Roll No. Total No. of Pages : 4

BT–6/M09 9731

CONTROL SYSTEM ENGINEERING

Paper—ECE-302E

Time : Three Hours] [Maximum Marks : 100

Note : —Attempt any **FIVE** questions.

1. (a) Define the term Servomechanism. Give comparison of open loop and closed loop control system. 5

(b) Determine the transfer function of the network shown in Fig. 1. Hence calculate the voltage $V_2(t)$ when the inputs are :

(i) $V_1(t) = 5$

(ii) $V_1(t) = 5t$. 7

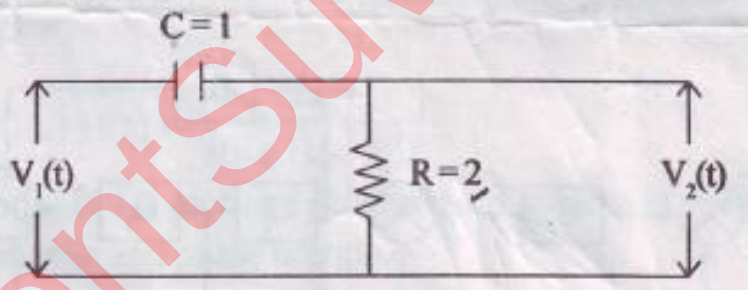


Fig. 1

(c) Draw the mechanical network for system shown in Fig. 2 and write the system differential equations. 8

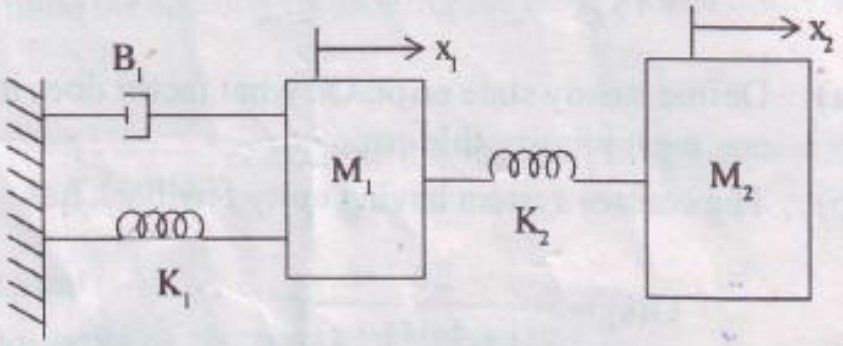


Fig. 2

2. (a) Define feedback and non feedback systems. 4

(b) Find the transfer function of Fig. 3 by block diagram reduction method. 8

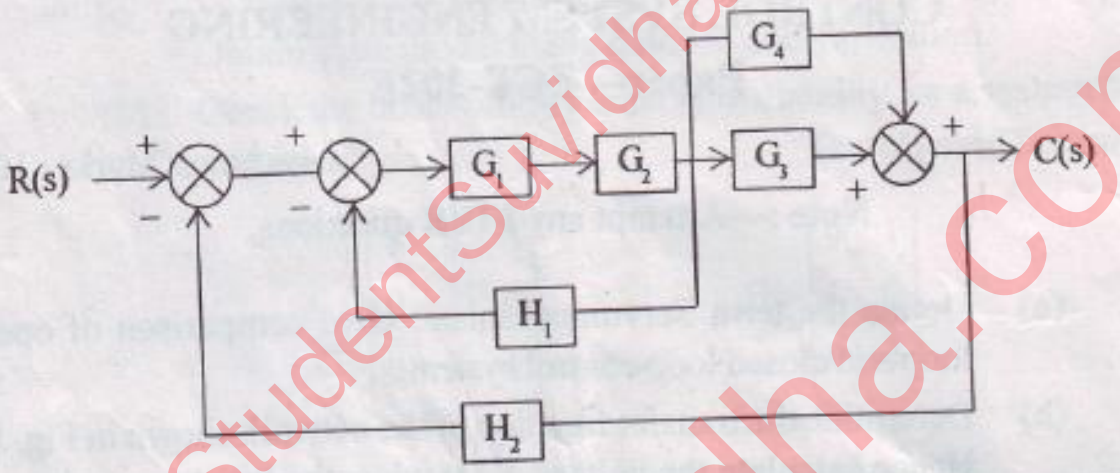
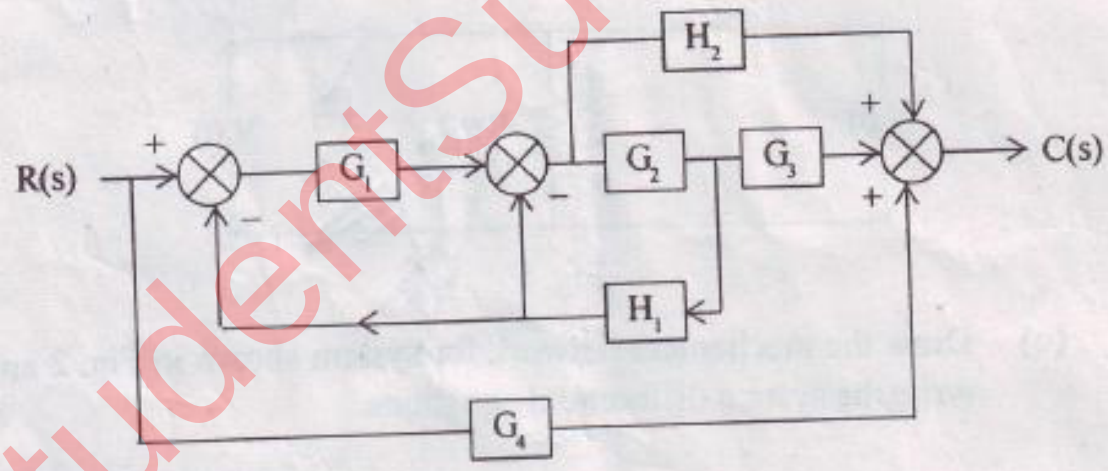


Fig. 3

(c) Find transfer function using Mason's gain formula. 8



3. (a) Define steady state error. On what factor does it depend ? How can we minimize this error ? 5

(b) The control system having unity feedback has

$$G(s) = \frac{20}{s(1+4s)(1+s)}.$$

Determine the static error constants. 5

(c) List the time domain specifications for 2nd order system. Derive the formula for peak time (t_p) and maximum overshoot (M_p). 10

4. (a) What are difficulties faced while applying Routh Hurwitz criteria ? How can these difficulties be overcomed ? 10

(b) Using Routh-criteria investigate the stability of a unity feedback control system whose open loop transfer function is given by :

$$G(s) = \frac{e^{-sT}}{s(s+2)}.$$ 10

5. (a) Draw the root locus for unity feedback system whose forward path transfer function is given by :

$$G(s) = \frac{s}{s(s^2+2s+25)}.$$

Also comment on the stability of the closed loop system. 10

(b) Given :

$$G(s)\,H(s) = \frac{12}{s(s+1)(s+2)}.$$

Draw the Polar plot and determine if system is stable and its gain margin and phase margin. 10

6. (a) Given :

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

Determine the stability by plotting the Bode Plot of the system. 10

(b) $GH(s) = \frac{1}{s^3(s+1)}$. Determine the stability using Nyquist Plot. 10

7. Write short note :—

(a) Various types of compensation techniques. 10

(b) Effect of feedback on sensitivity. 10

8. (a) The transfer function of the system is given by :

$$\frac{Y(s)}{U(s)} = \frac{s+2}{s^2+7s+12}.$$

Obtain state model using cascade decomposition. 10

(b) Check the observability and controllability for a system having matrices :

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 2 & 1 \end{bmatrix} \qquad B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$C^T = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix} \qquad D = [0].$$ 10