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TMA–102

B. TECH. (CS) (FIRST SEMESTER)
MID SEMESTER EXAMINATION, 2018

CALCULUS AND LINEAR ALGEBRA

Time : 1:30 Hours

Maximum Marks : 50

Note : (i) This question paper contains two Sections.

(ii) Both Sections are compulsory.

Section—A

1. State True/False/One-line answer :

(1×5=5 Marks)

(a) Maximum rank of matrix is not equal to maximum no. of rows of Matrix.

(True/False)

(b) Every square matrix never satisfies its own characteristic equation. (True/False)

(c) The sum rank and nullity is equal to number of columns of matrix. (True/False)

(d) The rank of matrix A and its transpose is equal. (True/False)

(e) Define Nilpotent matrix with example.

2. Attempt any *five* parts : (3×5=15 Marks)
   (a) Define rank of matrix.
   (b) Give any *three* applications of matrix in Computer Science.
   (c) Define null matrix and show the matrix of $O_{5 \times 3}$.
   (d) Define Idempotent Matrix.
   (e) Using row elementary operation, find the inverse of the matrix A, where $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$.
   (f) Define Skew-Hermitian matrix with example.

Section—B

3. Attempt any *two* parts of choice from (a), (b) and (c). (5×2=10 Marks)
   (a) Show that the set S = {(1, 0, 0), (1, 1, 0), (1, 1, 1), (0, 1, 0)} is not a basis.
   (b) Solve the given system by using Gauss's-Jordan method :

$$x_1 + 2x_2 + x_3 = 3$$
$$2x_1 + 3x_2 + 3x_3 = 10$$
$$3x_1 - x_2 + 2x_3 = 13$$

   (c) Examine whether the system of vectors $\alpha_1 = (1, 0, 3)$; $\alpha_2 = (1, 0, 1)$ and $\alpha_3 = (0, 1, 0)$ are linearly independent or not.

4. Attempt any *two* parts of choice from (a), (b) and (c). (5×2=10 Marks)
   (a) Reduce the matrix A to canonical form and hence find the rank, where $A = \begin{bmatrix} 1 & 2 & 1 & 0 \\ -2 & 4 & 3 & 0 \\ 1 & 0 & 2 & -8 \end{bmatrix}$.
   (b) Verify the Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$.
   (c) Find a basis for the column space of the matrix $A = \begin{bmatrix} 1 & 0 & -1 & 2 \\ 2 & 1 & 2 & 3 \\ -1 & 0 & 1 & -2 \end{bmatrix}$.

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5. Attempt any *two* parts of choice from (a), (b) and (c). (5×2=10 Marks)

(a) Using row elementary operation, find the inverse of the matrix A, where

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

(b) Reduce the matrix A to echelon form and hence find the rank, where

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

(c) Discuss the consistency and solution of the following system of equations :

$$2x + 3y + 4z = 1$$

$$x + 5y - 7z = 5$$

$$3x + 11y + 13z = 5$$