SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

IV SEMESTER

MD3462 – BIO CONTROL SYSTEMS

Regulation – 2023

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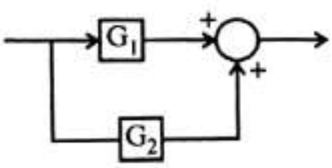
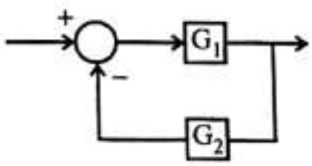
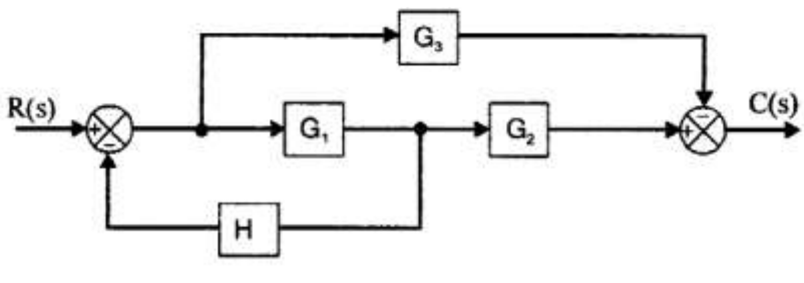
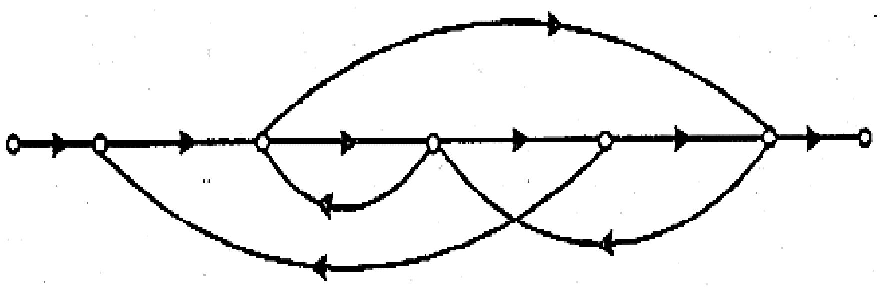
UNIT I INTRODUCTION

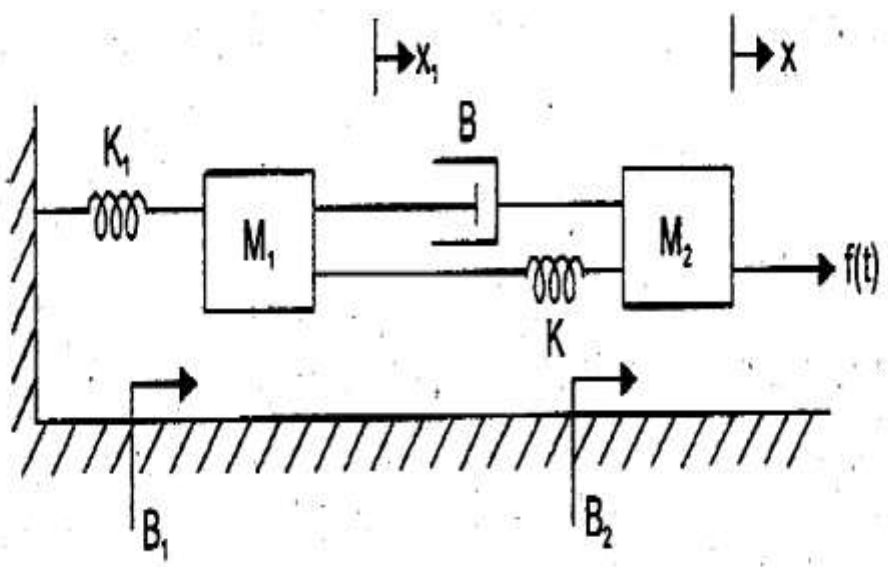
Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.

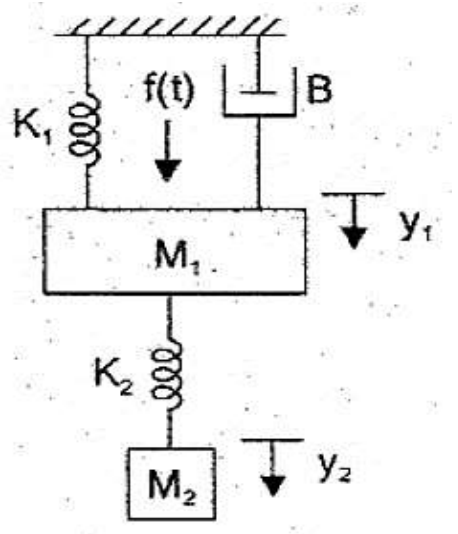
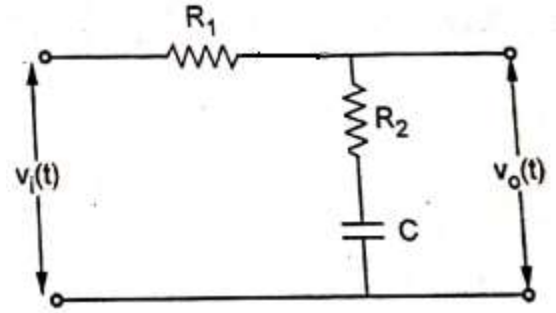
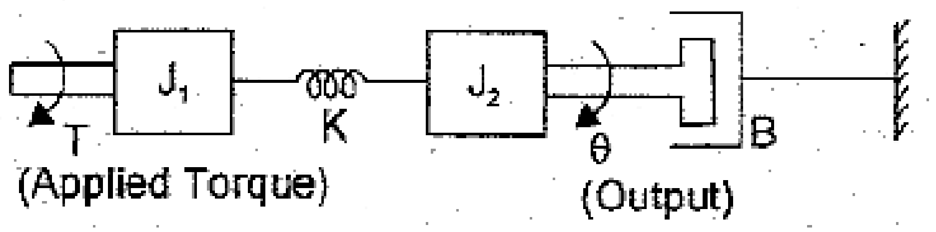
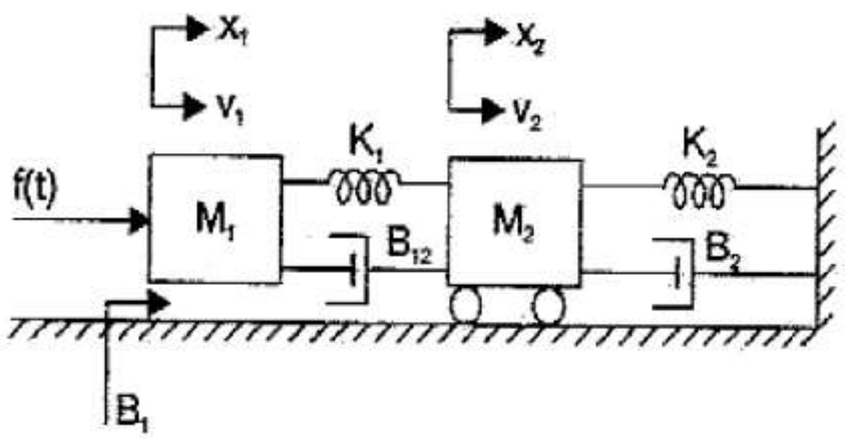
PART – A

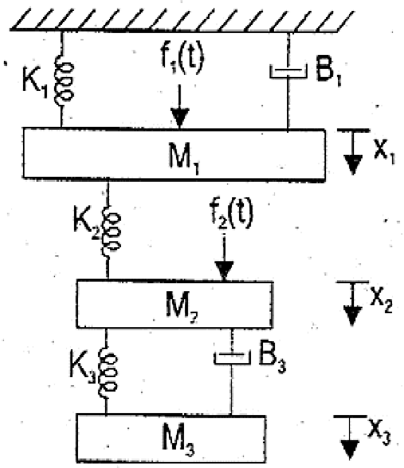
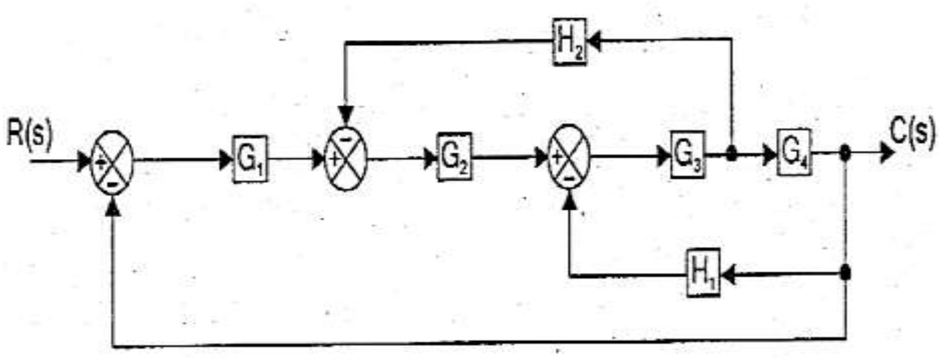
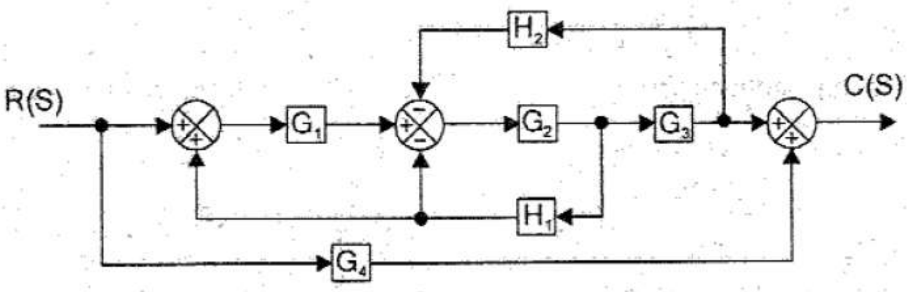
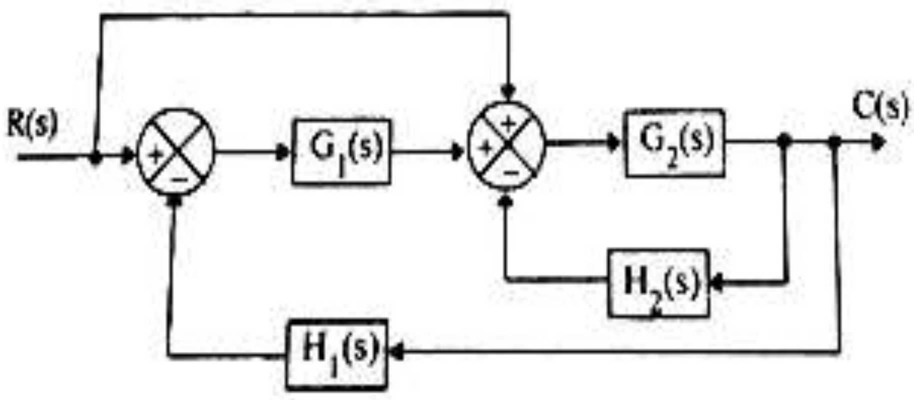
Q. No.	Questions	CO's	BT Level	Competence
1.	What are the components of feedback control system?	CO1	BTL1	Remember
2.	Define block diagram and list its basic components.	CO1	BTL1	Remember
3.	Distinguish between open loop and closed loop system.	CO1	BTL 2	Understand
4.	Why negative feedback is invariably preferred in a closed loop system?	CO1	BTL1	Remember
5.	Express the transfer function of a control system.	CO1	BTL 2	Understand
6.	Write the torque balance equation of a of an ideal rotational mass element.	CO1	BTL 2	Understand
7.	Find the poles and zeros of the following transfer function T(s) =2(s+2) / s(s+4)	CO1	BTL 2	Understand
8.	Mention the basic elements of the translational mechanical system.	CO1	BTL1	Remember
9.	Name the two types of electrical analogous for mechanical system.	CO1	BTL1	Remember
10.	Define signal flow graph.	CO1	BTL 2	Understand
11.	Draw the equivalent block diagram for the figures 1 and 2 given below: (i)  **Figure-1** (ii)  **Figure-2**	CO1	BTL 2	Understand
12.	Identify the forces acting on an ideal spring in a control system and explain the force balance equation.	CO1	BTL 2	Understand
13.	How will you reduce two blocks in parallel using block diagram reduction technique?	CO1	BTL1	Remember
14.	Draw the equivalent signal flow graph for the system whose block diagram is as shown in figure. 	CO1	BTL 2	Understand
15.	What are the basic properties of signal flow graph?	CO1	BTL1	Remember

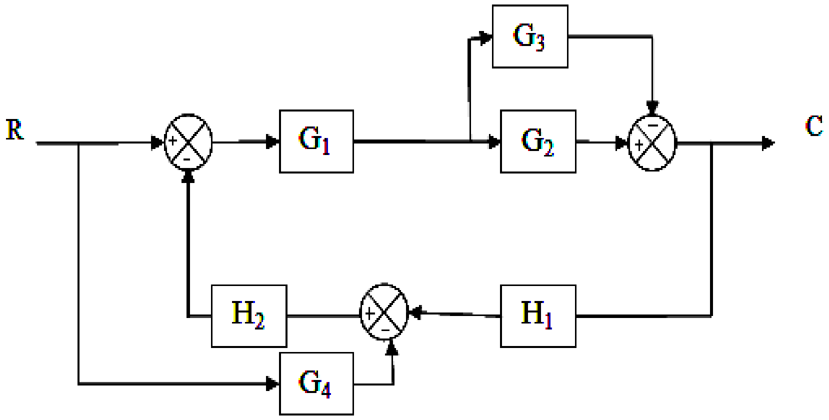
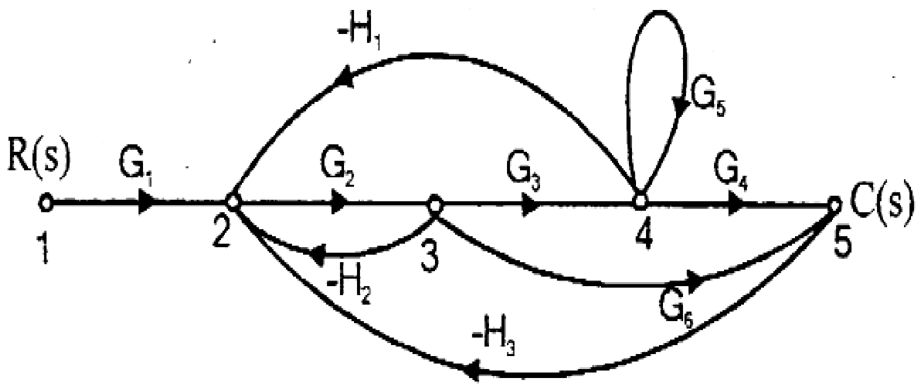
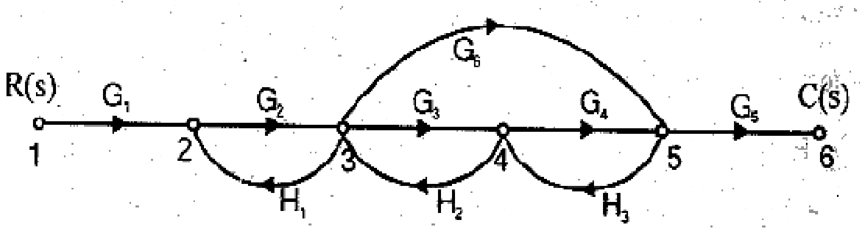
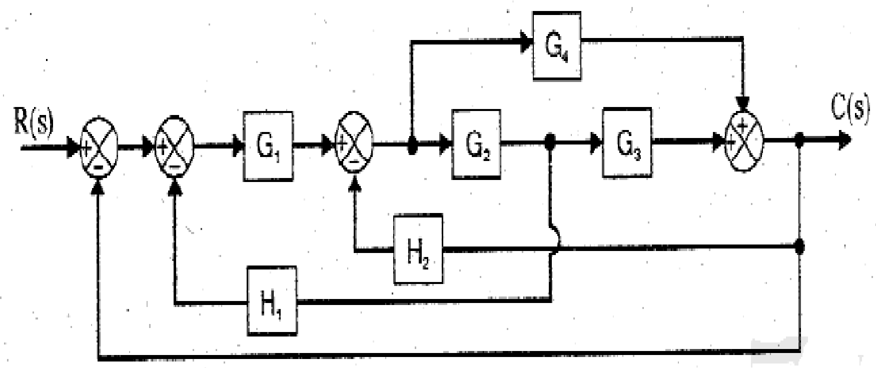
16.	Write the Mason's Gain formula.	CO1	BTL 2	Understand
17.	Determine the gain $\frac{Y}{X}$ for the signal flow graph shown below: 	CO1	BTL 2	Understand
18.	State non-touching loop.	CO1	BTL1	Remember
19.	List the characteristics of negative feedback.	CO1	BTL 2	Understand
20.	For the given signal flow graph, identify the number of forward paths and individual loops. 	CO1	BTL1	Remember
21.	Enumerate the advantages of physiological models.	CO1	BTL1	Remember
22.	Differentiate engineering and physiological control systems.	CO1	BTL 2	Understand
23.	Define qualitative and quantitative physiological model.	CO1	BTL1	Remember
24.	What are the elements of a physiological control system?	CO1	BTL1	Remember

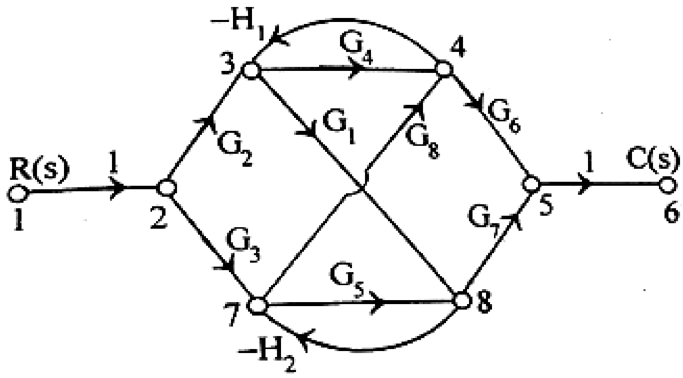
PART – B

1.	Apply the principles of system dynamics to determine the transfer function of the given mechanical translational system. (16) 	CO1	BTL 3	Apply

2.	Evaluate the differential equation governing the given mechanical translational system and derive its transfer function. (16)  	CO1	BTL 3	Apply
3.	Analyze the given electrical network and deduce the transfer function. (16)  	CO1	BTL 4	Analyze
4.	Examine the mechanical rotational system with an appropriate differential equation and obtain the transfer function of the system. (16)  	CO1	BTL 4	Analyze
5.	Illustrate the mechanical system with the Force Voltage and Force Current electrical analogous circuit. (16)  	CO1	BTL 3	Apply

6.	Demonstrate the given mechanical translational system with force-voltage and force-current electrical analogous circuits. (16)  	CO1	BTL 3	Apply
7.	Simplify the block diagram and find the transfer function C(s)/R(s) for the given system. (16)  	CO1	BTL 4	Analyze
8.	Calculate the transfer function C(s)/R(s) for the block diagram shown in figure using block diagram reduction technique. (16)  	CO1	BTL 4	Analyze
9.	Solve the transfer function of the system by reducing the given block diagram. (16)  	CO1	BTL 3	Apply

10. Calculate the transfer function for the block diagram shown in fig. using Mason's Gain Formula. (16) 	CO1	BTL 4	Analyze
11. Apply Masons gain formula to determine the transfer function of the given signal flow graph. (16) 	CO1	BTL 3	Apply
12. For the signal flow graph of the closed loop feedback system shown below, Determine the closed loop transfer function. (16) 	CO1	BTL 3	Apply
13. Interpret the transfer function by converting the block diagram into signal flow graph. (16) 	CO1	BTL 4	Analyze

14.	Using the mason's gain formula, compute the gain of the following system: (16) 	CO1	BTL 4	Analyze
15.	Explain the physiological control system analysis with an example. (16)	CO1	BTL 4	Analyze
16.	Compare and contrast the key differences between engineering and physiological control systems in detail. (16)	CO1	BTL 3	Apply
17.	Describe in detail the linear model of respiratory and muscle mechanics with necessary diagrams. (16)	CO1	BTL 3	Apply

UNIT II TIME REPONSE ANALYSIS

Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.

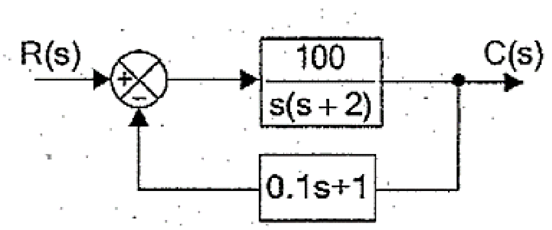
PART – A

Q. No.	Questions	CO's	BT Level	Competence
1.	What is time response?	CO2	BTL 1	Remember
2.	Name the test signals used in control system.	CO2	BTL 1	Remember
3.	Write the mathematical expressions for step and ramp signals.	CO2	BTL 2	Understand
4.	State various time domain specifications.	CO2	BTL 1	Remember
5.	Illustrate peak overshoot.	CO2	BTL 2	Understand
6.	Express the type and order of the following system $\frac{G(s)}{H(s)} = \frac{10}{s^3(s^2 + 2s + 1)}$	CO2	BTL 2	Understand
7.	Distinguish between the order and type of system.	CO2	BTL 2	Understand
8.	Label the response of the second order under damped systems.	CO2	BTL 1	Remember
9.	Define pole and zero of a function F(s).	CO2	BTL 1	Remember
10.	Mention two advantages of generalized error constant over static error constant.	CO2	BTL 1	Remember
11.	Find 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.	CO2	BTL 2	Understand

12.	The closed loop transfer function of a second order system is given by $\frac{C(s)}{R(s)} = \frac{200}{(S^2 + 20S + 200)}$ Determine the damping ratio and natural frequency of oscillation.	CO2	BTL 2	Understand
13.	A unity feedback system has an open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$ Compute the steady state error for unit step input.	CO2	BTL 2	Understand
14.	How the system is classified on the value of damping?	CO2	BTL 1	Remember
15.	Solve for the type and order of the system $G(s)H(s) = \frac{(s+4)}{(s-2)(s+0.25)}$	CO2	BTL 2	Understand
16.	Write the response of first-order system with unit step input.	CO2	BTL 2	Understand
17.	How did the type number of a system is identified? Mention its significance.	CO2	BTL 1	Remember
18.	Give the relation between generalized and static error coefficients.	CO2	BTL 2	Understand
19.	The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{10(S+2)}{S^2(S+5)}$ Find the acceleration error constant.	CO2	BTL 1	Remember
20.	Find the unit impulse of system given with zero initial conditions. $H(s) = \frac{5S}{(S+2)}$	CO2	BTL 1	Remember
21.	What are the transient and steady-state responses?	CO2	BTL 1	Remember
22.	Define settling time.	CO2	BTL 1	Remember
23.	The damping ratio of system is 0.6 and the natural frequency of oscillation is 8 rad/sec. Calculate the rise time.	CO2	BTL 2	Understand
24.	What is meant by type number of the system? Give its significance.	CO2	BTL 2	Understand

		PART –B			
1.	**(i)**	Name the various standard test signals? (3)	CO2	BTL 3	Apply
	(ii)	Draw the characteristics diagram and obtain the mathematical representation of the test signals. (13)			
2.		Analyze the response of first order system for a unit step input. Plot the response of the system. (16)	CO2	BTL 4	Analyze
3.		Write the response of undamped second order system for unit step input. (16)	CO2	BTL 3	Apply
4.		Derive the expression for second order system for under damped case and when the input is unit step. (16)	CO2	BTL 3	Apply

5.	Analyze the expression for second order system for critically damped case and when the input is unit step. (16)	CO2	BTL 4	Analyze
6.	Calculate the response of unity feedback system whose open loop transfer function is $G(s) = \frac{4}{s(s+5)}$ and when the input is unit step. (16)	CO2	BTL 4	Analyze
7.	Outline the expressions for the following time domain specifications of second order under damped system due to unit step input. **(i)** Rise time. (4) **(ii)** Peak time. (4) **(iii)** Delay time. (4) **(iv)** Peak over shoot. (4)	CO2	BTL 4	Analyze
8.	The unity feedback system is characterized by an open loop transfer function $$G(s) = \frac{K}{s(s+10)}$$ **(i)** Examine the gain K, so that the system will have a damping ratio of 0.5 for this value of K. (8) **(ii)** Examine peak overshoot for a unit step input. (8)	CO2	BTL 4	Analyze
9.	A Unity feedback control system is characterized by open loop transfer function $G(s) = \frac{10}{s(s+2)}$ Compute the rise time, percentage overshoot, peak time and settling time for a step input of 12 units. (16)	CO2	BTL 3	Apply
10.	A closed loop servo is represented by the differential equation $\frac{d^2c}{dt^2} + 8\frac{dc}{dt} = 64e$ where c is the displacement of the output shaft, r is the displacement of the input shaft and $e = r - c$. Calculate undamped natural frequency, damping ratio and percentage maximum overshoot for unit step input. (16)	CO2	BTL 4	Analyze
11.	Obtain the expression for K_p, K_v, and K_a for Type 0, 1 and 2 systems when the input is unit step, ramp and parabola. (16)	CO2	BTL 3	Apply

12.	For a unity feedback control system, the open loop transfer function is $G(s) = \dfrac{10(s+2)}{s^2(s+1)}$		CO2	BTL 3	Apply
	(i)	Find the position, velocity, acceleration error constants. (8)			
	(ii)	Compute the steady state error when the input is R(s) where (8) $R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^3}$			
13.	The open loop transfer function of a servo system with unity feedback is $G(s) = \dfrac{10}{s(0.1s+1)}$ 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, $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$ (16)		CO2	BTL 3	Apply
14.	Consider a unity feedback system with a closed loop transfer $\dfrac{C(s)}{R(s)} = \dfrac{Ks+b}{s^2+as+b}$ Determine the open loop transfer function G(s). Show that steady state error with unit ramp input is given by $\frac{a-k}{b}$ (16)		CO2	BTL 4	Analyze
15.	For the given open loop transfer function G(s) for servomechanism, interpret what type of input signal give rise to a constant steady state error and calculate the value. $G(s) = \dfrac{10}{s^2(s+1)(s+2)}$ (16)		CO2	BTL 3	Apply
16.	A positional control system with velocity feedback is shown. Examine the response of the system for unit step input. (16) 		CO2	BTL 4	Analyze
17.	Measurements conducted on a servo mechanism show that the system response to be $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$ when subjected to a unit step input.		CO2	BTL 3	Apply
	(i)	Obtain an expression for closed loop transfer function. (8)			
	(ii)	Compute the undamped natural frequency and damping ratio. (8)			

UNIT III FREQUENCY RESPONSE ANALYSIS

Frequency domain specifications - Polar plots - Bode plots - Nyquist plot – Nyquist stability criterion, closed loop stability - Constant M and N circles - Nichol's chart.

PART - A

Q. No.	Questions	CO's	BT Level	Competence
1.	Write the expression for resonant peak and resonant frequency.	CO3	BTL 2	Understand
2.	Define Phase margin & gain margin.	CO3	BTL 1	Remember
3.	What is meant by frequency response of the system?	CO3	BTL 1	Remember
4.	What are frequency domain specifications?	CO3	BTL 1	Remember
5.	The damping ratio and natural frequency of oscillations of a second order system is 0.5 and 8 rad/sec respectively. Find resonant frequency and resonant peak.	CO3	BTL 1	Remember
6.	How can the phase margin and gain margin be improved?	CO3	BTL 1	Remember
7.	Find the shape of polar plot for the open loop transfer function $G(s)H(s) = \frac{1}{s(1+Ts)}$	CO3	BTL 2	Understand
8.	Identify the shape of polar plot for the transfer function $G(s) = \frac{K}{s(1+sT_1)(1+sT_2)}$	CO3	BTL 2	Understand
9.	Why frequency domain analysis is needed?	CO3	BTL 1	Remember
10.	List the advantages of Frequency Response Analysis.	CO3	BTL 2	Understand
11.	Define phase cross over frequency.	CO3	BTL 1	Remember
12.	Define gain cross over frequency.	CO3	BTL 1	Remember
13.	State the significance of Nichol's plot.	CO3	BTL 2	Understand
14.	Write the correlation between time and frequency response.	CO3	BTL 2	Understand
15.	List the frequency domain methods to find the stability of the system.	CO3	BTL 2	Understand
16.	State Nyquist stability criterion.	CO3	BTL 1	Remember
17.	How do you determine the stability of a system by using Nyquist criterion?	CO3	BTL 1	Remember
18.	Identify the methods used to specify the performance of control systems.	CO3	BTL 2	Understand
19.	Discuss about the corner frequency in frequency response analysis?	CO3	BTL 2	Understand
20.	Compare the Bode plot and Nyquist plot analysis.	CO3	BTL 2	Understand
21.	List the various graphical techniques available for frequency domain analysis.	CO3	BTL 2	Understand

22.	State the limitations of frequency domain analysis.	CO3	BTL 1	Remember
23.	Find the phase angle of the given transfer function $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$	CO3	BTL 1	Remember
24.	List the advantages of Bode plot.	CO3	BTL 2	Understand

	PART –B			
1.	Plot the bode diagram for the given transfer function and estimate the gain and phase cross over frequencies. (16) $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$	CO3	BTL 3	Apply
2.	Sketch the bode plot for the transfer function $G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$ and determine phase margin and gain margin. (16)	CO3	BTL 3	Apply
3.	Calculate the system gain K by sketching the Bode plot for the transfer function $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$ with gain cross over frequency of 5rad/sec. (16)	CO3	BTL 3	Apply
4.	Analyze the bode plot for the function given by (16) $G(s) = \frac{5(1+2s)}{(1+4s)(1+0.25s)}$	CO3	BTL 4	Analyze
5.	Given $G(s) = \frac{Ke^{-0.2s}}{s(s+2)(s+8)}$ Draw the Bode plot and Calculate K for the following two cases: (16) **(i)** Gain margin equal to 6db. **(ii)** Phase margin equal to 45°.	CO3	BTL 3	Apply
6.	**(i)** Evaluate open loop transfer function of a unity feedback system given by $G(s) = \frac{1}{s(1+s)(1+2s)}$ Sketch the polar plot. (12) **(ii)** Evaluate the gain and phase margin for the above system. (4)	CO3	BTL 4	Analyze
7.	Report on the polar plot of an open loop transfer function of a unity feedback system given by $G(s) = \frac{1}{s^2(1+s)(1+2s)}$ Sketch the polar plot. Also determine the gain and phase margin for the above system. (16)	CO3	BTL 4	Analyze

8.	Construct the polar plot and determine the gain margin and phase margin of a unity feedback control system whose open loop transfer function is, $G(s) = \frac{(1+0.2s)(1+0.025s)}{s^3(1+0.005s)(1+0.001s)}$ (16)	CO3	BTL 3	Apply
9.	Consider a unity feedback system with open loop transfer function $G(s) = \frac{1}{s(1+s^2)}$ From the polar plot and determine the gain and phase margin. (16)	CO3	BTL 4	Analyze
10.	Outline the procedure for obtaining the polar plot for a system whose open loop transfer function is (16) $G(s) = \frac{4}{(s+2)(s+4)}$	CO3	BTL 4	Analyze
11.	Calculate the range of K for which closed loop system is stable for the open loop transfer function $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$ by drawing the Nyquist plot. (16)	CO3	BTL 4	Analyze
12.	Sketch the polar plot of a unity feedback system with open loop transfer function given by, $G(s) = \frac{50}{s(s+1)(s+5)(s+10)}$ and calculate the gain and phase margins of the closed loop system. (16)	CO3	BTL 4	Analyze
13.	Using polar plot, Estimate gain cross over frequency phase cross over frequency, gain margin and phase margin of feedback system with open loop transfer function. (16) $G(s) = \frac{10}{s(1+0.2s)(1+0.002s)}$	CO3	BTL 4	Analyze
14.	Sketch the Bode plot and hence calculate Gain cross over frequency, Phase cross over frequency, Gain margin and Phase margin for the function $G(s) = \frac{10(s+3)}{s(s+2)(s^2+4s+100)}$ (16)	CO3	BTL 3	Apply
15.	Write short notes on constant M and N circles and outline the procedure to derive the Nichol's chart from constant M circles. (16)	CO3	BTL 4	Analyze
16.	Describe the procedure for constructing the bode magnitude plot and phase plot. (16)	CO3	BTL 3	Apply
17.	Analyze the procedure for designing the Nyquist plot and explain the steps involved. (16)	CO3	BTL 4	Analyze

UNIT IV STABILITY ANALYSIS				
Definition of stability, Routh- Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability.				
PART – A				
Q. No.	**Questions**	**CO's**	**BT Level**	**Competence**
1.	What is characteristic equation?	CO4	BTL 1	Remember
2.	Quote BIBO stability criterion.	CO4	BTL 2	Understand
3.	State Routh's criterion for stability.	CO4	BTL 1	Remember
4.	Write the necessary and sufficient condition for stability.	CO4	BTL 2	Understand
5.	What conclusion can be provided when there is a row of all zeros in Routh array?	CO4	BTL 2	Understand
6.	List the advantages of Routh Hurwitz stability criterion?	CO4	BTL 1	Remember
7.	Give any two limitations of Routh stability criterion.	CO4	BTL 2	Understand
8.	Find the range of values of K for which the system would be stable. The characteristic equations of a system is $s^3 + 3s^2 + 7s + K = 0$ using Routh stability criterion.	CO4	BTL 2	Understand
9.	Identify the main objective of root locus analysis technique.	CO4	BTL 2	Understand
10.	Interpret the relationship between roots of characteristic equation and stability.	CO4	BTL 2	Understand
11.	Define relative stability.	CO4	BTL 1	Remember
12.	Identify dominant pole location in s-plane.	CO4	BTL 2	Understand
13.	What are the effects of adding a zero to open loop transfer function of a system?	CO4	BTL 1	Remember
14.	How centroid of the asymptotes found in root locus technique?	CO4	BTL 1	Remember
15.	How will you find root locus on real axis?	CO4	BTL 1	Remember
16.	Illustrate the effects of adding open loop poles and zeros on the nature of the root locus and on system?	CO4	BTL 2	Understand
17.	Point out the regions of root locations for stable, unstable and limitedly stable systems.	CO4	BTL 2	Understand
18.	Predict about the stability of the system when the roots of the characteristic equation are lying on imaginary axis?	CO4	BTL 2	Understand
19.	Is addition of a pole will make a system more stable? Justify your answer.	CO4	BTL 2	Understand
20.	How centroid of the asymptotes found in root locus technique?	CO4	BTL 1	Remember
21.	Define BIBO stability.	CO4	BTL 1	Remember

22.	Find the range of K for closed loop stable behavior of system with characteristic equation $2s^4 + 12s^3 + 22s^2 + 12s + K = 0$ by using Routh's stability criterion.	CO4	BTL 1	Remember
23.	State the rule for obtaining breakaway point in root locus.	CO4	BTL 1	Remember
24.	List the advantages of Nyquist stability criterion over that of Routh criterion.	CO4	BTL 1	Remember

PART –B					
1.	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 characteristic equation. (16)		CO4	BTL 4	Analyze
2.	Consider the sixth order system with the characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ Use Routh-Hurwitz criterion to examine the stability of the system and comment on location of the roots of the characteristics equation. (16)		CO4	BTL 4	Analyze
3.	Apply Routh array and determine the stability of the system represented by the characteristic equation, $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$ Comment on the location of characteristic equation. (16)		CO4	BTL 4	Analyze
4.	**(i)**	Evaluate the stability of the system by using Routh stability criterion for the equation $9s^5 - 20s^4 + 10s^3 - s^2 - 9s - 10 = 0$ (13)	CO4	BTL 4	Analyze
	(ii)	Identify the location of the roots and comment. (3)			
5.	Determine the location of roots on S- Plane and stability for the polynomial $s^7 + 9s^6 + 24s^5 + 24s^4 + 24s^3 + 24s^2 + 23s + 15 = 0$ (16)		CO4	BTL 4	Analyze
6.	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 $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$. (16)		CO4	BTL 4	Analyze
7.	Examine the range of K for the stability of unity feedback system whose open loop transfer function is (16) $G(s) = \frac{K}{s(s+1)(s+2)}$		CO4	BTL 4	Analyze

8.	A feedback system has open loop transfer function of $$G(s) = \frac{Ke^{-s}}{s(s^2+5s+9)}$$ Determine the maximum value of K for stability of closed loop system. (16)	CO4	BTL 4	Analyze
9.	Identify the root locus of a unity feedback system having transfer function $$G(s) = \frac{K}{s(s^2+4s+13)}$$ Find the range of K for which the system is stable. (16)	CO4	BTL 4	Analyze
10.	Sketch the root locus of the system whose open loop transfer function is $$G(s) = \frac{K}{s(s+2)(s+4)}$$ Find the value of K so that damping ratio of the closed loop system is 0.5. (16)	CO4	BTL 3	Apply
11.	The open loop transfer function of a unity feedback system $$G(s) = \frac{K(s+9)}{s(s^2+4s+11)}$$ Sketch the root locus of the system. (16)	CO4	BTL 3	Apply
12.	Sketch the root locus for the unity feedback system whose open loop transfer function is (16) $$G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}$$	CO4	BTL 3	Apply
13.	Sketch root locus for the unity feedback system whose open loop transfer function is, (16) $$G(s)H(s) = \frac{K(s+1.5)}{s(s+1)(s+5)}$$	CO4	BTL 3	Apply
14.	Explain the steps involved in constructing root locus. (16)	CO4	BTL 3	Apply
15.	The open loop transfer function of a unity feedback system is given by $$G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$$ By Apply the Routh criterion, discuss the stability of the closed loop system as a function of K. (16)	CO4	BTL 3	Apply
16.	Sketch the root locus for the unity feedback system whose open loop transfer is (16) $$G(s) = \frac{K(s^2+6s+25)}{s(s+1)(s+2)}$$	CO4	BTL 3	Apply

17.	Sketch the root locus for the unity feedback system whose open loop transfer function is (16) $G(s) = \frac{K}{s(s^2+6s+10)}$	CO4	BTL 3	Apply

UNIT V BIOLOGICAL CONTROL SYSTEM ANALYSIS

Simple models of muscle stretch reflex action - steady state analysis of muscle stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

PART A

Q. No.	**Questions**	CO's	**BT Level**	**Competence**
1.	What is the neuromuscular reflex model of action?	CO5	BTL 1	Remember
2.	Mention four examples of reflex actions.	CO5	BTL 1	Remember
3.	Identify the main functions of the neuromuscular junction.	CO5	BTL 2	Understand
4.	What happens when a muscle is excited?	CO5	BTL 1	Remember
5.	Distinguish between fast and slow twitch muscle fibers.	CO5	BTL 2	Understand
6.	List the types of neuromuscular disorders.	CO5	BTL 2	Understand
7.	Write any two examples of a polysynaptic reflex.	CO5	BTL 2	Understand
8.	Point out the role of the muscle spindle in the muscle stretch reflex action.	CO5	BTL 2	Understand
9.	What is the reflex arc?	CO5	BTL 1	Remember
10.	List the vitamins that are essential for nerve repair.	CO5	BTL 2	Understand
11.	Define nerve conduction velocity test.	CO5	BTL 2	Understand
12.	Classify two categories of sensations.	CO5	BTL 2	Understand
13.	How is the frequency response used to analyze auto regulation of blood flow and other physiological responses in circulatory control?	CO5	BTL 1	Remember
14.	What is the frequency response of a control system?	CO5	BTL 1	Remember
15.	List the functions of cardiovascular control systems.	CO5	BTL 2	Understand
16.	Name the most common eye problems.	CO5	BTL 1	Remember
17.	What is the Swinging Flashlight Test, and how does it assess for a relative afferent pupillary defect (RAPD)?	CO5	BTL 1	Remember
18.	Identify the basic components of reflex arc.	CO5	BTL 2	Understand
19.	State Pupillary Light Reflex.	CO5	BTL 1	Remember

20.	Point out the significance of the pupillary light reflex.	CO5	BTL 2	Understand
21.	What is the normal size of the pupil?	CO5	BTL 1	Remember
22.	What is meant by direct and indirect pupillary light reflex?	CO5	BTL 1	Remember
23.	Identify the other terms used for myopia and hypermetropia?	CO5	BTL 2	Understand
24.	What is the pupillary reaction score?	CO5	BTL 1	Remember
	PART – B			
1.	Explain in detail the simple models of muscle stretch reflex action. (16)	CO5	BTL 4	Analyze
2.	Analyze the steady-state behavior of the muscle stretch reflex action and evaluate its implications for maintaining muscle tone and posture. (16)	CO5	BTL 4	Analyze
3.	Write short notes on	CO5	BTL 3	Apply
	(i) Monosynaptic Reflex Model (8)			
	(ii) Polysynaptic Reflex Model (8)			
4.	Describe the following Models of Muscle Stretch Reflex Action.	CO5	BTL 3	Apply
	(i) Servo-control model (8)			
	(ii) Feedback mechanism model. (8)			
5.	Describe the steady state analysis of muscle stretch reflex action. (16)	CO5	BTL 3	Apply
6.	Analyze the transient response of neuromuscular reflex model action. (16)	CO5	BTL 4	Analyze
7.	Analyze the frequency response of circulatory control model. (16)	CO5	BTL 4	Analyze
8.	Explain in detail the stability analysis of pupillary light reflex. (16)	CO5	BTL 4	Analyze
9.	Describe the following components of pupillary light reflex	CO5	BTL 3	Apply
	(i) Afferent Pathway (8)			
	(i) Efferent Pathway (8)			
10.	How can the stability of the pupillary light reflex be analyzed using mathematical models to represent the reflex arc dynamics? (16)	CO5	BTL 4	Analyze
11.	Outline the several factors that can affect the stability of pupillary light reflex. (16)	CO5	BTL 4	Analyze
12.	Draw the block diagram of raw muscle model, open loop and closed loop model for muscle stretch reflex and explain it in detail. (16)	CO5	BTL 3	Apply
13.	Analyze the differences and similarities between monosynaptic and polysynaptic reflexes. (16)	CO5	BTL 4	Analyze
14.	Sketch the block diagram of muscle stretch reflex action and explain in detail. (16)	CO5	BTL 3	Apply

15.	Explain in detail about muscle model and muscle spindle model with neat diagrams. (16)	CO5	BTL 4	Analyze
16.	Illustrate the mathematical modeling and stability analysis of Pupillary Reflex. (16)	CO5	BTL 3	Apply
17.	Explain the mathematical model of circulatory control in detail. (16)	CO5	BTL 3	Apply