Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

Question Paper Code : 80497

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Electrical and Electronics Engineering

EE 2253/EE 44/EE 1253 A/10133 IC 401/080280033 – CONTROL SYSTEMS

(Common to Instrumentation and Control Engineering and Electronics and Instrumentation Engineering)

(Regulations 2008/2010)

(Also Common to PTEE 2253 - Control Systems for B.E. (Part-Time) Third Semester – EEE – Electronics and Instrumentation Engineering - Regulations 2009)

Time : Three hours | Maximum : 100 marks

Note : Polar plot to be issued.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Define transfer function of a system.

2. What are analogous systems?

3. Classify the system based on damping.

4. Write the relation between static error coefficients and generalized error coefficients.

5. Draw the polar plot for $G(s) = 10/\left[s^2(1+s)(s+2)\right]$.

6. State phase and gain margin.

7. Write the expressions for gain margin and phase margin.

8. How is pole locations and stability related?

9. Write the need for compensation.

10. Draw the circuit of lag-lead compensator.

PART B — (5 × 16 = 80 marks)

11. (a) Write the differential equations governing the system and draw the force current and force voltage analogous of the circuit. shown in Fig 11 (a) (16)

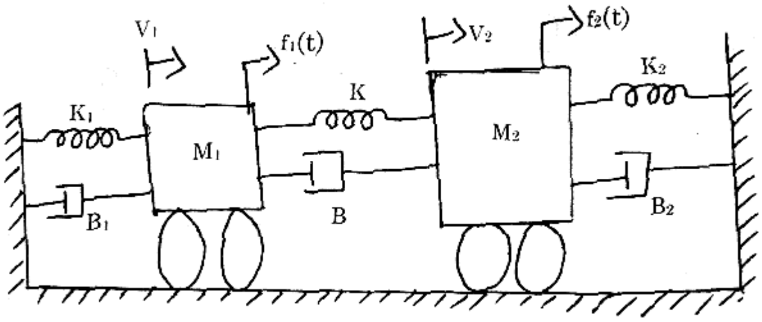

Fig 11 (a)

Or

(b) Obtain the transfer function using Mason's Gain formula for the system given in Fig 11 (b) (16)

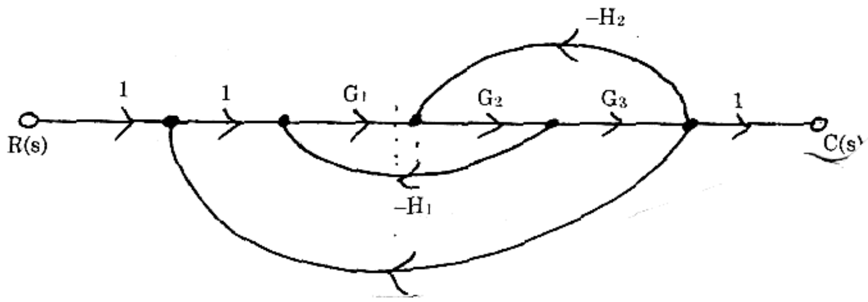

Fig 11 (b)

12. (a) Derive the time response of a typical under damped second order system for a unit step input. (16)

Or

(b) (i) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{k}{s(Ts+1)}$ where k and T are positive constants. By what factor should the amplifier gain be reduced so that the peak overshoot of unit step response of the closed loop system is reduced from 75% to 25%? (8)

(ii) For a closed loop system with $G(s) = \frac{1}{s+1}$ and $H(s) = 5$, calculate the generalized error coefficients and find error series. (8)

13. (a) Sketch the bode plot for the following transfer function and determine the value of K for the gain cross over frequency of 5 rad/sec $G(s) = Ks^2/[(1+0.2s)(1+0.02s)]$. (16)

Or

(b) Sketch the polar plot for the following transfer function and determine the gain and phase margin. $G(s) = 1/[s(1+s)(1+2s)]$. (16)

14. (a) The open loop transfer function of a unity negative feedback system is given by $G(s) = \frac{K(s+3)}{s(s^2+2s+2)}$. Using the Nyquist criterion or otherwise find the value of K for which the closed loop system just stable. (16)

Or

(b) A certain unity negative feedback control system has the following open loop transfer function $G(s) = \frac{K}{s(s+2)(s^2+2s+5)}$. Find the breakaway points and draw root locus for $0 \le K \le \infty$. (16)

15. (a) (i) Explain the different types of compensation techniques. (6)

(ii) A unity feedback system has the open loop transfer function $G(s) = \frac{K}{s(s+2)}$. Design a lead compensator for the system to achieve the following specifications. Velocity error constant $K_i \ge 12\, sec^{-1}$ and phase margin $\Phi_{pm} \ge 45°$. (10)

Or

(b) (i) Explain the performance characteristics of Lead, Lag, Lag-Lead compensators. (6)

(ii) A unity feedback system has the open loop transfer function $G(s) = \frac{K}{s(1+2s)}$. Design a lag compensator so that the phase margin is 40° and the steady state error for ramp input is less than or equal to 0.2. (10)

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