B.E. Sixth Semester (Electrical Engineering (Electronics & Power)) (C.B.S.)

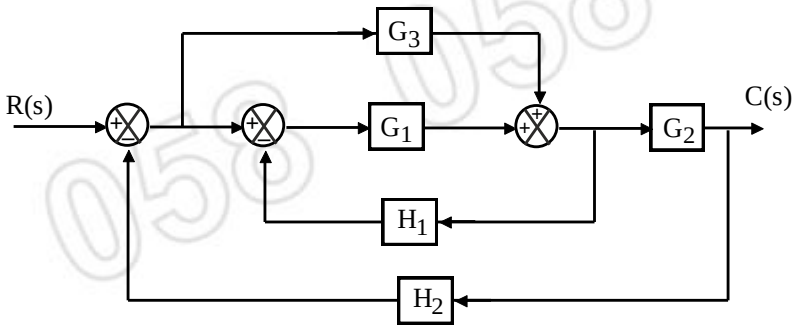
Control System - I

P. Pages : 3 **KNT/KW/16/7393**

Time : Three Hours Max. Marks : 80

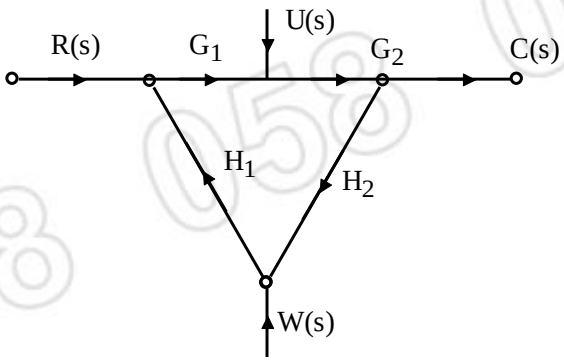
Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. a) Obtain the transfer function 'C(s)/R(s)' for the following by block diagram reduction technique = Refer 'Fig 1(a)' **7**



'Fig 1 (a)'

b) Using Mason's gain formula determine the overall gain of the following signal flow graph shown in 'Fig 1 (b)'. **6**



'Fig 1 (b)'

OR

2. a) Differentiate between open-loop control system and closed loop control system with example. **6**

b) Find the force voltage analogy of the following system = shown in 'Fig 2 (b)'. **7**

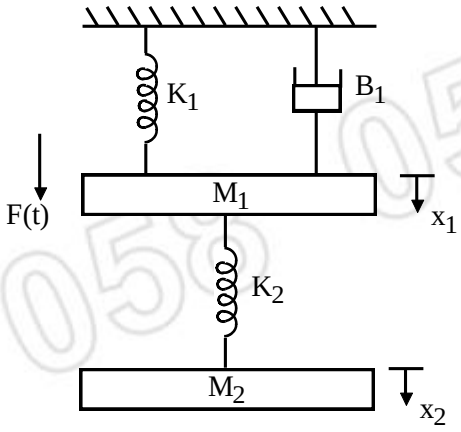


Fig. 2 (b)

3. a) Write a short note on sensitivity of control systems to parameter variations. **7**

b) Obtain the transfer function of a field controlled DC servomotor. **7**

OR

4. a) Explain the construction and working of synchro pair. **7**

b) Write a short note on error detectors. **7**

5. a) For the system : $G(s) = \frac{K}{S(1+ST)}$ with unity feedback system where K and T are constants. If the system overshoot is to be reduced from 0.6 to 0.2, by change in K only, show that: - **8**

$$\frac{TK_1 - 1}{TK_2 - 1} = 43.$$

b) Define:- **5**

i) Delay Time
ii) Rise Time
iii) Peak time
iv) Peak Overshoot
v) Settling Time

OR

6. a) A unity feedback system is characterised by open loop transfer function: **7**

$$G(s) = \frac{1}{s(0.5s+1)\,(0.2s+1)}$$

Determine:

i) the steady state errors for unit step and unit ramp input,
ii) The damping ratio and natural frequency of dominant roots.

b) Explain PID controller in detail. **6**

7. a) State Hurwitz stability criterion. What are its limitations? **5**

b) For $G(s) = 4/s\,(s^2 + qs + 2k)$. System oscillates at w = 4 rad/sec. Find q and k marginal. **8**

OR

8. Sketch the root locus and indicate all possible details for a unity feedback system with the following open-loop transfer function: $G(s) = \dfrac{K}{s(s+2)\,(s+4)\,(s+6)}$. **13**

9. a) Sketch the polar plot for the following transfer function:- $G(s)\,H(s) = \dfrac{10}{s(s+1)\,(s+2)}$. **8**

b) A unity feedback control system has $G(s) = \dfrac{5}{s\,(s+2)}$. Find the values of resonant peak & resonant frequency. **6**

OR

10. a) Sketch the Bode plot and determine the gain crossover and phase crossover frequencies. **9**

$$G(s) = \frac{10}{s\,(1+0.5s)(1+0.1s)}.$$

b) State and explain Nyquist criteria. **5**

11. For the system whose transfer function is : $\dfrac{C(s)}{R(s)} = \dfrac{10(s+4)}{s(s+1)(s+3)}$ Construct the state model by using phase variable and canonical variable as a state variable. Give block diagram representation. **13**

OR

12. a) Define:- **5**

i) State
ii) State vector
iii) State space
iv) State trajectory
v) State variables

b) Determine the system transfer function using the following state equations: **8**

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix} U$$

$$y = [1 \;\; 2] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

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