B.E. Sixth Semester (Mechanical Engineering) (C.B.S.)

Control System Engineering

P. Pages : 4 **KNT/KW/16/7396**

Time : Three Hours * 0 1 2 5 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) Find T. F. $\frac{Y_2(s)}{Y_1(s)}$ **7**

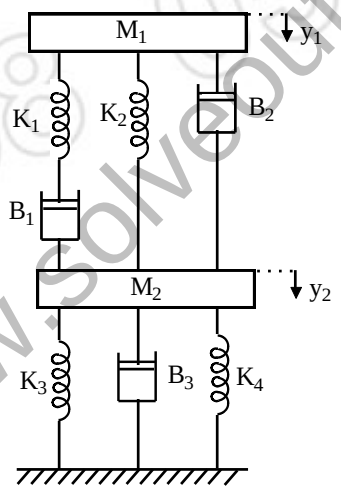


Fig. 1 (a)

b) Find T. F. $\frac{E_o(s)}{E_i(s)}$ **7**

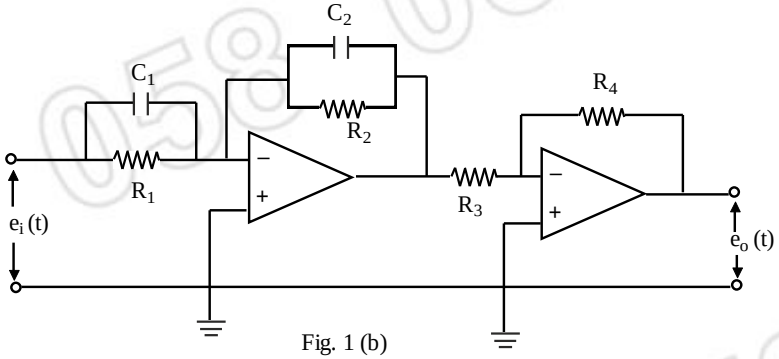


Fig. 1 (b)

OR

2. a) Explain open loop and close loop control system with advantages and disadvantages. **6**

b) Find T. F. $\frac{X(s)}{E_i(s)}$ **8**

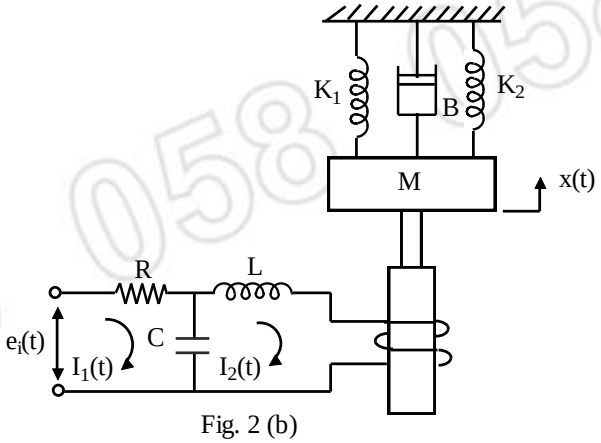


Fig. 2 (b)

3. a) Find $\frac{C(s)}{R(s)}$ by using Block Reduction Technique. **6**

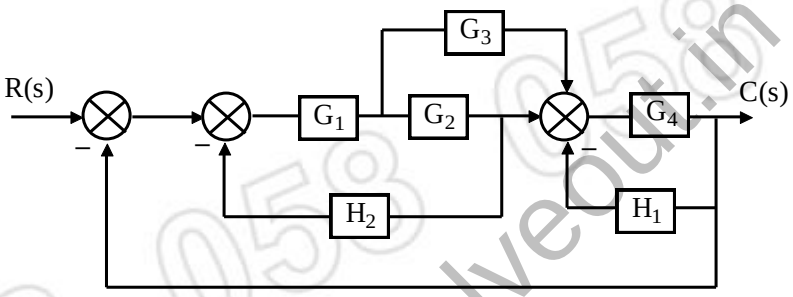


Fig. 3 (a)

b) Convert the given algebric equations into signal flow graph and find its transfer function. **7**

$$Y_2 = G_1Y_1 + G_3Y_3$$
$$Y_3 = G_4Y_1 + G_2Y_2 + G_5Y_3$$
$$Y_4 = G_6Y_2 + G_7Y_3$$

Where Y_4 is output and Y_1 is input.

OR

4. a) Obtain $\frac{C(s)}{R(s)}$ using block reduction technique. **6**

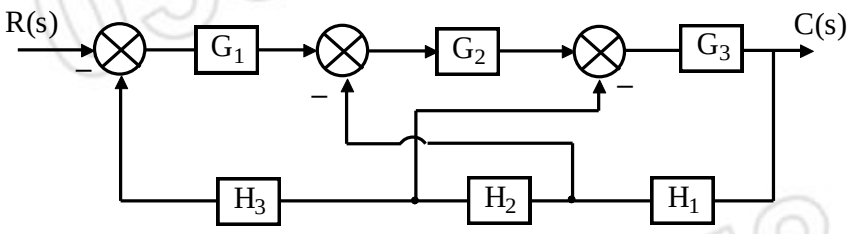


Fig. 4 (a)

b) Convert the given block diagram into SFG & find T. F. **7**

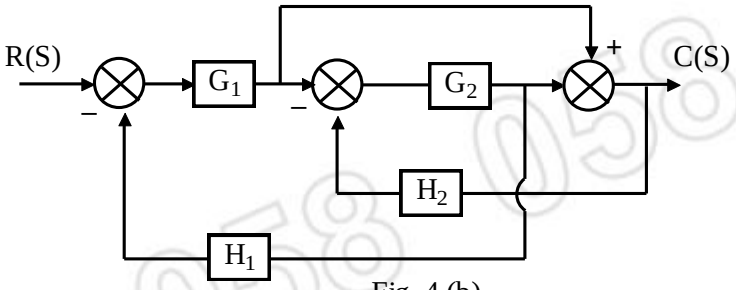


Fig. 4 (b)

5. a) Derive the transfer function of field controlled DC motor. **7**

b) Derive an expression for unit ramp response of first order system. **7**

OR

6. a) Find response of a given system for time of 0.5 sec when OLTF is $G(s)\,H(s) = \frac{36}{s(s+8)}$ with step input of 2.5 units. Also find maximum output; peak time; rise time; settling time. **7**

b) A system is described as – **7**

$$\frac{d^2y}{dt^2} + 10\frac{dy}{dt} + 49y = 100x$$

Find response, maximum output and all time domain specifications for a step input of 2.85 units.

7. a) Explain PID controller with its applications. **5**

b) For unity feedback system – **8**

$$G(s) = \frac{K}{s(1+0.4s)(1+0.25s)}$$

Find Range of value of K, K_{mas} and frequency of sustained oscillation. Also check the stability of the system.

OR

8. For a control system having $G(s) = \frac{K(s+1)}{(s^2+4s+5)}$ and feedback H(s) = 1/s. Sketch the root locus when the gain K varies upto ∞. **13**

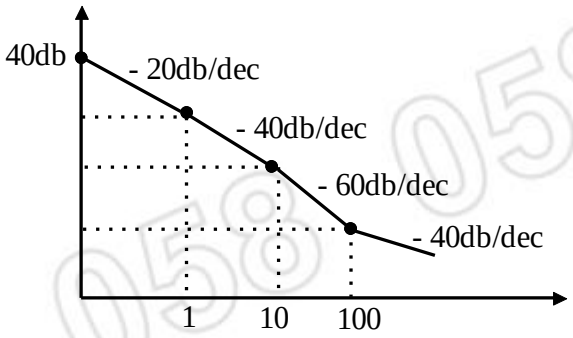
9. Draw bode plot for following function **14**

$$G(s)\,H(s) = \frac{80}{s(s+2)(s+20)}$$

Find gain margin and phase margin for the stability of given system.

OR

10. a) Determine T. F. of the system as shown in fig. **7**



b) Draw polar plot & find GM and PM **7**

$$G(s)\ H(s) = \frac{40}{s(s+4)(s+8)}$$

11. a) Explain the term controllability and observability. **6**

b) Give the state space representation for the system whose T. F. is given by – **7**

$$\frac{Y(s)}{U(s)} = \frac{2}{s^4 + 1.5s^3 + 2.5s + 1}$$

OR

12. a) Find T. F. of the system. Check whether the system is observable and controllable or not **8**

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & 6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$Y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

b) Explain lag-lead compensation and pole-zero placement in detail. **5**

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