Step-1

We have

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

$$\det P=(-1)\begin{vmatrix}1&0&0\\0&1&0\\0&0&1\end{vmatrix}$$

$=-1$ (expanding by first row with help of cofactors)

to obtain identify from P.

Step-2

We have

$$P=\xrightarrow[\substack{\text{interchange row3,}\\\text{row4 interchange}}]{Row1,Row2}\begin{bmatrix}1&0&0&0\\0&0&0&1\\0&0&1&0\\0&1&0&0\end{bmatrix}\xrightarrow[\text{interchange}]{Row2,Row4}\begin{bmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&1\end{bmatrix}$$

Step-3

We needed 3 exchanges of rows to get identity from P so that

$$\begin{aligned}\det P&=(-1)^2\det I=(-1).1\\&=-1\end{aligned}$$

$$P^2=\begin{bmatrix}0&0&1&0\\0&0&0&1\\1&0&0&0\\0&1&0&0\end{bmatrix}\xrightarrow[\substack{\text{interchange Row2,}\\\text{Row4 interchange}}]{Row3,Row1}\begin{bmatrix}1&0&0&0\\0&1&0&0\\0&0&1&0\\0&0&0&1\end{bmatrix}=I$$

Step-4

So P^2 needed by only two interchanges to reach identify hence

$\boxed{\det P^2 = \det I = 1}$