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Question Paper Code : 73500

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

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, Electronics and Instrumentation Engineering)

(Regulations 2008/2010)

(Also common to PTEE 2253 — Control Systems for B.E. (Part-Time) Third Semester – EEE – Regulations 2009)

Time : Three hours | Maximum : 100 marks

(Graph sheet, semi log sheet and polar sheet may be permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the advantages of closed loop control system?

2. Define Transfer function.

3. Find the acceleration error coefficient for $G(s) = [K(1+s)(1+2s)]/[s^2(s^2+4s+20)]$.

4. State the effect of PI and PD controller on system performance.

5. Why is frequency response analysis important in control applications?

6. List out the techniques used for determining closed loop response from open loop response.

7. What is dominant pole?

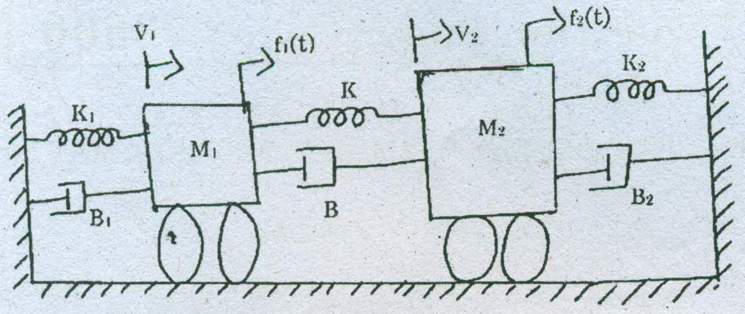
8. State the necessary and sufficient condition for stability.

9. Sketch pole zero plot of lag lead network.

10. Draw a bode plot of a typical lag compensator.

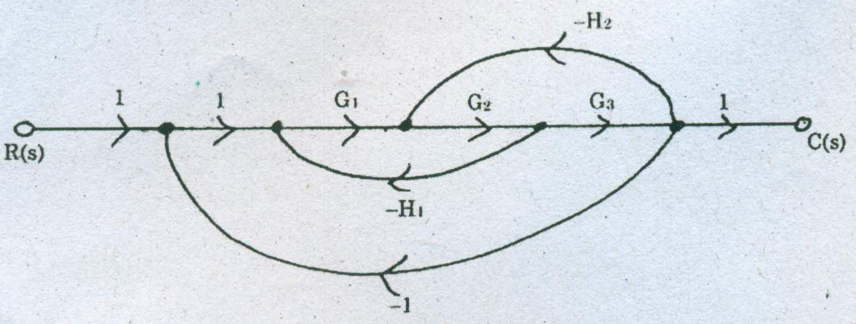
PART B — (5 × 16 = 80 marks)

11. (a) Write the differential equations governing the system and draw the force-current and force-voltage analogous circuit. (16)



Or

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



12. (a) Derive the time response specifications 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 $G(s) = \dfrac{k}{s(Ts+1)}$ 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 $G(s) = \dfrac{1}{s+1}$ 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 $K_v \ge 12\,\text{sec}^{-1}$ 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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