

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026

Control Systems

Time: 3 hrs.

Max. Marks: 100

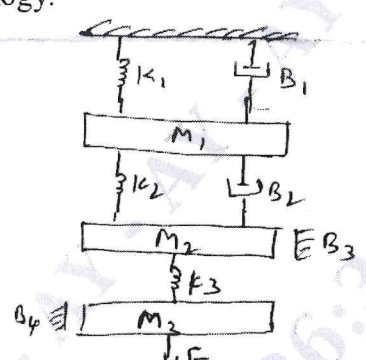
Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

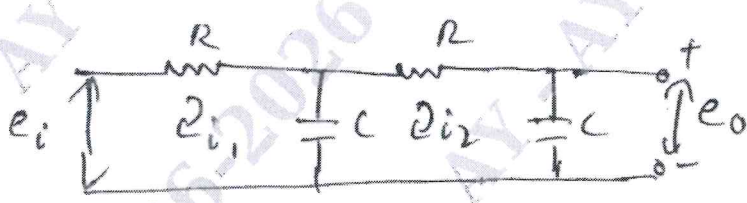
2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1

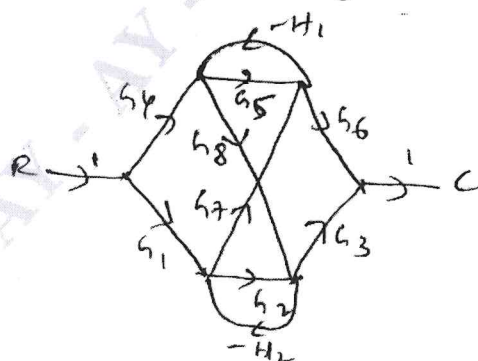
Q.1	a.	Derive an expression for the transfer function of an armature controlled D.C servo motor. Also construct the block diagram of a D.C. Servo motor.	M	L	C
			12	L4	CO1
	b.	Compare open loop and closed loop control system with examples.	8	L2	CO1

OR

Q.2	a.	Convert the given mechanical system into equivalent electrical system using F-V and F-I analogy.	12	L4	CO1
		 Fig. Q2 (a)			

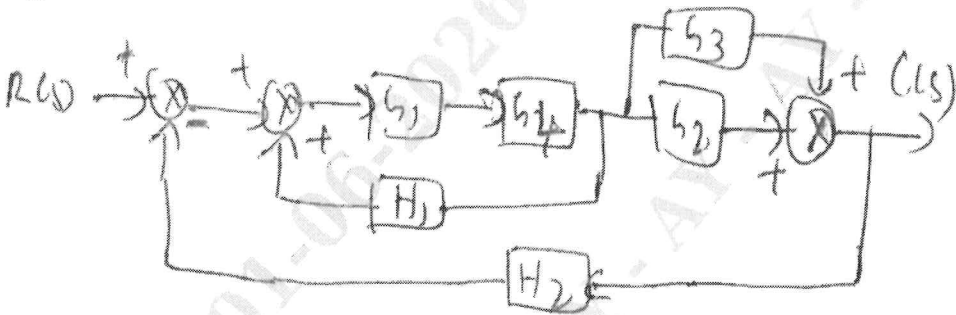
	b.	Obtain the transfer function of the electrical system shown in Fig. Q2 (b) below.	8	L4	CO1
		 Fig. Q2 (b)			

Module – 2

Q.3	a.	Obtain the transfer function using, Mason's gain formula.	10	L4	CO2
		 Fig. Q3 (a)			

	b.	Draw and explain the following with references to signal flow graph and also define them: (i) Input node (ii) Output node (iii) Forward path (iv) Feedback loop (v) Self loop	10	L3	CO2
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OR

Q.4	a.	Obtain the transfer function for the given block diagram using block diagram reduction rules. 	10	L4	CO2
	b.	Illustrate the following block diagram, reduction rules with examples : (i) Shifting summing point before a block. (ii) Shifting a take off point after a block (iii) Blocks in parallel. (iv) Shifting a take off point before a block. (v) Blocks in series.	10	L3	CO2

Module – 3

Q.5	a.	Draw the time response specifications of a typical second order system indicating all the parameters. Derive an expression for rise time and peak time.	8	L3	CO3
	b.	Obtain the response of a unity feedback system whose open loop transfer function for a unit step input is $G(s) = \frac{3}{s(s+4)}$	6	L3	CO3
	c.	Check the stability of the given characteristic equation using Routh's method: $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$	6	L3	CO3

OR

Q.6	a.	Derive an expression for the output response $C(t)$ of a second order under damped system for a unit step input.	8	L4	CO3
	b.	For a unity feedback system with, $G(s) = \frac{20(1+s)}{s^2(2+s)(4+s)}$, find (i) Static error coefficients (ii) The steady state error when input is $r(t) = 40 + 2t + 5t^2$	6	L3	CO3

	c.	A unity feedback control system has, $G(s) = \frac{K(s+13)}{s(s+3)(s+7)},$ Using Routh's criterion, calculate the range of 'K' for which, (i) The system is stable (ii) Has its closed loop poles more negative than -1.	6	L3	CO3
Module – 4					
Q.7	a.	The forward path transfer function of a unity feedback system is given by $G(s) = \frac{K}{s(s+4)(s+5)}$. Sketch the root locus plot as K varies from 0 to infinity.	12	L4	CO4
	b.	Explain the rules to sketch the root locus plot.	8	L3	CO4
OR					
Q.8	a.	Construct the Bode plot and phase diagrams for, $GH(s) = \frac{100(0.1s+1)}{s(s+1)^2(0.01s+1)}$ Comment on the closed loop stability of the system.	12	L4	CO4
	b.	Explain the general procedure for constructing bode plot. Also define (i) Gain margin (ii) Phase margin (iii) Gain cross over frequency (iv) Phase cross over frequency	8	L3	CO4
Module – 5					
Q.9	a.	Mention the properties of state transition matrix. For a system, when $x(0) = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$, $x(t) = \begin{bmatrix} e^{-3t} \\ -3e^{-3t} \end{bmatrix}$ while $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ when $x(t) = \begin{bmatrix} e^t \\ e^t \end{bmatrix}$ Determine system matrix A.	10	L3	CO5
	b.	Explain the concept of state. Define the following : (i) State variables (ii) State vector (iii) State space (iv) State trajectory	10	L3	CO5
OR					
Q.10	a.	Explain the effect of PI and PD controller on the second order system.	12	L3	CO5
	b.	What is lead compensation? Explain the steps to design lead compensator.	8	L3	CO5

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