DESIGN STEPS FOR POLE PLACEMENT.

$$\dot{x} = Ax + Bu \qquad x \in \mathbb{R}^n \qquad u \in \mathbb{R}$$

$$\boxed{u = -Kx}$$

Design k such that the eigen values of $A-BK$ are $\mu_1, \mu_2, \ldots, \mu_n$.

STEP 1:

Check the controlability for the system. If the system is completely ~~state~~ controlable use the following steps.

STEP 2:

Form the characteristic polynomial for A

$$\boxed{\det(sI - A) = s^n + a_1 s^{n-1} + \ldots + a_{n-1}s + a_n}$$

determine the values of $a_1, \ldots a_n$.

STEP 3:

Determine the transformation matrix T that transforms the system into Controllable canonical form. If the system is already in controlable caronical form the $T = I$.

$$T = CW$$

$$C = \begin{bmatrix} B & AB & \dots & A^{n-1}B \end{bmatrix}$$

$$W = \begin{bmatrix} a_{n-1} & a_{n-2} & \cdots & a_1 & 1 \\ a_{n-2} & a_{n-3} & & 1 & \\ \vdots & & & & \\ a_1 & 1 & & \emptyset & \\ 1 & & & & \end{bmatrix}$$

STEP 4:

Using the desired eigen values, write the characteristic eqn.

$$(s-\mu_1)(s-\mu_2)\cdots(s-\mu_n) = s^n + \alpha_1 s^{n-1} + \dots + \alpha_n$$

STEP 5:

$$K = \begin{bmatrix} \alpha_n - a_n, & \alpha_{n-1} - a_{n-1}, & \dots, & \alpha_1 - a_1 \end{bmatrix}$$

HW# 2

$$(M+m)\ddot{x} + m\ddot{\theta}l\cos\theta - m\dot{\theta}^2 l\sin\theta = u$$

$$ml^2\ddot{\theta} + ml\ddot{x}\cos\theta = mgl\sin\theta$$

$$\theta \approx 0$$

$$\dot{\theta} \approx 0$$

$$(M+m)\ddot{x} + m\ddot{\theta} = u$$

$$ml^2\ddot{\theta} + ml\ddot{x} = 0$$

SET POINT REGULATION.

$$\dot{x} = Ax + Bu$$

$$y = Cx$$

$$u = -Kx$$