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Question Paper Code : 33489

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Electronics and Instrumentation Engineering

IC 1251/EE 1253 — CONTROL SYSTEMS

(Common to Fourth Semester, Electrical and Electronics Engineering and Instrumentation and Control Engineering)

(Regulation 2004/2007)

(Common to B.E. (Part-Time) Third Semester, Electrical and Electronics Engineering, Regulation 2005)

Time : Three hours | Maximum : 100 marks

(Ordinary Graph, Semilog and Bode Plot are to be Provided)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the important features of open loop control system?

2. Define Transfer function.

3. Define Rise time.

4. Define maximum (peak) Overshoot, Mp.

5. Write expressions for constant M and N circles.

6. Write the expression to determine the resonant peak.

7. What is the condition for stable system in the given Nyquist plot?

8. What are the drawbacks of Routh Hurwitz criterion?

9. What is the importance of compensation?

10. What are the important types of compensating network?

PART B — (5 × 16 = 80 marks)

11. (a) Write the equations of motion in S-domain for the system shown in Fig. 11(a). Determine the transfer function of the system.

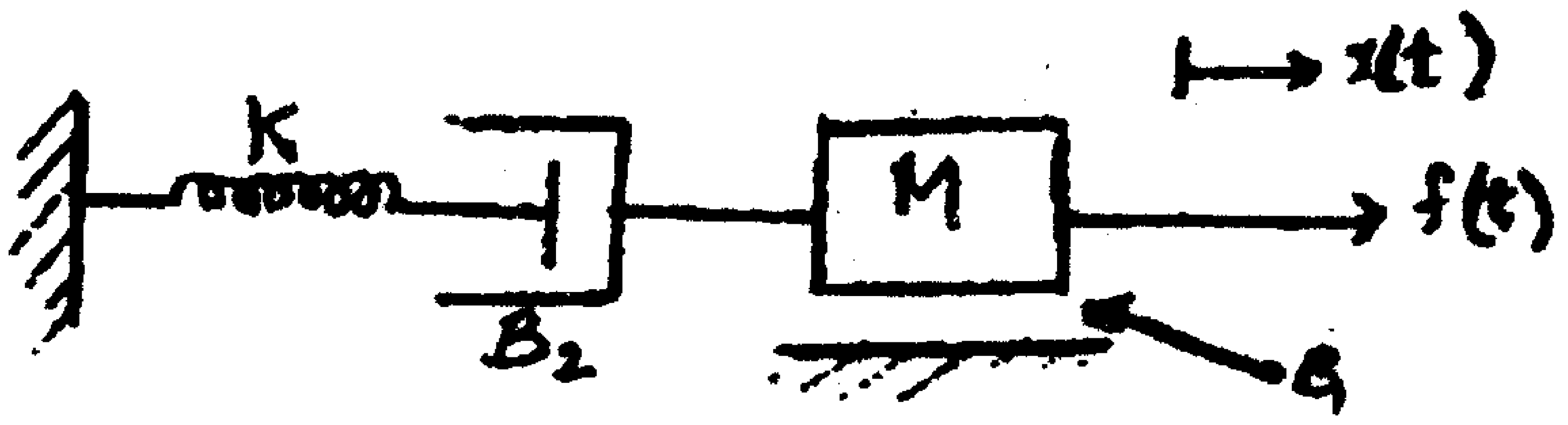

Fig. 11(a)

Or

(b) Convert the given block diagram in Fig. 11(b) to signal flow graph and determine $C(S)/R(S)$.

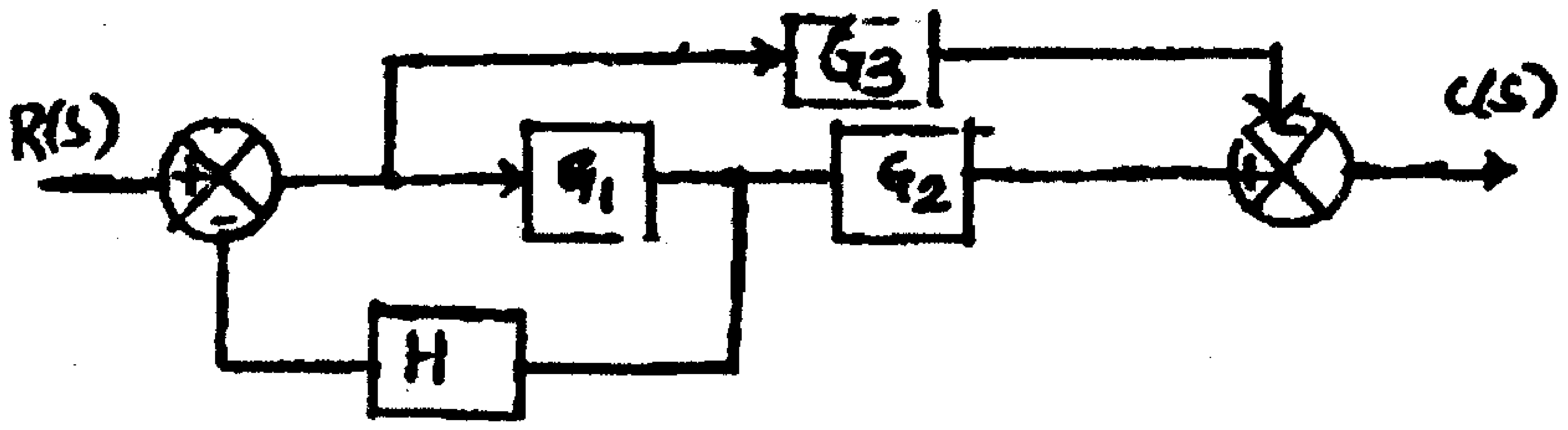

Fig. 11(b)

12. (a) A system has $G(S)=K[s(1+sT)]$ with unity feedback when K and T are constant. Determine the factor by which K should be multiplied to reduce the overshoot from 85% to 35%.

Or

(b) Given $G(S) = \dfrac{K}{s+1}$ for unity feedback system, find

(i) Error series for input $r(t)$

(ii) Steady state error for step, ramp and acceleration input.

(iii) Error for $r(t) = \left[a_0 + a_1 t + a_2 \dfrac{t^2}{2}\right] u(t)$.

13. (a) (i) Derive expressions for constant M and N circles. (8)

(ii) Using Bode plot for a unity feedback system with $G(s) = \dfrac{199}{s(s+1.71)(s+100)}$, determine the gain crossover frequency. (8)

Or

(b) (i) Explain how closed loop frequency response is obtained from open–loop response using Nichol's chart. (8)

(ii) Derive an expression for bandwidth of a second order system in terms of the damping factor ξ. (8)

14. (a) (i) Using Nyquist stability criterion comment on the closed loop system stability for a system whose open loop transfer function is given by

$$G(S)H(S) = \frac{K(S+3)}{S(S-1)}.$$ (8)

(ii) Explain how gain margin and phase margin are obtained using polar plot. (8)

Or

(b) (i) Check the stability of a feedback control system whose characteristic equation is given by $S^5 + S^4 + 4S^3 + 4S^2 + 2S + 1 = 0$. (8)

(ii) Sketch the root locus for the unity feedback system whose open loop transfer function is given by $G(S)H(S) = \frac{K(S+4)}{S(S^2+6S+13)}$. (8)

15. (a) The open loop transfer function of a unity feedback system is $G(s) = \frac{K}{s(s+1)}$. It is desired to have the velocity error constant $K_V = 12\ \text{sec}^{-1}$ and phase margin as 40°. Design a lead compensator to meet the above specification.

Or

(b) For the unity feedback control system forward path transfer function $G(s) = \frac{K}{s(s+4)(s+20)}$. Design a lag-lead compensator so that PM $\geq$ 40 and S.S. error for unit ramp input $\leq$ 0.04 rad.

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