AALIMMUHAMMEDSALEGHCOLLEGE OF ENGINEERING, CHENNAI-55
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
MODEL EXAMINATION –APRIL'14
EC2255-CONTROL SYSTEMS

SEM: IV Duration: 3 hrs
DATE: Max Marks: 100

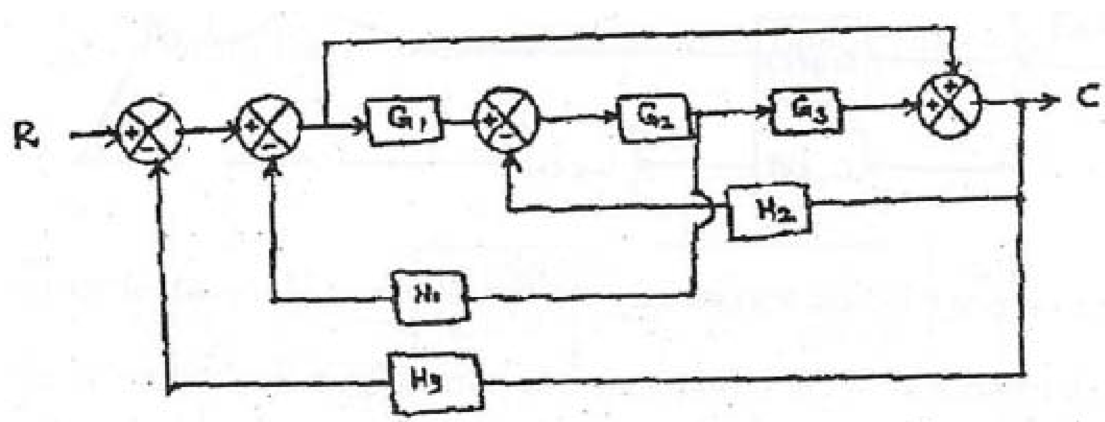
Answer all the questions

Part A (10 x 2=20)

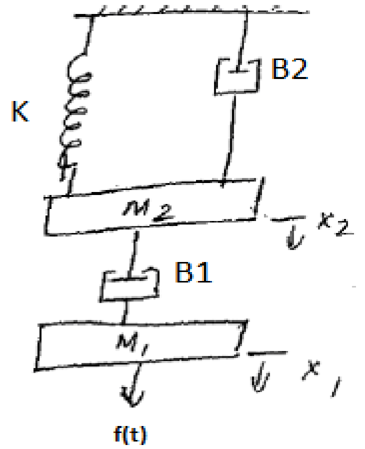
1. Give the comparison between open loop and closed loop systems
2. What are the advantages of closed loop systems?
3. Name the signals used to evaluate the performance of the given system
4. What may be the damping ratio when the percentage of overshoot of the system is 100%?
5. Define gain margin and phase margin
6. Draw the circuit of lead compensator and draw its pole-zero diagram
7. State Routh -Hurwitz stability criterion
8. Define asymptotic stability and relative stability
9. State the properties of state transition matrix
10. Define controllability and observability.

Part B (5 x 16 =80 marks)

11. (a) (i) Obtain the transfer function of the block diagram shown in fig 1 using Block diagram reduction rules(8)

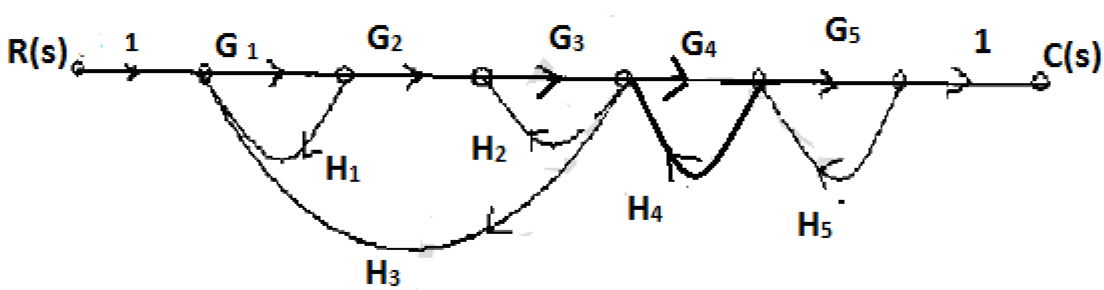


(ii) Obtain the transfer function of the mechanical system shown in fig2 (8)

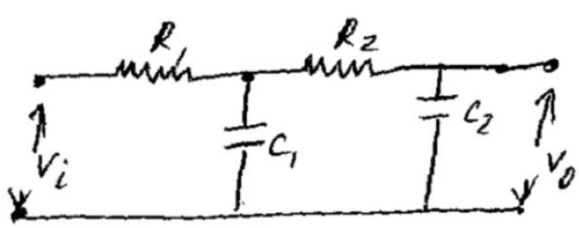


OR

(b) (i)Obtain the transfer function of the Signal flow graph shown in fig 3 using mason gain formula(8)



(ii) Obtain the transfer of the electrical system shown in fig4 (8)



12. (a) (i) Derive the impulse response of the critically damped system(8)

(ii) Determine the time response specifications and expression for output for unit step input to a system having system equations as follows

$$\frac{d^2y}{dt^2}+5\frac{dy}{dt}+16y=9x$$

Assume zero initial conditions (8)

OR

(b) (i) Determine the generalized error coefficients and steady state error whose open loop transfer function is $G(s) = \frac{1}{s(s+1)(s+10)}$ and the feedback is $H(s) = (s+2)$ with input $r(t) = 6 + t + t^2$ .Also determine Kp, Kv and Ka for unit step input.(8)

(ii) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$Determine the gain K, so that the system will have a dampingratio of 0.5. For this value of K, determine settling time, peak overshoot andtime to peak overshoot for a unit step input.

13. (a) Given $G(s) = \frac{Ke^{-0.2s}}{s(s+2)(s+8)}$ .Sketch the Bode plot and find K so that system is stable with (a)gain margin is equal to 2dB and (b) Phase margin is equal to 45 º.(16)

OR

(b) Discuss the design procedure for lag –lead compensator(16)

14. (a) (i)Sketch the root locus for the unity feedback system whose open loop transfer function

$$G(s) = \frac{K}{s(s+2)(s+4)}$$

Find the value of K so that the damping ratio of the closed loop system is 0.5 (8)

(ii) The open loop transfer function of aunity feedback control system is given by

$$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$$

. By applying the Routhcriterion , discuss the stability of the closed loop system as a function of K. Determine the value of K which will cause the sustained oscillations in the closed loop system. What are the corresponding oscillating frequencies.(8)

OR

(b) (i) Draw the Nyquist plot for the system whose open loop transfer function is $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$.Determine the range of K for which the closed loop system is stable.(12)

(ii) Discuss the advantages of Root Locus Techniques (4)

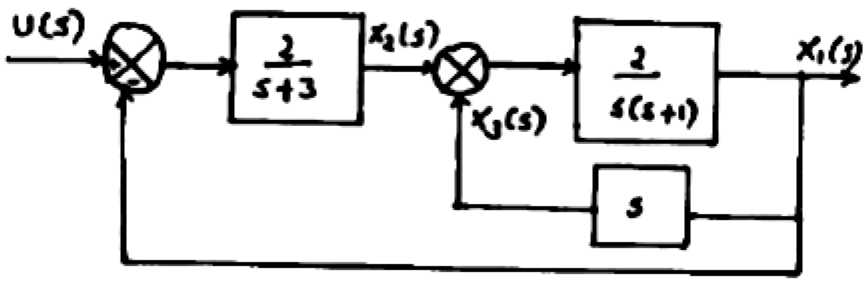
15. (a)(i) Obtain the Jordon canonical state model for the following system whose open loop transfer function is $G(s) = \dfrac{s^2+6s+8}{(s+3)(s^2+2s+2)}$ (8)

(ii)Find X(t) for the given state space representation

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -2 & -4 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$. The initial conditions are $X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ **(8)**

OR

(b)Write the state equations for the system shown below in which x_1 , x_2 and x_3 constitute the state vector.



Determine whether the system is completely controllable and observable.

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