Duration 3 Hours **[Maximum Marks 80]**

NOTE: 1) Question 1 is **compulsory**
2) Solve **any three** from the remaining five questions
3) Assume suitable data if necessary.
4) Figures to the right indicate full marks

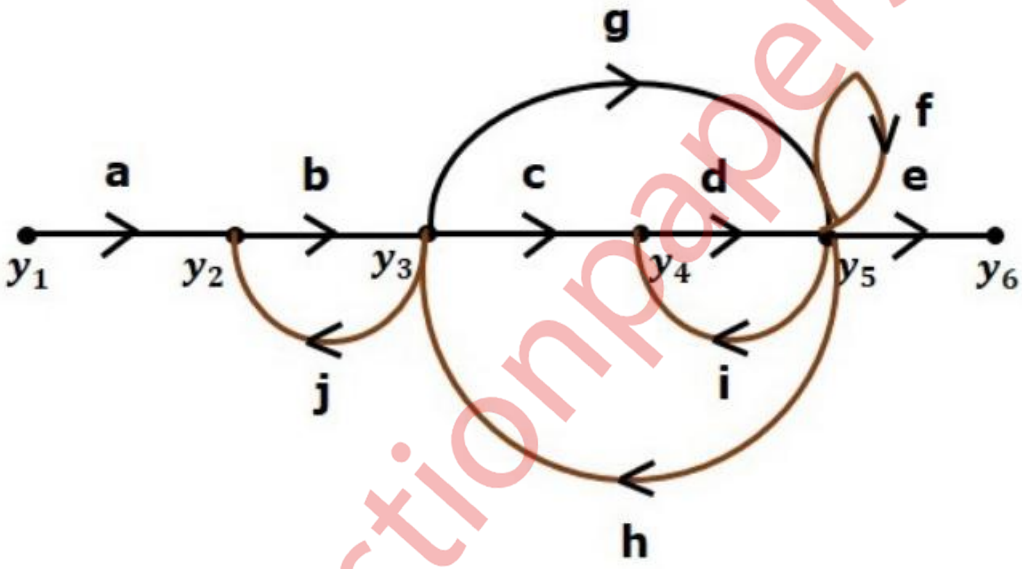
Q.1. a. Explain the terminologies associated with signal flow graphs **5**

b. Explain frequency domain specifications of second order control system. **5**

c. Explain the concept of relative stability **5**

d. Explain is Routh Hurwitz criterion **5**

Q.2. a. Find the transfer function of the signal flow graph shown in figure by using Mason's Gain formula. **10**



b. Find the stability of the control system having characteristic equation **10**

$$S^4 + 2S^3 + S^2 + 2S + 1 = 0$$

Q3. a. A unity feedback control system has a loop transfer function **10**

$$G(s) = \frac{10}{s\,(s+2)}.$$

Find the rise time, percentage overshoot, peak time and settling time for a unit step input.

b. Draw Nyquist plot of $G(s)\,H(s) = \frac{90}{(s+3)\,(s+6)}$ **10**

Q.4.a. Draw the Root locus diagram for the system and comment on stability. **10**

$$G(s)\,H(s) = \frac{K\,(s+1)}{s\,(s+2)(s+3)}$$

b. List the steps involved in design of lead compensator using Bode plot. **10**

Q.5. a. Draw the Bode plot for the given open loop transfer function and test the stability. **10**

$$\mathbf{G(s)\,H(s) = \frac{2000\,(s+0.5)}{s\,(s+10)\,(s+50)}}$$

b. Obtain the state model for the system with transfer function. **10**

$$\frac{Y(s)}{U(s)} = \frac{1}{s^2+s+1}$$

Q.6. Short note on (Any Two) **20**

a. Block Diagram Reduction Rules

b. Time domain specifications of Second order system

c. Concept of Observability

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