Step 1: $S_V = \left\{ e_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, e_2 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, e_3 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \right\}$

List all bases you need.

$S_W = \left\{ f_1 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, f_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \right\}$

$C_V = \{ v_1 = e_1, \; v_2 = e_3, \; v_3 = e_2 - 3e_1 \}$

$C_W = \{ w_1 = f_1 - f_2, \; w_2 = 2f_1 - f_2 \}$

Step 2 for V: Write vectors in C_V in S_V-coordinates.

$v_1 = e_1$, so $[v_1]_{S_V} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$

$v_2 = e_3$, so $[v_2]_{S_V} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

$v_3 = e_2 - 3e_1$ so $[v_3]_{S_V} = \begin{bmatrix} -3 \\ 1 \\ 0 \end{bmatrix}$

Step 3 for V: Then $P_{S_V \leftarrow C_V} = \begin{bmatrix} 1 & 0 & -3 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

Step 2 for W

$w_1 = f_1 - f_2$ $\quad [w_1]_{S_W} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

$w_2 = 2f_1 - f_2$ $\quad [w_2]_{S_W} = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$

Step 3 for W: So $P_{S_W \leftarrow C_W} = \begin{bmatrix} 1 & 2 \\ -1 & -1 \end{bmatrix}$