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

Control System Engineering

P. Pages : 4

Time : Three Hours

NKT/KS/17/7396

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. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Differentiate between hydraulic and pneumatic actuators. **4**

b) Write equation of motion of translational mechanical system shown in fig. 1(b) and determine Transfer function. **9**

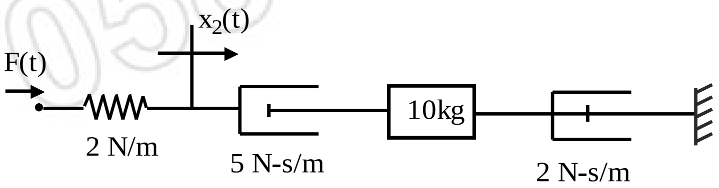

Fig. 1(b)

OR

2. a) Explain in brief classification of control system. **4**

b) Determine Transfer function of rotational mechanical system shown in fig. 2 (b) **9**

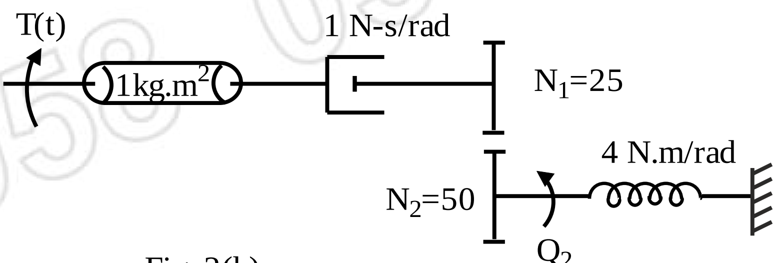

Fig. 2(b)

3. a) Simplify the following system shown in fig. 3 (a) using block diagram algebra and determine transfer function C(s) / R(s) **8**

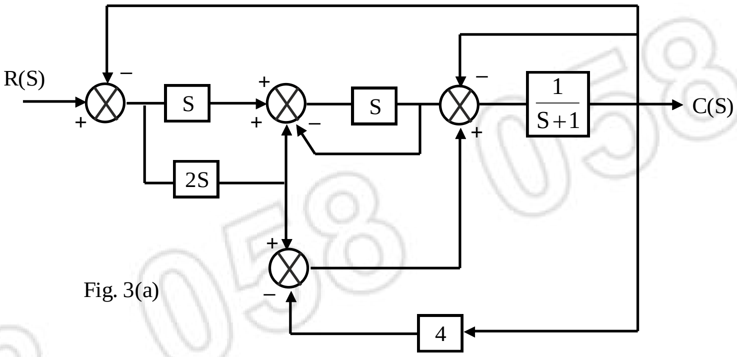

Fig. 3(a)

b) Name four components of block diagram for liner time invariant system. **5**

OR

4. a) Explain following terms w.r.to signal flow graph. **5**

i) Forward path ii) Feed back path. iii) Source and sink node.

b) Determine transfer function C(s) / R(s) of signal flow graph show in fig. 4 (b) using Mason's gain formula. **8**

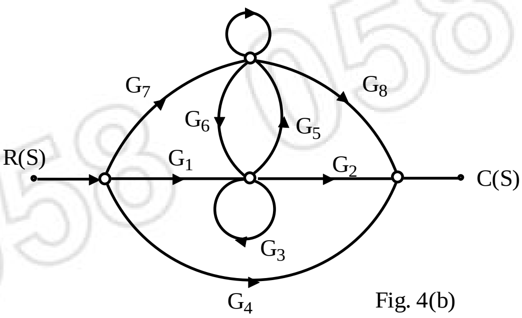

Fig. 4(b)

5. a) Explain PID controllers and there characteristics. **6**

b) A unity feed back system has $G(s) = \dfrac{K}{S(S+2)(S^2+2S+5)}$ **8**

i) Determine limiting value of gain 'K' for unit ramp input so that $e_{ss} \leq 0.2$

ii) Determine e_{ss} for input $r(t) = 2 + 4t + t^2/2$

OR

6. a) Explain general principles for generating control action. **5**

b) Determine transient response specifications of mechanical system shown in fig. 6 (b) **9**

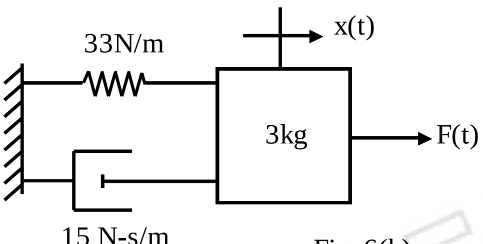

Fig. 6(b)

7. For the transfer function having characteristic equation **13**

$$1+G(s)H(s) = s^8+s^7+12s^6+22s^5+39s^4+59s^3+48s^2+38s+20$$

comment on system stability using Routh's criterion.
Also, tell how many poles lies in RH, in LH and on Jw axis.

OR

8. Sketch the root locus for a system represented by block diagram as below. **13**

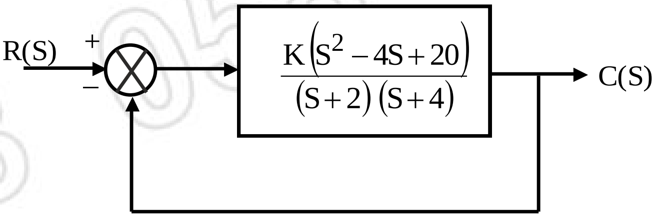

Fig. 8

i) determine gain 'K' for $\xi = 0.45$

ii) determine marginal value of gain 'K'

iii) find range of 'K' within which system is stable.

9. Draw the Bode log-magnitude and phase plots for **14**

$$GH(s) = \frac{(s+3)}{(s+2)\,(s^2+2s+25)}$$

Determine

i) Gain margin (Gm)

ii) Phase margin (Pm)

iii) Comment on stability

OR

10. a) Draw polar plot for system having **8**

$$GH(s) = \frac{12}{s\,(s+1)\,(s+2)}$$

state whether system is stable or not.

b) Find open loop transfer function of system having Bode magnitude plot as shown in fig. 10 (b) **6**

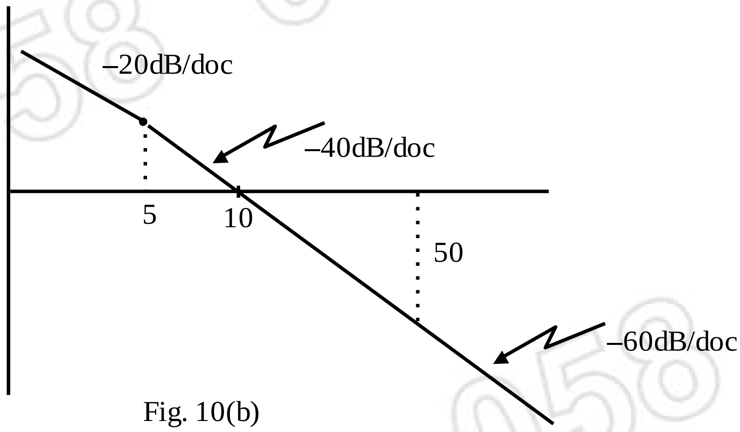

Fig. 10(b)

11. a) Determine whether the system given below is completely controllable and observable or not. **8**

$$\{\dot{x}\} = \begin{bmatrix} -6 & -18 & -6 \\ 2 & 3 & 1 \\ -4 & -8 & -3 \end{bmatrix} \{x\} + \begin{bmatrix} 2 \\ -3 \\ 7 \end{bmatrix} U$$

$$y = [1 \quad 3 \quad 1]\{x\}$$

b) Explain controllability and observability of the system. **5**

OR

12. a) Explain phase Lead-Lag compensation. **5**

b) Construct the state model for the system given by the differential eq^n. **8**

$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = \mu$ give block diagram representation of the state model.

****