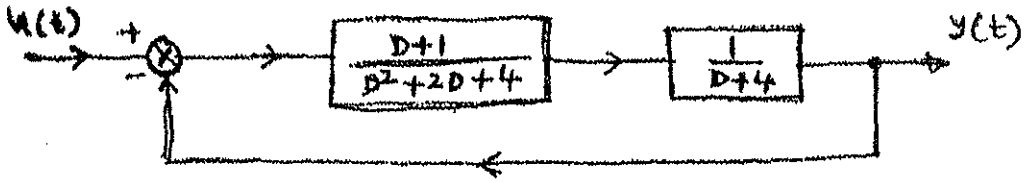
(3 Hours) | Total Marks : 80

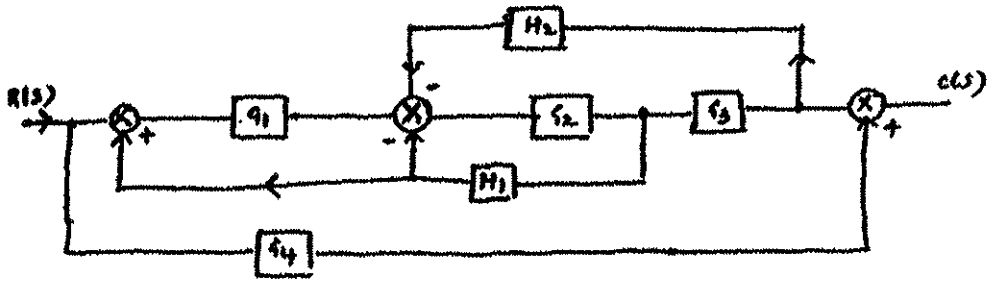
N.B. : (1) Attempt **any four** questions.
(2) **Figures** to the **right** indicate **full marks**.
(3) Assume suitable **data** if **necessary**.

1. (a) Derive the state-space equation for following system : **10**



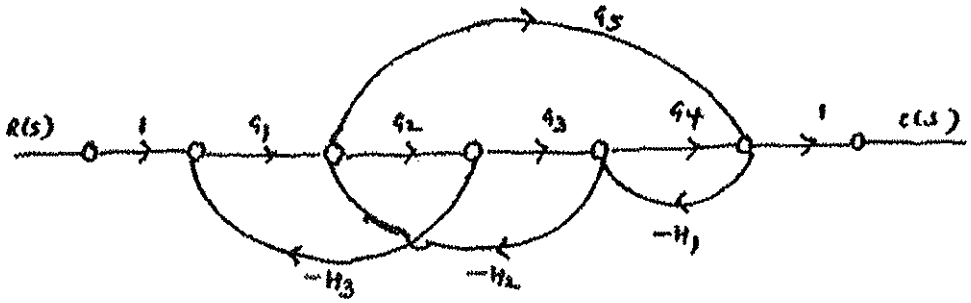
(b) Explain the working of Servo Motor and Stepper Motor. **06**
(c) Discuss the use of Nyquist plot in stability. **04**

2. (a) By Block reduction method, find the transfer function : **10**



(b) For the S. F. G. (Signal Flow Graph) shown below. **10**

Obtain $\frac{C(s)}{R(s)}$.



3. (a) For the unity feedback system having OLTF, **10**

$$G(s) = \frac{k(s+2)}{s(s^3 + 7s^2 + 12s)}$$

Find following :

(i) Type of the system.

(ii) Error coefficients.

(iii) Steady state error when input to the system is $\frac{R}{2}t^2$.

(b) Derive transfer function for spring mass damping system. **10**

4. (a) Find the range of value 'k' so that system with following C. E. (Characteristic Equation) is stable : $F(s) = s(s^2 + s + 1)(s + 4) + k = 0$. **05**

(b) A second order system is given by : **10**

$$\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$$

Find its rise time, peak time, peak overshoot and setting time, if subjected to unit step input. Also calculate expression for its output response.

(c) Discuss Low Cost Automation. **05**

5. (a) A unity feedback control system has :

$$G(s) = \frac{100}{s(s+0.5)(s+10)}$$

Draw the asymptotic Bode plot. Determine G.M., P.M., Wgc and Wpc. Comment on the stability.

(b) For the system with T.F. $\frac{Y(s)}{V(s)} = \frac{s^2 + 2s + 1}{s^3 + 7s^2 + 14s + 8}$ derive the state-space representation. **10**

6. (a) Sketch the Root Locus for $G(s)H(s) = \frac{k(s+4)}{s(s+1)(s^2+5s+121)}$ **10**

(b) Write short notes on : **10**

(i) Mathematical Modeling for R-L-C.

(ii) Synchros.