*Task 5

Let x_1, x_2, x_3, x_4 be state variable

$x_1 = \theta$

$x_2 = \dot{\theta} = \dot{x}_1$

$\dot{x}_2 = \ddot{\theta}$

$x_3 = x$

$x_4 = \dot{x}$

$\dot{x}_4 = \ddot{x}$

$$M\dot{x}_4 = F - mg x_1$$

$$\dot{x}_4 = -\frac{mg}{M} x_1 + \frac{F}{M}$$

$$Ml\dot{x}_2 = (M+m)g x_1 - F$$

$$\dot{x}_2 = \frac{(M+m)g}{Ml} x_1 - \frac{F}{Ml}$$

$$\dot{x}_1 = x_2$$

$$\dot{x}_3 = x_4$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{(M+m)g}{ml} & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ -\frac{mg}{M} & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} 0 \\ -1/ml \\ 0 \\ 1/M \end{bmatrix} [F]$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

Let $M = 5$

$m = 1$

$l = 1$