# INSTRUCTOR'S MANUAL

to accompany

*Linear Algebra:*
*4th Edition*

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# 1

# Vector Spaces

## 1.1 INTRODUCTION

**2.** **(b)** $x = (2, 4, 0) + t(-5, -10, 0)$ **(d)** $x = (-2, -1, 5) + t(5, 10, 2)$

**3.** **(b)** $x = (3, -6, 7) + s(-5, 6, -11) + t(2, -3, -9)$
**(d)** $x = (1, 1, 1) + s(4, 4, 4) + t(-7, 3, 1)$

**4.** $(0, 0)$

## 1.2 VECTOR SPACES

**2.** $\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$

**4.** **(b)** $\begin{pmatrix} 1 & -1 \\ 3 & -5 \\ 3 & 8 \end{pmatrix}$ **(d)** $\begin{pmatrix} 30 & -20 \\ -15 & 10 \\ -5 & -40 \end{pmatrix}$

**(f)** $-x^3 + 7x^2 + 4$ **(h)** $3x^5 - 6x^3 + 12x + 6$

**5.** $\begin{pmatrix} 8 & 3 & 1 \\ 3 & 0 & 0 \\ 3 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 9 & 1 & 4 \\ 3 & 0 & 0 \\ 1 & 1 & 0 \end{pmatrix} = \begin{pmatrix} 17 & 4 & 5 \\ 6 & 0 & 0 \\ 4 & 1 & 0 \end{pmatrix}$

**16.** Yes **18.** No, (VS 1) fails. **19.** No, (VS 8) fails.

## 1.3 SUBSPACES

**2.** **(b)** $\begin{pmatrix} 0 & 3 \\ 8 & 4 \\ -6 & 7 \end{pmatrix}$ **(d)** $\begin{pmatrix} 10 & 2 & -5 \\ 0 & -4 & 7 \\ -8 & 3 & 6 \end{pmatrix}$ The trace is 12. **(f)** $\begin{pmatrix} -2 & 7 \\ 5 & 0 \\ 1 & 1 \\ 4 & -6 \end{pmatrix}$

**(h)** $\begin{pmatrix} -4 & 0 & 6 \\ 0 & 1 & -3 \\ 6 & -3 & 5 \end{pmatrix}$ The trace is 2.

**8.** **(b)** No **(d)** Yes **(f)** No

**9.** $\mathsf{W}_1 \cap \mathsf{W}_3 = \{0\}$, $\mathsf{W}_1 \cap \mathsf{W}_4 = \mathsf{W}_1$,
$\mathsf{W}_3 \cap \mathsf{W}_4 = \{(a_1, a_2, a_3) \in \mathsf{R}^3 \colon a_1 = -11a_3 \text{ and } a_2 = -3a_3\}$

## 1.4 LINEAR COMBINATIONS AND SYSTEMS OF LINEAR EQUATIONS

**2.** **(b)** $(-2,-4,-3)$
**(d)** $\{x_3(-8,3,1,0)+(-16,9,0,2)\colon\ x_3 \in R\}$
**(f)** $(3,4,-2)$

**3.** **(a)** $(-2,0,3) = 4(1,3,0) - 3(2,4,-1)$
**(b)** $(1,2,-3) = 5(-3,2,1) + 8(2,-1,-1)$
**(d)** No
**(f)** $(-2,2,2) = 4(1,2,-1) + 2(-3,-3,3)$

**4.** **(a)** $x^3 - 3x + 5 = 3(x^3 + 2x^2 - x + 1) - 2(x^3 + 3x^2 - 1)$
**(b)** No
**(c)** $-2x^3 - 11x^2 + 3x + 2 = 4(x^3 - 2x^2 + 3x - 1) - 3(2x^3 + x^2 + 3x - 2)$
**(d)** $x^3 + x^2 + 2x + 13 = -2(2x^3 - 3x^2 + 4x + 1) + 5(x^3 - x^2 + 2x + 3)$
**(f)** No

**5.** **(b)** No **(d)** Yes **(f)** No **(h)** No

**11.** The span of $\{x\}$ is $\{0\}$ if $x = 0$ and is the line through the origin of $\mathsf{R}^3$ in the direction of $x$ if $x \neq 0$.

**17.** if W is finite

## 1.5 LINEAR DEPENDENCE AND LINEAR INDEPENDENCE

**2.** **(b)** Linearly independent **(d)** Linearly dependent
**(f)** Linearly independent **(h)** Linearly independent
**(j)** Linearly dependent

**10.** $(1,0,0)$, $(0,1,0)$, $(1,1,0)$

## 1.6 BASES AND DIMENSION

**2.** **(b)** Not a basis **(d)** Basis

**3.** **(b)** Basis **(d)** Basis

**4.** No, $\dim(\mathsf{P}_3(R)) = 4$. **5.** No, $\dim(\mathsf{R}^3) = 3$.

**8.** $\{u_1, u_3, u_5, u_7\}$

**10.** **(b)** $12 - 3x$ **(d)** $-x^3 + 2x^2 + 4x - 5$

**14.** $\{(0,1,0,0,0), (0,0,0,0,1), (1,0,1,0,0), (1,0,0,1,0)\}$ and $\{(-1,0,0,0,1), (0,1,1,1,0)\}$; $\dim(\mathsf{W}_1) = 4$ and $\dim(\mathsf{W}_2) = 2$.

**16.** $\dim(\mathsf{W}) = \frac{1}{2}n(n+1)$