A 243

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005

Fifth Semester

Electronics and Communication Engineering

EC 334 — CONTROL SYSTEMS

(Regulations 2001)

Time : Three hours Maximum : 100 marks

Graph Sheet, Semi log Sheet or Polar Plot are provided.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the electrical analogue of force and rotational damping in torque-voltage analogy?

2. Write any two advantages of block diagram representation.

3. Write any two test signals used to evaluate the performance of the given system.

4. What may be the damping ratio when the percentage of overshoot of the system is 100%?

5. Write any two advantages of stepper motor.

6. Write the condition for unstable system.

7. Explain relative stability of the system.

8. Explain how the stability is determined from the Routh–Hurwitz table.

9. Name the two types of feedback employed in control systems.

10. Name any two compensation techniques employed in the design of control systems.

11. (i) Derive the steady state error for type one system with unit step, ramp and parabolic inputs. (8)

(ii) With a schematic block diagram explain the construction and principle of operation of a stepper motor. (8)

12. (a) (i) Draw the voltage and current analogs for the following mechanical system. (Fig. 1) (8)

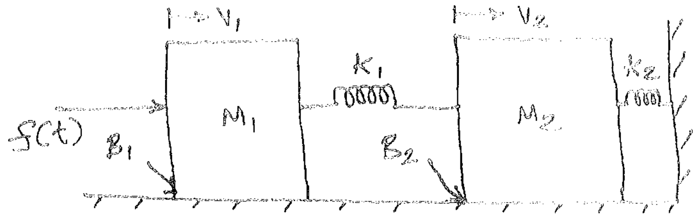

Fig. 1

(ii) Determine the overall transfer function of the following block diagram. (Fig. 2) (8)

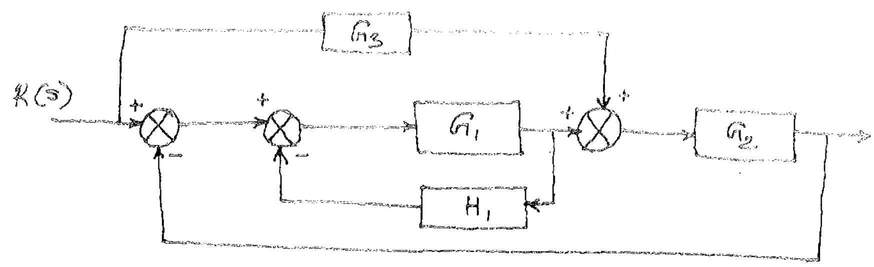

Fig. 2

Or

(b) (i) Explain Mason's gain formula. (6)

(ii) Using Mason's gain formula, determine the ratio C/R for the system represented by the following block diagram. (Fig. 3) (10)

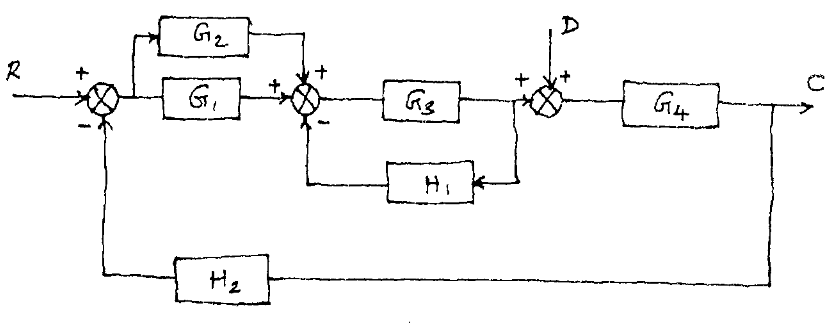

Fig. 3

13. (a) (i) Using Routh Hurwitz criterion determine the relation between K and T so that unity feedback control system whose open loop transfer function given below is stable.

$$G(S) = \frac{K}{S[S(S+10)+T]}$$

(ii) Determine the modified relation between K and T if all the roots of characteristic equation as determined in (i) are to lie to the left of the line S = -1 in S-plane. (16)

Or

(b) Sketch the root locus diagram of the following open-loop transfer function. (16)

$$G(S)\ H(S) = \frac{K}{S\ (S+2)\ (S+5)}$$

14. (a) Draw the Nyquist plot for the open loop transfer function given below and comment on the closed loop stability. (16)

$$G(S)\,H(S) = \frac{2.2}{S\ (S+1)\ (S^2+2S+2)}$$

Or

(b) Construct bode plot for the system whose open loop transfer function is given below and determine (i) the gain margin (ii) phase margin. (16)

$$G(S)\,H(S) = \frac{4}{S\ (1+0.5S)\,(1+0.08S)}$$

15. (a) Consider a type 1 unity feedback system with an OLTF $G_f(s) = \frac{k}{s(s+1)}$. It is specified that $k_v = 12\ \sec^{-1}$ and $\phi_{pm} = 40°$. Design lead compensator to meet the specifications. (16)

Or

(b) Consider the system whose open loop transfer is $G(s) = \frac{K}{s(s+1)(s+4)}$. The system is to be compensated to meet the following specifications. Damping ratio $z = 0.4$, settling time $t_s = 10$ sec. Velocity error constant $K_v = 5\ \sec^{-1}$. Convert the given specifications to suit frequency domain and then use bode plot to design the compensator. (16)

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