C 3262

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fourth Semester

(Regulation 2004)

Electrical and Electronics Engineering

IC 1251 — CONTROL SYSTEMS

(Common to Instrumentation and Control Engineering)

(Common to B.E. (Part-Time) Third Semester Regulation 2005)

Time : Three hours Maximum : 100 marks

(Necessary charts may be provided or permitted)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What are the advantages of closed loop systems?
2. Mention the applications of synchros.
3. Define : Peak Time and Peak overshoot.
4. What are the effects of PI controller?
5. What are M circles and N circles?
6. Draw the approximate polar plot for the functions,

   (a) $GH(s) = \dfrac{1}{(1+T_1 s)(1+T_2 s)}$,

   (b) $GH(s) = \dfrac{1}{s^2(1+Ts)}$.

7. What are the effects of adding open loop pole to root locus and the system?
8. State the advantages of Nyquist plot.
9. Mention the expression for frequency at which phase lead is maximum.
10. What are the effects of Lag-Lead compensator?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Obtain the Force-voltage analogous circuit for mechanical system shown in Figure (1).

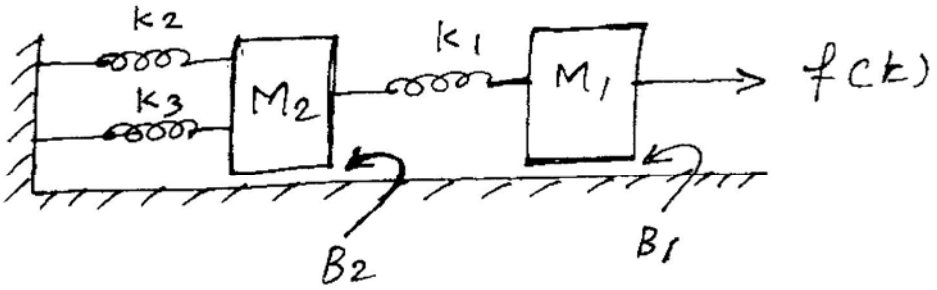

Figure 1

(ii) Describe the features and characteristics of an armature controlled D.C. servomotor.

Or

(b) (i) Reduce the block diagram shown in Figure (2) and obtain the overall transfer function

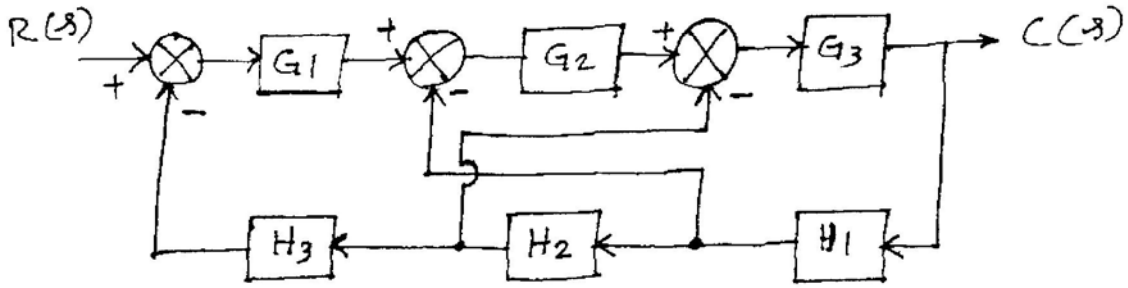

Figure 2

(ii) For the signal flow graph shown in Figure (3), obtain the value of $\frac{C(s)}{R(s)}$.

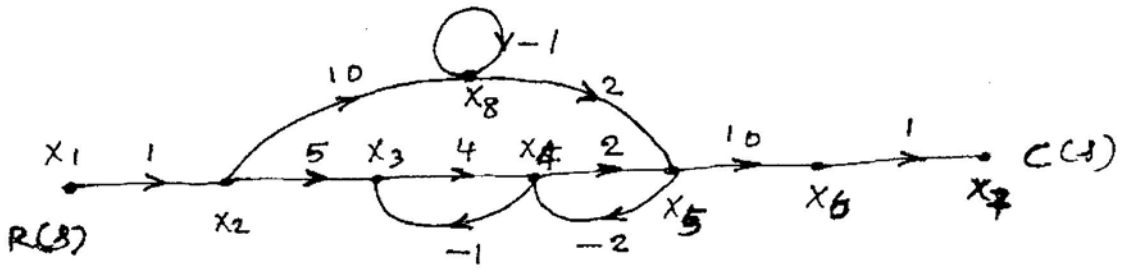

Figure 3

12. (a) (i) Describe the output response of type I and type II systems for ramp input.

(ii) A unity feedback heat treatment system has,

$$G(s) = \frac{10000}{(1+s)(1+.5s)(1+.02s)}.$$

The output set point is 500°C. What is the steady state temperature?

Or

(b) (i) If x is the input and y is the output, of the system described by a differential equation, $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 8x$, determine the undamped natural frequency, damping ratio, damped natural frequency time for peak overshoot, and settling time.

(ii) For a system with, $GH(s) = \frac{5}{(s+5)}$, calculate the generalised error co-efficients and the steady state error. Assume $r(t) = 6 + 5t$.

13. (a) (i) Draw the bode plot for the function, $G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$.

Determine the value of K for a gain cross over frequency of 20 rad/sec.

(ii) Explain how a closed loop response is obtained from open loop response.

Or

(b) (i) For a system with, $G(s)\,H(s) = \frac{400}{s(s+2)(s+10)}$. Draw the polar plot.

(ii) Prove that the locus of M is a circle.

14. (a) (i) For a system with, $F(s) = s^4 + 22s^3 + 10s^2 + s + k = 0$, obtain the marginal value of K, and the frequency of oscillations at that value of K.

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

Or

(b) (i) Construct the root locus for the function, $G(s)\,H(s) = \dfrac{K(s+2)}{(s+1)^2}$, and discuss about the stability of the system.

(ii) For a system with, $G(s)\,H(s) = \dfrac{40}{(s+4)\,(s^2+2s+2)}$, obtain the gain margin and stability using Nyquist plot.

15. (a) (i) Draw the circuit diagram of a Lag compensator and obtain its transfer function.

(ii) Describe the steps involved in the design of Lag compensator.

Or

(b) (i) Draw the circuit diagram of a Lead compensator and obtain its transfer function.

(ii) Describe the advantages and limitations of Lead compensator.