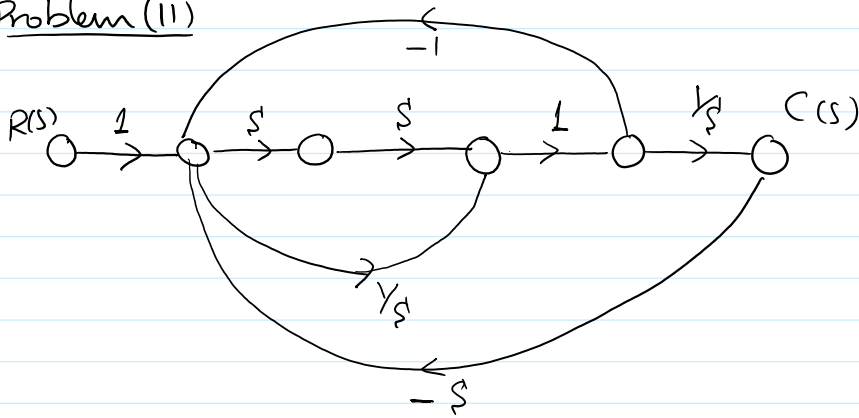


Problem (11)



$$T_1 = s \times s \times \frac{1}{s} = s$$

$$T_2 = \frac{1}{s} \times \frac{1}{s} = \frac{1}{s^2}$$

$$L_1 = s \times s \times -1 = -s^2$$

$$L_2 = s \times s \times \frac{1}{s} = s$$

$$L_3 = s \times s \times \frac{1}{s} \times s = -s^2$$

No Non-touching Loops $\rightarrow \Delta_1 = \Delta_2 = 1$

$$\Delta = 1 + 2s^2 - s = 2s^2 - s + 1$$

$$\frac{C(s)}{R(s)} = \frac{s + \frac{1}{s^2}}{2s^2 - s + 1} = \frac{s^3 + 1}{s^2(2s^2 - s + 1)}$$

Problem 12

$$T_1 = G_1 G_4 G_2$$

$$L_1 = G_1 G_4 H_1$$

$$T_2 = G_1 G_4 G_3$$

$$L_2 = -G_1 G_4 G_2 H_2$$

No non-touching loops

$$\Delta = 1 - G_1 G_4 H_1 + G_1 G_4 G_2 H_2$$

$$T(s) = \frac{G_1 G_4 G_2 + G_1 G_4 G_3}{1 - G_1 G_4 H_1 + G_1 G_4 G_2 H_2}$$

Problem B:

$$T_1 = G_1 G_2 G_3 G_4 G_5$$

$$L_1 = G_2 H_1$$

$$L_2 = G_4 H_2$$

$$L_3 = G_7 H_4$$

$$L_4 = G_2 G_3 G_4 G_5 G_6 G_7 G_8$$

NT 2 at a time

$$L_1, L_2 = G_2 H_1 G_4 H_2$$

$$L_1, L_3 = G_2 H_1 G_7 H_4$$

$$L_2, L_3 = G_4 H_2 G_7 H_4$$

NT 3 at a time

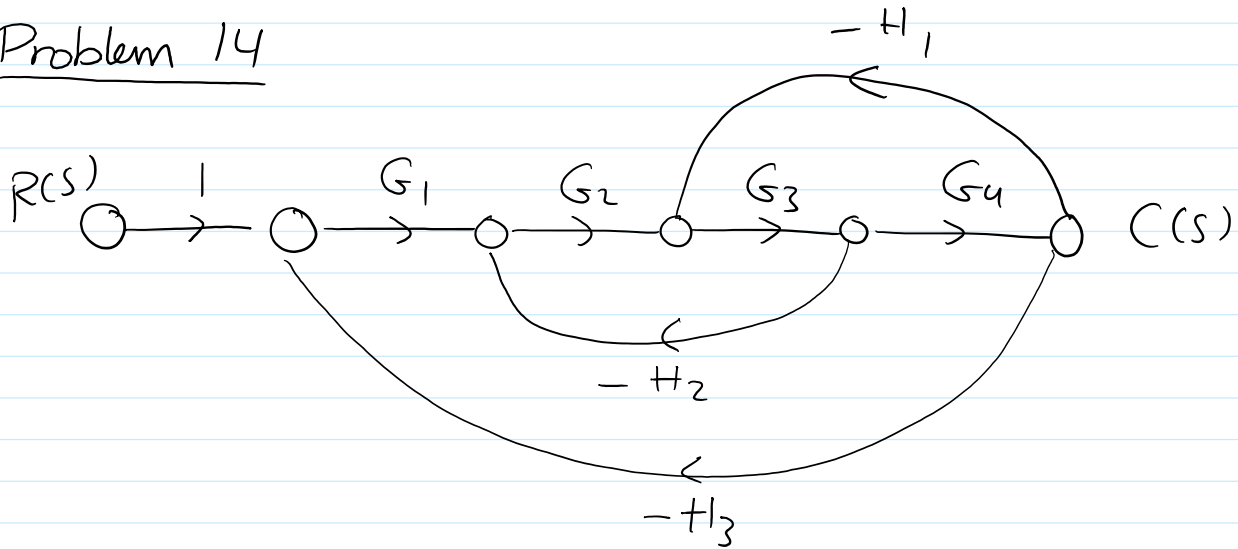
$$L_1, L_2, L_3 = G_2 H_1 G_4 H_2 G_7 H_4$$

$$\Delta = 1 - (L_1 + L_2 + L_3 + L_4) + ((L_1 L_2) + (L_1 L_3) + (L_2 L_3)) - (L_1 L_2 L_3)$$

$$\Delta_1 = 1 - G_7 H_4$$

$$\frac{C(s)}{R(s)} = \frac{T_1 \Delta_1}{\Delta}$$

Problem 14



$$T_1 = G_1 G_2 G_3 G_4$$

$$L_1 = -G_3 G_4 H_1$$

$$L_2 = -G_2 G_3 H_2$$

$$L_3 = -G_1 G_2 G_3 G_4 H_3$$

No non-touching loops

$$\Delta = 1 + G_3 G_4 H_1 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_3$$

$$\Delta_1 = 1$$

$$\frac{C(s)}{R(s)} = \frac{T_1 \Delta_1}{\Delta}$$