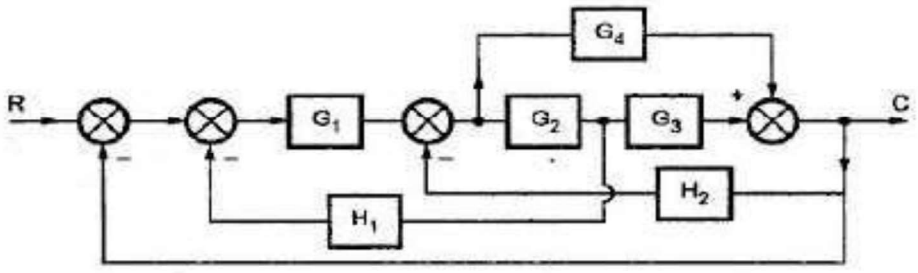
Department of EEE&ECE - Question Bank

Subject: Control Systems **Subject Code: 20PC0215**

Class: III YEAR II SEM

UNIT – I – 2 MARKS				
S.No		BL	CO	PO
1	Write Mason's gain formula	4	1	1,2,3,12
2	What do you meant by sensitivity of the control system?	2	1	1,2,3,12
3	What is control system?	4	1	1,2,3,12
4	Define open loop and closed loop systems?	4	1	1,2,3,12
5	What is feedback? What type of feedback is employed in control system?	4	1	1,2,3,12
6	Define transfer function?	2	1	1,2,3,12
7	What are the two assumptions to be made while deriving transfer function of electrical Systems?	2	1	1,2,3,12
8	What is the basic concept of block diagram representation?	2	1	1,2,3,12
9	Write short notes about servomotors?	2	1	1,2,3,12
UNIT – I – 10 MARKS				
1	a)Explain the effects of feedback in control systems. b) Derive the Transfer Function for a.c. servomotor. Explain about torque-speed characteristics of a.c. servomotor?	2	1	3
2	Using Block diagram reduction technique find the Transfer Function of thesystem. 	6	1	3,12

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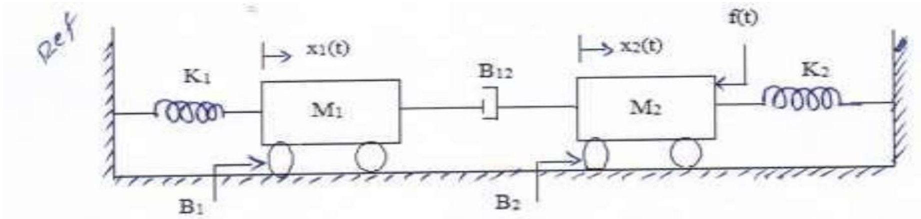
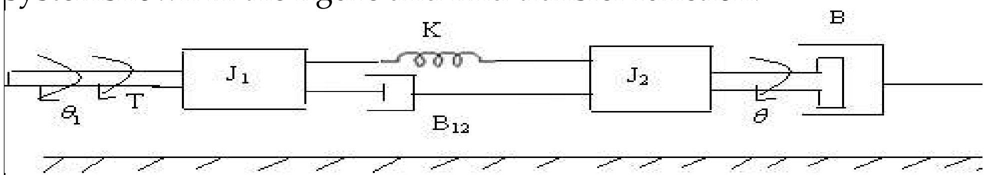
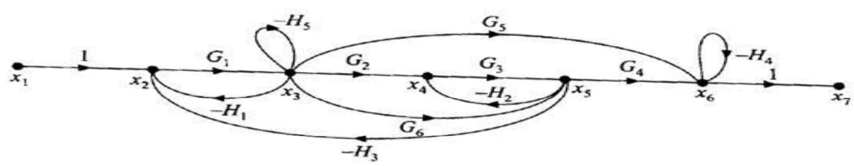
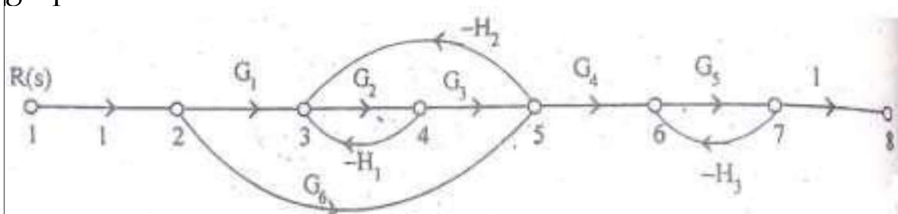
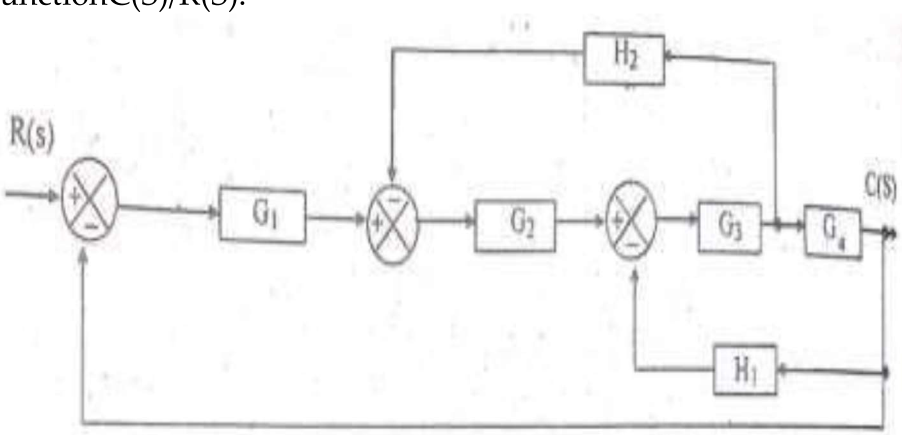
<table>
<tr><td>3</td><td>For the mechanical system shown in Fig, determine the transfer functions X1(s)/F(s) & X2(s)/F(s)
  </td><td>6</td><td>1</td><td>3,5</td></tr>
<tr><td>4</td><td>Write the differential equations governing the mechanical rotational systemshown in the figure and find transfer function.
  </td><td>4</td><td>1</td><td>1,2,3,12</td></tr>
<tr><td>5</td><td>Find the transfer function of the system shown in figure using Mason's gain formula.
  </td><td>4</td><td>1</td><td>3</td></tr>
<tr><td>6</td><td>Find the overall transfer function of the system whose signal flow graph is shown below
  </td><td>2</td><td>1</td><td>5</td></tr>
<tr><td>7</td><td>For the system represented in the given figure, determine transfer functionC(S)/R(S).
  </td><td>5</td><td>1</td><td>3</td></tr>
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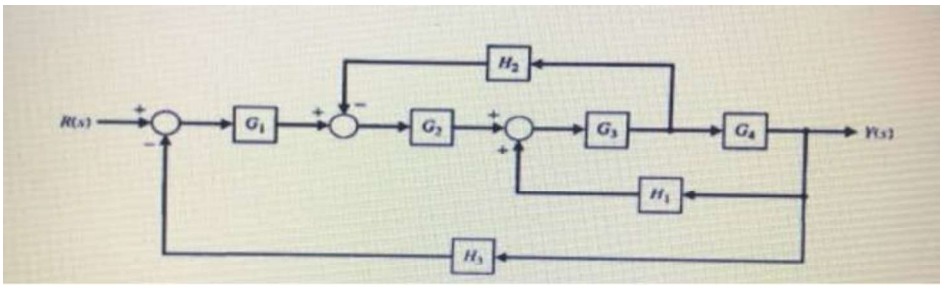
8	Simplify the block diagram shown in the figure below and determine the transfer function. 	5	1	1,2,3
9	Find the transfer function of the Field controlled D.C motor?	5	1	1,2,3,
10	Find the transfer function of the Armature controlled D.C motor?	5	1	1,3,
	UNIT – II – 2 MARKS			
1	Define Maximum Overshoot?	4	1	1,2,3,12
2	Define Ramp signal and parabolic signal.	4	1	1,2,3,12
3	Define delay time?	4	1	1,2,3,12
4	List the time domain specifications	2	2	1,2,3,12
5	What is called steady state error?	2	2	1,2,3,4,12
6	Define Peak time?	4	2	1,2,3,4,12
7	Define rise time?	4	1	1,2,3,12
8	What is the effect on system performance, when a proportional controller is introduced in a System?	2	2	1,2,3,4,12
9	What is time response?	2	2	1,2,3,4,12
10	What is type number of a system? What is its significance?	2	2	1,2,3,4,12
	UNIT – II – 10 MARKS			
1	Determine position error constant K_p, Velocity error constant K_v , acceleration error constant K_a, for type-0, type-1, type-2 and type_3 systems.	6	2	3,5
2	Derive the expression for Rise time, Peak time, Peak Overshoot and Settling time of second order system subjected to a unit step input.	3	2	3
3	For the servo mechanism with open loop transfer function given below, what type of input signal gives rise to a constant steady state error and calculate their values $G(s) = 10/S^2(S + 2)(S + 3)$.	3	2	3,5
4	Derive the solution of second order system for undamped case	5	2	2,6

5	a)A unity feedback system has the forward transfer function $G(s)=K_1(2S+1)/S(5S+1)(1+S)^2$. The input r(t)=1+6t is applied to the system. Determine the value of K_1 if the steady error is to be less than 0.1. b) Define transient and steady state response?	5	2	5
6	A unity feedback control system is characterized by the following open loop transfer function G(s) = (0.4S+1)/S(S+0.6). Determine its transient response for unit step input. Evaluate the maximum overshoot and corresponding peak time.	5	2	3
7	For the servomechanisms with open loop transfer function given below explain what type of input signal give rise to a constant steady state error and calculate their values i) G(S)=20(S+2)/S(S+1)(S+3) ii) G(S)=10/(S+2)(S+3) iii) $G(S)=10(S+2)/S^2(S+1)(S+2)$	3	2	5
8	a) 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) Steady state error when the input $R(s) = (3/S)-(2/ S^2)+(1/3 S^3)$.	6	2	3
9	A unity feedback control system has an open loop transfer function G(S) =10/S(S+2). Find the time domain specifications for a step input of 12 Units	4	2	3
10	a)Derive the solution of second order system for undamped case? b) Derive the solution of second order system for Critically damped case?	5	2	5

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UNIT – III – 2 MARKS				
S.No		BL	CO	PO
1	What are root loci?	4	1	1,2,3,12
2	What is a dominant pole?	4	1	1,2,3,12
3	What are the main significances of root locus?	4	1	1,2,3,12
4	What is the effect of adding a zero to a system?	2	2	1,2,3,12
5	State-Magnitude criterion.	2	2	1,2,3,4,12
6	State – Angle criterion.	4	2	1,2,3,4,12
7	What is the necessary condition for stability?	4	1	1,2,3,12
8	What is the necessary and sufficient condition for stability?	2	2	1,2,3,4,12
9	What is limitedly stable system?	2	2	1,2,3,4,12
UNIT – III – 10 MARKS				
S.No		BL	CO	PO
1	Sketch the root locus of the system whose open loop transfer function is G(s)=k/s(s+2)(s+4). Find the value of k so that the damping ratio of the closed loop system is 0.5	2	1	3
2	Using Routh-Hurwitz criterion investigate the location of roots of the given equation $S^6+2S^5+4S^4+4S3+9S2+S+6=0$	6	1	3,12
3	(a) Explain Routh-Hurwitz criterion to determine the stability of the system (b)Examine the characteristic equation $s^4+2s^3+s^2+4s+2=0$	6	1	3,5
4	Explain the stability of the system from root locus plot in the following situations with suitable examples: a) Addition of open loop poles b) Addition of open loop zeros.	4	1	1,2,3,12
5	Sketch the root locus for the unity feedback system whose open loop transfer function is $G(s)\,H(s) = K/s(s^2+4s+10)$.	4	1	3
6	Determine the stability of the following systems represented by the characteristics equations using Routh stability criterion i. $S^5+S^4+2S^3+2S^2+3S+5 = 0$. ii. $9S^5-20S^4+10S^3-S^2-9S-10 = 0$	2	1	5
7	Determine the stability of the following systems represented by the characteristics equations: i.$S^4+8S^3+18S^2+16S+5 = 0$ ii.$S^6+2S^5+8S^4+12S^3+20S^2+16S+16 =0$ Using Routh stability criterion.	5	1	3

8	A unity feedback control system has a open loop transfer function is given by the $G(s)= K/s(s^2+4s+13)$. Determine (i) Angle of asymptotes (ii) Angle of departure	5	1	1,2,3
9	Use the routh stability criterion to determine the location of roots on the s-plane and hence the stability for the system represented by the characteristic equation, $s^6+s^5+3s^4+3s^3+3s^2+2s+1=0$.	5	1	1,2,3
10	Briefly explain the various steps in the procedure for constructing root locus.	5	1	1,3
UNIT – IV – 2 MARKS				
S.No		BL	CO	PO
1	What is frequency response?	4	1	1,2,3,12
2	List out the different frequency domain specifications?	4	1	1,2,3,12
3	Define resonant Peak?	4	1	1,2,3,12
4	What is bandwidth?	2	2	1,2,3,12
5	Define Gain Margin?	2	2	1,2,3,4,12
6	Define Phase cross over frequency?	4	2	1,2,3,4,12
7	What is phase margin?	4	1	1,2,3,12
8	Define Phase lag and phase lead?	2	2	1,2,3,4,12
9	State Nyquist stability criterion.	2	2	1,2,3,4,12
10	What are the main advantages of Bode plot?	2	2	1,2,3,4,12
UNIT – IV – 10 MARKS				
S.No		BL	CO	PO
1	For the following transfer function draw bode plot and obtain gain cross-over frequency. $G(s)=\frac{20}{s(1+3s)(1+4s)}$	6	2	3,5
2	Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies. $G(s)= \frac{10}{s(1+0.4s)(1+0.1s)}$	3	2	3
3	(a) What is compensation? What are the different types of compensators? (b) What is a lag compensator? Obtain the transfer function of lag compensator and draw pole-zero plot.	3	2	3,5
4	Define the following terms (a) Cut off rate (b) gain margin (c) Phase margin (d) Phase	5	2	2,6

	cross over frequency (b) The open loop transfer function of a unity feedback system is given by G(s)=1/s(1+s)(1+2s). Sketch the polar plot and determine the gain margin and phase margin.			
5	A unity feedback control system has G(s)= $\frac{80}{s(s+2)(s+20)}$ draw the Bode plot. Determine Gain Margin, Phase Margin, Gain Cross over frequency and Phase cross over frequency. Comment on the stability.	5	2	5
6	(a) Lag and Lead networks are called compensating networks. Why? (b)Write the advantages of PID controllers and their applications.	5	2	3
7	The open loop transfer function of a unity feedback system is given by G(s)=1/s^2(1+s)(1+2s). Sketch the polar plot and determine the gain margin and phase margin.	3	2	5
8	(a) Differentiate between Polar and Nyquist plots. (b)Explain about the Nyquist stability criterion. Write its advantages	6	2	3
9	Sketch the bode plot of the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec. G(s)= $\frac{Ks^2}{(1+0.2s)(1+0.02s)}$	5	2	5

UNIT – V – 2 MARKS

S.No		BL	CO	PO
1	What is state?	4	1	1,2,3,12
2	What is a state transition matrix?	4	1	1,2,3,12
3	Difference between transfer function analysis and state space analysis?	4	1	1,2,3,12
4	What are state variables?	2	2	1,2,3,12
5	Write the state model?	2	2	1,2,3,4,12
6	Write the advantages of state space analysis?	4	2	1,2,3,4,12
7	What do you mean by canonical form of representation?	4	1	1,2,3,12
8	Mention any two properties of state transition matrix?	2	2	1,2,3,4,12
9	What are the advantages of state space analysis?	2	2	1,2,3,4,12
10	What are state variables?	2	2	1,2,3,4,12

UNIT – V – 10 MARKS				
S.No		BL	CO	PO
1	(a) A linear tine invariant system is characterized by homogenous state equation. $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Compute the solution of homogenous equation, assuming the initial state vector. (b) Obtain the state model of armature controlled dc motor	2	1	3
2	(a) Find the Controllability of the system . X = $\begin{bmatrix} 1 & 1 \\ 2 & -1 \end{bmatrix}\begin{bmatrix} X1 \\ X2 \end{bmatrix}+\begin{bmatrix} 0 \\ 1 \end{bmatrix} U(t)$ (b) Evaluate the Observability of the system with A= $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, B=$\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and C=$[3 \quad 4 \quad 1]$ (c) Evaluate the Observability of the system $\begin{bmatrix} \dot{X1} \\ \dot{X2} \end{bmatrix}= \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix}\begin{bmatrix} X1 \\ X2 \end{bmatrix}+\begin{bmatrix} 0 \\ 1 \end{bmatrix} U(t)$ and Y(t)=$[1 \quad 0]\begin{bmatrix} X1 \\ X2 \end{bmatrix}$	6	1	3,12
3	(a) A system is described by $\dot{x} = \begin{bmatrix} -1 & -4 & -1 \\ -1 & -6 & -2 \\ -1 & -2 & -3 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u.$ $y = [1 \quad 1 \quad 1]\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ Find the transfer function. (b) Define state, state variable and explain the significance of state variable analysis?	6	1	3,5
4	(a) Determine the State transition matrix for the given matrix A=$\begin{bmatrix} -1 & -2 \\ 0 & 2 \end{bmatrix}$ (b) Obtain e^{At} for the given matrix by using Power series method A=$\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$	4	1	1,2,3,12
5	(a) For the given system X = Ax + Bu Where $A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$	4	1	3

	Find the characteristic equation of the system and its roots. (b) Given $\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 & (t) \\ x_2 & (t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$ Find the unit step response when, $X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$			
6	Consider a system matrix State model $\begin{bmatrix} \dot{X}1 \\ \dot{X}2 \end{bmatrix} = \begin{bmatrix} -2 & -3 \\ 4 & 2 \end{bmatrix} \begin{bmatrix} X1 \\ X2 \end{bmatrix} + \begin{bmatrix} 3 \\ 5 \end{bmatrix} U(t)$ and $Y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} X1 \\ X2 \end{bmatrix}$ With D=0, Obtain transfer function.	2	1	5
7	Determine the transfer function for $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and $C = [1 \quad 2 \quad 0]$	5	1	3
8	(a) Discuss the significance of state Space Analysis? (b) Define state variables. (c) Obtain the state variable representation of an armature controlled D.C Servomotor? (d) Construct the state model for a system characterized by the differential equation. $\ddot{y} + 5\dot{y} + 6y = u$.	5	1	1,2,3
9	(a) Explain about state variable and state transition equation (b)Describe the properties of state transition matrix.	5	1	1,2,3
10	Obtain the state model of the system whose transfer function is given as $Y(s)/U(s) = 10/s^3+4s^2+2s+1$	5	1	1,3