Question Paper Code: E3088

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2010

Fourth Semester

Electrical and Electronics Engineering

EE2253 — CONTROL SYSTEMS

(Common to Electronics and Instrumentation Engineering and Instrumentation and Control Engineering)

(Regulation 2008)

Time: Three hours Maximum: 100 Marks

Answer ALL Questions

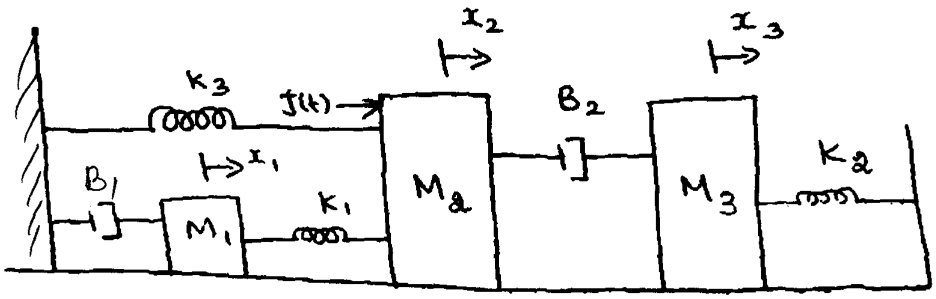
PART A — (10 × 2 = 20 Marks)

1. List out the advantages of closed loop control system.
2. State "transfer function" of a system.
3. Distinguish between steady state and transient response of the system.
4. Define "Settling time".
5. What is cutoff frequency?
6. Define phase margin.
7. State Nyquist stability criterion.
8. What is the correlation between Phase margin and Damping factor?
9. What is the relation between ϕ_m and α?
10. What type of compensator suitable for high frequency noisy environment?

PART B — (5 × 16 = 80 Marks)

11. (a) (i) Discuss the mathematical modelling of fundamental components of mechanical translational system. (6)

(ii) Obtain the mathematical model of the mechanical system shown in Figure below. (10)



Or

(b) (i) Using block diagram reduction technique, find $\frac{C(s)}{R(s)}$. (8)

(ii) Write detailed notes on "synchros". (8)

12. (a) (i) Discuss the unit step response of second order system. (8)

(ii) Obtain the unit step response and unit impulse response of the following system $\frac{C(s)}{R(s)} = \frac{10}{s^2 + 2s + 10}$. (8)

Or

(b) (i) Write short notes on Dynamic error coefficients. (8)

(ii) For a unity feedback second order system, the open loop transfer function is $G(s) = \frac{w_n^2}{s(s^2 + 2\varepsilon w_n)}$. Calculate the generalized error coefficients and find error series. (8)

13. (a) (i) Explain the frequency domain specifications of a typical system. (6)

(ii) Draw the Bode plot of the open loop transfer function

$$G(s) = \frac{200\,(s+10)}{s(s+5)\,(s+20)}.$$ (10)

Or

(b) (i) What is the effect on polar plot if a pole at origin is added to the transfer function? Explain. Draw the polar plot of a first order system. (5)

(ii) For the following system, sketch the polar plot

$$G(s)\,H(s) = \frac{500}{s(s+6)(s+9)}. \quad (11)$$

14. (a) For each of the characteristic equation of feedback control system given, determine the range of K for stability. Determine the value of K so that the system is marginally stable and the frequency of sustained oscillations.

(i) $s^4 + 25s^3 + 15s^2 + 20s + K = 0$

(ii) $s^4 + Ks^3 + s^2 + s + 1 = 0$

(iii) $s^3 + 3Ks^2 + (K+2)\,s + 4 = 0$

(iv) $s^4 + Ks^3 + 5s^2 + 10s + 10K = 0$. (16)

Or

(b) (i) Write short notes on Root locus construction. (6)

$$G(s)\;H(s) = \frac{1}{s^4\,(s+1)}. \quad (10)$$

15. (a) (i) List out the characteristics of lag compensator. (4)

(ii) The open loop transfer function of the uncompensated system is $G(s) = \frac{5}{s(s+2)}$. Design a suitable lag 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. (12)

Or

(b) (i) Draw the Bode Plot of a typical lag-lead compensator. (4)

(ii) Design a lead compensator for a type-2 system with an open loop transfer function $G(s) = \frac{K}{s^2\,(0.2s+1)}$. Assume that the system is required to be compensated to meet the following specifications: (12)

(1) Acceleration error constant $K_a = 10$;

(2) Phase margin = 35°.

———————