$$\bar{x} = \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \omega_1 \\ \omega_2 \end{bmatrix}$$

$$\frac{10}{9}\ddot{\varphi}_1 + 0.1(\dot{\varphi}_1 - \dot{\varphi}_2) + (\varphi_1 - \varphi_2) = I$$

$$10\ddot{\varphi}_2 + 0.1(\dot{\varphi}_2 - \dot{\varphi}_1) + (\varphi_2 - \varphi_1) = T_d$$

$$\ddot{\varphi}_1 = -\frac{9}{10}\varphi_1 + \frac{9}{10}\varphi_2 - \frac{9}{100}\dot{\varphi}_1 + \frac{9}{100}\dot{\varphi}_2 + \frac{9}{10}I$$

$$= -\frac{9}{10}\varphi_1 + \frac{9}{10}\varphi_2 - \frac{9}{100}\omega_1 + \frac{9}{100}\omega_2 + \frac{9}{10}I$$

$\dot{\varphi}_1 = \omega_1$

$\dot{\varphi}_2 = \omega_2$

$\dot{\omega}_1 = \ddot{\varphi}_1$

$\dot{\omega}_2 = \ddot{\varphi}_2$

$$\ddot{\varphi}_2 = \frac{1}{10}\varphi_1 - \frac{1}{10}\varphi_2 + \frac{1}{100}\dot{\varphi}_1 - \frac{1}{100}\dot{\varphi}_2$$

$$= \frac{1}{10}\varphi_1 - \frac{1}{10}\varphi_2 + \frac{1}{100}\omega_1 - \frac{1}{100}\omega_2$$

$$\dot{\bar{x}} = \begin{bmatrix} \dot{\varphi}_1 \\ \dot{\varphi}_2 \\ \dot{\omega}_1 \\ \dot{\omega}_2 \end{bmatrix} = \begin{bmatrix} \dot{\varphi}_1 \\ \dot{\varphi}_2 \\ \ddot{\varphi}_1 \\ \ddot{\varphi}_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -9/10 & 9/10 & -9/100 & 9/100 \\ 1/10 & -1/10 & 1/100 & -1/100 \end{bmatrix} \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \omega_1 \\ \omega_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 9/10 \\ 1/10\, d \end{bmatrix} I$$

$$y = \varphi_2 = \begin{bmatrix} 0 & 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \omega_1 \\ \omega_2 \end{bmatrix}$$