13 JUN 2023

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Question Paper Code	11866

B.E./B.Tech. - DEGREE EXAMINATIONS, APRIL/MAY 2023

Fifth Semester

Electronics and Communication Engineering

20ECEL508 - CONTROL SYSTEMS ENGINEERING

(Regulations 2020)

(Semi-log Graphs and Polar Chart need to be provided)

Duration: 3 Hours — Max. Marks: 100

Answer ALL Questions

PART-A (10 × 2 = 20 Marks)

Marks, K-Level, CO

1. Compare open loop and closed loop control system. *2,K2, CO1*
2. What are the basic elements used for modelling mechanical translational system? *2,K1,CO1*
3. Draw the block diagram representation of a state model. *2,K2,CO2*
4. What is controllability? *2,K1,CO2*
5. Choose how the system is classified depending on the value of damping. *2,K3,CO3*
6. What is the effect on system performance when a proportional controller is introduced in a system? *2,K1,CO3*
7. List out the different frequency domain specifications. *2,K1,CO4*
8. Analyze the necessary conditions for stability. *2,K4,CO5*
9. Analyze how to find the gain K at a point on root locus. *2,K4,CO5*
10. Explain the need for lag/lag-lead compensation. *2,K2,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11. a) Develop the differential equations governing the mechanical translational system shown in Figure 1. Draw the electrical equivalent analogy circuits. *13,K3,CO1*

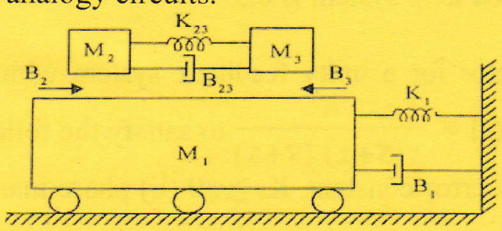

Figure 1

OR

b) Write down the differential equation governing mechanical system shown Figure 2. Draw the torque voltage and torque current electrical analogous circuit. *13,K3,CO1*

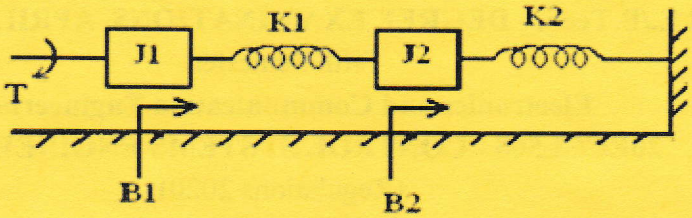

Figure 2

12. a) Develop the response of underdamped second order system for unit step input. *13,K3,CO3*

OR

b) A unity feedback system has the forward transfer function $G(s) = \frac{K1(2S+1)}{S(5S+1)\ (1+S)^2}$ when the input r(t)=1+6t, Solve the minimum value of K1 so that the steady error is less than 0.1. *13,K3,CO3*

13. a) Sketch the bode plot for the following transfer function and determine phase margin and gain margin. $G(s) = \frac{75(1+0.2S)}{S(S^2+16S+100)}$ *13,K3,CO4*

OR

b) The open loop function of a unity feedback system is given by $G(s) = \frac{1}{[S(1+S)\ (1+2S)]}$. Sketch the polar plot and determine the gain and phase margin. *13,K3,CO4*

14. 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. *13,K3,CO5*

OR

b) Sketch the root locus of the system whose open loop transfer function is, $G(s) = \frac{K}{S(S+2)\ (S+4)}$. Determine the value of K so that the damping ratio of the closed loop system is 0.5. *13,K3,CO5*

15. a) Design a lead compensator for a unity feedback system with open loop transfer function, $G(s) = \frac{K}{S(S+1)\ (S+5)}$ to satisfy the following specifications (i) velocity error constant, $K_v \geq 50$ (ii) phase margin is $\geq 20^\circ$. *13,K3,CO6*

OR

b) For the given system, $G(s) = \frac{K}{S(S+1)(S+2)}$. Design a suitable lag-lead compensator to give, velocity error constant=10sec^{-1}, phase margin=50, gain margin>=10dB. *13,K3,CO6*

PART - C (1 × 15 = 15 Marks)

16. a) Discuss the concepts of Kalman's test for controllability and observability and explain the condition for complete state controllability in the S- Plane. *15,K2,CO2*

OR

b) Draw a signal flow graph and develop the closed loop transfer function of a system whose block diagram is shown in Figure 3. *15,K2,CO2*

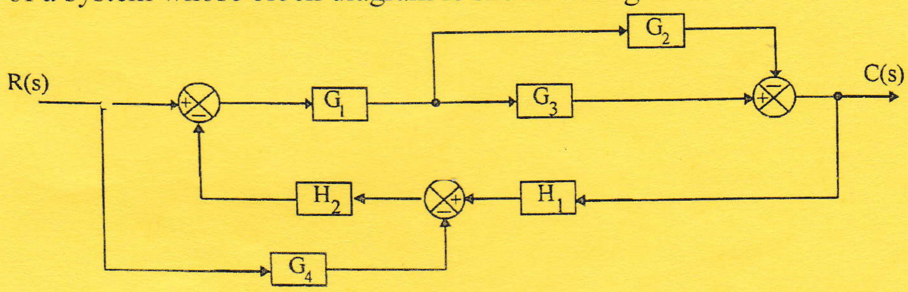

Figure 3