


Name: Enrolment No:	
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UPES
End Semester Examination, December 2023

Course: Control Engineering Program: BTech ADE Course Code: MECH 4034P	Semester: VII Time: 03 hrs. Max. Marks: 100
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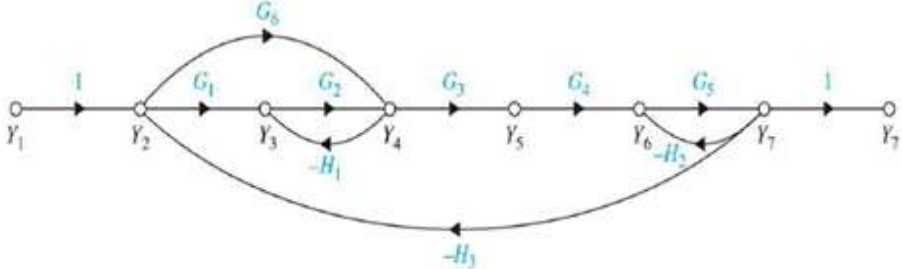
Instructions: Attempt all questions.

SECTION A
(5Qx4M=20Marks)

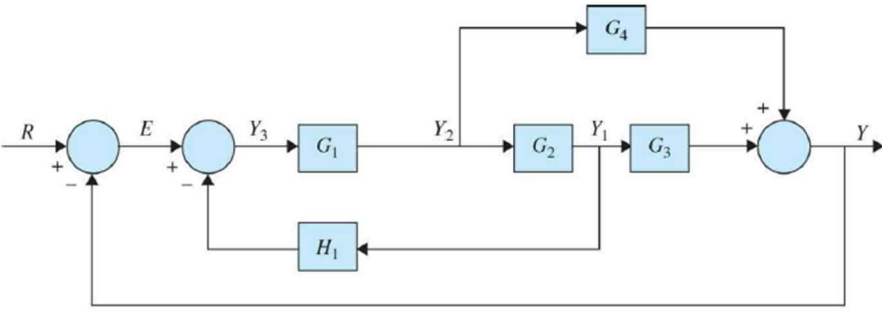
S. No.		Marks	CO
Q 1	Determine the poles and zeros of the given transfer function. Also comment on the stability of the system. $G(s) = \frac{(s + 3)(s + 8)}{(s + 5)(s - 4)(s - 2)}$	4	CO3
Q 2	Define the closed loop control system by an example.	4	CO1
Q 3	Define the steady state error in the system for the unity feedback control system.	4	CO1
Q 4	Explain the time response parameters of any feedback control system.	4	CO2
Q 5	Using the Routh-Hurwitz criterion, determine the stability of the system that has the following characteristic equations. $s^3 + 25 s^2 + 10 s + 450 = 0$	4	CO3

SECTION B
(4Qx10M= 40 Marks)

Q 6	Apply the Mason's gain rule to signal flow graph as shown in figure, to determine the transfer function Y_7/Y_1 .	10	CO2
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The signal flow graph consists of seven nodes labeled Y1 through Y7. The input signal 1 enters at node Y1. The signal then passes through a summing junction at Y2. From Y2, there are two paths: one through branch G1 to node Y3, and another through branch G6 to node Y4. From Y3, there is a path through branch G2 to node Y4, and a feedback path through branch H1 back to Y2. From Y4, the signal passes through branch G3 to node Y5, then through branch G4 to node Y6, and finally through branch G5 to node Y7. There are two feedback paths from Y7: one through branch H2 back to Y6, and another through branch H3 back to Y2. The output signal 1 is taken at node Y7.

Q 7	Determine the time response of the given system model for unit step input and comment on the stability of the system. $\ddot{y}(t) + 8\dot{y}(t) + 16y(t) = u(t)$	10	CO2
Q 8	Determine the input-output transfer function (Y/R) of the system by reduce the block diagram. 	10	CO2
Q 9	Given the forward-path transfer function of unity-feedback control systems, apply the Routh-Hurwitz criterion to determine the stability of the closed-loop system as a function of K . $G(s) = \frac{K(s + 4)(s + 20)}{s^3(s + 100)(s + 500)}$ <p style="text-align: center;">Or,</p> Determine the range of feedback gains so that closed loop system will be stable. The transfer function of the system is given as $G(s) = \frac{(s - 5)}{(s^2 + s + 1)(s + 10)}$	10	CO3
SECTION-C (2Qx20M=40 Marks)			
Q 10	A unity-feedback control system has the forward-path transfer functions given in the following. Construct the complete root-locus diagram for $0 \leq K \leq \infty$. Find the values of K at all the breakaway points. $G(s) = \frac{K(s + 3)}{s(s^2 + 4s + 4)(s + 5)(s + 6)}$ <p style="text-align: center;">Or,</p>	20	CO3

	<p>The feedforward transfer function of a unity-feedback system is</p> $G(s) = \frac{K(s + 2)^2}{(s^2 + 4)(s + 5)^2}$ <p>a) Construct the root loci for $K = 25$. b) Find the range of K value for which the system is stable.</p>		
Q 11	<p>Draw the Nyquist plot and determine the range of stable gains for the given forward-path transfer function of the system.</p> $G(s) = \frac{(s + 5)}{(s + 2)(s^2 + 2s + 2)}$	20	CO4