7. **40%** Misalkan $S=\{\mathbf{u}_1,\mathbf{u}_2,\mathbf{u}_3\}$ basis untuk R^3, dengan $\mathbf{u}_1=[1,a,1]$, $\mathbf{u}_2=[1,1,-1]$, dan $\mathbf{u}_3=[-1,1,0]$. Carilah basis ortonormal $B=\{\mathbf{v}_1,\mathbf{v}_2,\mathbf{v}_3\}$ untuk R^3

$u_1 = [1 \quad 5 \quad 1]$
$u_2 = [1 \quad 1 \quad -1]$
$u_3 = [-1 \quad 1 \quad 0]$

$$v_1 = \frac{u_1}{|u_1|} = \frac{[1 \quad 5 \quad 1]}{\sqrt{27}} = \left[\frac{1}{\sqrt{27}} \quad \frac{5}{\sqrt{27}} \quad \frac{1}{\sqrt{27}}\right] = \left[\frac{\sqrt{3}}{9} \quad \frac{5\sqrt{3}}{9} \quad \frac{\sqrt{3}}{9}\right]$$

$$v_2 = \frac{x_2}{|x_2|}, dengan\ x_2 = u_2 - [u_2 * v_1]v_1$$

$$[u_2 * v_1] = [1 \quad 1 \quad -1] * \left[\frac{\sqrt{3}}{9} \quad \frac{5\sqrt{3}}{9} \quad \frac{\sqrt{3}}{9}\right]$$

$$[u_2 * v_1] = \frac{\sqrt{3}}{9} + \frac{5\sqrt{3}}{9} - \frac{\sqrt{3}}{9} = \frac{5\sqrt{3}}{9}$$

$$[u_2 * v_1]v_1 = \frac{5\sqrt{3}}{9} * \left[\frac{\sqrt{3}}{9} \quad \frac{5\sqrt{3}}{9} \quad \frac{\sqrt{3}}{9}\right] = \left[\frac{5}{27} \quad \frac{25}{27} \quad \frac{5}{27}\right]$$

$$x_2 = [1 \quad 1 \quad -1] - \left[\frac{5}{27} \quad \frac{25}{27} \quad \frac{5}{27}\right] = \left[\frac{22}{27} \quad \frac{2}{27} \quad -\frac{32}{27}\right]$$

$$v_2 = \frac{\left[\frac{22}{27} \quad \frac{2}{27} \quad -\frac{32}{27}\right]}{\sqrt{\frac{56}{27}}} = \left[\frac{11\sqrt{42}}{126} \quad \frac{\sqrt{42}}{126} \quad -\frac{8\sqrt{42}}{63}\right]$$

$$v_3 = \frac{x_3}{|x_3|}, dengan\ x_3 = u_3 - [u_3 * v_1]v_1 - [u_3 * v_2]v_2$$

$$[u_3 * v_1] = [-1 \quad 1 \quad 0] * \left[\frac{\sqrt{3}}{9} \quad \frac{5\sqrt{3}}{9} \quad \frac{\sqrt{3}}{9}\right] = \frac{4\sqrt{3}}{9}$$

$$[u_3 * v_1]v_1 = \frac{4\sqrt{3}}{9} * \left[\frac{\sqrt{3}}{9} \quad \frac{5\sqrt{3}}{9} \quad \frac{\sqrt{3}}{9}\right] = \left[\frac{4}{27} \quad \frac{20}{27} \quad \frac{4}{27}\right]$$

$$[u_3 * v_2] = [-1 \quad 1 \quad 0] * \left[\frac{11\sqrt{42}}{126} \quad \frac{\sqrt{42}}{126} \quad -\frac{8\sqrt{42}}{63}\right] = -\frac{5\sqrt{42}}{63}$$

$$[u_3 * v_2]v_2 = (-\frac{5\sqrt{42}}{63}) * \begin{bmatrix}\frac{11\sqrt{42}}{126} & \frac{\sqrt{42}}{126} & -\frac{8\sqrt{42}}{63}\end{bmatrix} = \begin{bmatrix}-\frac{55}{189} & -\frac{5}{189} & \frac{80}{189}\end{bmatrix}$$

$$x_3 = u_3 - [u_3 * v_1]v_1 - [u_3 * v_2]v_2$$

$$x_3 = [-1 \quad 1 \quad 0] - \begin{bmatrix}\frac{4}{27} & \frac{20}{27} & \frac{4}{27}\end{bmatrix} - \begin{bmatrix}-\frac{55}{189} & -\frac{5}{189} & \frac{80}{189}\end{bmatrix}$$

$$x_3 = \begin{bmatrix}-\frac{6}{7} & \frac{2}{7} & -\frac{4}{7}\end{bmatrix}$$

$$v_3 = \frac{x_3}{|x_3|}$$

$$v_3 = \frac{\begin{bmatrix}-\frac{6}{7} & \frac{2}{7} & -\frac{4}{7}\end{bmatrix}}{\sqrt{\frac{8}{7}}} = \begin{bmatrix}-\frac{3\sqrt{14}}{14} & \frac{\sqrt{14}}{14} & -\frac{\sqrt{14}}{7}\end{bmatrix}$$

$$\text{B} = \left\{\begin{bmatrix}\frac{\sqrt{3}}{9}\\ \frac{5\sqrt{3}}{9}\\ \frac{\sqrt{3}}{9}\end{bmatrix}, \begin{bmatrix}\frac{11\sqrt{42}}{126}\\ \frac{\sqrt{42}}{126}\\ -\frac{8\sqrt{42}}{63}\end{bmatrix}, \begin{bmatrix}-\frac{3\sqrt{14}}{14}\\ \frac{\sqrt{14}}{14}\\ -\frac{\sqrt{14}}{7}\end{bmatrix}\right\}$$