



Instructor: Dr. M. Waseem  
Program/ Class: BSM-B2 / BSE-B9 / BSE-B10  
Course: Linear Algebra (MTH231)

Time Allowed: 3 Hrs  
Max. Marks: 50  
Date: 26-06-2019

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Note: Attempt all questions. All questions carry equal marks.

Q 1: Let  $f: R^2 \rightarrow R^2$  be a matrix transformation defined by:  $f(u) = Au$ , where  $A = \begin{bmatrix} 1 & -3 \\ 0 & 1 \end{bmatrix}$ .

Consider a rectangle  $R$  with the vertices:  $(x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4)$ . The vertices of the image of rectangle  $R$  under the transformation  $f(u) = Au$ , are given as:  $(0,0), (-6,2), (4,0), (-2,2)$ . Find the vertices  $(x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4)$  of rectangle  $R$ . Also draw the rectangle  $R$  and its image on different  $xy$ -planes.

Q 2: Find the solution (if possible) of the following system of linear equations (using reduced row echelon form):

$$\begin{aligned} x + y &= 3 - i, \\ ix + y + z &= 3, \\ y + iz &= 3. \end{aligned}$$

Q 3: Find determinant (if it exists) of the following matrix by using the Definition of Determinant:

$$\begin{bmatrix} 2 & 1 & -1 & 2 \\ 2 & -3 & -1 & 4 \\ 1 & 3 & 2 & -3 \\ 1 & -2 & -1 & 1 \end{bmatrix}$$

Q 4: The set  $V$  of all  $2 \times 2$  matrices  $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$  with trace equal to zero ( $\text{trace}(A) = a_{11} + a_{22} = 0$ ). Let the operations defined on  $V$ :  $\oplus$  and  $\odot$  are the usual matrix addition and scalar multiplication. Is  $V$  a vector space?

Q 5: Let  $P_2$  be the vector space of all polynomials of degree 2 or less and the zero polynomial, with the operations  $\oplus$  and  $\odot$ , the usual addition and scalar multiplication. Let  $W$  be the subset of  $P_2$  consisting of all polynomials of the form:

$$a_2 t^2 + a_1 t + a_0, \text{ where } a_2 + a_1 = a_0.$$

Is  $W$  a subspace of vector space  $P_2$  or not?