Problem 3.3

a) Two coupled 2nd order ODE's

$$J\ddot{\theta} + kr^2\theta - krx = T$$
$$m\ddot{x} + b\dot{x} + kx - kr\theta = 0$$

b) State-space form

$$\begin{Bmatrix} \dot{\theta} \\ \dot{\omega} \\ \dot{x} \\ \dot{v} \end{Bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -kr^2/J & 0 & kr/J & 0 \\ 0 & 0 & 0 & 1 \\ kr/m & 0 & -k/m & -b/m \end{bmatrix} \begin{Bmatrix} \theta \\ \omega \\ x \\ v \end{Bmatrix} + \begin{bmatrix} 0 \\ 1/J \\ 0 \\ 0 \end{bmatrix} \{T(t)\}$$

You output equation should look like this:

$$\begin{Bmatrix} x \\ v \\ \omega \\ F_{spring} \end{Bmatrix} = \begin{bmatrix} \text{You be able to should fill this in} \end{bmatrix} \begin{Bmatrix} \theta \\ \omega \\ x \\ v \end{Bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \{T(t)\}$$