Reg. No.															

Question Paper Code	14389

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Fourth Semester

Electronics and Instrumentation Engineering

(Common to Instrumentation and Control Engineering)

20ICPC401 - CONTROL SYSTEMS

Regulations - 2020

(Use of Ordinary graph sheets, semi-logarithmic graph sheets and polar plot graph sheets is permitted)

Duration: 3 Hours Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	*K – Level*	*CO*
1.	The transfer function is defined as: a) Ratio of input to output b) Ratio of output to input in time domain c) Ratio of Laplace transform of output to input d) Difference between input and output	*1*	*K1*	*CO1*
2.	A linear system is one that obeys: a) Random behavior b) Superposition Principle c) Only differential equations d) Non physical laws	*1*	*K2*	*CO1*
3.	In a closed-loop system, if feedback is increased, the system sensitivity generally: a) Increase b) Decrease c) Becomes Infinite d) Remains Unchanged	*1*	*K3*	*CO1*
4.	Static error constants are used to determine a) Stability b) Steady-state accuracy c) Transient response d) Frequency response	*1*	*K1*	*CO2*
5.	PID controlled system has a) P and I actions in forward path and D action in feedback path b) P and I actions in feedback path and actions in forward path c) All the three (i.e., P, I and D) actions in forward path d) All the three (i.e., P, I and D) actions in feedback path	*1*	*K2*	*CO2*
6.	**Assertion(A):**The time response of the system with $G(s) = \frac{36}{s^2 + 36s + 36}$ will not have any overshoot for unit step input. **Reason (R):** A critically damped system does not have any overshoot to a unit step input. a) Both A and R are correct and R is correct explanation of A b) Both A and R are correct but R is not correct explanation of A c) A is correct but R is wrong d) R is correct but A is wrong	*1*	*K3*	*CO2*
7.	The relationship between time and frequency domain is mainly based on a) Fourier and Laplace transforms b) Newton's law c) Ohm's law d) Kirchhoff's law	*1*	*K1*	*CO3*
8.	The gain margin for a stable system a) has a positive decibel value b) has a negative decibel value c) has a large negative decibel value d) none of the above	*1*	*K2*	*CO3*
9.	For Bode plot of (1 + jωT) has a) slope of 20 dB/decade and phase angle + tan-1 (ωT) b) slope of - 20 dB/decade and phase angle + tan-1 (ωT) c) slope of 20 dB/decade and phase angle - tan-1 (ωT) d) slope of - 40 dB/decade and phase angle - tan-1(ωT)	*1*	*K3*	*CO3*

10. The root locus represents the locus of system poles when *1 K1 CO4*
a) Time varies b) Gain varies
c) Input changes d) Output is constant

11. For a stable system, Nyquist plot must not encircle *1 K2 CO4*
a) origin b) (−1, j0) point
c) (1, j0) point d) any pole

12. The first column of a Routh array is *1 K3 CO4*

s^5	1
s^4	2
s^3	1.5
s^2	-1/3
s^1	10
s^0	2

a) 2 b) 3
c) 4 d) 5

13. Lead compensator improves transient response by *1 K1 CO5*
a) Increasing overshoot b) Reducing rise time
c) Increasing delay d) Removing poles

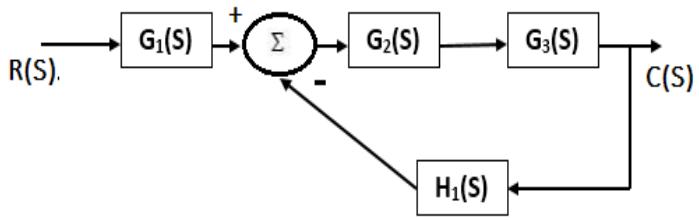
14. If steady-state error is high, we use *1 K2 CO5*
a) Lead compensator b) Lag compensator
c) Differentiator only d) Root locus only

15. The main purpose of lag-lead compensation is to achieve *1 K3 CO5*
a) Only stability b) Only Speed
c) Compromise between accuracy and speed d) Infinite gain

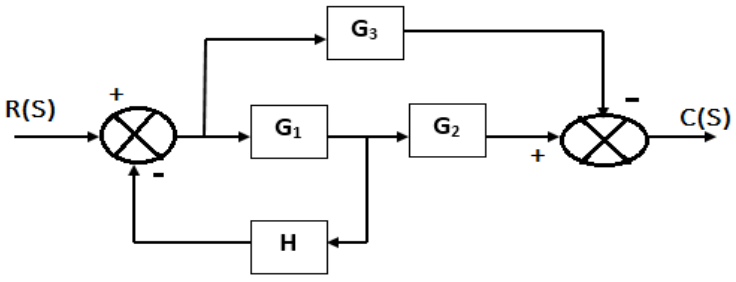
16. A unity feedback system has the open-loop transfer function G(s)=10/(s(s+2)) A lead compensator is introduced to improve the phase margin by adding a zero at s=−1. Which of the following is the most likely effect on the system? *1 K3 CO5*
a) Decrease in phase margin and slower response b) Increase in phase margin and improved transient response
c) No change in stability d) Increase in steady-state error

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17. Identify the transfer function of the system whose block diagram is shown below: *3 K3 CO1*



18. Develop the equivalent signal flow graph of the below given block diagram. *3 K3 CO1*



19. A unity feedback system has an open loop transfer function of G(s) =10/(s+1)(s+2).Solve the given transfer function to obtain the steady state error for unit step input. *3 K3 CO2*

20. Identify the Type and Order of the following system: *3 K3 CO2*

$$\frac{C(S)}{R(S)} = \frac{10}{S^3\,(S^2 + 2S + 1)}$$

21. Infer the phase angle equation of the open loop transfer function given below $G(S) = \frac{5}{S(S+1)(S+2)}$.Discuss the effect of each poles on the total phase angle. *3 K4 CO3*

22. Inspect the stability of the system for the given characteristic equation $s^4 + 8s^3 + 18s2 + 16s + 5 = 0$. *3 K4 CO4*

23. Analyse the Nyquist stability criterion and explain how it is used to determine the stability of a control system. Inspect one application with a suitable example. *3 K4 CO4*

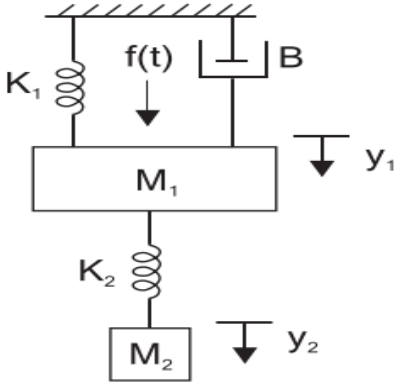
24. Draw and analyse the RC phase lead network circuit, and explain how the circuit components contribute to producing phase lead and improving system performance. *3 K4 CO5*

PART - B (Descriptive Answer Questions)

(5 × 12 = 60 Marks)

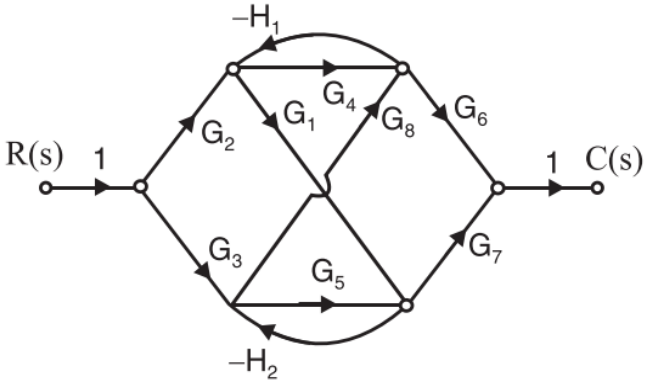
Answer ALL Questions

25. a) Develop the transfer function $Y_2(s)/F(s)$ of the system given below. *12 K3 CO1*



OR

b) Construct the overall gain of the system whose signal flow graph is shown: *12 K3 CO1*



26. a) A unity feedback system has an Open loop transfer function G(s) = 10/(s(s+2)).Solve the rise time, percentage overshoot, peak time and settling time for a step input of 12units. *12 K3 CO2*

OR

b) A unity feedback system has characterized by an open loop transfer function G(s) = $\frac{K}{(S(S+10))}$ Determine the gain k, so that the system will have a damping ratio of 0.5 for this value of k. Also determine the peak overshoot and time at peak overshoot for a unit step input. *12 K3 CO2*

27. a) Examine the bode plot for the given transfer function G(S) = $\frac{10}{S(1+0.4S)(1+0.1S)}$ by finding the gain cross over frequency and phase crossover frequency and discuss their significance in assessing system stability. *12 K4 CO3*

OR

b) Consider a unity feedback system having an open loop transfer function *12 K4 CO3*

$$G(s) = \frac{K}{s(1 + 0.2s)(1 + 0.05s)}$$

Analyze the polar plot and determine the value of K so that (i) Gain Margin is 18 dB and (ii) Phase Margin is 600.

28. a) Using the Routh–Hurwitz criterion, examine the stability of the system and determine the number of roots in the right half-plane, left half-plane, and on the imaginary axis for the characteristic equation: $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. *12 K4 CO4*

OR

b) Analyze the root locus for the unity feedback system whose open loop transfer function. *12 K4 CO4*

$$G(s)H(s) = \frac{K}{s(s + 4)(s^2 + 4s + 20)}$$

29. a) The open loop transfer function of certain unity feedback control system is given by *12 K3 CO5*

$$G(s) = \frac{K}{s(s + 4)(s + 80)}$$

It is desired to have the phase margin to be at-least 33° and the velocity error constant Kv = 30 sec−1. Construct a phase lag series compensator.

OR

b) Construct the procedure for lag-lead compensator using Bode plot. *12 K3 CO5*