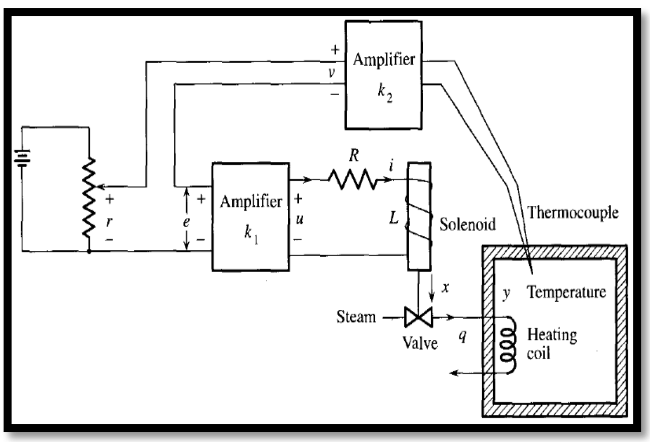
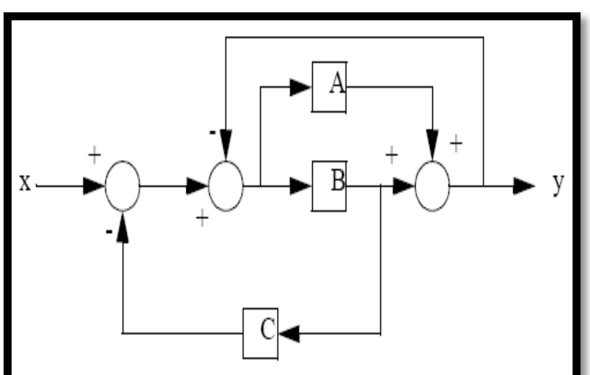
Prob. 1

A. Consider the temperature control system shown below. The problem is to control the temperature y inside the chamber. The chamber is heated by steam. The flow q of hot steam is proportional to the valve opening x ; that is, $q = k_q x$. The valve opening x is controlled by a solenoid and is assumed to be proportional to the solenoid current i; that is, $= k_s i$. It is assumed that the chamber temperature y and the steam flow q are related by $\frac{dy}{dt} = -cy + k_c q$ where c depends on the insulation and the temperature difference between inside and outside the chamber. Find $\frac{Y(s)}{R(s)}$



Prob. 2

A. Reduce the block diagram shown below to find the transfer function $Y(s)/X(s)$



B. Check the stability of the system that have the characteristic equation

$$s^5 + 3s^4 + 2s^3 + 6s^2 + 6s + 9$$

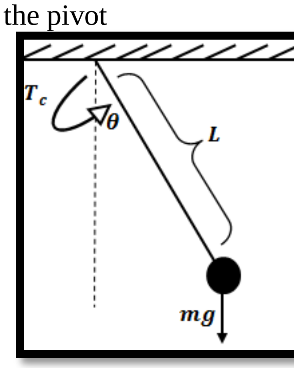
C. Use **MATLAB** to find the exact roots.

Prob. 3

A. Find the range of the controller gains (K, K_I) so that the **PI** feedback systems that have the characteristic equation

$$1 + \left(K + \frac{K_I}{s}\right)\frac{1}{(s+1)(s+2)} \quad \text{to be stable}$$

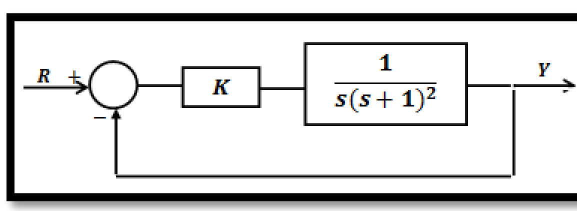
B. Write the equations of motions for the simple **pendulum** shown, where all the mass is concentrated at the end point and there is a torque, T_c , applied at the pivot



Prob. 4

A. For the system shown below,

i. Construct the **Root locus**, then determine
ii. Coordinate of **centroid,** Slopes of **asymptotes**
iii. **Imaginary** axis crossing
iv. The value of K for a pole location $S = (-10, 0)$



Best Wishes
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