Dronacharya Group of Institutions, Greater Noida

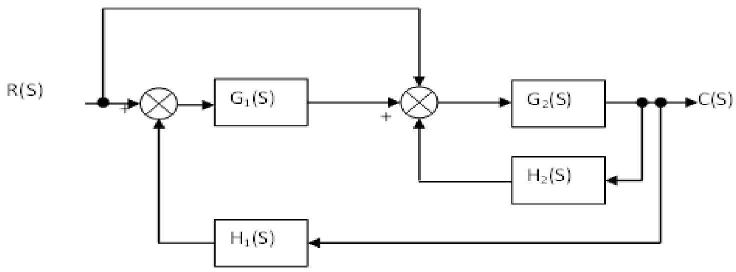
Electronics and Communication Engineering Department

Question Bank

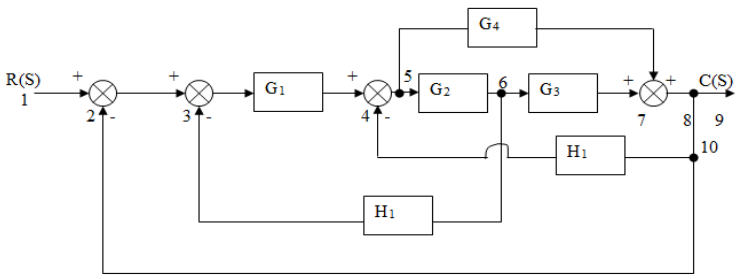
Subject: Control System (EIC-501) **Course: B. Tech 5thSem (ECE)**

UNIT I

1. What is a control system?
2. Define Transfer function.
3. What is a state variable model?
4. What are the advantages and disadvantages of open loop system?
5. What are the advantages and disadvantages of closed loop system?
6. Distinguish between open loop and closed loop systems.
7. What is feedback?
8. What is a summing point?
9. Write the rule for elimination of a feedback loop in a block diagram.
10. What is signal flow graph?
11. What is a mixed node? How can it be eliminated?
12. Write the Mason's Gain formula.
13. The block diagram of a closed loop system is shown in the figure using the block reduction technique determine the closed loop transfer function C(s)/R(s).

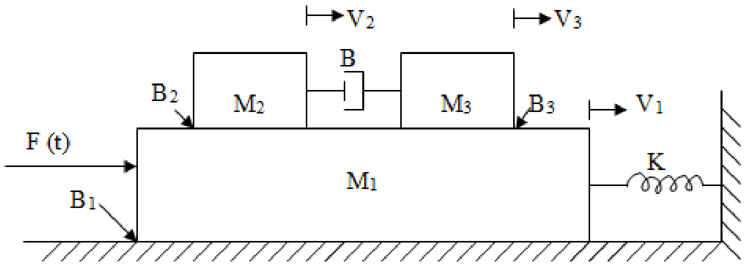


14. Convert the block diagram to signal flow graph and determine the transfer function using mason's gain formula.

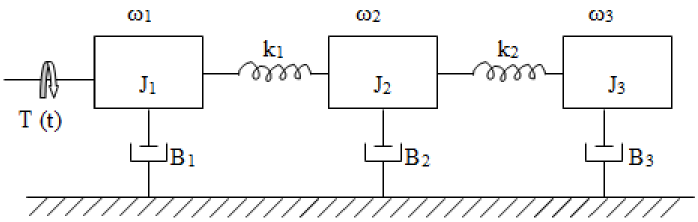


15. Derive the transfer function of an armature controlled dc motor and hence develop its block diagram.

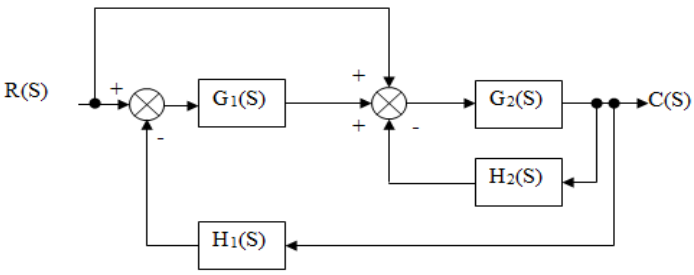
16. Consider the mechanical translation system shown in the givenfigure, draw (a) force-voltage and (b) force –current analogous circuits



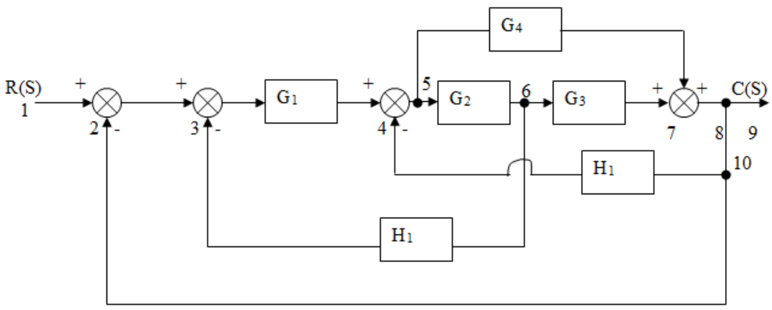
17. Write the differential equation governing the rotational systems shown in the figure and determine the transfer function



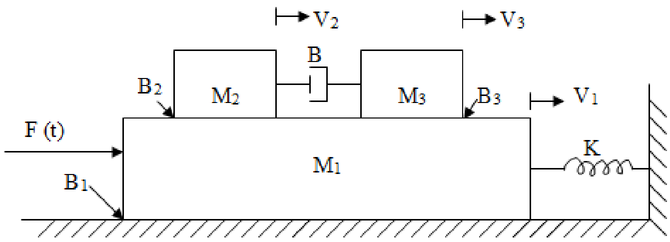
18. Convert the block diagram to signal flow graph and determine the transfer function using mason's gain formula.



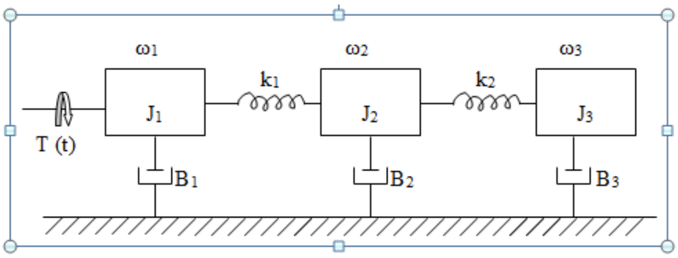
19. The block diagram of a closed loop system is shown in the figure. Using the block reduction technique determine the closed loop transfer function C(s)/R(s).



20. Write the differential equation governing the translational systems shown in the figure and determine the transfer function



21. Consider the mechanical rotational system shown in the figure; draw (a) force-voltage and force – current analogous circuits



22. Write the rules for Block diagram reduction techniques.

UNIT II

1. Determine State Space Equation for the following differential equations
   a. $\frac{d^3y(t)}{dt^3} + a_2\frac{d^2y(t)}{dt^2} + a_1\frac{dy(t)}{dt} + a_0y(t) = u(t)$
   b. $\dddot{y} + \ddot{y} + \dot{y} + y(t) = u(t)$
   c. $5\ddot{y} + 6\dot{y} + y(t) = 2u(t)$

2. Determine State Space Equation for the following differential equations and draw signal flow graph
   a.) $\frac{2s-1}{s^2+4s+1}$ b.) $\frac{1}{s^2+3s+2}$
3. For a system whose differential equation is $\frac{d^3x}{dt^3} + \frac{3d^2x}{dt^2} + \frac{4dx}{dt} + 4x(t) = u_1(t) + 3u_2(t) + 4u_3(t)$, $y_1 = \frac{4dx}{dt} + 3u_1$ and $y_2 = \frac{d^2x}{dt^2} + 4u_2 + u_3$ Represent the system in its state space form.
4. Define the following terms with respect to phase variable approach:
   i) State.
   ii) State variables.
   iii) State space.
   iv) State vector.
   v) State model.
5. Obtained the state model using ***Phase variable*** as state variables for the given transfer function $T(s) = \frac{C(s)}{R(s)} = \frac{2}{s^3+6s^2+11s+6}$. Also draw Signal Flow Graph (SFG) and Block diagram.
6. The state model of a system is represented by the following equations.

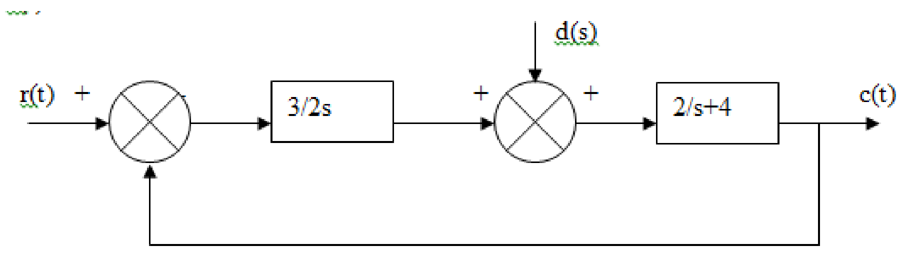
$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & 6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} u$$

$y = [1 \quad 0 \quad 0]x.$ Find the transfer function of the system.

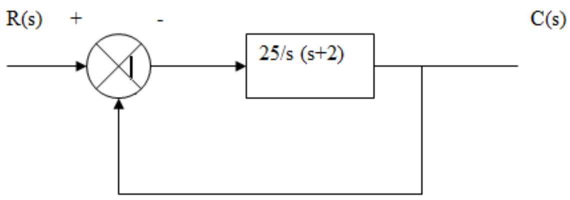
7. Find the state model using ***Canonical variable*** as state variables for the given transfer function $T(s) = \frac{C(s)}{R(s)} = \frac{2}{s^3+6s^2+11s+6}$. Also draw Signal Flow Graph (SFG) and Block diagram.

UNIT – III

1. Define Peak Time.
2. Define Peak Over Shoot.
3. Define Settling Time.
4. What is the order of a system?
5. Write the second order systems response.
6. How the system is classified depending on the value of damping?
7. The closed loop transfer function of second order system is $\frac{C(s)}{R(s)} = \frac{10}{(s^2+6s+10)}$. Determine the damping ratio and the natural frequency of oscillations.
8. What is the type of damping in the system?
9. What is steady state error?
10. What are generalized error coefficients?
11. Mention two advantages of generalized error constants over static error constants.
12. What is a PID controller?
13. Derive the expression for unit impulse response of a second order under damped system
$$C(s) = \frac{\omega_n^2}{(\omega_n^2+2\xi\omega_n s+\omega_n^2)}$$
14. Find the unit impulse response of the second order system whose transfer function $G(s) = \frac{9}{(s^2+4s+9)}$
15. Derive the expression for steady state error of the closed loop system in terms of generalized error coefficients.
16. For a closed loop system with $G(s) = \frac{1}{(s+5)}$ and $H(s) = 5$, calculate generalized error coefficients and find the error series.
17. The system shown in fig. is initially at equilibrium, with $r = 1$ and $d = 0$. A step function disturbance $d\ (t) = u\ (t)$ is then initiated at $t = 0$. Determine the response $c(t)\ for\ t > 0$.

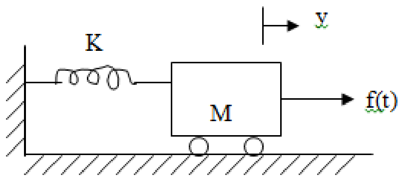


18. Determine the damping ratio, undamped natural frequency for the system shown in fig. What is the response $c\ (t)$ of this system to a unit-step function excitation $r(t) = u(t)$ when all initial conditions are zero?



19. The parameters of a mechanical system as shown in fig. are $M = 100Kg,\ f = 1000N/m/sec.$ and $k = 10000N/m.$ A step force of $100\ Newton$ is applied to the mass at $t = 0.$ The initial conditions are $y(0) = dy\ (0)/dt = 0.$ Find

- Damping factor.
- Undamped natural frequency.
- Damped natural frequency.
- Step response as function of time.



20. Derive the expression for peak time from the expression for step response of second order under damped system.

21. For a Unity feedback second order system, the open loop transfer function $G(s) = \frac{\omega_n^2}{s(s+2\xi\omega_n)}$. Calculate the generalized error coefficients and find error series.

22. Explain PI, PD and PID controllers.

UNIT IV

1. Define BIBO stability.
2. What is the requirement for BIBO stability?
3. How the roots of characteristics equation are related stability?
4. What is the necessary condition for stability?
5. What is Routh stability criterion?
6. What is Nyquist stability criterion?
7. Write the transfer function of Nyquist stability criterion?

8. What is magnitude criterion?
9. Distinguish between the concept of encircled and enclosed ofNyquist stability criterion?
10. Define gain margin and phase margin.
11. What are the necessary conditions for stability?
12. Using Routh criterion, determine the stability of the system represented by the characteristics equation, $s^4+8s^3+18s^2+16s+5 = 0$. Comment on the location of the roots of the roots of characteristics equation.
13. Construct Routh array and determine the stability of the system represented by the
    a. characteristics equation $s^5+s^4+2s^3+2s^2+3s+5 = 0$. Comment on the location of the roots of characteristics equation.
14. Construct Routh array and determine the stability of the system whose characteristics equation, $s^6+2s^5+8s^4+12s^3+20s^2+16s+16 = 0$. Also determine the number of roots lying on the half of s-plane and on imaginary axis.
15. The open loop transfer function of a unity feedback system is given by
    a. $G(s) = K/(s+2)(s+4)(s^2+6s+25)$.
16. Write the procedure for investigating the stability using Nyquist criterion.
17. Draw the Nyquist plot for the system whose open loop transfer function is
18. $G(s) H(s) = K/s(s+2)(s+10)$. Determine the range of K for which closed loop system is stable.
19. Construct theNyquist plot for a system whose open loop transfer function is given by $G(s) H(s)= K(1+s)^2/s^3$.Find the range of K for stability.
20. The open loop transfer function of a unity feedback system is given by
21. $G(s) = K/s(1+sT_1)(1+sT_2)$.Determine an expression for gain K in terms T_1, T_2 and specified gain margin, K_g.
22. Determine the Gain crossover frequency, phase crossover frequency, Gain margin an phase margin of a system with open loop transfer function, $G(s)=1/s(1+2s)(1+s)$.

UNIT V

1. Define gain margin.
2. Define phase margin.
3. What is a Nicholas plot?
4. What is the advantage of polar plot?
5. Define polar plot.
6. Define Bode plot.
7. What is cut off frequency?
8. What is gain cross over frequency?

9. What is phase cross over frequency?
10. Define corner frequency.
11. Consider a unity feedback system having open loop transfer function $G(s) = \frac{K}{s(1+0.5s)(1+4s)}$. Sketch polar plot
12. Consider a unity feedback system having open loop transfer function $G(S) = 1/s\,(1+2s)$. Sketch polar plot find gain and phase margin.
13. Derive expression for M circle.
14. Derive expression for N circle.
15. Write the procedure for Nichols chart.
16. Consider a unity feedback system having open loop transfer function $G(S) = 75(1+0.2s)/s(s+5)$. Sketch Bode plot.
17. Write the procedure for polar plot.
18. For the following transfer function draw Bode plot $G(s) = 20/s(1+3s)(1+4s)$
19. For the following transfer function $G(s) = 20/s(1+3s)\,(1+4s)$. Sketch polar plot and find gain margin.
20. Write the procedure for Bode plot.