

$$\textcircled{2} \quad \begin{aligned} \dot{x}_1 &= x_2 \\ \dot{x}_2 &= x_3 \end{aligned} \quad * \quad \begin{aligned} \dot{x}_3 &= x_3 + u \quad * \end{aligned}$$

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$C = [B \ AB \ A^2B]$$

$$AB = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = (0)(0) + (1)(0) + (0)(1) = 0$$

$$= (0)(0) + (0)(0) + (1)(1) = 1$$

$$= (0)(0) + (0)(0) + (1)(1) = 1$$

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

$$A^2B = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$$

$$C = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad \det(C) = (1) \begin{bmatrix} (0)(1) - (1)(1) \end{bmatrix} = \boxed{-1}$$