$\vec{U_1} = (3,1,0,1)$

$\vec{U_2} = (1,2,1,1)$

$U_3 = (-1,0,2,-1)$

$$\boxed{\vec{V_1} = \frac{1}{\sqrt{11}}(3,1,0,1)}$$

$$\text{Proy}_{V_1} U_2 = \frac{6}{\sqrt{11}} \cdot (3,1,0,1)\frac{1}{\sqrt{11}} = \left(\frac{18}{11}, \frac{6}{11}, 0, \frac{6}{11}\right)$$

$$\vec{V_2} = (1,2,1,1) - \left(\frac{18}{11}, \frac{6}{11}, 0, \frac{6}{11}\right)$$

$$\vec{V_2} = \left(\frac{-7}{11}, \frac{16}{11}, 1, \frac{5}{11}\right)$$

$$\boxed{\vec{V_2} = \frac{1}{\sqrt{451}}(-7,16,11,5)}$$

$$S_2 = \text{gen}\left\{\frac{1}{\sqrt{11}}(3,1,0,1), \frac{1}{\sqrt{451}}(-7,16,11,5)\right\}$$

$$\text{Proy}_{S_2} U_3 = (U_3 \cdot V_1)V_1 + (U_3 \cdot V_2)V_2$$

$$= \frac{-4}{\sqrt{11}}\frac{1}{\sqrt{11}}(3,1,0,1) + \frac{24}{\sqrt{451}}\frac{1}{\sqrt{451}}(-7,16,11,5)$$

$$= \frac{-4}{11}(3,1,0,1) + \frac{24}{451}(-7,16,11,5)$$

$$= \left(\frac{-12}{11}, \frac{-4}{11}, 0, \frac{-4}{11}\right) + \left(\frac{-168}{451}, \frac{384}{451}, \frac{264}{451}, \frac{120}{451}\right)$$

$$= \left(\frac{-60}{41}, \frac{20}{41}, \frac{24}{41}, \frac{-4}{41}\right)$$

$$\vec{V_3} = (-1,0,2,-1) - \left(\frac{-60}{41}, \frac{20}{41}, \frac{24}{41}, \frac{4}{41}\right)$$

$$\vec{V_3} = \left(\frac{19}{41}, \frac{-20}{41}, \frac{58}{41}, \frac{-37}{41}\right)$$

$$\vec{V_3} = \frac{1}{41}(19,-20,58,-37)$$

$$\boxed{\vec{V_3} = \frac{1}{\sqrt{5494}}(19,-20,58,-37)}$$

$$P_w(b) = C_1 V_1 + C_2 V_2 + C_3 V_3$$

$$C_1 = (-3,-3,8,9)\cdot(3,1,0,1)\frac{1}{\sqrt{11}} \qquad -9-3+9$$

$$C_1 = \frac{-3}{\sqrt{11}}$$

$$C_2 = (-3,-3,8,9)\cdot(-7,16,11,5)\frac{1}{\sqrt{451}}$$

$$C_2 = \frac{106}{\sqrt{451}}$$

$$C_3 = (-3,-3,8,9)\cdot(19,-20,58,-37)\frac{1}{\sqrt{5494}}$$

$$C_3 = \frac{134}{\sqrt{5494}}$$

$$P_w(b) = \frac{-3}{\sqrt{11}}\frac{1}{\sqrt{11}}(3,1,0,1) + \frac{106}{\sqrt{451}}\frac{1}{\sqrt{451}}(-7,16,11,5) + \frac{134}{\sqrt{5494}}\frac{1}{\sqrt{5494}}$$

$$(19,-20,58,-37)$$

$$= \frac{-3}{11}(3,1,0,1) + \frac{106}{451}(-7,16,11,5) + \frac{1}{41}(19,-20,58,-37)$$

$$= \left(\frac{-9}{11}, \frac{-3}{11}, 0, \frac{-3}{11}\right) + \left(\frac{-742}{451}, \frac{1696}{451}, \frac{1166}{451}, \frac{530}{451}\right) + \left(\frac{19}{41}, \frac{-20}{41}, \frac{58}{41}, \frac{-37}{41}\right)$$

$$\left(\frac{-101}{41}, \frac{143}{41}, \frac{106}{41}, \frac{37}{41}\right) + \left(\frac{19}{41}, \frac{-20}{41}, \frac{58}{41}, \frac{-37}{41}\right)$$

$$\boxed{Proy_w(b) = (-2, 3, 4, 0)}$$