

Assuming θ is defined in the opposite direction to θ_i , the EOM for J is:

(a)
$$J\ddot{\theta} + (c_1 + c_2)\dot{\theta} + k\theta = k\frac{n_1}{n_2}\theta_i$$

(b)
$$\omega_n = \sqrt{\frac{k}{J}}$$

To specify $\ddot{\theta}$ as the output of your state space representation, use the equation where you wrote $\ddot{\theta}$ in terms of the states and input of the system.

(c)
$$\underline{A} = \begin{bmatrix} 0 & 1 \\ -\frac{k}{J} & -\frac{(c_1 + c_2)}{J} \end{bmatrix}$$

(d) No answer given.