

Answer all the following questions:

Problem 1: (30 Marks)

a) Simplify the block diagram then obtain the close-loop transfer function $C(s)/R(s)$. [15 Marks]

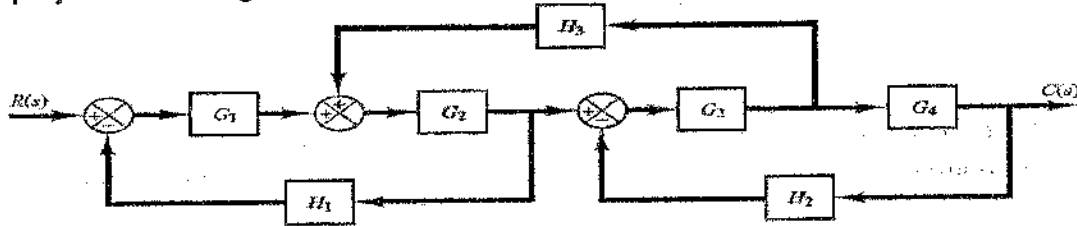


Fig. 1

b) Determine the transfer function C/R for the block diagram shown in Fig. 2 by signal flow graph (SFG) techniques. [15 Marks]

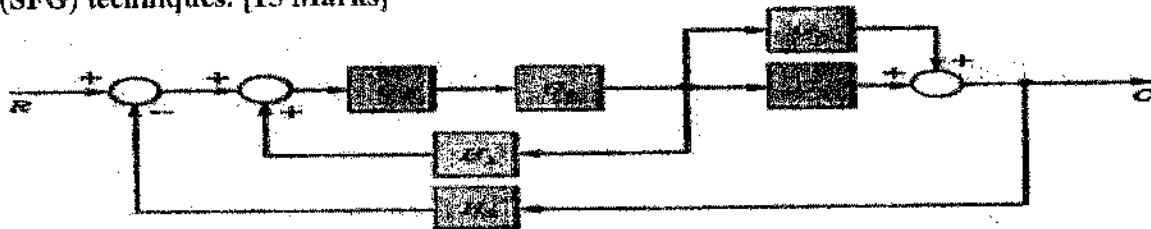


Fig. 2

Problem 2: (30 Marks)

- What are the advantages and disadvantages of open-loop and closed-loop control systems? [12 Marks]
- Find the steady-state error for the system given below for (a) a unit-step input, (b) a unit-ramp input, and (c) a unit-parabolic input.. (18 Marks)

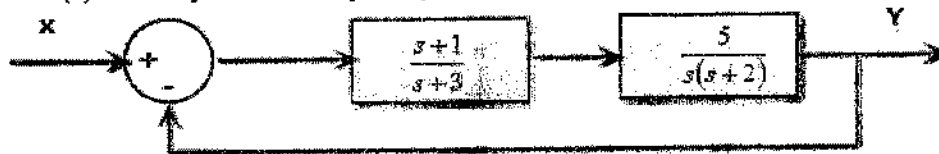


Fig. 3

Problem 3: (30 Marks)

- Consider the spring-mass-dashpot system mounted on a massless cart as shown in Figure 4. [10 Marks]
 - Obtain the mathematical model of the system.
 - If $m = 10 \text{ kg}$, $b = 20 \text{ N-s/m}$ and $k = 100 \text{ N/m}$. Find the response $y(t)$ for a unit step input. (10 Marks)

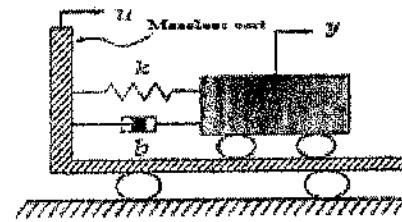


Fig. 4

b) A feedback control system is proposed. The corresponding block diagram is: [20 Marks]

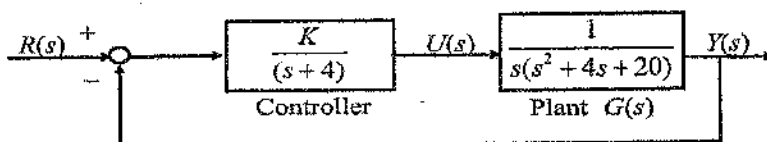


Fig. 5

Sketch the root locus of the closed-loop poles as the controller gain K varies from 0 to ∞ .