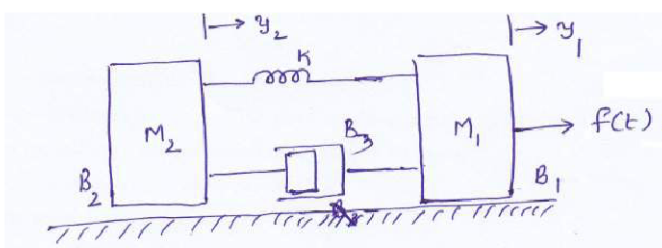
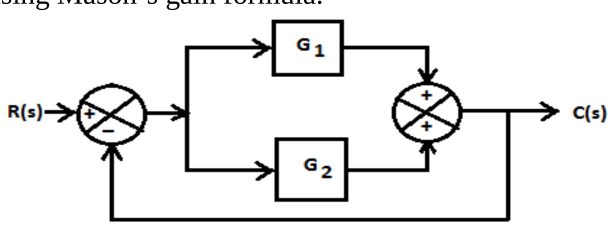
SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

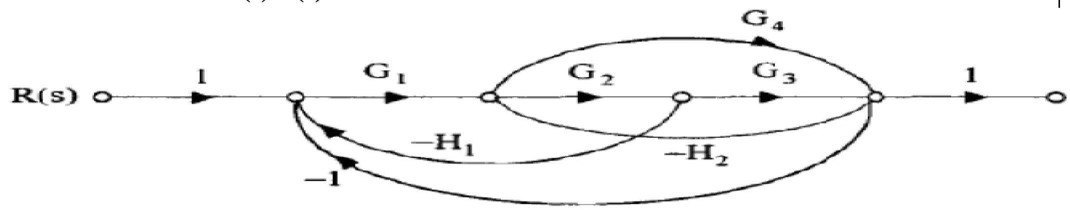
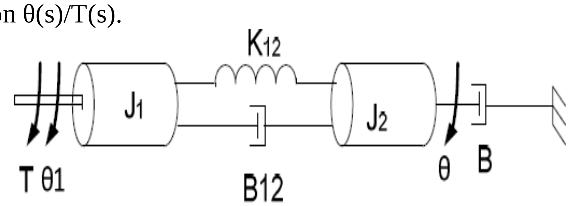
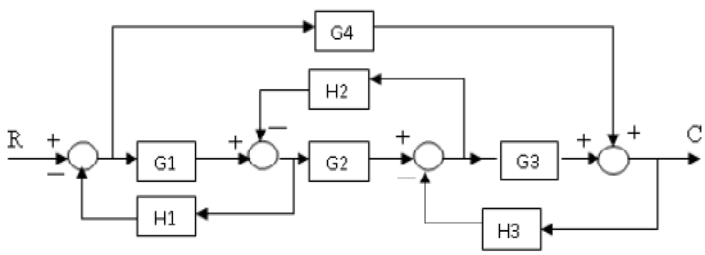
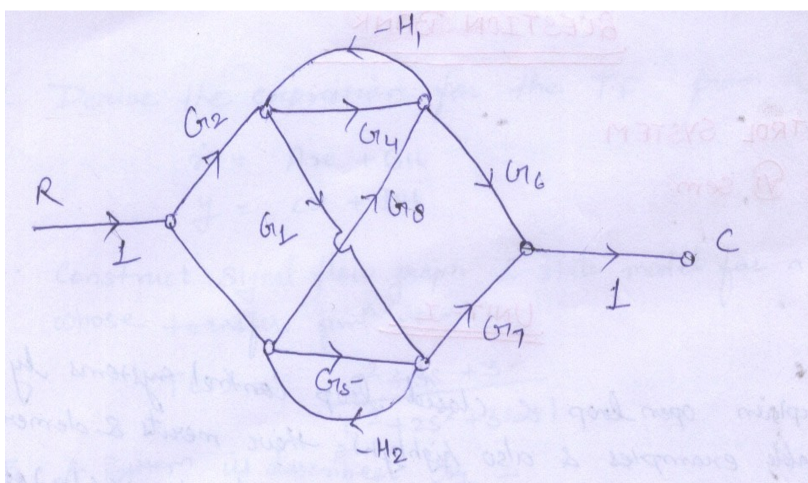
(Autonomous)

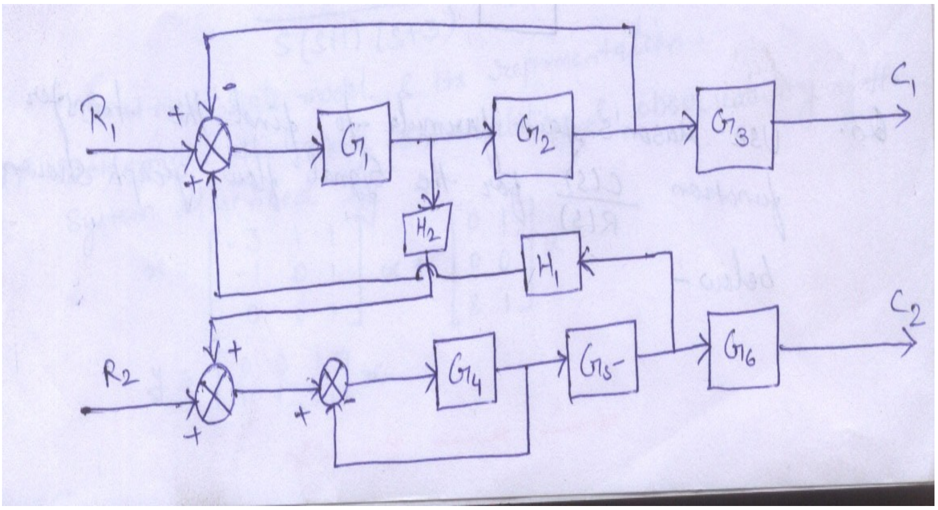
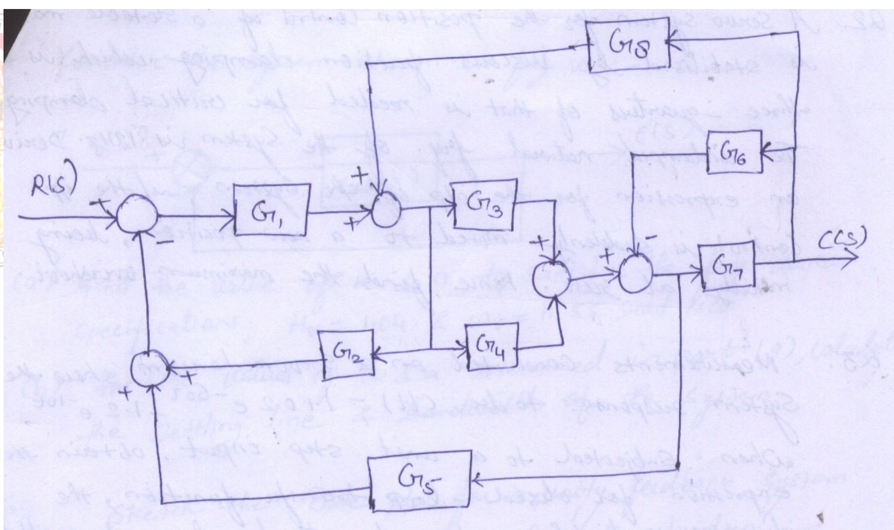
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

20ECE241 – LINEAR CONTROL SYSTEMS

Question No.	Questions	PO Attainment
	UNIT – 1: CONTROL SYSTEM CONCEPTS	
	PART A (2 Marks)	
1	Define control system	PO1
2	Differentiate open loop and closed control system	PO1
3	What are the components of feedback control system	PO1
4	Define transfer function	PO1
5	What are the basic elements used for modeling mechanical translational system	PO1
6	What are the basic elements used for modeling mechanical rotational system	PO1
7	What is block diagram?	PO1
8	What are the basic components of Block diagram	PO1
9	What is the basis for framing the rules of block diagram reduction technique	PO1
10	What is a signal flow graph	PO1
11	What is transmittance	PO1
12	What is sink and source	PO1
13	Define non touching loop.	PO1
14	Write Masons Gain formula	PO1
15	Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system	PO1
16	Write the analogous electrical elements in force current analogy for the elements of mechanical translational system	PO1
17	Write the analogous electrical elements in torque voltage analogy for the elements of mechanical rotational system	PO1
18	Write the analogous electrical elements in torque current analogy for the elements of mechanical rotational system	PO1
19	What are the basic properties of signal flow graph	PO1
20	Write the force balance equation of an ideal mass, dashpot and spring element	PO1
	PART-B (10 Marks)	
1	Write the force equations of the linear translational system shown in figure. Draw the equivalent electrical network using force-voltage Analogy, with the help of necessary mathematical equations.  	PO1, PO2,PO3
2	Draw the signal flow graph for the block diagram below and then obtain the transfer function C(s)/R(s) using Mason's gain formula.  	PO1, PO2,PO3

3	Find transfer function C(s)/R(s). 	PO1, PO2,PO3
4	Find transfer function θ(s)/T(s). 	PO1, PO2,PO3
5	Draw the equivalent signal flow graph and determine C (s)/R(s) using Mason's gain formula. 	PO1, PO2,PO3
6	Explain open loop & closed loop control systems by giving suitable examples & also highlights their merits & demerits.	PO1, PO2
7	Draw signal flow graph for the following equations- (i) y2 = a1*dy1/dt (ii) y3 = d2y2/dt2 + dy1/dt – y1 (iii) d2y/dx2 + 2/3 * dy/dx + 11/2 * y = x	PO1, PO2,PO3
8	Use Mason's gain formula to find the transfer function C(s)/R(s) for the signal flow graph shown below- 	PO1, PO2,PO3

9	Evaluate C_1/R_1 & C_2/R_2 for a system whose block diagram representation is shown in figure- 	PO1, PO2,PO3
10	Determine C(s)/R(s)- 	PO1, PO2,PO3

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20ECE241 – LINEAR CONTROL SYSTEMS

Question No.	Questions	PO Attainment
	UNIT – 2: TIME DOMAIN ANALYSIS	
	PART A (2 Marks)	
1	What is an order of a system	PO1
2	What is step signal	PO1
3	What is ramp signal	PO1
4	What is a parabolic signal	PO1
5	What is transient response	PO1
6	What is steady state response	PO1
7	List the time domain specifications	PO1
8	What is damped frequency of oscillation	PO1
9	What will be the nature of response of second order system with different types of damping	PO1
10	Define Delay time	PO1
11	Define Rise time	PO1
12	Define peak time	PO1
13	Define peak overshoot.	PO1
14	What are the different types of controllers	PO1
15	What is the significance of integral controller and derivative controller in a PID controller	PO1
16	What are the three constants associated with a steady state error?	PO1
17	What are the effects of adding a zero to a system?	PO1
18	Why derivative controller is not used in control system?	PO1
19	What is the effect of PI controller on the system performance	PO1
20	What are the main advantages of generalized error coefficients	PO1
	PART-B (10 Marks)	
1	For a unity feedback system whose open loop transfer function is G(s) = 50/(1+0.1s)(1+2s) , find the position, velocity & acceleration error constants.	PO1, PO2
2	A feedback control system is described as G(s) = 50/s(s+2)(s+5) , H(s) = 1/s For a unit step input, determine the steady state error constants & errors.	PO1, PO2
3	The closed loop transfer function of a unity feedback control system is given by-C(s)/R(s) = 10/(s^2+4s+5) Determine (i) Damping ratio (ii) Natural undammed resonance frequency	PO1, PO2

	(iii) Percentage peak overshoot (iv) Expression for error response.	
4	With neat sketch explain all the time domain specifications	PO1, PO2
5	Determine the gain K so the system will have a damping ratio of 0.5.For this value of K find settling time (2% criterion) peak overshoot and time to peak overshoot for a unit step input	PO1, PO2
6	Explain proportional-integral-derivative controller and it effect on stability	PO1, PO2
7	Differentiate P,PI, PD and PID controllers and mention merits and demerits.	PO1, PO2
8	Measurements conducted on a servomechanism show the system response to be C(t) = 1+0.2 e-60t – 1.2 e-10t , when subjected to a unit step input, obtain the expression for closed loop transfer function, the damping ratio & undamped natural frequency of oscillations.	PO1, PO2,PO4
9	The transfer function of a control system is given by G(s) = 1/(1+sT)2 . Show that if the input is a step displacement, the output will complete 98.26% of the step in 6T seconds for critical damping.	PO1, PO2,PO4
10	A servo system for the position control of a rotable mass is stabilized by viscous friction damping which is three-quarters of that is needed for critical damping. The undamped natural frequency of the system in 12Hz. Derive an expression for the output of the system, if the input control is suddenly moved to a new position, being initially at rest. Hence, find the maximum overshoot.	PO1, PO2,PO4

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QUESTION BANK

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Question No.	Questions	PO Attainment
	UNIT – 3: STABILITY ANALYSIS AND ROOT–LOCUS TECHNIQUES	
	PART A (2 Marks)	
1	Define stability	PO1
2	State Nyquist stability criterion	PO1
3	What is nyquist contour	PO1
4	Define Relative stability	PO1
5	What will be the nature of impulse response when the roots of characteristic equation are lying on imaginary axis?	PO1
6	What is Routh stability criterion?	PO1
7	What is limitedly stable system?	PO1
8	In routh array what conclusion you can make when there is a row of all zeros?	PO1
9	What are root loci?	PO1
10	What is a dominant pole?	PO1
11	What are the main significances of root locus?	PO1
12	What are break away and break in points?	PO1
13	What are asymptotes? How will you find angle of asymptotes?	PO1
14	What is centroid?	PO1
15	How will you find the root locus on real axis?	PO1
16	What is characteristic equation?	PO1
17	How the roots of characteristic are related to stability?	PO1
18	What is the necessary condition for stability?	PO1
19	What are the requirements for BIBO Stability?	PO1
20	What is auxiliary polynomial?	PO1
	PART-B (10 Marks)	
1	Plot the root locus pattern of a system whose forward path transfer function is $G(s) = \frac{K(S+1)}{s^2(s+2)}$.	PO1, PO2,PO3
2	Using Routh criterion investigate the stability of a unity feedback control system whose open loop transfer function is given by. $$G(S) = \frac{e^{-sT}}{S(S+2)}$$	PO1, PO2,PO3
3	Sketch the root locus plot for the open loop transfer function given below Calculate the value of K at $G(S)H(S) = \frac{K(S^2+4)}{S(S+2)}$. i) break away point and ii) S= -0.7 +j0.9.	PO1, PO2,PO3
4	Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis. $3s^4 + 7s^3 + 2s^2 + s + 8 = 0$	PO1, PO2,PO3

5	Find the angles of departure and arrival for all complex poles and zeros of the open loop transfer function of $$G(s)\,H(s) = \frac{K(s^2+s+2)}{s(s^2+9)},\ K>0$$	PO1, PO2,PO3
6	Determine the value of K such that the roots of the characteristics equation given below lie to the left of line S= -1. $S^3 + 10S^2 + 18S + K = 0.$	PO1, PO2,PO3
7	Plot the root locus pattern of a system whose forward path transfer function is $$G(s) = \frac{K(S+1)}{s^2(s+2)}$$	PO1, PO2,PO3
8	Find the angles of asymptotes and the intersect of the asymptotes of the root locus of the following equation when K varies from − *to* □ $$(1+K)\,s^3 + (2+3K)\,s^2 + s(3-K) - 3K = 0\,.$$	PO1, PO2,PO3
9	Sketch the root-locus of G(s) = $k/(s^2+10s+100)$	PO1, PO2,PO3
10	With the help of Routh Hurwitz criterion comments upon the stability of the system having the following characteristic equation $S^6+s^5-2s^4-3s^3-7s^2-4s-4=0$	PO1, PO2,PO3

Question No.	Questions	PO Attainment
	UNIT – 4: FREQUENCY DOMAIN ANALYSIS	
	PART A (2 Marks)	
1	What is frequency response?	PO1
2	List out the different frequency domain specifications	PO1
3	Define –resonant Peak	PO1
4	What is bandwidth	PO1
5	Define Cut-off rate	PO1
6	Define –Gain Margin	PO1
7	Define Phase cross over	PO1
8	What is phase margin	PO1
9	Define Gain cross over	PO1
10	What are the main advantages of Bode plot?	PO1
11	Define Corner frequency	PO1
12	Define Phase lag and phase lead	PO1
13	What are the uses of lead compensator	PO1
14	When lag/lead/lag-lead compensation is employed	PO1
15	What are the effects of adding a zero to a system	PO1
16	What is the use of lag compensator	PO1
17	What are the three types of compensators	PO1
18	What is Bode plot?	PO1
19	What is polar plot	PO1
20	When lag-lead compensator is required	PO1
	PART-B (10 Marks)	
1	The open loop transfer function of a unity feedback system is given by draw the bode plot, $\frac{10(s+3)}{s(s+2)(s^2+4s+100)}$ find the gain margin and phase margin and comment on stability by bode plot.	PO1, PO2,PO3
2	Construct Bode plot for the system whose open loop transfer function is given below and determine (i) the gain margin (ii) the phase margin and (iii) the closed loop stability $G(S)H(S)=\frac{4}{S(1+0.5S)(1+0.08S)}$.	PO1, PO2,PO3
3	The loop transfer function of a system is given by $G(s)\,H(s)=\frac{25}{(s+2)^2}$ Using Bode diagram, find gain and phase margins of the	PO1, PO2,PO3

	system.	
4	Sketch the Bode plot for the open loop transfer function for the unity feedback system given below and assess stability $G(S)=\dfrac{50}{(S+1)(s+2)}$.	PO1, PO2,PO3
5	The forward path transfer function of a unity feedback system is given by $G(s)=\dfrac{K}{(s+1)^2}$ Using Bode diagram, determine the value of K so that the gain margin of the system is 20 dB.	PO1, PO2,PO3
6	Draw the Nyquist plot of and there from $G(s)H(s)=\dfrac{k}{s(2+s)(10+s)}$ determine range of K for stability using Nyquist Criterion.	PO1, PO2,PO3
7	Draw the polar plot of $G(S)\,H(S)=\dfrac{K}{S(S+3)(S+5)}$ and there from determine i)range of K for stability using Nyquist Criterion.	PO1, PO2,PO3
8	Sketch the Nyquist Plot for a unity feedback system having open-loop transfer function given by- $G(s) = k/s(1+s)(1+2s)(1+3s)$ Determine the range of values of k for which the system is stable.	PO1, PO2,PO3
9	Sketch the polar plot for the following transfer function- $G(s) = 1/s(s+1)$	PO1, PO2,PO3
10	The open loop transfer function of a unity gain feedback is given by- $G(s) = k(s+2)/(s^4+3s^3+4s^2+2s)$, $k>=0$ (a) Determine all the poles & zeros of G(s). (b) Draw the root locus.	PO1, PO2,PO3

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20ECE241 – LINEAR CONTROL SYSTEMS

Question No.	Questions	PO Attainment
	UNIT – 5: STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS	
	PART A (2 Marks)	
1	Define state and state variable.	PO1
2	Write the general form of state variable matrix.	PO1
3	Write the relationship between z-domain and s-domain.	PO1
4	What are the methods available for the stability analysis of sampled data control system?	PO1
5	What is controllability?	PO1
6	What is observability?	PO1
7	Write the properties of state transition matrix.	PO1
8	What is similarity transformation?	PO1
9	What is the need for controllability test?	PO1
10	What is the need for observability test?	PO1
11	State the condition for controllability by Gilbert's method	PO1
12	State the condition for observability by Gilbert's method	PO1
13	State the duality between controllability and observability.	PO1
14	What is the need for state observer?	PO1
15	How will you find the transformation matrix, P_o to transform the state model to observable phase variable form?	PO1
16	Write the observable phase variable form of state model	PO1
17	List the advantages of state space representation	PO1
18	Define state equation	PO1
19	What is meant by quantization	PO1
20	State sampling theorem	PO1
	PART-B (10 Marks)	
1	The transfer function of a control system is given by $\frac{Y(S)}{U(S)} = \frac{S+2}{S^3+9S^2+26S+24}$ check for controllability and observability	PO1, PO2
2	A system is characterized by the following state space equations. $$\begin{bmatrix}\dot{X}_1 \\ \dot{X}_2\end{bmatrix} = \begin{bmatrix}-3 & 1 \\ -2 & 0\end{bmatrix}\begin{bmatrix}X_1 \\ X_2\end{bmatrix} + \begin{bmatrix}0 \\ 1\end{bmatrix}u;\ t>0$$ $$y = [1 \quad 0]\begin{bmatrix}X_1 \\ X_2\end{bmatrix}$$ Find the transfer function of the system. Compute the state transition matrix. Solve the state equation for the unit step input under zero initial conditions.	PO1, PO2

3	The state equation of a linear time invariant system is represented by $\frac{d\,x(t)}{dt} = A\,x(t) + Bu(t)$ $A = \begin{bmatrix} 3 & 0 \\ 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ Find the state transition matrix and the Eigen values of A.	PO1, PO2
4	Test the system represented by following equations is state controllable and observable. $[X] = \begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix}[x] + \begin{bmatrix} 3 \\ 1 \end{bmatrix}u\,,\; y = [1 \quad 0]\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$	PO1, PO2
5	$[X] = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}[x] + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u \quad , \; y = [1 \quad 0]\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ with initial conditions $x(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Calculate STM, complete solution x(t) and y(t).	PO1, PO2
6	Define controllability and observability. Find controllability and observability of the given system $\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 11 \\ 1 \\ -14 \end{bmatrix}[u] \;:\; Y = [-3 \quad 5 \quad -2]\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$	PO1, PO2
7	Derive the Expression for the Transfer function from the state model $\dot{x} = Ax + Bu$ $y = Cx + Du$	PO1, PO2
8	State equation of a control system is given by- $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ Obtain the state-transition Matrix.	PO1, PO2
9	Determine the state controllability & observability of the system described by-	PO1, PO2

	$\dot{x} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u$ $y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} x$	
10	A feedback system has a closed loop transfer function- 10(s+4)/s(s+1)(s+3) Construct state model & its representation.	PO1, PO2

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