Ref:- EX/M.SC/INST./1/1//104A/IV/39/2019

Master of Science (Instrumentation) Examination, 2018-19

1ST year, 1st Semester

SUBJECT: LINEAR CONTROL SYSTEM

PAPER:.IV CODE I104A

Total Marks 50 time : 2 hr

Q1 and any four from rest

1. Any Five (2×5=10)

A Define open loop control system & closed loop control system

B. What is transient response & steady state response?

C. What is the significance of integral controller and derivative controller in a PID controller?

D. What are the main advantages of Bode plot?

E. Define- Corner frequency.

F. Define Phase lag and phase lead.

G. State Nyquist stability criterion

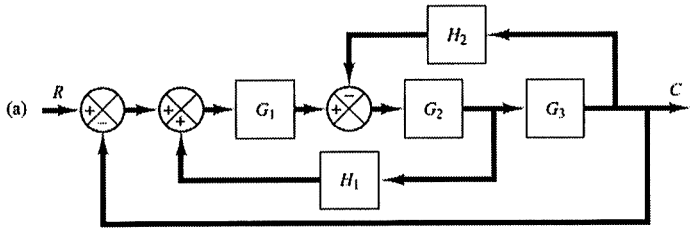
H. What is meant by steady state error ?

I. Define relative stability

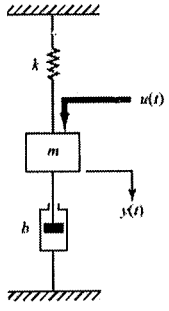
J. What are break away and break in points?

K. What are the advantages of state space analysis?

1. Design an electronic PID controller and derive the transfer function of the electronic system. Show a block diagram how the PID controller implemented in close loop control system 10
2. Consider the system and simplify the block diagram. 10



3. Consider a mechanical system given below .Derive that state space equation and output equation assuming that system is linear and external force u(t) is input to the system and displacement y(t) of mass is the output of the system. 10



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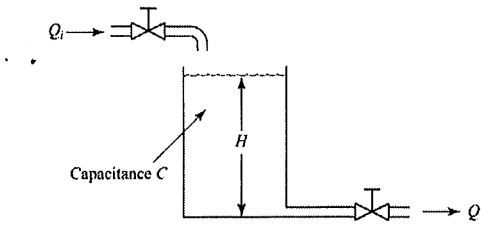
4. Compare the pneumatic system over hydrolic system. 10

In the liquid level system of following figure assume that outflow rate Q m^3/sec through the outflow valve is related to the head H m by $Q=KH^{1/2}= 0.01\ H^{1/2}$, Assume also that when the inflow rate Q_i is 0.015m^3/sec the head stays constant. For t<0 the system is at steady state (Q_i = 0.015 m^3/sec) . At t=0 the inflow valve is closed and so there is no inflow at t>= 0. Find thetime necessary to empty the tank to the half original head. The capacitance C of the tank is 2m^2.



5. Obtain a state –space equation and output equation for the system defined by 10

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

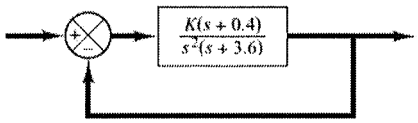
6. Define the transient response specification of a second order underdamped system. 10

Consider this second order system, whose damping factor is 0.6 and natural frequency is 5 rad /sec. Obtain rise time, peak time, and maximum overshoot settling time when system is subjected to unit step signal.

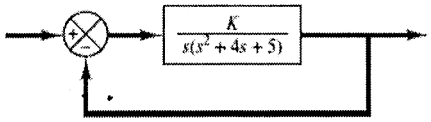
7. Explain Routh's stability criterion . Find the value of K in the closed loop control system for Routh's stability. The transfer function is 10

$$\frac{C(s)}{R(s)} = \frac{K}{s(s^2 + s + 1)(s + 2) + K}$$

8. Sketch the root loci of the following system 10



9. Sketch the root loci of the system .observe that small and large value of K system is underdamped and, medium value of K system is overdamped. 10



10. Draw a Bode diagram on logarithmic graph paper of the following open loop system. Determine The Gain Margin and Phase Margin 10

$$G(s) = \frac{1}{S(S+1)(0.5S+1)}$$