B.E. Electrical (Electronics & Power) Engineering (Model Curriculum) Semester-V

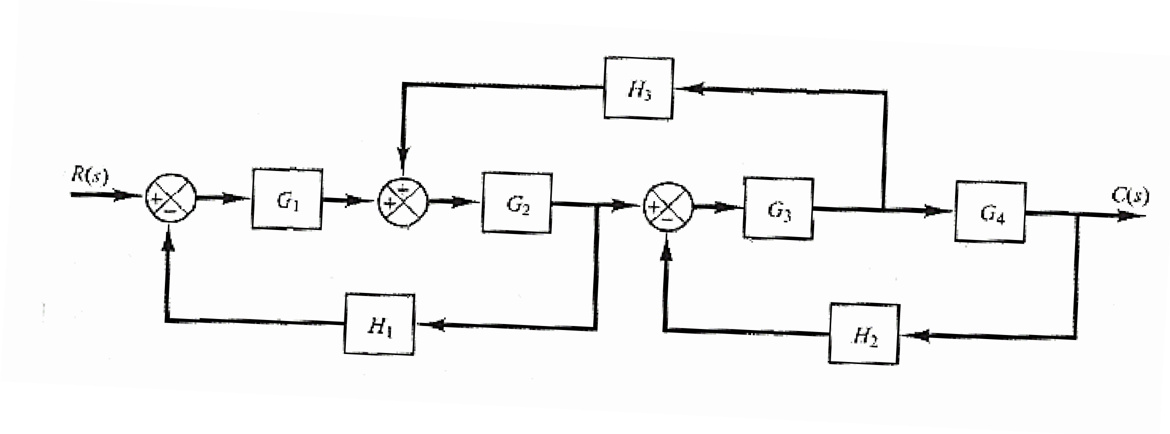
TE105 - Control Systems

P. Pages : 4 **GUG/W/23/13868**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry equal marks.
2. Answer **any five** questions as per internal given choice.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
7. Use of non-programmable calculator is permitted.

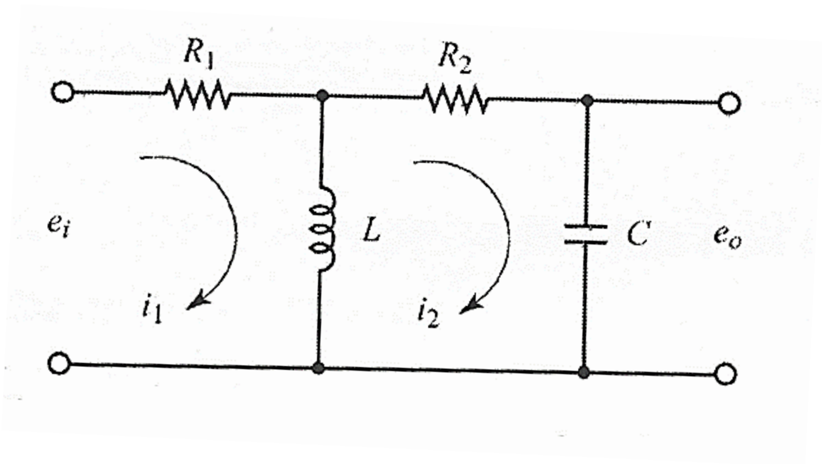
1. a) Simplify the block diagram shown in figure. Then obtain the closed-loop transfer function C(s) / R(s). **8**



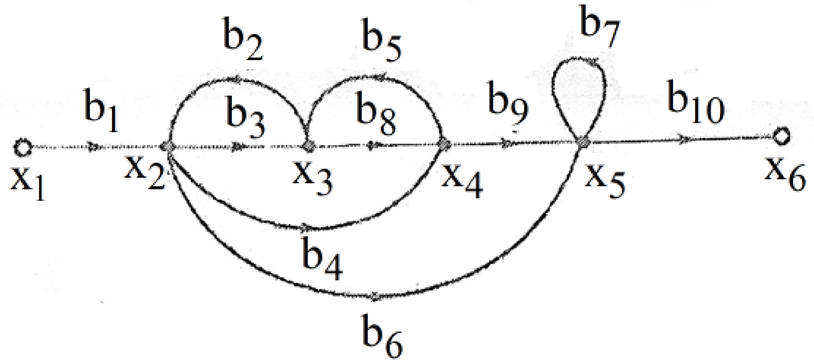
b) Discuss basis for framing the rules of block diagram reduction technique? What are drawbacks of the block diagram reduction technique? **8**

OR

2. a) Obtain the transfer function $E_o(s)/E_i(s)$ of the electrical circuit shown in figure. **8**



b) Determine the transfer function for the signal flow graph shown in Figure given below. **8**



3. a) Define the following: **8**

i) Time response.

ii) Transient response

iii) Steady state response

iv) Delay time

v) Rise time

vi) Peak time

vii) Settling time.

b) Consider a unity-feedback control system with the closed-loop transfer function **8**

$$\frac{C(s)}{R(s)} = \frac{K_s + b}{s^2 + as + b}$$

Determine the open-loop transfer function $G(s)$.

Show that the steady-state error in the unit-ramp response is given by

$$e_{ss} = \frac{1}{K_\nu} = \frac{a-K}{b}$$

OR

4. a) A unity feedback system has $G(s) = \dfrac{40(s+2)}{s(s+1)(s+4)}$ Determine (i) Type of the system (ii) All error coefficients and (iii) Error for the ramp input with magnitude 4. **8**

b) Discuss the advantages and disadvantages of proportional, proportional derivative, proportional integral control system. **8**

5. a) The system having characteristics equation $2s^4 + 4s^2 + 1 = 0$. **8**

i) The number of roots in the left half of s-plane.

ii) The number of roots in the right half of s-plane

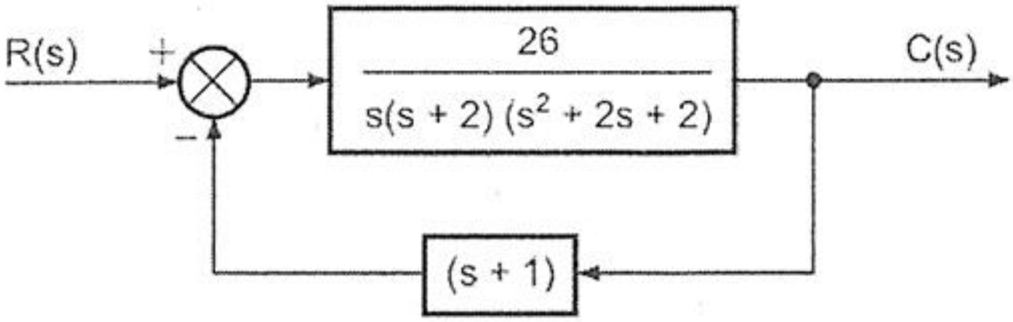
iii) The number of roots on imaginary axis use RH stability criterion.

b) Sketch the root locus plots for the following open-loop transfer functions and determine the value of K such that the damping ratio is 0.707. **8**

$$G(s)H(s)=\frac{K(s+20)}{s(s+1)(s+10)(s+30)}$$

OR

6. a) Determine the number of roots having positive real part of the characteristics equation whose block diagram is shown in fig. **8**



b) For the open-loop transfer function given below. Determine the value of K at s = -2 and comment on the stability and time response of the system. **8**

$$G(s)H(s)=\frac{K(s+1)}{\left(s^2+0.4s+0.4\right)}$$

7. a) Sketch the asymptotic Bode plot for the transfer function given **8**

$$G(s)H(s)=\frac{2(s+0.25)}{s^2(s+1)(s+0.5)}$$

From the Bode plot determine:

i) the phase crossover frequency.

ii) the gain crossover frequency

iii) the gain margin and

iv) the phase margin

Is the system stable?

b) Write short notes on various frequency domain specifications. **8**

OR

8. a) Draw the polar plot for open loop transfer function for unity feedback system **8**

$$G(s)=\frac{1}{s(1+s)(1+2s)}$$

determine gain margin, phase margin?

b) The open-loop transfer function of a unity feedback control system is given below. **8**

$$G(s)=\frac{(s+0.25)}{s^2(s+1)(s+0.5)}$$

Determine the closed-loop stability by applying Nyquist criterion.

9. a) The State space representation of a system is given below: Obtain the transfer function. **8**

$$\dot{X}(t)=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}X(t)+\begin{bmatrix}2 & 1\\ 0 & 1\end{bmatrix}R(t)$$

$$Y(t)=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}X(t)$$

b) The transfer function of a system is given by $\frac{Y(s)}{U(s)}=\frac{(s+3)}{(s+1)(s+2)}$ Obtain the state model in canonical form. **8**

OR

10. a) Obtain state equations for the differential equation. **8**

$$\frac{d^2y}{dt^2}+\frac{3dy}{dt}+4y=\frac{du}{dt}+3u$$

b) Draw the state block diagram for the transfer function given below and obtain state equations. **8**

i) $\frac{C(s)}{R(s)}=\frac{1}{(s+1)(s+3)}$ and

ii) $\frac{C(s)}{R(s)}=\frac{2s+1}{s^2+2}$

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