Reg. No.															

Question Paper Code	13652

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Fourth Semester

Instrumentation and Control Engineering

(Common to Electronics and Instrumentation Engineering)

20ICPC401 - CONTROL SYSTEMS

Regulations - 2020

(Use of Semilog, Polar and Ordinary Graphs is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	In Mason's Gain Formula, what is meant by a "non-touching loop"? (a) Two loops that share a node (b) Two loops that do not share any common nodes (c) Two loops that share a branch (d) Two loops with the same gain	1	K2	CO1
2.	The transfer function G(s)=Y(s)/U(s) represents: (a)Time-domain response of a system (b) Frequency response of a system (c) Relationship between output and input in Laplace domain (d) Differential equation of the system	1	K2	CO1
3.	The amount by which the system output exceeds its steady-state value is referred to as: (a) Peak time (b) Settling time (c) Overshoot (d) Delay time	1	K2	CO2
4.	In a second-order under damped system, the overshoot depends on: (a) The natural frequency only (b) The damping ratio only (c) Both the natural frequency and damping ratio (d) None of the above	1	K1	CO2
5.	Gain margin comprises of. (a) The reciprocal of the magnitude of the open-loop transfer function at the phase crossover frequency (b) The magnitude of the open-loop transfer function at the gain crossover frequency (c) The phase shift of the open-loop transfer function at the gain crossover frequency (d) The phase shift of the open-loop transfer function at the phase crossover frequency	1	K1	CO3
6.	How does a high damping ratio affect the time-domain response? (a) Increased oscillations (b) Reduced oscillations (c) No change in oscillations (d) Increased peak overshoot	1	K2	CO3
7.	Root locus is used to calculate: (a) Marginal stability (b) Absolute stability (c) Conditional stability (d) Relative stability	1	K1	CO4
8.	Which of the following is a necessary condition for the stability of a system? (a) All poles of the system must lie on the real axis. (b) All poles of the system must have negative real parts. (c) The transfer function must have at least one zero. (d) The open-loop transfer function must be proper.	1	K1	CO4
9.	In a Bode plot, a lead compensator shifts the phase curve: (a) Downward (b) Upward (c) Leftward (d) Rightward	1	K1	CO5

10. Effect of a Lag-Lead compensator on the Bode plot? *1 K2 CO5*
(a) It increases phase margin and steady-state error simultaneously.
(b) It increases phase margin and reduces the steady-state error.
(c) It decreases phase margin but improves transient response.
(d) It increases bandwidth and reduces overshoot.

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. Write the Mason's Gain Formula. *2 K2 CO1*
12. Define Transfer function. *2 K1 CO1*
13. Mention the characteristics of negative feedback. *2 K1 CO1*
14. Define damping ratio and how the system is classified on the value of damping. *2 K1 CO2*
15. Give the relation between static and dynamic error constants. *2 K2 CO2*
16. List the different types of controllers. *2 K1 CO2*
17. Recall the term Gain Margin. *2 K1 CO3*
18. List the available methods to obtain the closed loop frequency response from open loop frequency response. *2 K1 CO3*
19. Summarize BIBO Stability and mention its requirement. *2 K1 CO4*
20. State Nyquist stability criterion. *2 K2 CO4*
21. Draw the S-plane representation of lead compensator. *2 K2 CO5*
22. What is meant by Lag compensator? *2 K1 CO5*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Write the differential equations of the mechanical system shown in fig.1 and draw the force-voltage & force -current analogous circuit and verify by writing Mesh and Nodal equations. *11 K3 CO1*

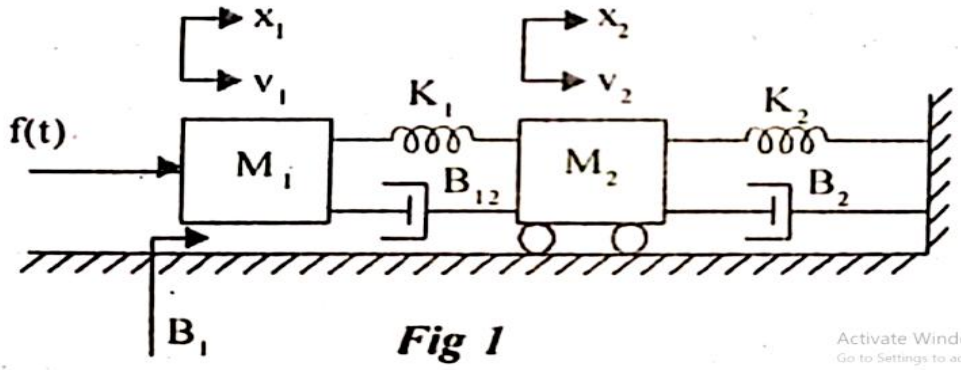
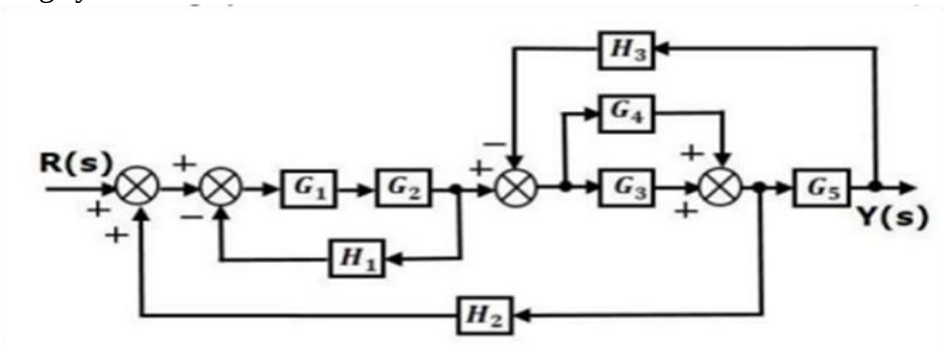


Fig 1

OR

b) Apply block diagram reduction rules and obtain the transfer function of the following system. *11 K3 CO1*



24.	a)	Derive the expressions for Time domain specifications with unit step input.	*11*	*K2*	*CO2*
		OR			
	b)	Derive the expression and draw the response of second order system for critically damped case with unit step input.	*11*	*K2*	*CO2*
25.	a)	The open loop transfer function of a unity feedback system is given by $G(s)= 1/s(1+s)^2$. Sketch the polar plot and determine the gain and phase margin.	*11*	*K3*	*CO3*
		OR			
	b)	Sketch the bode plot for the unity fed back control system with transfer function G(S)=K/S(S+4)(S+10).	*11*	*K3*	*CO3*
26.	a)	A unity feedback control system has on open loop transfer function $G(s)= K/s(s^2+4s+13)$.Sketch the root locus.	*11*	*K3*	*CO4*
		OR			
	b)	The characteristic polynomial of a system is s7+9s6+24s5+24s4+24s3+24s2+23s+15=0. Determine the location of roots on s-plane and hence the stability of the system.	*11*	*K3*	*CO4*
27.	a)	The open loop transfer function of certain unity feedback control system is given by $G(s)= K/s(s+4)(s+80)$.It is desired to have the phase margin to be at least 33˚ and the velocity error constant $Kv =30sec^{-1}$. Design a phase lag series compensator.	*11*	*K3*	*CO5*
		OR			
	b)	A unity feedback system has open loop transfer function of G(S)= k/s(1+2s). Design a suitable lag compensator that the phase margin is 40◦ and steady state error for ramp input is less than or equal to 0.2.	*11*	*K3*	*CO5*
28.	a) (i)	Write the procedure for the construction of Routh Hurwitz stability criterion.	*6*	*K2*	*CO4*
	(ii)	Describe the procedure for the construction of lead compensator using Bode plot.	*5*	*K2*	*CO5*
		OR			
	b) (i)	Explain the procedure for the construction of Root locus.	*6*	*K2*	*CO4*
	(ii)	Describe the procedure for the construction of lag compensator using Bode plot.	*5*	*K2*	*CO5*