Reg. No.																

Question Paper Code	13050

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Fourth Semester

Instrumentation and Control Engineering

(Common to Electronics and Instrumentation Engineering)

20ICPC401 - CONTROL SYSTEMS

Regulations - 2020

(Use of Ordinary Graph ,Semi log Graph and Polar Graph is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	In block diagram reduction, the rule for combining two blocks in series is: (a) Multiply their transfer functions (b) Add their transfer functions (c) Subtract their transfer function (d) Divide their transfer functions	1	K1	CO1
2.	The electrical analogy of a mechanical translational mass is: (a) Resistance (b) Inductance (c) Capacitance (d) Conductance	1	K1	CO1
3.	Which of the following is NOT an element in a closed-loop control system? (a) Actuator (b) Feedback element (c) Error detector (d) Nonlinear converter	1	K1	CO1
4.	The transfer function of a system is defined as the ratio of the: (a) Output response to the input disturbance (b) Laplace transform of the output to the Laplace transform of the input (c) Input to the feedback element (d) Output to the summing junction	1	K1	CO1
5.	What is the term used for the time taken by the system output to reach 50% of the final value for the first time? (a) Rise time (b) Settling time (c) Delay time (d) Peak time	1	K1	CO2
6.	The time-domain specification that indicates how quickly a system responds to changes in input before reaching the steady-state is: (a) Peak time (b) Settling time (c) Rise time (d) Delay time	1	K1	CO2
7.	If the damping ratio (ζ) of a second-order system is equal to 1, the system is: (a) Under damped (b) Critically damped (c) Over damped (d) Undamped	1	K1	CO2
8.	The acceleration error constant Ka is used to determine the steady-state error for which type of input? (a) Unit step input (b) Unit ramp input (c) Unit parabolic input (d) None of the above	1	K1	CO2
9.	The Bode plot is used to analyze: (a) Time-domain response (b) Frequency response (c) Stability margins (d) Transient response	1	K2	CO3
10.	In a Bode plot, the gain margin is determined from: (a) The phase plot at a frequency where the magnitude is 0 dB (b) The magnitude plot at a frequency where the phase is -180 degrees (c) The magnitude plot at the cut-off frequency (d) The phase plot at the resonant frequency	1	K1	CO3
11.	What is the slope of the magnitude plot in dB/decade for a first-order system with a pole? (a) +20 dB/decade (b) -20 dB/decade (c) +40 dB/decade (d) -40 dB/decade	1	K2	CO3
12.	Which of the following is NOT typically assessed from a polar plot? (a) Gain margin (b) Phase margin (c) System stability (d) Steady-state error	1	K1	CO3
13.	On the root locus plot, the poles of the system are located at: (a) The start of the root locus branches (b) The end of the root locus branches (c) Along the imaginary axis (d) At infinity	1	K2	CO4

14. What happens to the stability of the system if all the branches of the root locus remain on the left half of the s-plane? *1 K2 CO4*
(a) The system is stable
(b) The system is unstable
(c) The system has a damping ratio greater than 1
(d) The system oscillates with increasing amplitude

15. The Routh-Hurwitz criterion is used to determine: *1 K1 CO4*
(a) The transient response of the system (b) The stability of a linear time-invariant system
(c) The frequency response of the system (d) The steady-state error of the system

16. If any of the elements in the first column of the Routh array is zero, it indicates: *1 K1 CO4*
(a) The system is marginally stable
(b) The system is stable
(c) The system is unstable
(d) Special methods must be used to determine stability

17. Which of the following compensators improves both transient and steady-state response? *1 K1 CO5*
(a) Lead compensator (b) Lag compensator
(c) Lead-lag compensator (d) Proportional compensator

18. In a Bode plot, a lead compensator shifts the phase curve: *1 K2 CO5*
(a) Downward (b) Upward (c) Leftward (d) Rightward

19. A compensator is classified as a lead compensator if the phase introduced by the compensator is: *1 K1 CO5*
(a) Positive (b) Negative (c) Zero (d) None of the above

20. Which of the following compensators tends to reduce overshoot and improve system stability? *1 K1 CO5*
(a) Lead compensator (b) Lag compensator
(c) Lead-lag compensator (d) None of the above

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Define Transfer function. *2 K1 CO1*
22. Distinguish between open loop and closed loop system. *2 K2 CO1*
23. Define damping ratio and how the system is classified on the value of damping. *2 K1 CO2*
24. Distinguish between type and order of a system. *2 K2 CO2*
25. Mention the frequency domain specifications. *2 K1 CO3*
26. Draw the typical polar plot of $G(s)= 1/s(1+sT_1)(1+sT_2)$. *2 K2 CO3*
27. What is centroid? How the centroid is calculated? *2 K2 CO4*
28. State Nyquist stability criterion. *2 K1 CO4*
29. Draw the S-plane representation of lag compensator. *2 K2 CO5*
30. Define lead compensator. *2 K1 CO5*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Write the differential equations of the mechanical system shown in the Fig.1 and draw the force-voltage & force -current analogous circuit and verify by writing Mesh and Nodal equations. *10 K3 CO1*

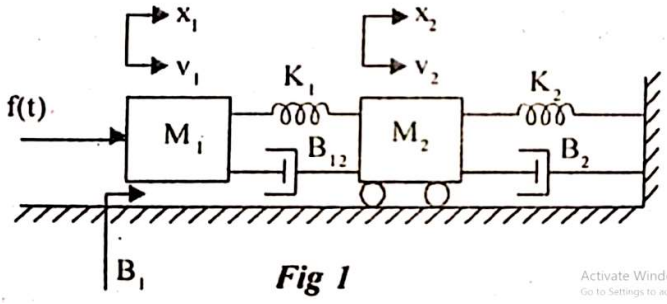
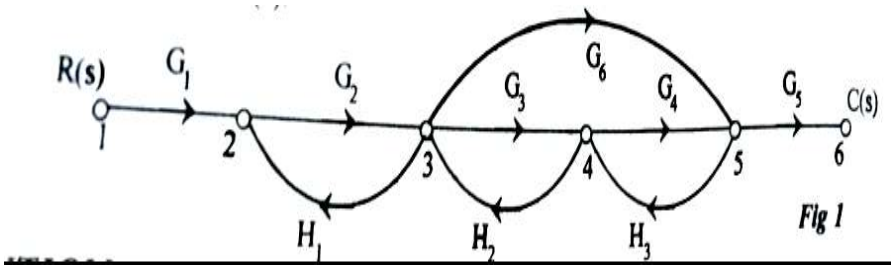


Fig 1

OR

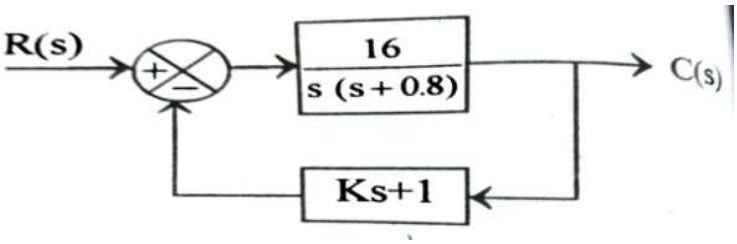
b) Calculate the overall transfer function C(s)/R(s) for the signal flow graph shown in fig.1 — *10 K3 CO1*



32. a) Derive the expression and draw the response of second order system for under damped case with unit step input. — *10 K2 CO2*

OR

b) A positional control system with velocity feedback is shown in fig. What is the response of the system for unit step input. Given that $\zeta = 0.5$. Also calculate rise time, peak time, maximum overshoot and settling time. — *10 K3 CO2*



33. a) Sketch the bode plot for the unity feed back control system with transfer function and determine phase margin and gain margin. $G(s) = 75(1+0.2s)/s(s^2+16s+100)$. — *10 K3 CO3*

OR

b) Sketch the polar plot for the following transfer function and find Gain cross over frequency , Phase cross over frequency, Gain margin and Phase margin.$G(S)= 1/S(1+S)(1+2S)$ — *10 K3 CO3*

34. a) The characteristic polynomial of a system is $s^7+9s^6+24s^5+24s^4+24s^3+24s^2+23s+15=0$. Determine the location of roots on s-plane and hence the stability of the system. — *10 K3 CO4*

OR

b) A unity feedback control system has on open loop transfer function $G(s)= K/s(s^2+4s+13)$. Sketch the root locus. — *10 K3 CO4*

35. a) 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^o and steady state error for ramp input is less than or equal to 0.2. — *10 K3 CO5*

OR

b) Discuss the procedure for design of lead compensator using bode plot. — *10 K2 CO5*

36. a) Discuss the procedure for construction of Root locus. — *10 K2 CO4*

OR

b) Find C/R using block diagram reduction. *10 K3 CO1*