B.E. (Electronics Engineering / Elect. Telecommunication / Elect. Communication Engineering)
Sixth Semester (C.B.S.)

Control System Engineering

P. Pages : 4

Time : Three Hours

|||||||| *0602* ||||||||

Max. Marks : 80

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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 $\dfrac{C(s)}{R(s)}$ for 'Fig 1 (a)' by block diagram reduction technique. 8
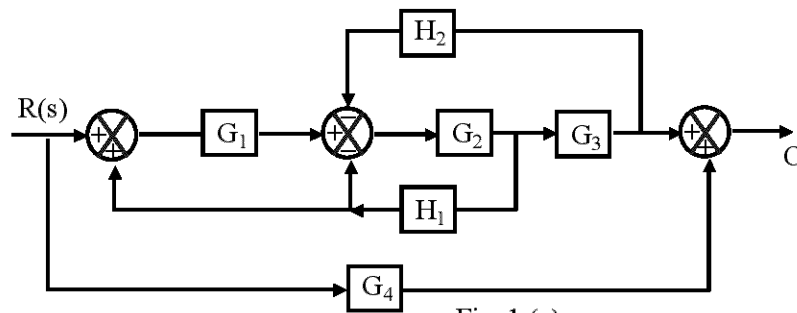

Fig. 1 (a)

b) Compare open loop and closed loop system with one example of each. 5

OR

2. a) For the electrical network shown in 'Fig. 2 (a)' obtain the transfer function. 7
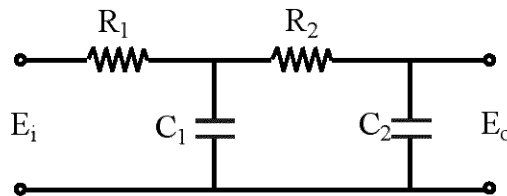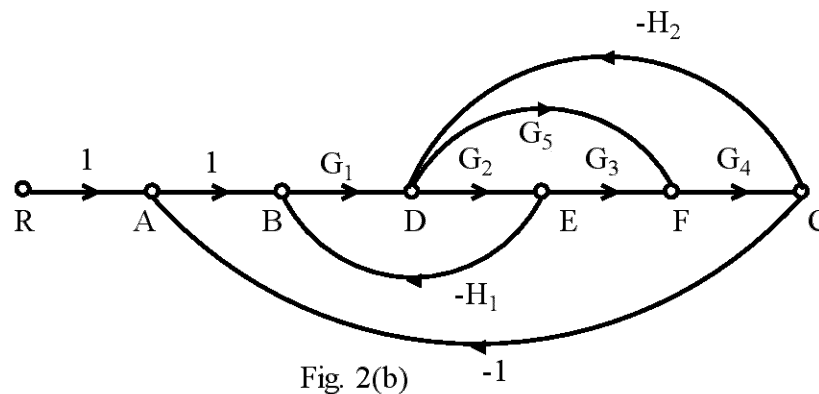

Fig. 2 (a)

b) For the signal flow graph shown in 'Fig. 2 (b)', obtain C/R. **6**

Fig. 2(b)

3. a) For a system having forward path transfer function $G(s) = \dfrac{K}{s(s+6)}$ and H (s) = 1. Find the time response to an input r (t) = 2u (t). Where (i) k = 13 (ii) k = 8. **7**

b) Derive an expression for a time response of underdamped second order system for a unit step input. **6**

OR

4. a) For a unity feedback system with forward path transfer function given as. **7**
$$G(s) = \frac{10(s+1)}{s^2(s+2)(s+10)}.$$
Determine.
i) Type of system
ii) Steady state error for an i/p $r(t) = 1 + 4t + \dfrac{t^2}{2}$.

b) For the system shown in 'Fig 4 (b)' determine a and b such that the response will have an overshoot of 16.3% to a unit step i/p and a time constant of 0.1 sec. Assume k = 10. **6**
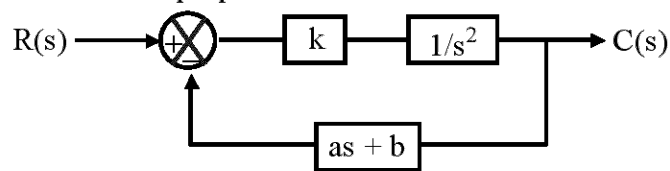

Fig. 4(b)

5. a) Consider the 4th order system whose characteristic equation is $s^4 + 8s^3 + 18s^2 + 16s + s = 0$ comment on stability of system by ROUTH stability criterion. **7**

b) A system oscillates with a frequency 'ω' if it has poles on $s = \pm j\omega$ and no poles in the right half of S - Plane. Determine the value of 'k' and 'a' so that the system shown in 'Fig. 5 (b)' oscillates at a frequency of $\omega = 2$ rad/sec. **7**
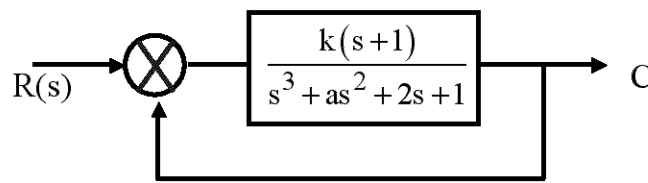
R(s) $\xrightarrow{\hspace{1cm}}$ ⊗ $\xrightarrow{\hspace{1cm}}$ $\boxed{\dfrac{k(s+1)}{s^3 + as^2 + 2s + 1}}$ $\xrightarrow{\hspace{1cm}}$ C

Fig. 5(b)

OR

6. The open loop Transfer function of a unity feedback system is given by

$$G(s) = \frac{k}{s(s+2)(s+4)}.$$

a) Sketch the root locus of system. **8**

b) Determine gain k for critical damping. **3**

c) Find the range of values of 'k' for which system has Damped oscillatory response. **3**

7. Draw the Bode plot for the transfer function **14**

$$G(s)H(s) = \frac{50}{s(1+0.25s)(1+0.1s)}$$

From the graph, determine.
i) Gain crossover frequency
ii) Phase Crossover frequency
iii) G.M. and P.M.
iv) Stability of the system

OR

8. a) A unity feedback control system has $G(s) = \dfrac{5}{s(s+2)}$ Find the value of resonant peak and resonant frequency. **6**

b) Sketch the polar plot for the following transfer function $G(s) \cdot H(s) = \dfrac{20}{s(s+2)(s+4)}$ **8**

9. a) Derive the transfer function of a lag compensator. draw its pole zero plot. **7**

b) What is the need for compensation? Explain in brief the selection process for type of compensator for a particular system. **6**

OR

10. a) Explain Transducers in brief. **7**

b) Distinguish between Lag compensator and Lead compensator. **6**

11. a) Determine the state model of the system characterized by the differential equation $\left(s^3 + 8s^2 + 4s + 3\right)y(s) = 10\,U(s)$.   **6**

   b) Find the state model in canonical form of a system whose transfer function is   **7**

$$\frac{y(s)}{U(s)} = \frac{s+1}{(s+2)(s+3)(s+5)}$$

OR

12. a) Closed Loop Transfer function of a system is given by $T(s) = \dfrac{s^2 + 3s + 3}{s^3 + 2s^2 + 3s + 1}$. Draw the signal flow graph for the system and hence obtain the state model for the system.   **8**

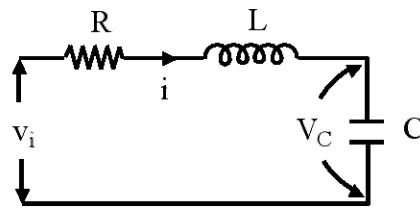   b) Obtain the state model for the following electrical network shown in 'Fig 12 (b)'.   **5**

Fig. 12 (b)

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