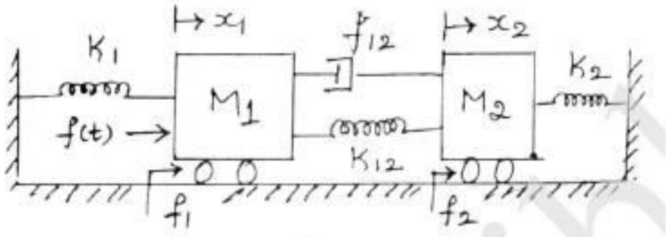
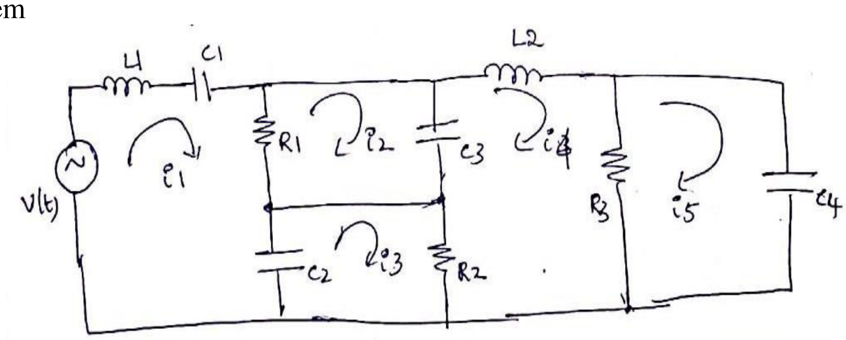
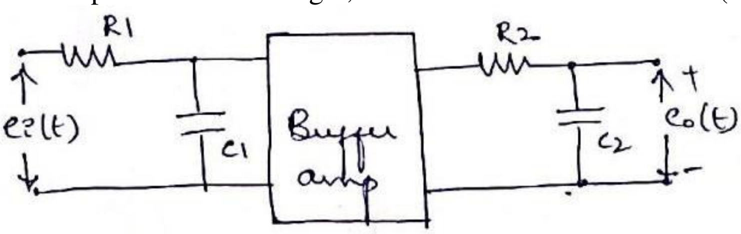
Model Question Paper-1 with effect from 2022-23 (CBCS Scheme)

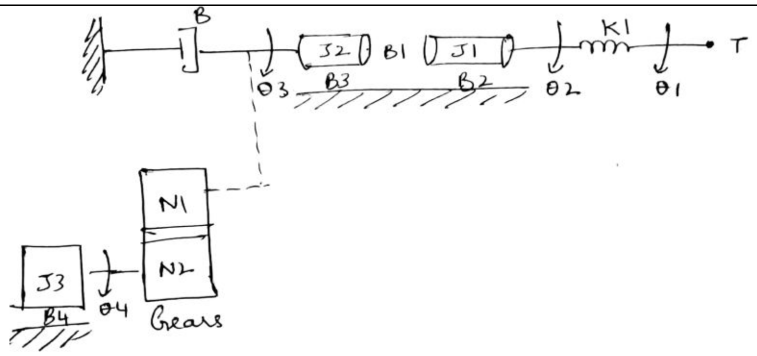
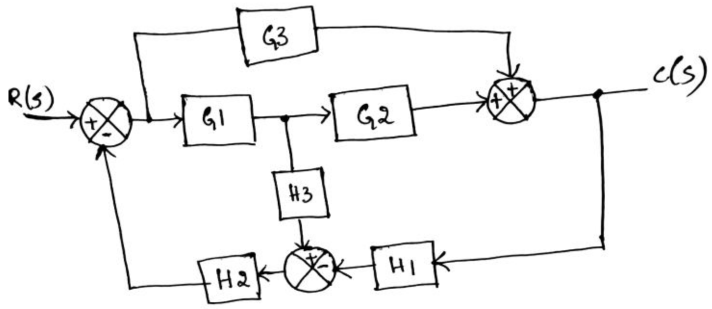
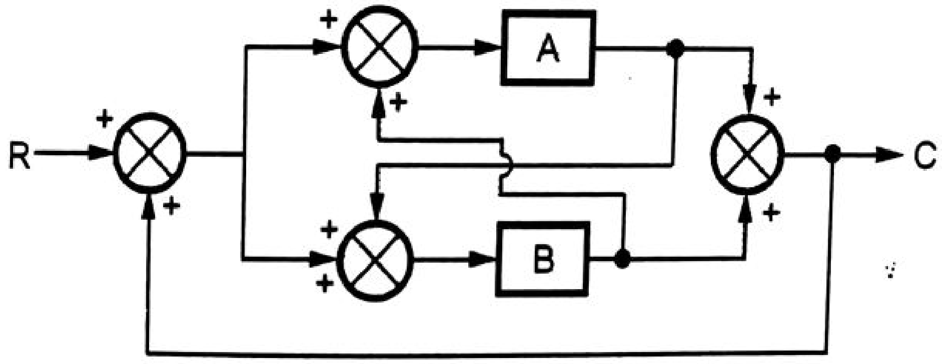
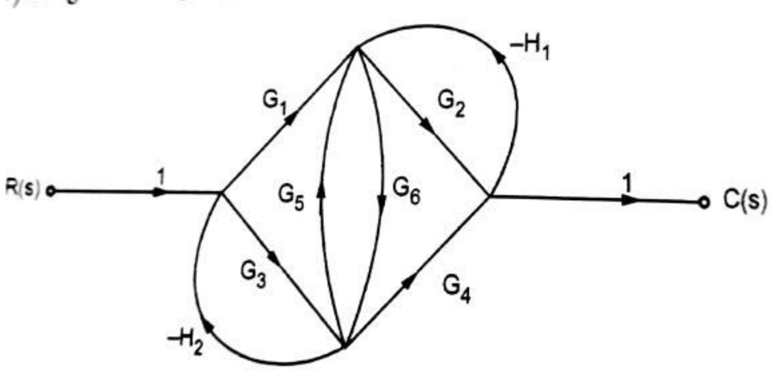
USN | | | | | | | | | | |

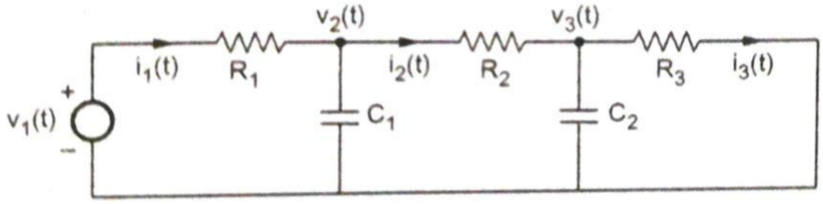
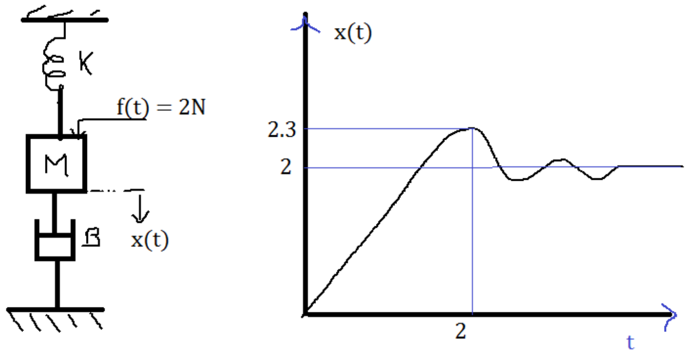
Fourth Semester B.E. Degree Examination
CONTROL SYSTEMS

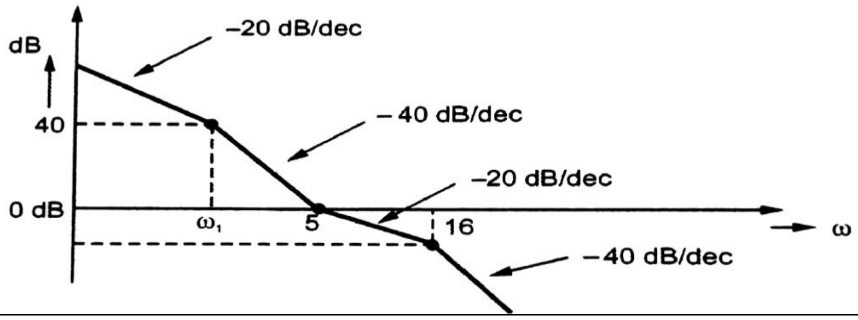
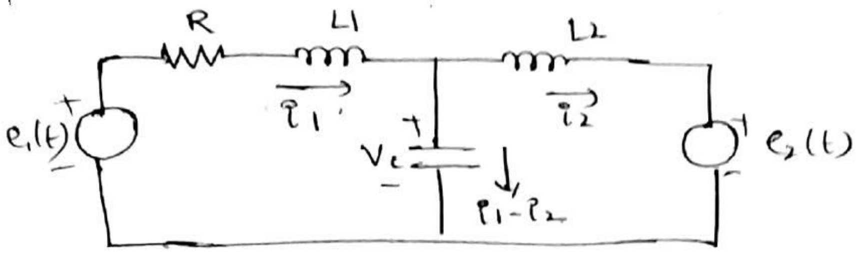
TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	***Bloom's Taxonomy Level**	**Marks**
Q.01	a	For the mechanical system shown in Fig 1 a) Construct the nodal equivalent circuit and write the differential equations governing its dynamic behavior. b) Develop force voltage and force current analogous circuit with relevant equations.  Fig 1	L3	10
	b	Develop translational mechanical system for the force voltage analogous circuit shown in Fig 2. Also write the differential equations governing the mechanical system  Fig 2	L3	10
		OR		
Q.02	a	Compare open loop and closed loop control system with practical example.	L2	6
	b	For the buffer amplifier shown in Fig 3, obtain the transfer function Eo(S)/Ei(S)  Fig 3	L3	6
	c	For the mechanical system shown in Fig 4 a) Construct the nodal equivalent circuit. b) Develop force voltage and force current analogous circuit	L3	8

	b	 Fig 4		
Module-2				
Q. 03	a	Apply Block diagram reduction technique to find the transfer function C(S)/ R(s) for the system shown in Fig 5  Fig 5	L3	10
	b	Construct the signal flow graph for the block diagram shown in Fig 6. Find the transfer function using Mason's gain formula.  Fig 6	L3	10
OR				
Q.04	a	Apply Mason's Gain formula to find the transfer function for the signal flow graph shown from Fig 8  Fig 8	L3	10
	b	Construct the signal flow graph for the electrical network shown in Fig 9. Find the transfer function.	L3	10

		 Fig 9		
Module-3				
Q. 05	a	Make use of the response curve of second order underdamped system to define and derive the expression for (i) Peak time (ii) Peak overshoot (ii) Rise time	L3	10
	b	Analyze a feedback control system with forward path gain $G(s) = 12/(S^2 + 4S + 16)$ and feedback gain H(S)= KS to determine the constant K and all the time domain specifications. Given the damping ratio to be 0.8.	L3	5
	c	Analyze the steady state error for type-2 control system with step input, ramp input and parabolic input.	L3	5
OR				
Q. 06	a	Analyze the response curve obtained for the mechanical system shown in Fig 10 to find the values of mass M, spring constant K and the dashpot B.  Fig 10	L3	10
	b	Determine the value of K for a control system with open loop transfer function of K(S+5)/S(S+2)(S+10) which produces 30% steady state error with unit ramp input.	L3	5
	c	Analyze the effect of PD controller for 2nd order control system with appropriate equations	L3	5
Module-4				
Q. 07	a	Analyze the stability of the system using R-H criteria for a system having the characteristic equation $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$. How many roots of the characteristic equation are on the imaginary axis and right half of the S-plane.	L3	8
	b	Analyze the stability of a control system with open-loop transfer function $\frac{K(S+6)}{S(S+2)}$ using Root locus technique. Show that a part of root locus is a circle of radius √24 units with centre at (-6, 0).	L3	12
OR				
Q. 08	a	Analyze the range of K for which the system with closed loop transfer function $\frac{K}{S(S+2)(S^2+S+1)+K}$ is stable using R-H criteria. For what value of K the system oscillates and what is the corresponding frequency of oscillation.	L3	8
	b	Analyze the stability of a control system with characteristic equation $(S^2+2S+2)+K(S+4)$ using Root locus technique.	L3	12
Module-5				
Q. 09	a	The open loop transfer function of a unity feedback control system is $\frac{K}{S(1+0.02S)(1+0.05S)}$. Draw the asymptotic Bode plot and hence find the value of K for which the gain margin is 10db. What is the corresponding phase margin?	L3	10

	b	Analyze the Bode plot shown in Fig below to estimate the transfer function of a control system. 	L3	10
OR				
Q. 10	a	Develop a state model for the electrical network shown such that e1(t) and e2(t) are inputs and output is taken across the resistor R. 	L3	10
	b	Construct Nyquist plot for a feedback control system whose open loop transfer function is given by $\frac{5}{S(1-S)}$	L3	10

BEC403

Model Question Paper-1/2 with effect from 2022-23 (CBCS Scheme)

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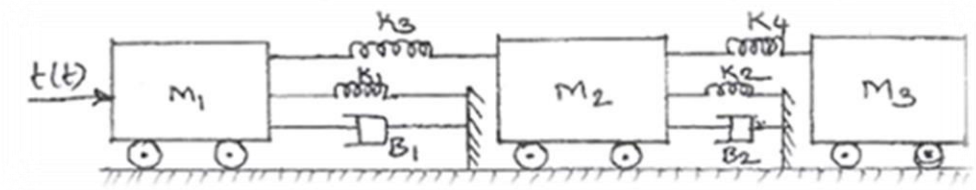
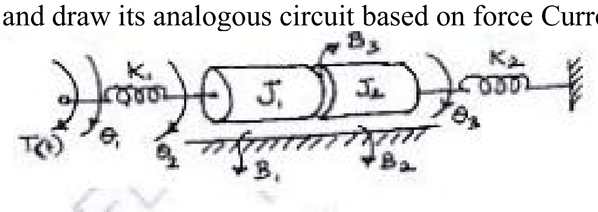
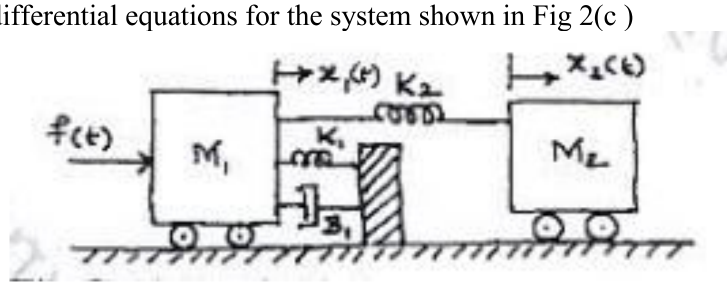
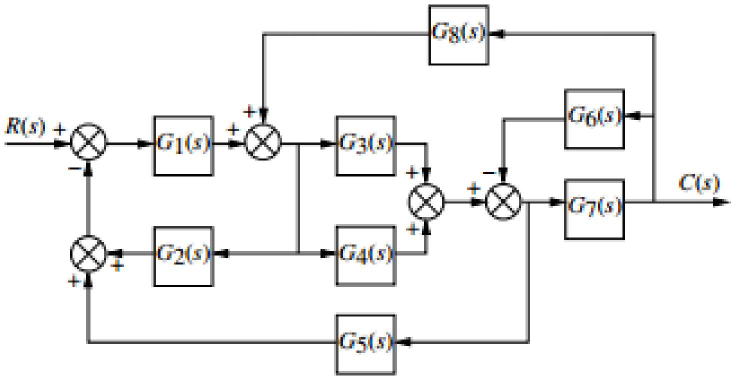
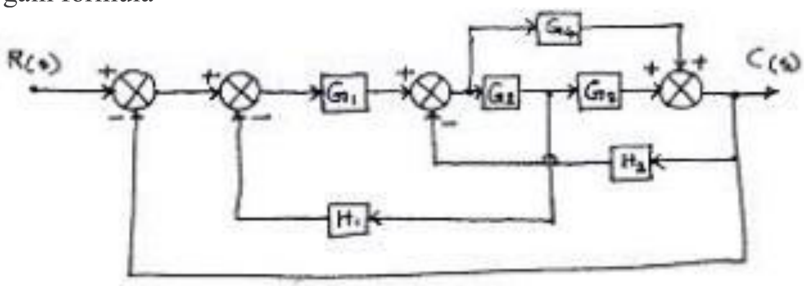
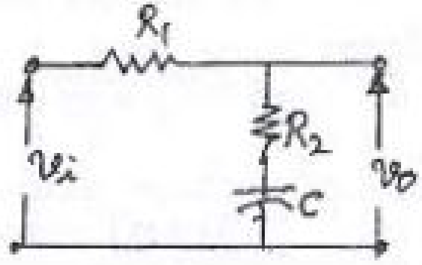
Fourth Semester B.E. Degree Examination
Control Systems

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02.
03.

		Module -1	***Bloom's Taxonomy Level**	**Marks**
Q.01	a	Distinguish between open loop and closed loop control system	L2	04
	b	Draw the mechanical network for the system shown in Fig.1 (b). Write the equations of performance and draw its analogous circuit based on force voltage analogy  Fig 1(b)	L3	10
	c	With relevant expressions explain the concept of gear trains	L3	06
		OR		
Q.02	a	Define a Control system. What are the requirements of good control system	L2	04
	b	Draw the mechanical network for the system shown in Fig.2(b). Write the equations of performance and draw its analogous circuit based on force Current analogy  Fig 2(b)	L3	10
	c	Write the differential equations for the system shown in Fig 2(c)  Fig 2(c)	L3	06
		Module-2		
Q.03	a	Derive an expression for the closed loop transfer function of a negative feed back system	L2	05
	b	Find the overall transfer function using block diagram reduction technique for the system shown in Fig. 3(b)	L3	10

		 Fig 3(b)		
	c	Write a program to implement block diagram reduction technique to obtain transfer function of the system shown in Fig 3(b)	L3	05
		OR		
Q.04	a	For the block diagram, given in Fig.Q.2(c) obtain over all transfer function using Mason's gain formula  Fig 4(a)	L3	10
	b	Determine the transfer function of the system shown in Fig 4(b)  Fig 4(b)	L3	05
	c	Write a program to implement signal flow graph technique to obtain transfer function of the system shown in Fig 4(a)	L3	05
		Module-3		
Q. 05	a	Derive the expression for the rise time of a second order system	L2	05
	b	Find all the time domain specifications for a unity feedback control system whose open loop transfer function is given by $G(S) = \frac{25}{s(s+5)}$	L3	10
	c	Define steady state error? Derive the static error components for Type 2 systems?	L2	05
		OR		
Q. 06	a	For a unity feedback control system the open loop transfer function $G(S) = \frac{10(S+2)}{S^2(S+1)}$ (i) Determine the position, velocity and acceleration error constants. (ii) The steady state error when the input is $R(S) = \frac{3}{S} - \frac{2}{S^2} + \frac{1}{3S^3}$	L3	10

	b	Find and draw the step response of the first order system order system.	L2	05
	c	Write a program to implement PI and PD controllers	L3	05
Module-4				
Q. 07	a	With the help of Routh's stability criterion find the stability of the following system represented by the characteristic equations: $$S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$$	L3	06
	b	Sketch the root locus of the system whose open loop transfer function is $$G(S) = \frac{K}{S(S^2 + 4S + 13)}$$	L3	10
	c	Make use of suitable software tool to analyse the stability of the system $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$ using RH criterion	L3	04
OR				
Q. 08	a	Explain the procedure for constructing root locus.	L2	10
	b	Determine the range of K for stability of unity feedback system whose open loop transfer function is $G(s) = \frac{K}{S(S+1)(S+2)}$ using Routh's stability criterion.	L3	10
Module-5				
Q. 09	a	Sketch the bode plot for the following transfer function and determine phase margin and gain margin. $G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$	L3	10
	b	For the state equation $\dot{X} = \begin{pmatrix} 0 & 1 \\ -2 & -3 \end{pmatrix} X + \begin{pmatrix} 0 \\ 1 \end{pmatrix} U$ with the unit step input and the initial conditions are $X(0) = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$ Solve the following (a) State transition matrix (b) Solution of the state equation.	L3	10
OR				
Q. 10	a	Determine the Solution for Homogeneous and Non homogeneous State equations	L2	10
	b	A system is given by $G(S) = \frac{(4S+1)}{S^2(S+1)(2S+1)}$ Sketch the Nyquist plot and determine the stability of the system.	L3	10