DEPT. OF ELECTRONICS & COMMUNICATION ENGINEERING
B. Tech. I-Mid Question Bank (R22 Regulation)

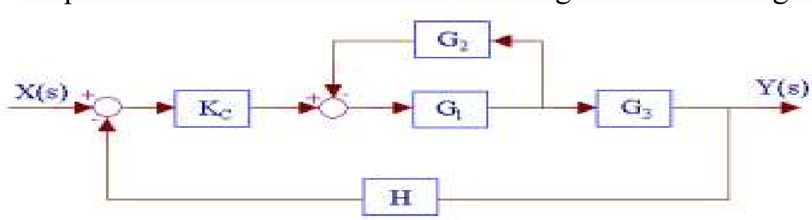
Academic Year: 2024-2025 **Semester: V**
Subject Name: CONTROL SYSTEMS [22EC502PC]
Faculty Name: Dr.Bandi Doss, A.Vamshidhar Reddy

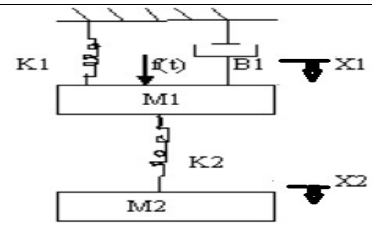
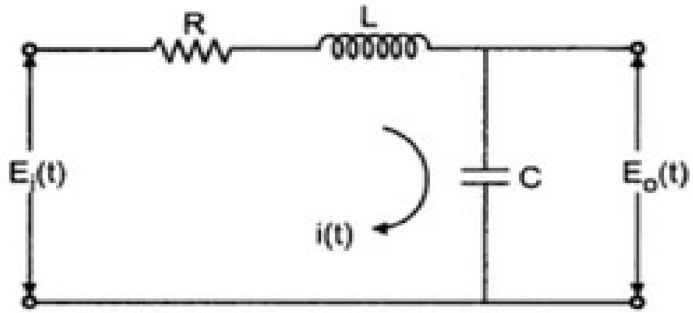
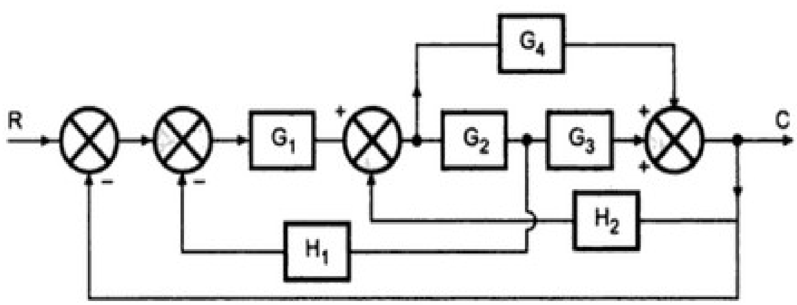
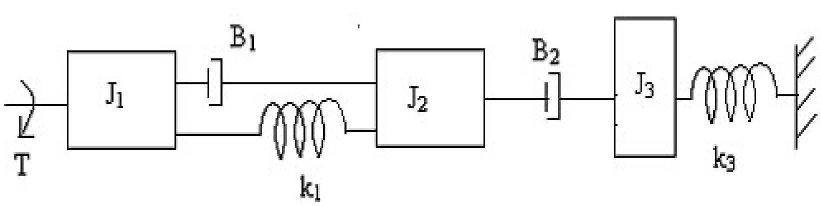
PART-A

MID-I Questions					
Q.NO	**QUESTIONS**	**MARKS**	**BL**	**CO**	**UNIT NO.**
1	Define control system. List out the types.	2M	L1	CO1	I
2	Define Block, Summing Point, and Branch point.	2M	L1	CO1	I
3	List any two rules for block diagram reduction techniques?	2M	L1	CO1	I
4	Explain any two benfits of Feedback.	2M	L2	CO1	I
5	Formulate the expression for closed loop transfer function.	2M	L6	CO1	I
6	Define characteristic equation of a transfer function and give an example.	2M	L1	CO1	I
7	Define time response and steady state response?	2M	L1	CO2	II
8	Define damping ratio and classify the system depending on damping ratio.	2M	L1	CO2	II
9	Sketch the response of a second order under damped system	2M	L3	CO2	II
10	Define BIBO Stability.	2M	L1	CO2	II
11	List the time domain specifications.	2M	L1	CO2	II
12	Define steady state error and explain static error constants.	2M	L1	CO2	II
13	Define frequency response. List out the different frequency domain specifications.	2M	L1	CO3	III
14	Describe the Bode plot with advantages.	2M	L2	CO3	III
15	Describe the Polar plot with advantages.	2M	L2	CO3	III
MID-II Questions					
16	Define nyquist stability criterion and nyquist contour.	2M	L1	CO3	III
17	Sketch the polar plot for type 2 and 5th order sytem.	2M	L3	CO3	III
18	Explain relative stability using nyquist criterion.	2M	L2	CO3	III
19	Define controller. Why it is needed for control system?	2M	L1	CO4	IV

20	Explain robustness of control system.	2M	L2	CO4	IV
21	List the types of compensation. What is a compensator?	2M	L1	CO4	IV
22	Distinguish lead compensator, lag compensator.	2M	L4	CO4	IV
23	Discuss the transfer function of lag and lead compensators.	2M	L2	CO4	IV
24	Sketch basic lag-lead compensator using electrical network.	2M	L3	CO4	IV
25	Define state, state variable and state vector.	2M	L1	CO5	V
26	Discuss the advantages of state space analysis? Write the general form of state variable matrix.	2M	L2	CO5	V
27	Solve the state transition matrix of the system $\begin{bmatrix}\dot{x}1\\ \dot{x}2\end{bmatrix}=\begin{bmatrix}-3 & 1\\ 0 & -1\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix}$	2M	L3	CO5	V
28	List out the properties of state transition matrix.	2M	L1	CO5	V
29	Develop the equation for state transition matrix.	2M	L6	CO5	V
30	Define diagonalization and modal matrix. How the modal matrix is determined?	2M	L1	CO5	V

PART-B

MID-I Questions					
Q.NO	**QUESTIONS**	**MARKS**	**BL**	**CO**	**UNIT NO.**
1	Develop the transfer function of the block diagram shown in figure 	4	L6	CO1	I
2	Distinguish between Open loop and Closed loop Systems.	4	L4	CO1	I
3	Develop the transfer function of given mechanical translation system.	4	L2	CO1	I

					
4	Explain the Traffic light control system and Room temperature control system with neat sketches as control system examples.	4	L2	CO1	I
5	Explain the mechanical translational and rotational system elements.	4	L2	CO1	I
6	Develop the transfer function of following electrical circuit 	4	L6	CO1	I
7	Discuss all Block Diagram reduction rules.	8	L2	CO1	I
8	Develop transfer function of below block diagram. 	8	L6	CO1	I
9	Develop the transfer function of given mechanical rotational system 	8	L6	CO1	I
10	The open loop transfer function of a unit feedback control system is given by $G(S)=\frac{2}{s(s+3)}$. Develop the expression for unit step response of the system.	4	L6	CO2	II
11	Solve the damping ratio and natural frequency of oscillation for the closed loop transfer function of a second order system is given	4	L3	CO2	II

	by 400/ (s^2+2s+400).				
12	Develop the time response of first order system for unit ramp signal	4	L6	CO2	II
13	F(S) =S^6 +S^5+2S^4 +3S^3 +7S^2+4S^1+4 =0. Judge the stability based on the number of roots falling in the RHS plane and LHS plane using RH criteria	4	L5	CO2	II
14	Construct the expression for maximum peak over shoot and rise time.	4	L6	CO2	II
15	Develop the time response of second order system for unit step signal under damped condition.	4	L6	CO2	II
16	Sketch the root locus for the unity feedback system whose open loop transfer function is G(S)= $\frac{k(s+9)}{s(s^2 +4s+11)}$	8	L3	CO2	II
17	a) For 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) $G(s) = \frac{20(s+2)}{s(s+1)(s+3)}$; (ii) $G(s) = \frac{10}{(s+2)(s+3)}$; (iii) $G(s) = \frac{10}{s^2(s+1)(s+2)}$ b) The open loop transfer function of a servo system with unity feedback system is G(S) = $\frac{10}{S(0.1S+1)}$.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_1t +(a_2 /2)t^2.	8	L2	CO2	II
18	Sketch the root locus for G(S)= $\frac{K(S^2-4S+20)}{(S+2)(S+4)}$ Find the gain, K at the point where the locus crosses the imaginary axis.	8	L3	CO2	II
19	Sketch the Bode plot and hence find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin. G(S) = $\frac{0.75(1+0.2S)}{S(1+0.5S)(1+0.1S)}$	4	L3	CO3	III
20	The open loop transfer function of a unity feedback system is G(S)= $\frac{1}{S(1+S)(1+2S)}$. Sketch the Polar plot and determine the Gain margin and Phase margin.	4	L3	CO3	III
21	Construct Nyquist plot for a feedback control system whose open loop transfer function is given by G(S)H(S) =$\frac{5}{S(1-S)}$. comment on the stability of open loop and closed loop transfer function.	4	L6	CO3	III
MID-II Questions					
22	Construct the Bode plot for the system whose open loop transfer function is G(S)H(S) =$\frac{5(1+2S)}{(1+4S)(1+0.25S)}$.Determine the Gain Margin and Phase Margin.	4	L6	CO3	III

23	Construct the polar plot for the function G(S)H(S) $=\frac{2(S+1)}{s^2}$. Find Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin	4	L6	CO3	III
24	Construct Nyquist plot for a feedback control system whose open loop transfer function is given by G(S)H(S) $=(s+1)(s+2)/\ s(s+3)$. comment on the stability of open loop and closed loop transfer function.	4	L6	CO3	III
25	Explain the design procedure for lead compensator using bode plot and root locus	4	L2	CO4	IV
26	Explain the design procedure for lag compensator using bode plot and root locus	4	L2	CO4	IV
27	Define frequency domain specifications (i)Resonant Peak (ii) Resonant Frequency (iii) Bandwidth (iv) Cut-off rate (iv) Gain Margin (v) Phase Margin	4	L1	CO4	IV
28	Discuss different applications of Proportional, Integral and derivative controllers	4	L2	CO4	IV
29	Obtain the transfer function of Lead Compensator, draw pole-zero plot	4	L4	CO4	IV
30	Obtain the transfer function of Lag Compensator, draw pole-zero plot	4	L3	CO4	IV
31	Derive the expression for resonant frequency and resonant frequency	8	L4	CO4	IV
32	Design a lead compensator for the unity feedback system with open loop transfer function **G(S)** $=\frac{K}{s\,(s+1)\,(s+5)}$ is to meet the following specifications: (i) Velocity error constant, Kv ≥ 50. (ii) Phase Margin $\gamma \geq 20$.	8	L6	CO4	IV
33	Design a lag compensator for the unity feedback system whose closed loop transfer function G(**S**) $=\frac{K}{s\,(s+1)\,(0.2s+1)}$ is to meet the following specifications: PM ≥ 40 and $K_V \geq 8$.	8	L6	CO4	IV
34	The state equation of a linear time invariant system is given as $\dot{x}=\begin{bmatrix} 0 & 5 \\ -1 & -2 \end{bmatrix}x+\begin{bmatrix} 1 \\ 1 \end{bmatrix}u$ $\quad$ $y=[1 \quad 1]\ x$ Develop the transfer function and draw the state diagram	4	L6	CO5	V
35	Reframe the matrix A to the diagonal matrix A= $\begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$	4	L5	CO5	V
36	Test the controllability & observability of the system whose state space representation is given as $\begin{bmatrix} \dot{x1} \\ \dot{x2} \end{bmatrix}=\begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix}\begin{bmatrix} x1 \\ x2 \end{bmatrix}+\begin{bmatrix} 2 \\ 5 \end{bmatrix}u$ $y=[1 \quad 2]\begin{bmatrix} x1 \\ x2 \end{bmatrix}$	4	L6	CO5	V

37	Solve the state space representation for following differential equation $d^2y/dt^2+5dy/dt+7y=11u$ where y is output and u is the input	4	L3	CO5	V
38	A system is characterized by transfer function $\frac{Y(S)}{U(S)}=\frac{2}{S^3+6S^2+11S+6}$ Find the state and output equation in matrix form	4	L5	CO5	V
39	A system is characterized by the following state space equations: • $\frac{d}{dx}X_1 = -3x_1 + x_2$; $\frac{d}{dx}(X_2) = -2x_1 + u$; $Y = x_1$ .Find the transfer function of the system and Stability of the system	4	L3	CO5	V
40	Determine the Solution for Homogeneous and Non homogeneous State equations	8	L3	CO5	V
41	Construct the canonical form of representation for the following state model $\begin{bmatrix}\dot{x}1\\ \dot{x}2\\ \dot{x}3\end{bmatrix} = \begin{bmatrix}2 & -2 & 3\\ 1 & 1 & 1\\ 1 & 3 & -1\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix} + \begin{bmatrix}11\\ 1\\ -14\end{bmatrix}u$ $y=\begin{bmatrix}-3 & 5 & -2\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}$ between early and late range gates	8	L6	CO5	V
42	Consider a control system with state model $\begin{bmatrix}\dot{x}1\\ \dot{x}2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x1\\ x2\end{bmatrix} + \begin{bmatrix}0\\ 2\end{bmatrix}u$ where u is unit step function and $x(0)=\begin{bmatrix}0\\ 1\end{bmatrix}$.Develop the state transition matrix and there from find the response for $t>0$	8	L6	CO5	V