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

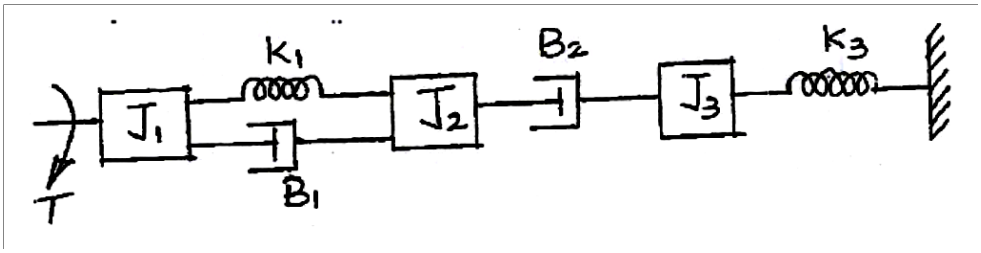
Answer all the questions

Part A (10 x 2=20)

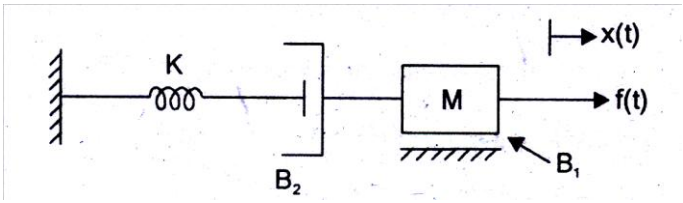
1. Define transfer function
2. Write Mason's gain formula.
3. What is transient and steady state response?
4. Why derivative controllers are not used in control system
5. Define Phase cross over frequency and gain crossover frequency
6. Draw the polar plot of the function $G(s) = \frac{1}{s(s+T_1)(s+T_2)}$
7. State Nyquist stability Criterion for a closed loop system when the open loop system is stable.
8. What is meant by BIBO stability
9. What is sampled data control system?
10. Define state and state variable.

Part B (5 x 16 =80 marks)

11. (a) (i) Write the differential equation governing the mechanical rotational system shown in fig.1. Draw the torque –voltage and torque – current electrical analogous circuits and verify mesh and node equations(8)

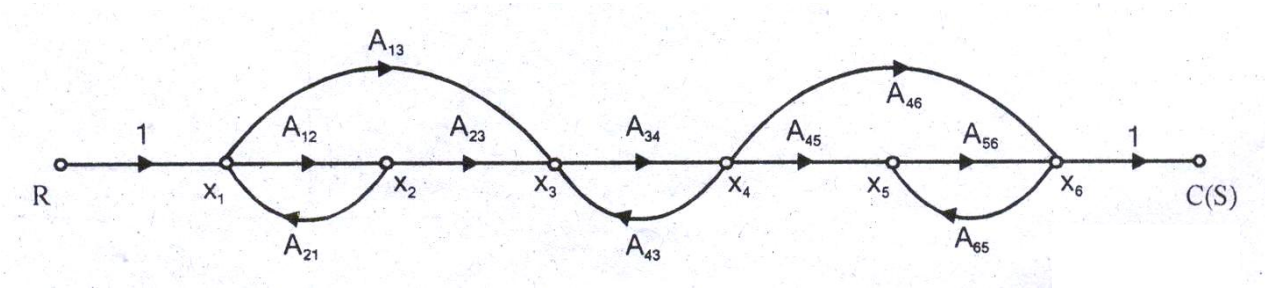


(ii) For the mechanical system shown in fig , determine the transfer function(8)

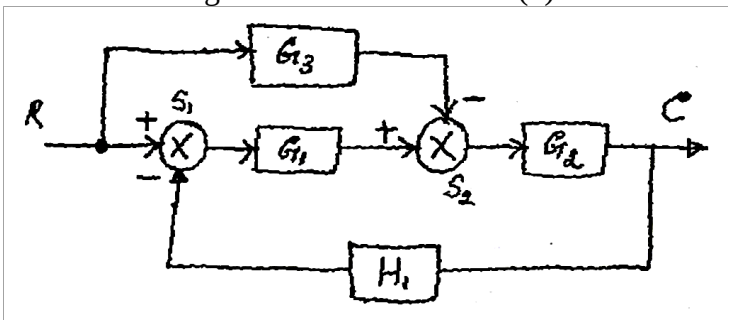


OR

(b) (i)Using Mason Gain formula to obtain C(s)/R(s) of the system shown below (8)



(ii) Using block diagram reduction technique , find the closed loop transfer function C/R of the system whose block diagram is shown in below (8)



12. (a) (i) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{s(sT+1)}$where K and T are positive constants .By what factor should the amplifier gain be reducedso that the peak overshoot of unit step response of the system is reduced so that the peakovershoot of unit step response of the system is reduced from 75% to 25% (8)

(ii) A unity feedback system has the forward transfer function $G(s) = \frac{K_1(2s+1)}{s(5s+1)(1+s)^2}$. The input $r(t) = (1 + 6t)$is applied to the system. Determine the minimum value of K_1 , if the steady state error is to be less than 0.1

OR

(b)With suitable block diagram and equations , explain the following types of controllers employed in control systems:

a) Proportional controller
b) Integral controller
c) PI controller
d) PD controller
e) PID controller

13. (a) (i) Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. (10)

$$G(S) = \frac{10(S+3)}{S(S+2)(S^2+4S+100)}$$

(ii) Write the procedure to obtain Nichol's chart from Constant M circles.(6)

OR

(b)A unity feedback control system has, Design a lead compensator such that the closed loop system will satisfy the following specifications:

i. Static velocity error constant = 20 sec.

ii. Phase margin = 50°

iii. Gain margin ≥ 10dB

Draw the bode plots and explain

14. (a) (i) A certain unity negative feedback control system has the following open loop transfer function $G(s)H(s) = \frac{K}{s(s+2)(s^2+2s+5)}$ Find the breakaway points and draw the root locus $0 \le K \le \infty$.(8)

(ii) List the advantages of Routh's array method of determining stability of a control system.(8)

OR

(b) (i) Construct the Nyquist plot for a system whose open loop transfer function is given by $G(s)H(s) = K\frac{(1+s)^2}{s^3}$ Find the range of K for stability. (12)

(ii) Discuss the rules for constructing Root Locus (4)

15. (a)(i) Explain in detail the state space representation for continuous time systems.(8)

(ii) A system is represented by the state equation $\dot{X} = AX + BU; Y = CX$ where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix} \text{and } C = [1 \quad 0 \quad 0].$$

Determine the transfer function.

(8)

OR

(b)Determine the state controllability and observability of the following state equations

$$\dot{X} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix} X + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} U$$

$$Y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} X$$

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