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

Fourth Semester

Electrical and Electronics Engineering

EE 235 — CONTROL SYSTEMS

(Common to Mechatronics Engineering)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give some applications of stepper motor.

2. Define transfer function of a system.

3. What are the various test signals used for the analysis of systems?

4. What is meant by velocity error?

5. Define resonant frequency.

6. What is an all pass system?

7. State the condition for stability in terms of location of the roots in s-plane of a characteristic equation.

8. Using Bode plot how will you assess the stability of a system?

9. What is lag compensation?

10. Draw an electrical lead network.

11. (i) Define the time domain specifications for a second order system. (8)

(ii) A unity feedback control system is described by the forward path transfer function as $G(s) = \dfrac{10(s+2)}{s^2(s+1)}$. For a unit step input obtain the static error coefficients. (8)

12. (a) Using Mason's gain formula obtain the overall transfer function of the signal flow graph given in Fig. 12 (a).
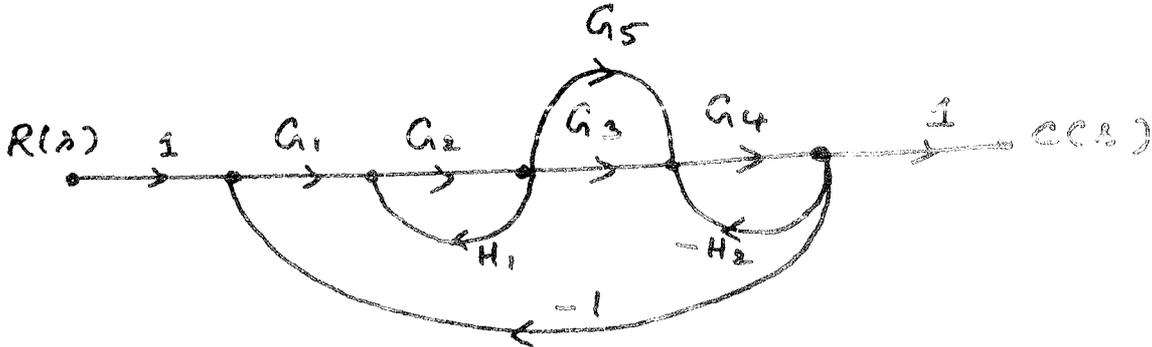

Fig. 12 (a)

Or

(b) Explain the principle of working of synchros with relevant sketches. How are synchros useful in control system engineering?

13. (a) Deduce that the locus of constant magnification and phase of closed loop system are circles. Find their radius and centre.

Or

(b) Draw the Bode plot for a system whose open loop transfer function is $G(s)\,H(s) = \dfrac{225(0.1s+1)}{s^2(0.01s+1)}$. Also determine the phase and gain margin.(16)

14. (a) By applying Nyquist criterion, state whether the closed loop system having the following open loop transfer function is stable or not. (16)

$$G(s)\,H(s) = \frac{1}{(s+1)(s-2)}$$

Or

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(b) Construct the Routh array and determine the stability of the following systems represented by the characteristic equations

(i) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$

(ii) $s^4 + 2s^3 + 10s^2 + 20s + 5 = 0$.

Also determine the number of roots lying on right half of s-plane, left half of s-plane and on imaginary axis. (8 + 8)

15. (a) For a feedback system with loop transfer function

$$GH = \frac{(s+1)}{s(s+4)(s^2 + 6s + 10)},$$

draw the root locus. (16)

Or

(b) (i) Discuss the design procedure of a lead network using Bode plot. (6)

(ii) The open loop transfer function of the uncompensated system is,

$$G(s) = \frac{5}{s(s+2)}$$

Design a lead compensator for the system so that the static velocity error constant K_v is 20 sec^{-1}, the phase margin is atleast 55° and the gain margin is atleast 12 dB. (10)

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