KINGS

COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

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YEAR : II SEMESTER : IV

UNIT I

CONTROL SYSTEM MODELLING

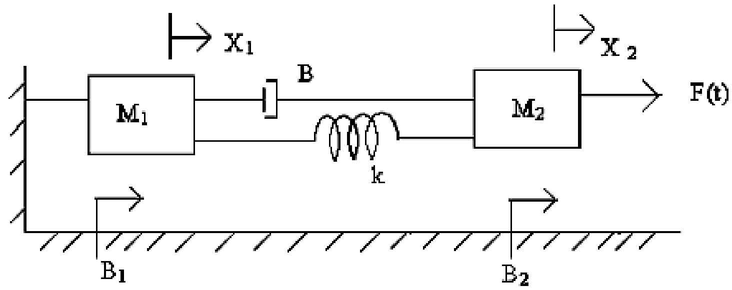
PART – A

1. What is control system?
2. Define open loop control system.
3. Define closed loop control system.
4. Define transfer function.
5. What are the basic elements used for modeling mechanical rotational system?
6. Name two types of electrical analogous for mechanical system.
7. What is block diagram?
8. What is the basis for framing the rules of block diagram reduction technique?
9. What is a signal flow graph?
10. What is transmittance?
11. What is sink and source?
12. Define non- touching loop.
13. Write Masons Gain formula.
14. Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system.
15. Write the analogous electrical elements in force current analogy for the elements of mechanical translational system.
16. Write the force balance equation of m ideal mass element.
17. Write the force balance equation of ideal dashpot element.
18. Write the force balance equation of ideal spring element.
19. What is servomechanism?

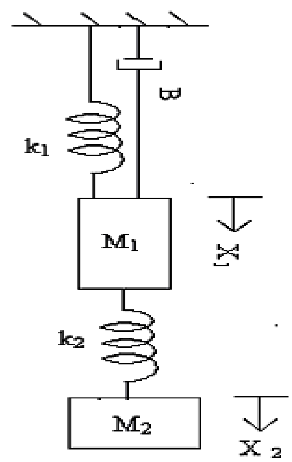
20. Why is negative feedback invariably preferred in closed loop system?

PART – B

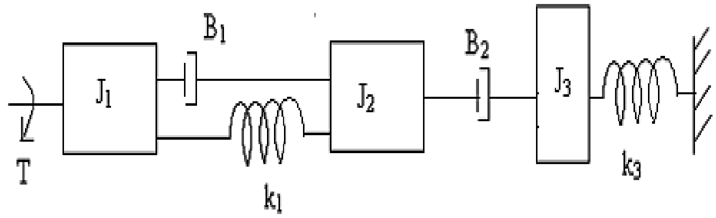
1. Write the differential equations governing the Mechanical system shown in fig. and determine the transfer function. (16)



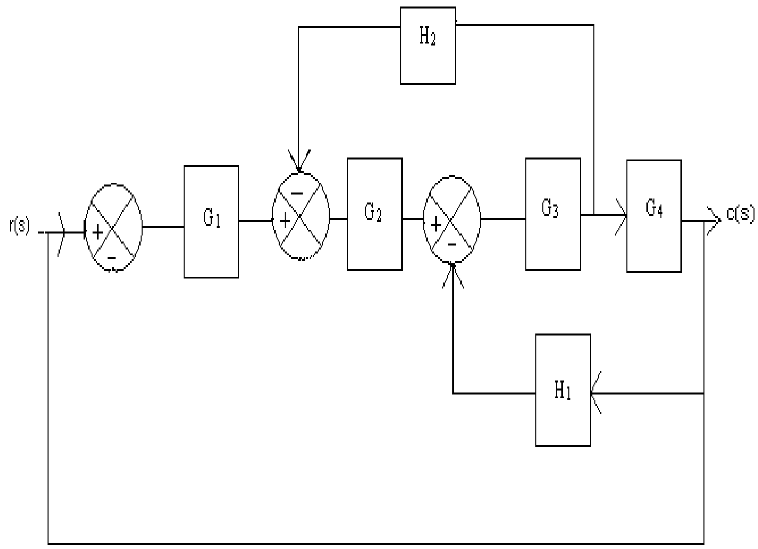
2. Determine the transfer function Y2(S)/F(S) of the system shown in fig. (16)



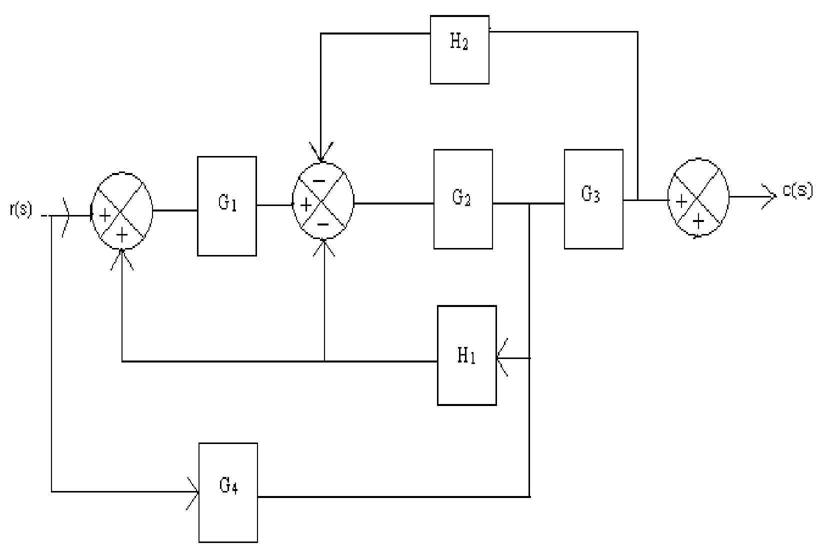
3. Write the differential equations governing the Mechanical rotational system shown in fig. Draw the Torque-voltage and Torque-current electrical analogous circuits. (16)



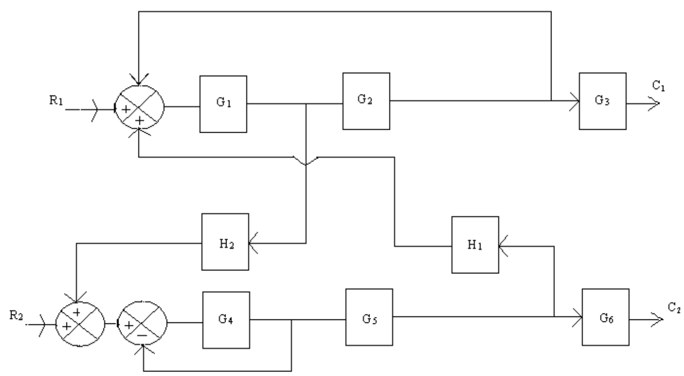
4. Determine the overall transfer function C(S)/R(S) for the system shown in fig. (16)



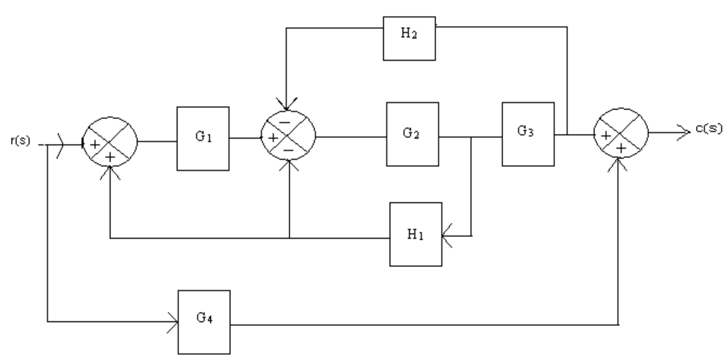
5. Obtain the closed loop transfer function C(S)/R(S) of the system whose block diagram is shown in fig. (16)



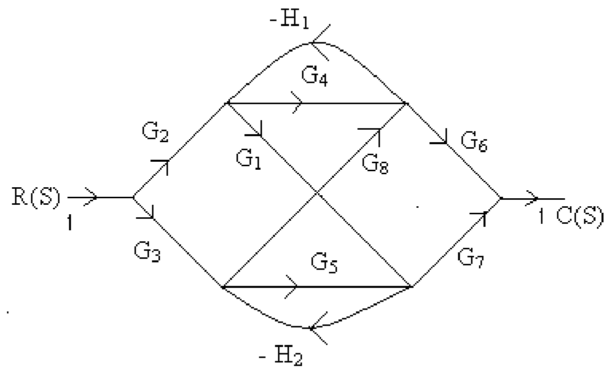
6. For the system represented by the block diagram shown in fig. Determine C1/R1 and C2/R1. (16)



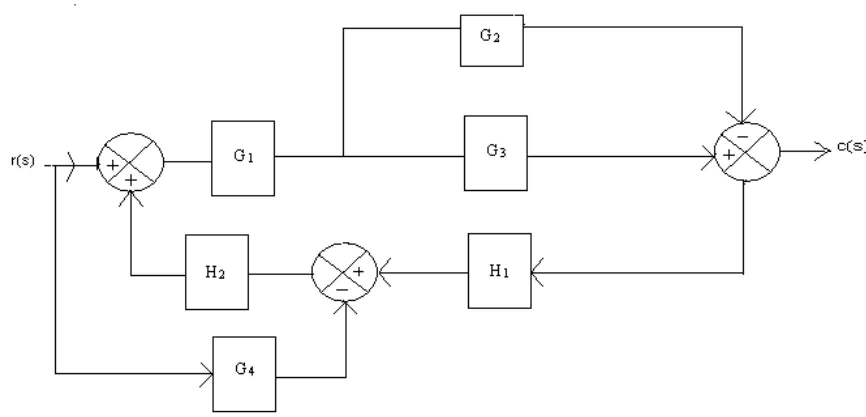
7. Obtain the closed loop transfer function C(S)/R(S) of the system whose block diagram is shown in fig. (16)



8. Find the overall gain of the system whose signal flow graph is shown in fig. (16)



9. Draw a signal flow graph and evaluate the closed loop transfer function of a system Whose block is shown in fig? (16)



10. Derive the transfer function for Armature controlled DC servo motor. (16)

11. Derive the transfer function for Field controlled DC servo motor. (16)

UNIT II

TIME RESPONSE ANALYSIS

PART-A

1. What is Proportional controller and what are its advantages?
2. What is the drawback in P-controller?
3. What is integral control action?
4. What is the advantage and disadvantage in integral controller?
5. What is PI controller?
6. What is PD controller?
7. What is PID controller?
8. What is time response?

9. What is transient and steady state response?

$$F(s) = \frac{1}{1 + G(s)H(s)}$$

10. What is the importance of test signals?

11. Name the test signals used in control system.

12. Define Step signal:

13. Define Ramp signal:
14. Define parabolic signal:
15. What is an impulse signal?

16. What is the order of a system?

17. Define Damping ratio.

18. Give the expression for damping ratio of mechanical and electrical system.

19. How the system is classified depending on the value of damping?

20. What will be the nature of response of a second order system with different types of damping?
21. Sketch the response of a second order under damped system.

22. What is damped frequency of oscillation?

23. List the time domain specifications:

24. Define Delay time.

25. Define rise time.

26. Define Peak time.

27. Define Peak overshoot.

28. Define settling time.

29. What is type number of a system? What is its significance?

30. Distinguish between type and order of a system:

31. What is steady state error?

32. Define acceleration error constant:

33. What are generalized error coefficients?

34. Give the relation between generalized and static error coefficients:

35. Mention two advantages of generalized error constants over static error constants

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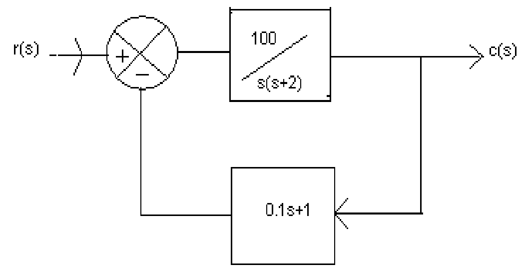
PART-B

1. (a) Derive the expressions and draw the response of first order system for unit step input. (8)

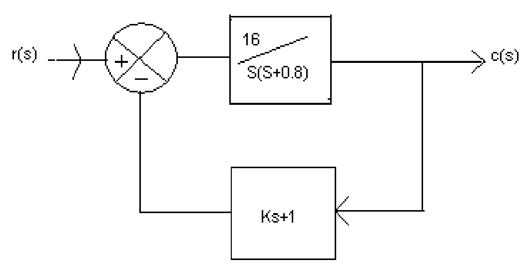
   (b) Draw the response of second order system for critically damped case and when input is unit step. (8)

2. Derive the expressions for Rise time, Peak time, and Peak overshoot. (16)

3. A potential control system with velocity feedback is shown in fig. What is the response of the system for unit step input? (16)



4. Measurements conducted on a Servomechanism show the system response to be c(t)=1+0.2 ê 60t-1.2 ê –10 t. when subjected to a unit step. Obtain an expression for closed loop transfer function. (16)
5. A positional control system with velocity feedback is shown in fig. What is the response c(t) to the unit step input. Given that ς =0.5.and also calculate rise time, peak time, Maximum overshoot and settling time. (16)
6. A unity feedback control system has an open loop transfer function G(S) = 10/S(S+2). Find the rise time, percentage over shoot, peak time and settling Time. (16)



7. A closed loop servo is represented by the differential equation, where c is the displacement of the output shaft, r is the displacement of the input shaft and e= r-c. Determine undamped natural frequency, damping ratio and percentage maximum overshoot for unit step input. (16)

8. For a unity feedback control system the open loop transfer function $G(S) = 10(S+2)/ S^2 (S+1)$. Find

(a) Position, velocity and acceleration error constants.

(b) The steady state error when the input is R(S) where $R(S) = 3/S - 2/S^2 + 1/3S^3$ (16)

9. The open loop transfer function of a servo system with unity feedback system is

$G(S) = 10/ S(0.1S+1)$.Evaluate the static error constants of the system. Obtain the steady state error of the system when subjected to an input given by the polynomial $r(t) = a_0 + a_1 t + a_2/2\, t^2$. (16)

UNIT III

FREQUENCY RESPONSE ANALYSIS

1. What is frequency response?
2. What are advantages of frequency response analysis?
3. What are frequency domain specifications?
4. Define Resonant Peak.
5. What is resonant frequency?
6. Define Bandwidth.
7. What is cut-off rate?
8. Define gain margin.
9. Define phase margin.
10. What is phase and Gain cross-over frequency?
11. What is Bode plot?
12. Define corner frequency.
13. What are the advantages of Bode Plot?
14. What is a Nichols plot?
15. What are M and N circles?
16. What is Nichols chart?
17. What are the advantages of Nichols chart?
18. What is polar plot?
19. What is minimum phase system?
20. What are All-Pass systems?

PART-B

1. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies: $G(S) = 10/ S(1+0.4S)(1+0.1S)$ (16)
2. The open loop transfer function of a unity feedback system is $G(S) = 1/ S(1+S)(1+2S)$ Sketch the Polar plot and determine the Gain margin and Phase margin. (16)
3. Sketch the Bode plot and hence find Gain cross over frequency,

Phase cross over frequency, Gain margin and Phase margin. $G(S) = 0.75(1+0.2S)/ S (1+0.5S) (1+0.1S)$ (16)

4. Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. $G(S) = 10(S+3) / S(S+2) (S^2+4S+100)$ (16)

5. Sketch the polar plot for the following transfer function and find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin.

$G(S) = 10(S+2) (S+4)/ S (S^2 {}^- 3S+10)$ (16)

6. Construct the polar plot for the function $GH(S) =2(S+1)/ S^2$. Find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. (16)

7. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies. $G(S) =KS^2 / (1+0.2S) (1+0.02S)$. Determine the value of K for a gain cross over frequency of 20 rad/sec. (16)

8. Sketch the polar plot for the following transfer function and find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin.

$G(S) = 400/ S (S+2) (S+10)$ (16)

9. A unity feedback system has open loop transfer function

$G(S) = 20/ S(S+2) (S+5)$.Using Nichol's chart determine the closed loop frequency Response and estimate all the frequency domain specifications. (16)

10. Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin: $G(S) = 10(1+0.1S)/ S (1+0.01S) (1+S)$. (16)

11. Write short notes on correlation between the time and frequency response? (16)

12. What is compensation? Why it is needed for control system? Explain the types of compensation (16)

13. Realize the basic compensators using electrical network and obtain the transfer function. (16)

14. Design a suitable lead compensators for a system with unity feedback and having open loop transfer function $G(S)= K/ S(S+1) (S+4)$ to meet the specifications.

(i)Damping ratio=0.5 (ii) Undamped natural frequency ω_n =2 rad/sec. (16)

15. A unity feedback system has an open loop transfer function

$G(S) = K/ S(S+1) (0.2S+1)$.Design a suitable phase lag compensators to achieve the following specifications K_v= 8 and Phase margin 40 deg with usual notation. (16)

16. Explain the procedure for lead compensation and lag compensation. (16)

17. Explain the design procedure for lag-lead compensation. (16)

18. Consider a type 1 unity feedback system with an OLTF $G(S) =K/S (S+1) (S+4)$.

The system is to be compensated to meet the following specifications $K_v > 5sec$ and PM>43 deg. Design suitable lag compensators.

UNIT IV

STABILITY ANALYSIS

PART-A

1. Define BIBO Stability.
2. What is impulse response?
3. What is characteristic equation?
4. How the roots of characteristic equation are related to stability?
5. What is the necessary condition for stability?
6. What is the relation between stability and coefficient of characteristic polynomial?
7. What will be the nature of impulse response when the roots of characteristic equation
8. What will be the nature of impulse response if the roots of characteristic equation are
9. What is principle of argument?
10. What is the necessary and sufficient condition for stability?
11. What is routh stability condition?
12. What is auxiliary polynomial?
13. What is quadrantal symmetry?
14. In routh array what conclusion can you make when there is a row of all zeros?
15. What is limitedly stable system?
16. What is Nyquist stability criterion?
17. What is root locus?
18. How will you find root locus on real axis?
19. What are asymptotes?
20. What is centroid, how it is calculated?
21. What is breakaway point and break in point?
22. What is dominant pole?

PART-B

1. Using Routh criterion determine the stability of the system whose characteristics equation is $S^4+8S^3+18S^2+16S+5=0$. (16)

2. $F(S)=S^6 + S^5 - 2S^4 - 3S^3 - 7S^2 - 4S^1 - 4 = 0$.Find the number of roots falling in the RHS plane and LHS plane. (16)

3. Draw the Nyquist plot for the system whose open loop transfer function is $G(S)H(S) = K/S\ (S+2)\ (S+10)$.Determine the range of K for which closed loop system is stable. (16)

4. Construct Nyquist plot for a feedback control system whose open loop transfer function is given by $G(S)H(S) = 5/\ S(1-S)$.comment on the stability of open loop and closed loop transfer function. (16)

5. Sketch the Nyquist plot for a system with the open loop transfer function $G(S)H(S) = K(1+0.5S)\ (1+S)\ /\ (1+10S)\ (S-1)$.determine the range of values of K for which the system is stable. (16)

6. Sketch the root locus for the open loop transfer function of unity feedback control system given below: $G(S)H(S)=K/S(S+2)(S+4)$. (16)

7. Sketch the root locus for the open loop transfer function of unity feedback control system given below: $G(S)H(S)=K/S(S+1)(S+2)$.Also find K of breakaway point. (16)

UNIT V
STATE VARIABLE ANALYSIS & DIGITAL CONTROL
PART – A

1. What is sampled data control system?
2. State (Shanon's) sampling theorem.
3. What is periodic sampling?
4. What are hold circuits?
5. What are the problems encountered in a practical hold circuits?
6. What are the methods available for the stability analysis of sampled data control system?
7. What are state variables?
8. What is the state space?
9. What are phase variables?
10. What is a state vector?
11. Define Acquisition time.

PART-B

1.a. Explain the importance of controllability and observability of the control system model in the design of the control system. (8)

b. Explain the solution for state equation for discrete time system. (8)

2. Explain sampling theorem and Sample & Hold operation briefly. (16)

3. Explain stability analysis of sampled control system and Jury's stability. (16)

4. Explain state space representation for discrete time system (16)

5. Explain state space representation for continuous time system. (16)

6 a. Explain the solution for state equation for discrete time system. (8)

b. Explain Jury's stability test (8)

7. Given the transfer function of a system, determine a state variable representation for the system $Y(S) / U(S) = 1/ (S+2) * (S+3) * (S+4)$ (16)

8. Determine the state variable representation of the system whose transfer function is given as $Y(S) / U(S) = 2S^2+8S+7 / (S+2)^2 *(S+1)$ (16)

9. Discuss the advantage of state space techniques over the transfer function techniques of analyzing the control system . (16)

10. Explain the procedure of deriving the state space representation of a system whose dynamics has been expressed in the form of a differential equation. (16)

11. Test the controllability & observability of the system whose state space representation is given as , (16)

$$\begin{pmatrix} X_1 \\ X_2 \end{pmatrix} = \begin{pmatrix} 2 & 1 \\ -1 & 2 \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \end{pmatrix} \begin{pmatrix} U_1 \\ U_2 \end{pmatrix}$$

$$\begin{pmatrix} Y_1 \\ Y_2 \end{pmatrix} = \begin{pmatrix} 1 & 1 \end{pmatrix} \begin{pmatrix} X_1 \\ X_2 \end{pmatrix}$$