr \begin{bmatrix} 2+x & 3 & 4 \\ 1 & -1 & 2 \\ -5 & 1 & x \end{bmatrix} = 5$. (E, CO1)
10. Find the sub-matrix, principal sub-matrix and leading sub-matrix of $A = \begin{bmatrix} 1 & 8 & 5 \\ 3 & 5 & 8 \\ 2 & 6 & 3 \end{bmatrix}$. (E, CO2)

11. Differentiate row-echelon form and reduced row-echelon form and give an example for each. (An, CO2)
12. Define a singular matrix. For what value(s) of k is the matrix $\begin{bmatrix} k & 1 & 1 \\ 1 & k & 1 \\ 1 & 1 & k \end{bmatrix}$ singular. (E, CO2)
13. Determine whether the following system has a non-trivial solution and find the non-trivial solution, if it exists:
 $2x + y - z = 0, \quad x + y + z = 0, \quad 3x + 2y = 0.$ (E, CO3)
14. Solve the system by using Gauss elimination method:
 $3x + 4y - z = 8, \quad -2x + y + z = 3, \quad x + 2y - z = 2$ (A, CO3)
15. What are the assumptions of input-output model? (R, CO4)
16. Explain the input-output model and derive the gross output vector for a given final demand vector (U, CO4)

PART C

(Maximum marks from this part is 30). Each question carries 15 marks

17. i) Differentiate symmetric and skew-symmetric matrices and give an example for each.
- ii) Let $A = \begin{bmatrix} 1 & 2 & -1 \\ 0 & 3 & 4 \end{bmatrix}$. Find $A^T A$ and determine whether it is symmetric.
- iii) If $A = \begin{bmatrix} 2 & -1 & 0 \\ 1 & 3 & 4 \\ 0 & 2 & -2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 0 & 1 \\ 2 & 1 & 4 \end{bmatrix}$, find
- $A + B$
 - $A - B$
 - $3A - 2B$. (E, CO1, CO2)
18. i) Find the adjoint of $A = \begin{bmatrix} 2 & -1 & 3 \\ 0 & 4 & 2 \\ 1 & 1 & -1 \end{bmatrix}$ and verify $A(\text{adj } A) = |A|I$.
- ii) Reduce the matrix $\begin{bmatrix} 2 & 1 & -1 & 3 \\ 4 & 2 & 1 & 7 \\ 6 & 3 & 0 & 10 \end{bmatrix}$ into row echelon form and hence, find its rank and nullity.

iii) Check whether matrix $A = \begin{bmatrix} 3 & 0 & 2 \\ 3 & -4 & -3 \\ -4 & 4 & 4 \end{bmatrix}$ is invertible. Find the inverse of the

matrix using elementary row operations, if it exists. (A, CO2)

19. i) How does Gauss elimination help in determining the consistency of a system?

ii) Compare Cramer's rule with Matrix inversion method (any two points).

iii) Solve the following system by using matrix inversion method:

$$x + y + z = 6, \quad 2x + y + z = 7, \quad x + 2y + 3z = 13 \quad (\text{A, CO3})$$

20. The input output matrix with three industries is given below. Find the gross output vector

when the final demand changes to 60, 80 and 50 respectively. (E, CO4)

| Producer Industry | Consumer Industry | | | Final Demand |
|-------------------|-------------------|------------|------------|--------------|
| | Industry 1 | Industry 2 | Industry 3 | |
| Industry 1 | 30 | 70 | 60 | 40 |
| Industry 2 | 80 | 40 | 90 | 30 |
| Industry 3 | 60 | 90 | 40 | 50 |

OBE: Questions to Course Outcome Mapping

| CO | Course Outcome Description | CL | Questions | Total Marks |
|-----|--|----|----------------|-------------|
| CO1 | Understand the concept of matrices, types of matrices and basic operations on matrices and its properties. | U | 1,9,10,17 | 27 |
| CO2 | Evaluate determinants, inverse and apply transformations to find inverse and rank. | E | 2,3,11,12,18 | 29 |
| CO3 | Apply matrix inversion method and Cramer's rule to solve system of equations | A | 4,5,13,14,19 | 29 |
| CO4 | Apply the matrix inversion method to solve problems input-output analysis. | A | 6,7,8,15,16,20 | 31 |

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER.