53 (IE 605) PINC

2021

PROCESS INSTRUMENTATION AND CONTROL

Paper : IE 605

Full Marks : 100

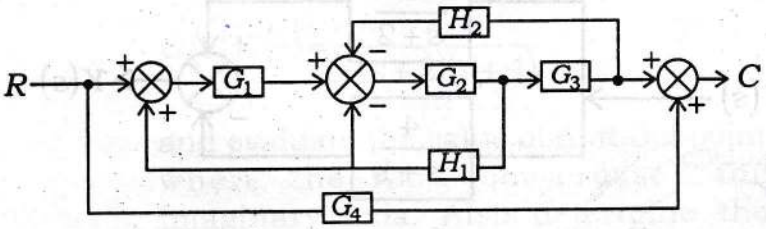
Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

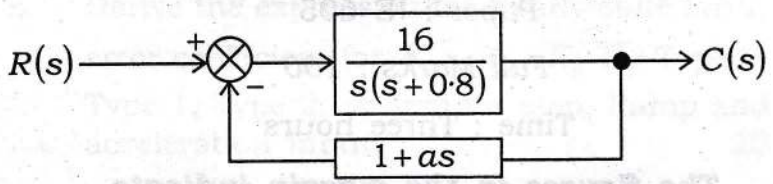
1. *(a)* Find out $C(s)/R(s)$ using Block reduction technique. 10

   (b) Find out $C(s)/R(s)$ using signal flow graph. 10

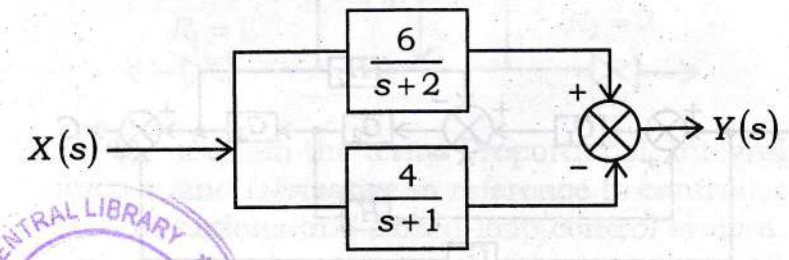


Contd.

2. *(a)* For the second order system, determine the value of "a" such that the damping ratio is 0·5. Also obtain the values of rise time and maximum overshoot M_p in its step response. 10



(b) Show that the system transfer function $Y(s)/X(s)$ has a zero in the RHS plane. Obtain $y(t)$ when $x(t)$ is a UNIT STEP for the system. 10



3. *(a)* The open-loop transfer function of a unity feedback system is given by

$$G(s)=\frac{108}{s^2(s+4)\left(s^2+3s+12\right)}$$

Find the static error coefficients and steady state error of the system when subjected to $r(t)$.

$$r(t)=2+5t+2t^2$$

10

(b) Find the stability of system whose characteristic equation is given by — 10

$$s^6+3s^5+5s^4+9s^3+8s^2+6s+4=0\,.$$

4. *(a)* Describe the procedure of plotting Root Locus. 10

(b) Sketch the Root Locus given by

$$G(s)H(s)=\frac{K}{s(s+2)(s+4)}$$

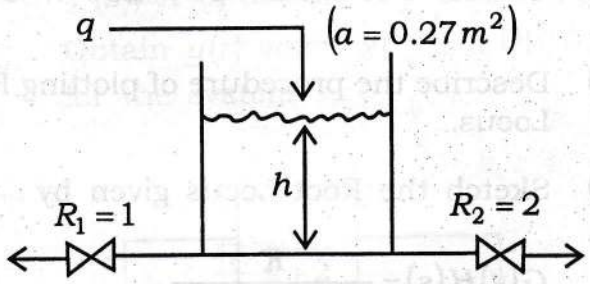
and evaluate the value of K at the point where the root loci crosses the imaginary axis. Also determine the frequency. 10

5. *(a)* Define the Static and Dynamic characteristics of an instrument which you are using in your laboratory. 10

(b) State the rules of Block Reduction technique. 10

6. Derive the expression for steady state error, error coefficient for K_p, K_v, K_a for Type 0, Type 1, Type 2, system for step, Ramp and acceleration input. 20

7. *(a)* Derive the transfer function $H(s)/Q(s)$ for the liquid-level system [H and Q are deviation variables in h and q]. 10



(b) Explain the terms Proportional, Integral and Derivative in reference to controller actions in a closed-loop control system. 10