Reg. No.												

Question Paper Code	12718

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Fourth Semester

Instrumentation and Control Engineering

(Common to Electronics and Instrumentation Engineering)

20ICPC401 - CONTROL SYSTEMS

Regulations - 2020

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

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

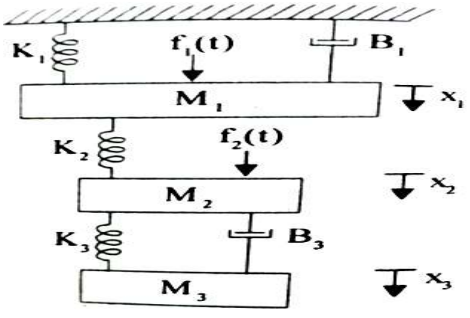
Answer ALL Questions

		Marks	K – Level	CO
1.	Distinguish between open loop and closed loop system.	2	K2	CO1
2.	What are the characteristics of servomotors?	2	K1	CO1
3.	Differentiate type and order of a system.	2	K2	CO2
4.	What is steady state error?	2	K1	CO2
5.	Define gain Margin.	2	K1	CO3
6.	Mention the frequency domain specifications.	2	K2	CO3
7.	State dominant pole.	2	K1	CO4
8.	What is BIBO Stability? Mention its requirement.	2	K2	CO4
9.	Define lag-lead compensator.	2	K1	CO5
10.	Draw the S-plane representation of lead compensator.	2	K2	CO5

PART - B (5 × 13 = 65 Marks)

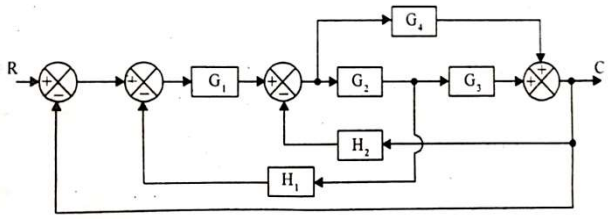
Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Write the differential equations of the mechanical system shown in fig and draw the force-voltage & force - current analogous circuit and verify by writing Mesh and Nodal equations.	13	K3	CO1



OR

b) Obtain the closed loop transfer function C(S) / R(S) using block diagram reduction techniques. *13 K3 CO1*



12. a) i) The open loop transfer function of a unity feedback system is given by G(s)= K/s(sT+1), where K and T are positive constants. By what factor should the amplifier gain K be reduced, so that the peak overshoot of unit step response of the system is reduced from 75% to 25%? *7 K3 CO2*

ii) A closed loop servo is represented by the differential equation $d^2c/dt^2+8dc/dt = 64\rho$, where c is the displacement of output shaft, r is the displacement of the input shaft and ρ=(r-c).Determine undamped natural frequency, damping ratio and percentage maximum overshoot for unit step input. *6 K3 CO2*

OR

b) Derive the expressions for Time domain specifications with unit step input. *13 K3 CO2*

13. a) Sketch the bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec. $G(s) = Ks^2/(1+0.2s)(1+0.02s)$. *13 K3 CO3*

OR

b) Sketch the polar plot for the following transfer function and find Gain margin and Phase margin. $G(S)= 1/s^2(1+s)(1+2s)$. *13 K3 CO3*

14. a) G(s)= K/s(s+2)(s+4) Sketch the Root locus, find the value of K so that ζ =0.5. *13 K3 CO4*

OR

b) Construct the Nyquist plot for a system whose open loop transfer function is given by $G(s)H(s)= K(1+s)^2/s^3$. Find the range of K for stability. *13 K3 CO4*

15. a) Consider a unity feedback system with open loop transfer function G)s)= K/s(s+8). Design a lead compensator to meet the following specifications. (i) Percentage peak overshoot=9.5% (ii) Natural frequency of oscillation = 12 rad/sec (iii) Velocity error constant Kv≥ 10. *13 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. *13 K3 CO5*

PART - C (1 × 15 = 15 Marks)

16. a) i) The characteristic polynomial of a system is $s^7+5s^6+9s^5+9s^4+4s^3+20s^2+36s+36=0$. Determine the location of roots on s-plane and hence the stability of the system. *8 K3 CO4*

ii) Write the procedure for design of lag compensator using bode plot. *7 K2 CO5*

OR

b) i) The open loop transfer function of a unity feedback system is given by $G(s)= K(s+1)/s^3+as^2+2s+1$. Determine the value of K and a so that the system oscillates at a frequency of 2rad/sec. *8 K3 CO4*

ii) Write the procedure for design of lag –lead compensator using bode plot. *7 K2 CO5*