Total No. of Questions : 10] [Total No. of Printed Pages : 4

Roll No. ....

EC–402(N)

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

(Electronics & Communication Engg. Branch)

CONTROL SYSTEMS

[EC – 402(N)]

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt *one* question from each Unit. All questions carry equal marks.

Unit – I

1. (a) Derive transfer function of armature-controlled d. c. servomotor using mathematical modeling. 10

(b) Determine C_1/R_1 and C_2/R_1 (assuming $R_2 = 0$) by reducing the block diagram shown in Fig. 1. 10

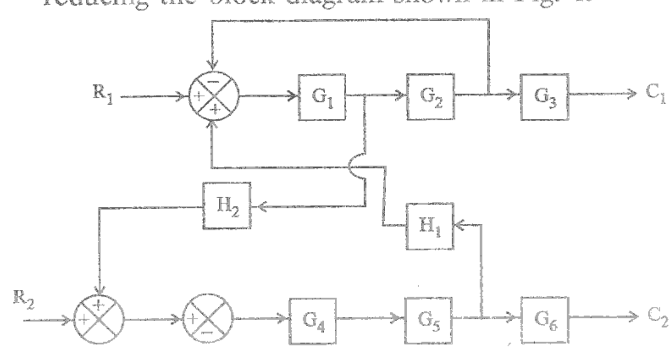

Fig. 1

Or

2. (a) Derive transfer function of mechanical accelerometer using mathematical modeling. 10

P. T. O.

(b) Find expressions for the outputs C_1 and C_2 from the following signal flow graph as shown in Fig. 2. 10

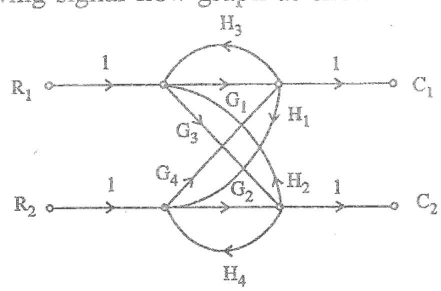

Fig. 2

Unit – II

3. (a) The block diagram of a position control system is shown in Fig. 3. Determine the sensitivity of closed loop transfer function T with respect to G and H, the forward path and feedback path transfer function respectively for $\omega = 1$ rad/sec. 10

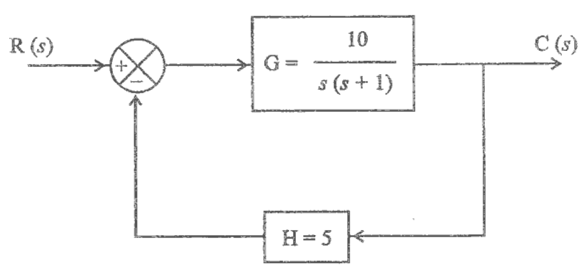

Fig. 3

(b) Measurements conducted on a servomechanism show the system response to be :

$$c(t) = 1 + 0{\cdot}2\,e^{-60t} - 1{\cdot}2\,e^{-10t}$$

when subjected to a unit-step input. 10

(i) Obtain the expression for the closed-loop transfer function.

(ii) Determine the undamped natural frequency and damping ratio of the system.

Or

4. (a) Describe in detail the design specifications of 2nd order system and higher order system. 10

 (b) Show the effects of feedback on gain, time constant, pole location, bandwidth, sensitivity, stability and steady state error by using suitable example. 10

Unit – III

5. A feedback control system has an open-loop transfer function :

$$G(s)\,H(s) = \frac{k}{s(s+3)(s^2+2s+2)}$$

Find the root locus as k is varied from 0 to ∞. Also determine value of k to get $\xi = 0 \cdot 5$ of dominant roots. 20

Or

6. Draw the Bode plot for the transfer function :

$$G(s) = \frac{64(s+2)}{s(s+0 \cdot 5)(s^2+3 \cdot 2s+64)}$$

Also evaluate the gain margin and phase margin. 20

Unit – IV

7. Consider a unity feedback type-2 system with open-loop gain :

$$G(s) = \frac{k}{s^2}$$

It is desired to compensate the system so as to meet the following transient response specification : 20

Settling time ≤ 4 sec.

Peak overshoot for step input $\leq 20\%$.

Or

8. Consider a type-I system with an open-loop transfer function $G(s) = \frac{k}{s(s+1)(s+4)}$.

This system is to be compensated to meet the following specifications : 20

(i) Damping ratio $\xi = 0 \cdot 5$.

(ii) Undamped natural frequency $\omega_n = 2$.

Unit—V

9. (a) Obtain the time response of the following systems : 10

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

where $u(t)$ is a unit step occurring at $t = 0$ and $X^T(0) = [1 \quad 0]$.

(b) Obtain the state-space representation of the following RLC network. 10

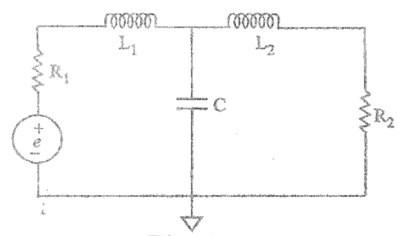

Fig. 4

Assume the voltage across R_2 and current through R_2 are the output variables y_1 and y_2 respectively.

Or

10. Examine the observability of the system given below : 20

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$