Question Bank

Details of the Course

Academic Year	**: 2025 – 2026**
Regulation	**: 2024**
Name of the Department	**: Electronics and Communication Engineering**
Name of the Course	**: Control System**
Course Code	**: EC242303**
Semester	**: III**
Common To Programme(s)	**:**

Course Outcome: (List the Course Outcomes of the Course)

On completion of this course, the students will be able to

CO1: Compute the transfer function of different physical systems

CO2: Analyze the time domain specification and calculate the steady state error

CO3: Illustrate the frequency response characteristics of open loop and

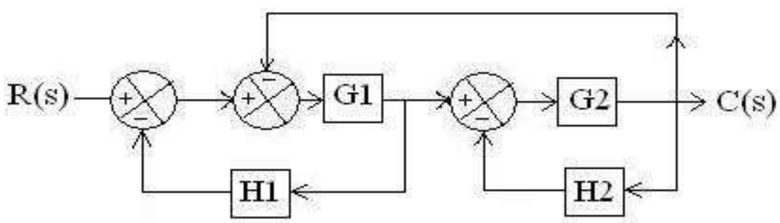
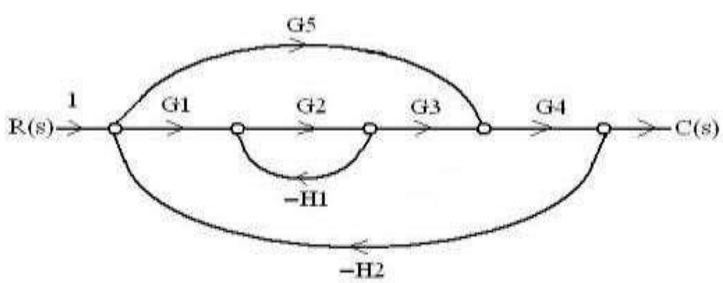
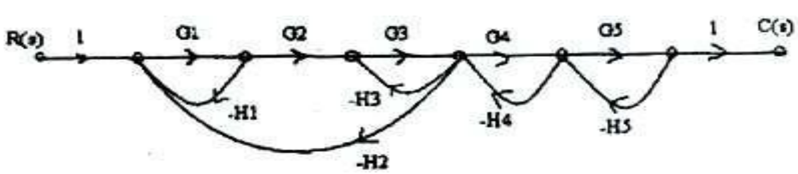
closed loop system response

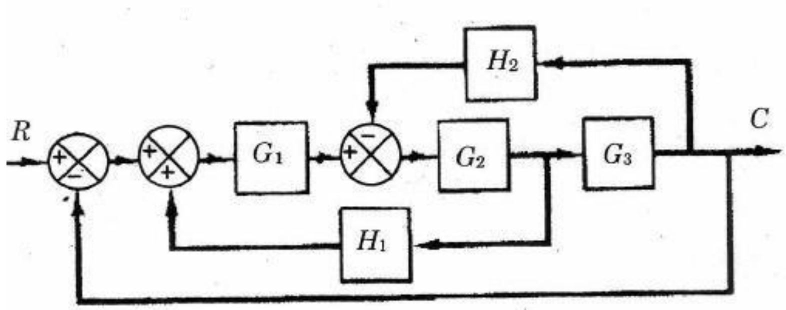
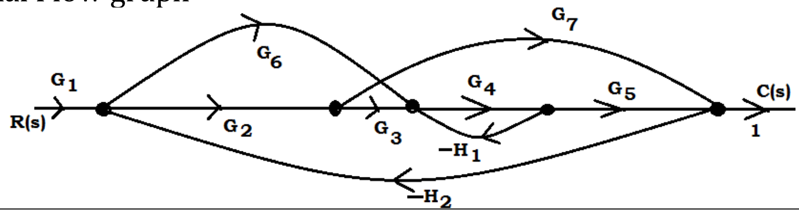
CO4: Analyze the stability using Routh and root locus techniques

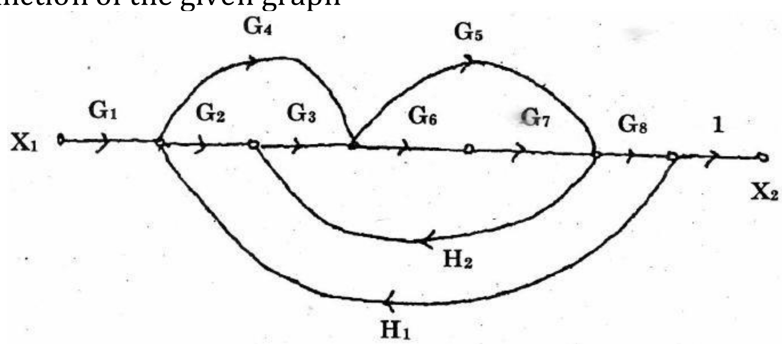
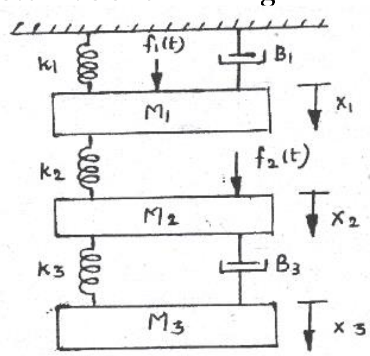
CO5: Illustrate the state space model of a physical system and discuss the concepts of sampled data control system

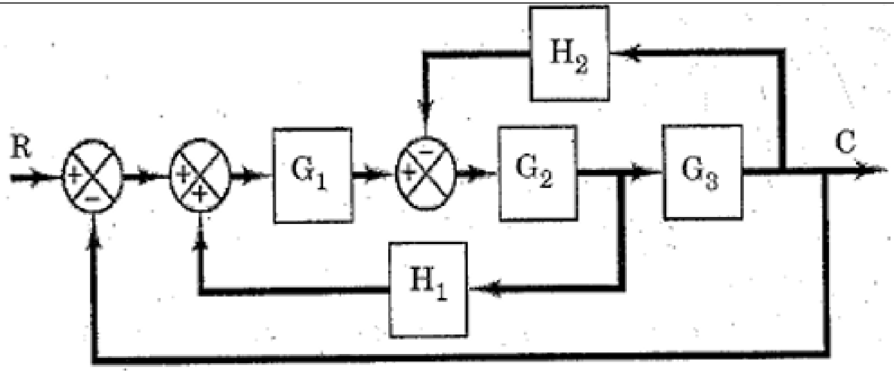
Bloom's Level: BL1-Remembering, BL2-Understanding, BL3-Applying, BL4-Analyzing, BL5–Evaluating, BL6-Creating.

UNIT- I – Systems Components and their Representation				
	PART – A (2 Marks)	Bloom's Level	Course Outcome	Marks Allotted
1.	Construct the block diagram of closed loop control system?	[BL1]	[CO1]	[2]
2.	Define transfer function of a system?	[BL2]	[CO1]	[2]
3.	Point Out the advantages of the closed loop system.	[BL2]	[CO1]	[2]
4.	List the properties of signal flow graph	[BL2]	[CO1]	[2]
5.	Classify the types of control system?	[BL2]	[CO1]	[2]
6.	Compare the difference between the open loop and closed loop system?	[BL2]	[CO1]	[2]

7.	Explain the block diagram simplification rule for removing the feedback loop?.	[BL1]	[CO1]	[2]
8.	Investigate the basic elements of a block diagram?	[BL1]	[CO1]	[2]
9.	Evaluate the usage of takeoff point in block diagram reduction technique?	[BL2]	[CO1]	[2]
10.	Discuss the Mason's Gain formula.	[BL2]	[CO1]	[2]
	Descriptive Questions (13/15 Marks)			
1.	i) Reduce the block diagram shown in fig and obtain its closed loop transfer function $C(s)/R(s)$ 	[BL5]	[CO1]	[7]
	ii) Find closed loop transfer function by using Mason's gain formula for the signal flow graph shown 			[6]
2.	i) Find $\frac{C(s)}{R(s)}$ for the signal flow graph shown below 	[BL5]	[CO1]	[13]
3.	Convert the block diagram shown in figure to signal flow graph and find the transfer function using mason's gain formula. Verify with the block diagram approach	[BL3]	[CO1]	[13]

				
4.	Obtain the closed loop transfer function of the system from the given Signal Flow graph 	[BL3]	[CO1]	[13]

5.	Demonstrate the usage of Mason's gain formula to derive the transfer function of the given graph 	[BL4]	[CO1]	[13]
6.	Write the differential equations governing the mechanical translational system as shown in fig 	[BL3]	[CO1]	[13]
7.	a. Give the block diagram reduction rules to find the transfer function of the system. b. List the properties of signal flow graph.	[BL1]	[CO1]	[15]
8.	a. Compare open loop and closed loop control systems based on different aspects? b. Distinguish between Block diagram Reduction Technique and Signal Flow Graph?	[BL3]	[CO1]	[15]
9.	Derive the transfer function of a RLC series circuit.	[BL1]	[CO1]	[15]
10.	Draw the signal flow graph for the given system block diagram and obtain the closed loop transfer of the system C(S)/R(s) using Manson's Gain formula	[BL1]	[CO1]	[15]



UNIT- II – Time Response Analysis

	PART – A (2 Marks)	Bloom's Level	Course Outcome	Marks Allotted
1.	Define peak overshoot	[BL6]	[CO2]	[2]
2.	Define transient and steady state response	[BL6]	[CO2]	[2]
3.	Outline the time domain specifications.	[BL1]	[CO2]	[2]
4.	Estimate the damped frequency of oscillation for a second order system which has a damping ratio of 0.6 and natural frequency of oscillation is 10 rad/sec.	[BL3]	[CO2]	[2]
5.	Name the test signals used in control system	[BL1]	[CO2]	[2]
6.	What is damped frequency of oscillation	[BL6]	[CO2]	[2]
7.	Sketch the response of a second order under damped system	[BL4]	[CO2]	[2]
8.	Classify the system based on the value of damping	[BL5]	[CO2]	[2]
9.	Discuss about the positional error constant	[BL5]	[CO2]	[2]
10.	Interpret the type and order of the system. $G(s)H(s) = \frac{(s+4)}{(s-2)(s+0.25)}$	[BL4]	[CO2]	[2]
	Descriptive Questions (13/15 Marks)			
1.	The unity feedback system is characterized by an open loop transfer function $G(S) = \frac{10}{S(S+2)}$. Examine the gain K, so that the system will have a damping ratio of 0.5 for this value of K. Examine settling time, peak overshoot and peak time for a unit step input.	[BL3]	[CO2]	[13]
2.	Consider a second order model $\frac{Y(S)}{R(S)} = \frac{\omega_n^2}{S^2 + 2\xi\omega_n S + \omega_n^2}; 0 < \xi < 1.$ Find the response y(t) to a input of unit step function.	[BL3]	[CO2]	[13]
3.	A unity feedback control system has an open loop transfer function G(s) = 10/s(s+5). Determine its closed loop transfer function, damping ratio and natural frequency of oscillations. Also evaluate the rise time, peak Overshoot, peak time and settling time for a step input of 12 units	[BL3]	[CO2]	[13]

4.	The unity feedback control system is characterized by an open loop transfer function. $G(S)=\dfrac{K}{S(S+10)}$. Determine the gain K, so that the system will have damping ratio of 0.5 for this value of K. Determine the peak overshoot and peak time for a unit step input.	[BL3]	[CO2]	[13]
5.	Name the various standard test signals? Draw the characteristics diagram and obtain the mathematical representation of all.	[BL5]	[CO2]	[13]
6.	Write the response of undamped second order system for unit step input	[BL5]	[CO2]	[13]
7.	A unity feedback control system has an open loop transfer function, G(s) = ⍰(⍰+⍰) . Find the rise time, percentage overshoot, peak time and settling time for a step input of 12 units.	[BL5]	[CO2]	[15]
8.	Derive the expression of the step response of a standard second order underdamped system.	[BL5]	[CO2]	[15]
9.	List out the time domain specifications and derive the expressions for Rise time, Peak time and Peak overshoot	[BL5]	[CO2]	[15]
10.	Find all the time domain specifications for a unity feedback control system whose open loop transfer function is given by G(S) = ⍰⍰ /⍰(⍰+⍰) .	[BL5]	[CO2]	[15]
11	A second order system is given by C(S)/R(S)=25/ $s^2+6s+25$. Find its rise time, peak time, peak over shoot and settling time if subjected unit step input. Also calculate expression for its output response	[BL5]	[CO2]	[15]

Unit – III Frequency Response and System Analysis

	PART – A (2 Marks)	**Bloom's Level**	**Course Outcome**	**Marks Allotted**
1.	Derive the transfer function of a lead compensator network	[BL2]	[CO3]	[2]
2.	Define Phase margin & gain margin.	[BL3]	[CO3]	[2]
3.	Analyze the effects of addition of poles and zeros in polar plot.	[BL4]	[CO3]	[2]
4.	Summarize the advantages of Frequency Response Analysis	[BL2]	[CO3]	[2]
5.	Write about gain crossover Frequency	[BL1]	[CO3]	[2]
6.	Demonstrate the correlation between time and frequency response	[BL4]	[CO3]	[2]

7.	Explain compensators and list types of compensators	[BL2]	[CO3]	[2]
8.	Explain the corner frequency in frequency response analysis?	[BL2]	[CO3]	[2]
9.	Frame the specifications required for frequency domain analysis?	[BL3]	[CO3]	[2]
10.	Sketch shape of polar plot for the open loop transfer function. $G(s)H(s)=\dfrac{1}{s(1+Ts)}$	[BL4]	[CO3]	[2]

Descriptive Questions (13/15 Marks)

1.	Sketch the polar plot and find the gain and phase margin of a control system has with unity feedback $G(s) = \frac{1}{s^2(s+1)(1+2s)}$	[BL4]	[CO3]	[13]
2.	Consider a Unity feedback system has an open loop transfer function, $G(s) = \frac{K}{s(1+0.2s)(1+0.05s)}$. Apply the polar plot and determine the value of k so that (i)Gain margin is 18db (ii)Phase margin is 60 degrees	[BL4]	[CO3]	[13]
3.	Sketch the Polar plot for $G(s) = \frac{1}{s(s+1)(1+2s)}$ and determine the gain margin and phase margin	[BL4]	[CO3]	[13]
4.	A unity feedback control system has $G(s) = \frac{1}{s(1+0.1s)(1+s)}$ Find the Bode plot, Determine the gain cross over frequency, phase cross over frequency, gain margin and phase margin	[BL4]	[CO3]	[13]
5.	Report the value of gain and phase cross over frequencies for the following function using bode plot. $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$	[BL4]	[CO3]	[13]
6.	List out the frequency domain specifications of a standard second order system. Derive the expressions for resonant peak and Bandwidth of a second order system	[BL4]	[CO3]	[13]
7.	Design the procedure for constructing the bode magnitude plot and bode phase plot	[BL1]	[CO3]	[15]
8.	Sketch the root locus of the system whose open loop transfer function is G(s)H(s) = □ / S (□^{2}+□□+□□)	[BL4]	[CO3]	[15]
9.	Sketch the root locus of the system whose open loop transfer function is G(s) H(s) = □(□^{2}+□□+□□) / □ (□ + □) (□ + □)	[BL4]	[CO3]	[15]
10.	Sketch the root locus of the system whose open loop transfer function is G(s) H(s) = □ (□+□) /S(□^{2}+□□+□□)	[BL4]	[CO3]	[15]

UNIT- IV – Concepts of Stability Analysis

	PART – A (2 Marks)	Bloom's Level	Course Outcome	Marks Allotted
1.	Assess the advantages of Routh Hurwitz stability criterion.	[BL2]	[CO4]	[2]
2.	Discover the advantages of Nyquist stability criterion over that of Routh's criterion	[BL2]	[CO4]	[2]
3.	How will you find root locus on real axis?	[BL3]	[CO4]	[2]
4.	State Nyquist stability criterion	[BL1]	[CO4]	[2]
5.	List the advantages of using root locus for design?	[BL1]	[CO4]	[2]
6.	Express the rules to obtain the breakaway point in root locus	[BL2]	[CO4]	[2]
7.	Define Centroid?	[BL1]	[CO4]	[2]
8.	Explain stability of a system.	[BL2]	[CO4]	[2]
9.	Illustrate the stability of the system when the roots of characteristic	[BL2]	[CO4]	[2]

	equation are lying on imaginary axis.			
10.	What is meant by relative stability?	[BL2]	[CO4]	[2]
	Descriptive Questions (13/15 Marks)			
1.	Discuss the stability of a system with characteristics equation $9S^5-20S^4+10S^3-S^2-9S-10=0$ using Routh Hurwitz criterion	[BL5]	[CO4]	[13]
2.	Using Routh Hurwitz criterion determine the stability of a system representing the characteristic equation $S^6 + S^5 + 3S^4 + 3S^3 + 3S^2 + 2S + 1 = 0$ and comment on location of the roots of the characteristic equation	[BL5]	[CO4]	[13]
3.	Label the Root Locus of the system whose open loop transfer function $G(s)=\dfrac{K}{s(s^2+6s+10)}$. Determine the Value of K for which the given system is stable	[BL4]	[CO4]	[13]
4.	Sketch the root locus of the system whose open loop transfer function $G(s)=\dfrac{K}{s(s+2)(s+4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5	[BL4]	[CO4]	[13]
5.	Explain briefly about the steps to be followed to construct a root locus plot of a given transfer function	[BL6]	[CO4]	[13]
6.	Write detailed notes on relative stability with its roots of S- plane	[BL6]	[CO4]	[13]
7.	State and explain about different cases of Routh Hurwitz criterion	[BL6]	[CO4]	[15]
8.	Obtain the transfer function of Lead Compensator, draw pole-zero plot and write the procedure for design of Lead Compensator using Bode plot.	[BL6]	[CO4]	[15]
9.	A system is given by G(s) H(s) = (□□+□) / □²(□+□) (□□+□) Sketch the nyquist plot and determine the stability of the system.	[BL5]	[CO4]	[15]

10.	Obtain the transfer function of Lag Compensator, draw pole-zero plot and write the procedure for de	[BL6]	[CO4]	[15]
	UNIT- V – Control System Analysis using State Variable Methods			
	PART – A (2 Marks)	**Bloom's Level**	**Course Outcome**	**Marks Allotted**
1.	Name the methods of state space representation for phase variables.	[BL1]	[CO5]	[2]
2.	Identify the definition of state vector	[BL1]	[CO5]	[2]
3.	Write the properties of State transition matrix	[BL1]	[CO5]	[2]
4.	Determine the controllability of the system described by the state equation	[BL3]	[CO5]	[2]
5.	Summarize the advantages of state space modeling using physical variable	[BL2]	[CO5]	[2]
6.	List the advantages of Sate Space representations.	[BL1]	[CO5]	[2]
7.	Describe State and State Variable	[BL2]	[CO5]	[2]

8.	Define State equation	[BL1]	[CO5]	[2]
9.	Analyze the concept of Controllability	[BL3]	[CO5]	[2]
10.	Discuss the basic elements used to construct the state diagram.	[BL2]	[CO5]	[2]
	Descriptive Questions (13/15 Marks)			
1.	Determine the controllability of the following system: $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 0\\ 10\end{bmatrix}u \quad y = \begin{pmatrix}1 & 0 & 0\end{pmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$	[BL3]	[CO5]	[13]
2.	A system is characterized by the transfer function $\frac{Y(S)}{U(S)} = \frac{3}{S^3 + 6S^2 + 11S + 6}$. Find the state and output equation in matrix form	[BL3]	[CO5]	[13]
3.	A system is characterized by the transfer function Y(S)/U(S)= 3/ $s^3 + 5s^2 + 11s + 6$. Identify the first state as the output. Determine whether or not the system is completely controllable and observable.	[BL2]	[CO5]	[13]
4.	Explain how controllability and observability for a system can be tested with an example	[BL2]	[CO5]	[13]
5.	Check the controllability of the following state space system. $\dot{x}_1 = x_2 + u_2;\ \dot{x}_2 = x_3;\ \dot{x}_3 = -2x_2 - 3x_3 + u_1 + u_2$	[BL3]	[CO5]	[13]
6.	Test the observability of the system whose state space representation is given as: $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix} = \begin{bmatrix}0 & 0 & 2\\ -2 & -3 & 0\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix} + \begin{bmatrix}0\\ 2\\ 0\end{bmatrix}u \quad y = \begin{pmatrix}1 & 0 & 0\end{pmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$	[BL4]	[CO5]	[13]
7.	Obtain a state model for the system whose Transfer function is given by G(s) H(s) = (□□²+□□□+□) / (□³+□□²+□□□+□)	[BL3]	[CO5]	[15]
8.	Obtain the state model of the system whose transfer function is given as $Y(s)/U(s) = 10 / s^3 + 4s^2 + 2s + 1$	[BL4]	[CO5]	[15]
9.	A system is characterized by the following state space equations: • X1 = -3 x1 + x2 ; • X2 = -2 x1 + u ; Y = x1 (a) Find the transfer function of the system and Stability of the system. (b) Compute the STM	[BL5]	[CO5]	[15]
10.	a. Define state, state variable, state equation. b. Derive the expression for the transfer function from the state model. • X= Ax + Bu and y = Cx + Du	[BL3]	[CO5]	[15]