Total No. of Questions : 10] [Total No. of Printed Pages : 5

Roll No. ....

EX–602(N)

B. E. (Sixth Semester) EXAMINATION, June, 2011

(Electrical & Electronics Engg. Branch)

CONTROL SYSTEMS

[EX – 602(N)]

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

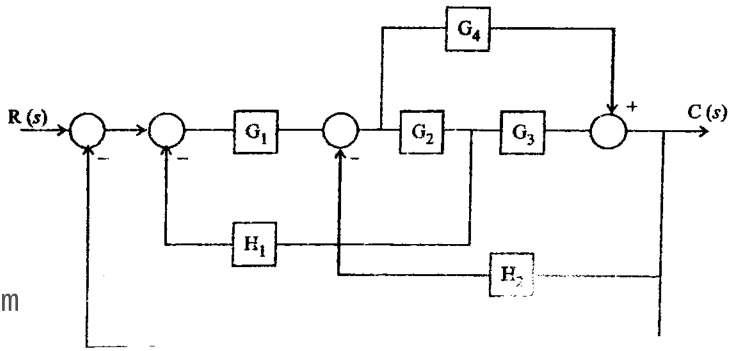
Note : (i) Attempt any *one* question from each Unit.

(ii) All questions carry equal marks.

(iii) Use cm/semilog paper suitably.

Unit – I

1. (a) Using block diagram reduction technique reduce the following system shown in fig. 1 and determine the overall transfer functions. 10



(b) Determine the transfer function by Mason's gain formula for the SFG in fig. 2. 10

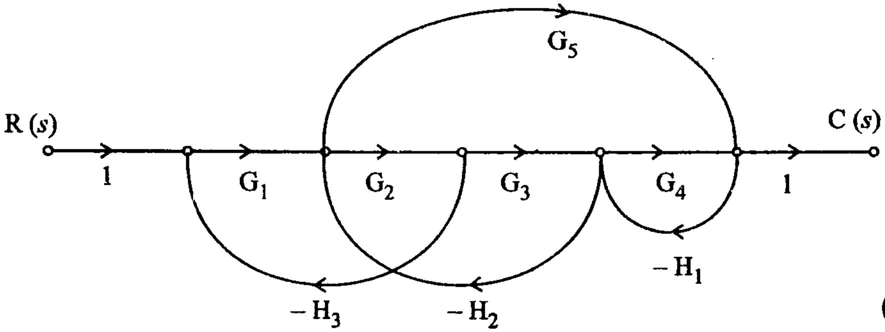


Fig. 2

Or

2. (a) Find the electrical analogous system for the mechanical system shown in fig. 3 and obtain the transfer function $\frac{x_2(s)}{F(s)}$. 10

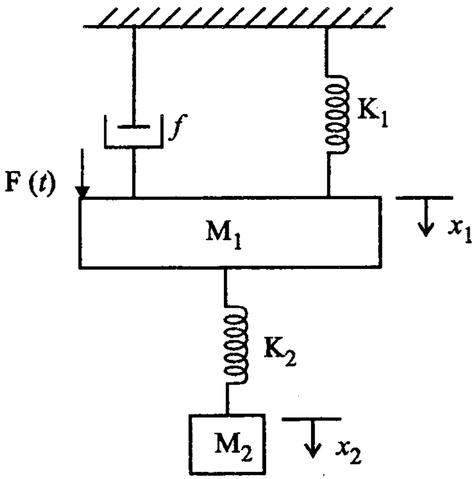


Fig. 3

(b) Explain the construction and working of a Selsyn. 10

Unit – II

3. (a) A unity feedback system is characterised by an open loop transfer function :

$$G(s) = \frac{k}{s(s+10)}$$

Determine the gain k so that the system will have a damping ratio of $0 \cdot 5$. For this value of k determine the settling time, peak overshoot and time to peak overshoot for a unit step input. 10

(b) Find k_p, k_v and k_a and steady state error for a system with open loop transfer function : 10

$$G(s)H(s) = \frac{10(s+2)(s+3)}{s(s+1)(s+4)(s+5)}$$

where input is $r(t) = 3 + t + t^2$.

Or

4. (a) A feedback system is described by the following transfer function :

$$G(s) = \frac{12}{s^2 + 4s + 16}, \ H(s) = ks$$

The damping factor is $0 \cdot 8$. Determine the overshoot of the system and the value of k. 10

(b) The open loop T. F. of a unity feedback control system is given as :

$$G(s) = \frac{k}{(s+2)(s+4)(s^2 + 6s + 25)}$$

By applying Routh criteria, discuss the stability of the closed loop system as a function of k. Determine the value of k which will cause sustained oscillation in a closed loop system. What are the corresponding oscillation frequencies ? 10

Unit – III

5. (a) Calculate the angle of asymptotes and the centroid of the system having :

$$G(s)\,H(s) = \frac{k}{s\,(s+1+j)\,(s+1-j)}$$

and also sketch the root locus for $k > 0$. 10

(b) Explain the following terms : 10

(i) Root sensitivity

(ii) Root locus of systems with dead time or transportation lag.

Or

6. (a) Sketch the root locus for a system given by :

$$G(s)\,H(s) = \frac{k\,(s+1)}{s\,(s-1)}$$

and also show that the loci of complex roots are part of a circle with (– 1, 0) as centre and radius is 1·414. 10

(b) Give the general procedure for plotting root locus plot. 10

Unit – IV

7. (a) A unity feedback control system has open loop transfer function as :

$$G(s) = \frac{10}{s\,(1+0{\cdot}1\,s)\,(1+0{\cdot}2\,s)}$$

Sketch the Bode plot and determine from it : 10

(i) Gain crossover frequency

(ii) Phase crossover frequency

(iii) Gain margin

(iv) Phase margin

(v) Closed loop stability of the system

(b) Sketch Nyquist plot and determine the stability for the unity feedback system having the transfer function : 10

$$G(s)\,H(s) = \frac{100}{s\,(s+2)\,(s+10)}$$

Or

8. (a) State and explain the Nyquist criterion of stability. Hence define the terms gain margin and phase margin. 10

(b) State the Bode plot for the following transfer function and determine the gain k for gain cross over frequency to be 5 rad/sec. : 10

$$G(s) = \frac{ks^2}{(1+0{\cdot}2\,s)\,(1+0{\cdot}02\,s)}$$

Unit – V

9. (a) The open loop transfer function of type two system with unity feedback is given by : 15

$$G(s) = \frac{k}{s^2\,(1+0{\cdot}25\,s)}$$

Design a lead compensator to meet the following specifications :

(i) Acceleration constant $k_a = 10$

(ii) PM = 35°

(b) Discuss the necessity of compensating networks in a control system. Where are they located ? 5

Or

10. (a) Discuss the detailed procedure of design of a phase lead compensating network. Also discuss its effects and limitations. 15

(b) Compare phase lead with phase lag compensating network. 5