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B 2180

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Fourth Semester

Electrical and Electronics Engineering

EE 235 — CONTROL SYSTEMS

(Common to Mechatronics Engineering)

Time : Three hours

Maximum : 100 marks

(Semilog, Nichol's, XY graph sheets should be provided)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State whether transfer function is applicable to non linear system.
2. Differentiate between open loop and closed loop system.
3. The closed loop transfer function of a second order system is given by $\frac{200}{s^2 + 20s + 200}$. Determine the damping ratio and natural frequency of oscillation.
4. List the importance of type and order of a system.
5. What is an All-pass system?
6. What are M and N circles?
7. What is the effect of positive feedback on stability?
8. For stability of a closed loop system, what is the condition for gain margin and phase margin?
9. What are the two basic design approaches for compensator?
10. Compare phase lead and phase lag compensators.

11. (a) Draw the signal flow graph and evaluate the closed loop transfer function of the system whose block diagram is shown in Fig. 1

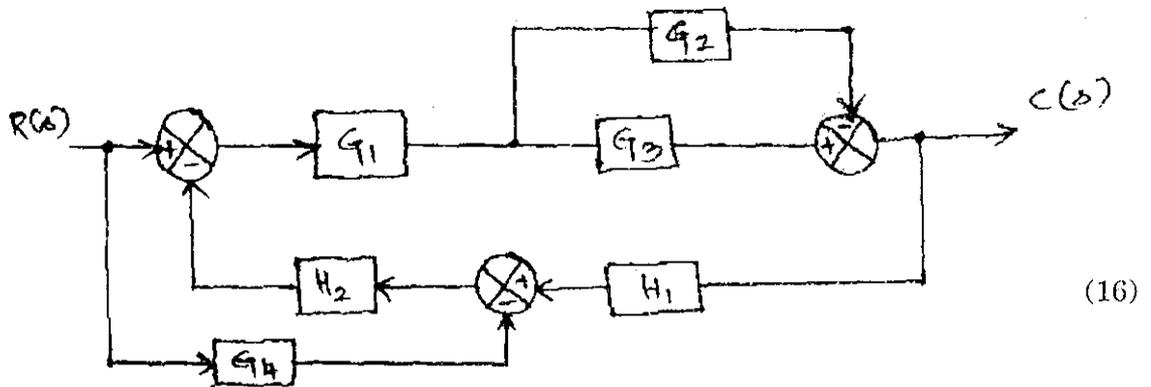


Fig. 1

Or

- (b) (i) Draw the block diagram of a closed loop control system and briefly explain the various components. (6)
- (ii) Derive the transfer function of a field controlled DC motor. (10)
12. (a) A positional control system with velocity feedback is shown in Fig. 2. What is the response $c(t)$ to the unit step input. Given that $\xi = 0.5$. Also calculate rise time, peak time, maximum overshoot and settling time. (16)

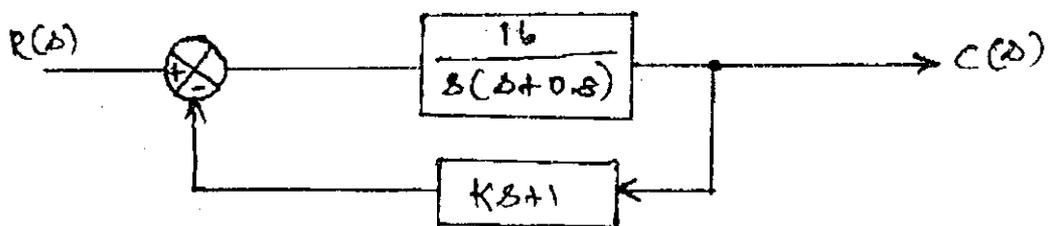


Fig. 2

Or

- (b) (i) Discuss in detail the effects of adding a zero to a system. (5)
- (ii) Write notes on robust control. List the two methods for implementing a controller for robust control. (5)

- (iii) For servomechanism with open loop transfer function $G(s) = \frac{10}{s^2(s+1)(s+2)}$. What type of input signal gives rise to a constant steady state error and calculate the value? (6)

13. (a) For the transfer function $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$, plot the Bode diagram and obtain the gain and phase cross over frequencies. (16)

Or

- (b) A unity feedback system has open loop transfer function given by $G(s) = \frac{54}{(1+0.1s)(s^2+8s+25)}$. Using Nichols chart determine the closed loop frequency response. From the closed loop response determine the resonant peak, resonant frequency and bandwidth. (16)

14. (a) 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 the roots on the s-plane and hence the stability of the system. (16)

Or

- (b) Sketch the Nyquist plot for a system with the open loop transfer function $G(s)H(s) = \frac{(1+0.5s)(1+s)}{(1+10s)(s-1)}$. Determine the closed loop stability of the system using Nyquist stability criterion. (16)

15. (a) Design a lead compensation for a type-2 system with an open loop transfer function $G_f(j\omega) = \frac{K}{(j\omega)^2 \cdot (j0.2\omega + 1)}$. Assume that the system is required to be compensated to meet the following specifications.

- (i) Acceleration error constant $K_a = 10$
 (ii) Phase Margin = 35° . (16)

Or

- (b) Discuss the step by step design procedure of time domain design of lead compensator. (16)