Problem 1

$$F_2 = \begin{bmatrix} 1 & 1 \\ 1 & e^{i2\pi/2} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}.$$

Problem 2

We have

$$b = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

to match the roots of F_2, and

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$