National University of Computer and Emerging Sciences
Lahore Campus

Linear Algebra (MT1004)

Date: November 2nd, 2024

Course Instructor(s)

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Sessional-II Exam

Total Time (Hrs):   1 Hour

Total Marks: 40

Total Questions: 1

____ ..No   Section   Student Signature

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Instruction/Notes: 1. Programmable calculators are not allowed.

     2. Any incorrect calculations found at a step will not be marked further. Marks will only be awarded for correct calculations.

     3. Do all the questions in the given order as mentioned in the paper.

     4. Your kind cooperation will be appreciable for obeying the instructions.

CLO #2: Properties of vectors in 2-space, 3-space and n-space and recognize vector spaces and/or subspaces to compute their bases and its dimension

Q#1. (a): Consider the set $V = R^2$ of all ordered pairs of real numbers, with standard vector addition but with scalar multiplication defined by $k(x, y) = (3kx, 1)$. Identify the axioms that do not hold for V to be a vector space.   [10 marks]

b): Use subspace test to determine whether the set of all $n \times n$ matrices A such that $tr(A) = 0$ *is* a subspace of M_{nn}.   [4 marks]

c): Find the basis and dimension for the solution space of the given homogenous linear system.   [10 marks]

$$2x + y + 3z = 0$$
$$x \quad\quad + 5z = 0$$
$$y + \quad z = 0$$

d): Verify that the Cauchy-Schwarz inequality holds for the given vectors in $4 - space$.

$$\vec{u} = (5, 0, -3, 7), \quad \vec{v} = (1, 2, 2, 2, 1). \qquad \text{[3 marks]}$$

$$\vec{v} = (1, 2, 2, 1)$$

e): Show that the set $S = \{p_1, p_2, p_3\}$ is a basis for P_2, where

$$p_1 = 1 + x + x^2, \quad p_2 = x + x^2, \quad p_3 = x^2.$$

Also find the coordinate vector of $p = 7 - x + 2x^2$ relative to the basis set S. \qquad [8 marks]

f): Find the volume of parallelepiped with sides u, v and w. Also determine whether u, v and w lie in same plane when positioned so that their initial points coincide. \qquad [5 marks]

$$u = (2, 6, -1), \qquad v = (1, 1, 1), \qquad w = (4, 6, 2).$$

Good Luck!