Past Question Paper with answers on Linear Algebra 1 MAT 213

1. A square $(n \times n)$ matrix A is said to be **orthogonal** if it satisfies the condition
$$A \cdot A^T = A^T \cdot A = I_n$$

   (a). Show that the following (3×3)- matrices are each orthogonal

   $$A = \frac{1}{9}\begin{bmatrix} 4 & 7 & -4 \\ 1 & 4 & 8 \\ 8 & -4 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}, \quad C = \begin{bmatrix} \cos 2\theta & \sin 2\theta & 0 \\ \sin\theta & -\cos 2\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

   (b). Let A and B be any $(n \times n)$-matrices
   $A(¿B)$ is said to be **symmetric** if $A = A^T$; A or B is said to be **skew-symmetric** if $A = -A^T$. Show that if A is any square matrix, then $A + A^T$ is **symmetric**, and $A - A^T$ is **skew-symmetric**.

2. **(a)** Let

   $$A = ¿\begin{bmatrix} a & b & c¿ \end{bmatrix}\begin{bmatrix} 0 & 1 & 2¿ \end{bmatrix}¿_{¿}$$

   (i)   Find $det|A| \wedge det(B)$
   (ii)   Show that $det(AB) = det|A| \cdot det(B)$

   (b). Write the following system of linear equations in matrix form:

   $$2x - y = 1¿ \quad x + 3y + z = 0¿ ¿¿ \quad |A¿$$

   (c). State the (4) properties of Transpose operation in Matrix.

3. **(a).** Define a vector space over a field K.
   (b). Give and explain 3 examples of Vector Space.

4. (a) Reduce the Matrix A to row canonical form and determine its rank.

   $$A = \begin{pmatrix} 5 & -9 & 6 \\ 0 & 2 & 3 \\ 0 & 0 & 7 \end{pmatrix}$$

   (b) Suppose $B = \begin{bmatrix} 4 & x+2 \\ 2x-3 & x+1 \end{bmatrix}$ is symmetric. Find the value x and B.

5(a)(i) Define a field?
(ii) Define a Vector space (over a field x) and list the properties associated with its definition

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