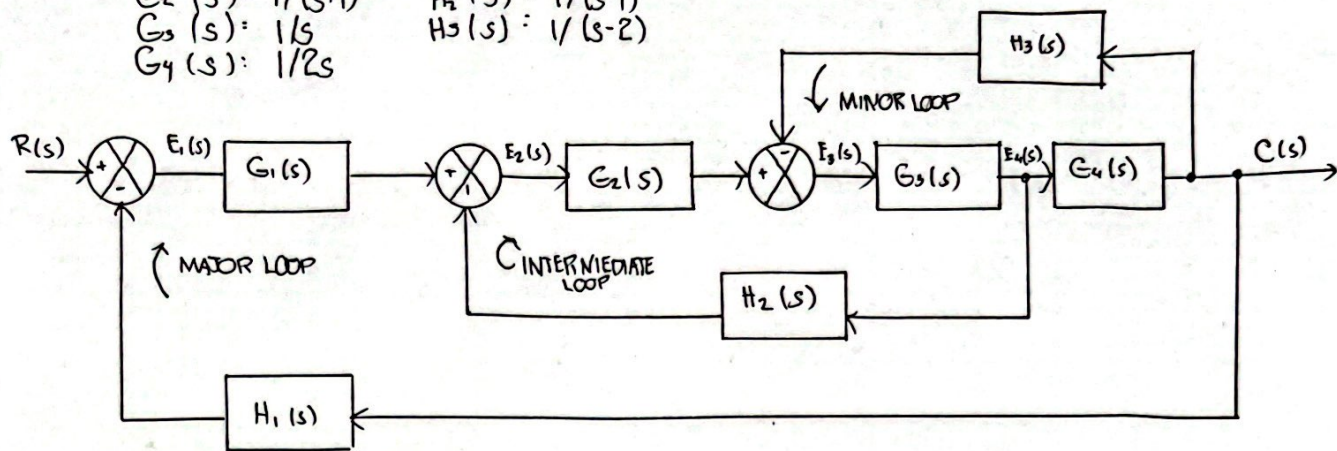
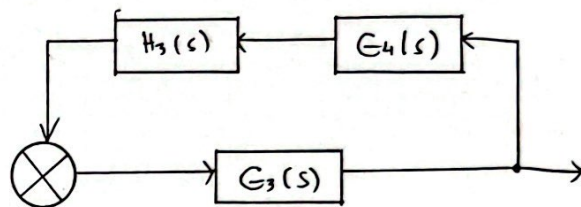


SOLUTION:
BLOCK DIAGRAM 2

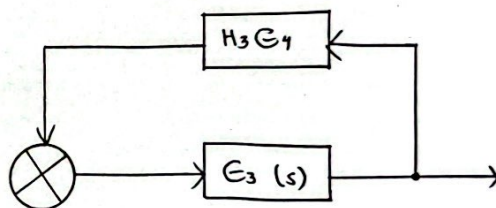
$$\begin{aligned} G_1(s) &= 1/s^2 & H_1(s) &= 1/s \\ G_2(s) &= 1/(s+1) & H_2(s) &= 1/(s-1) \\ G_3(s) &= 1/s & H_3(s) &= 1/(s-2) \\ G_4(s) &= 1/2s \end{aligned}$$



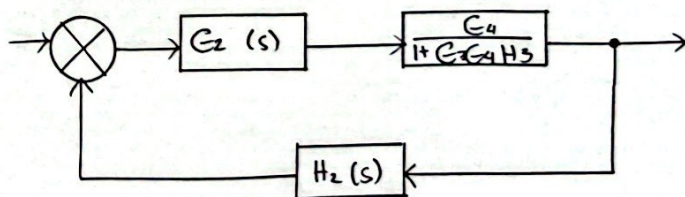
SERIES: $H_3 \cdot G_4$
TF: $H_3 G_4 = \frac{1}{s-2} \left(\frac{1}{2s} \right)$
 $\frac{1}{2s^2 - 4s}$



PARALLEL: $G_3 \cdot H_3 G_4$
TF: $\frac{G_3}{1 + G_3 G_4 H_3}$
 $G_3 G_4 H_3 = \frac{1}{s} \left(\frac{1}{2s^2 - 4s} \right)$
 $\frac{1/s}{1 + \frac{1}{2s^2 - 4s}}$
 $\frac{1}{s} \cdot \frac{2s^3 - 4s^2}{2s^3 - 4s^2 + 1}$
TF2: $\frac{2s^3 - 4s^2}{2s^4 - 4s^3 + s}$



SERIES: G_2
 $1 + G_3 G_4 H_3 = \frac{2s^3 - 4s^2}{2s^4 - 4s^3 + s}$
 $G_2 G_3 G_4 H_3 = \frac{1}{s+1} \left(\frac{2s^3 - 4s^2}{2s^4 - 4s^3 + s} \right)$
TF3: $\frac{2s^3 - 4s^2}{2s^5 - 2s^4 - 4s^3 + s^2 + s}$



PARALLEL: $H_2 = \frac{G_2 G_3}{1 + G_3 G_4 H_4}$

$$\frac{\frac{G_2 G_3}{1 + G_3 G_4 H_4}}{1 + \left[\frac{G_2 G_3}{1 + G_3 G_4 H_4} (H_2) \right] \times \frac{1 + G_3 G_4 H_3}{1 + G_3 G_4 H_3}}$$

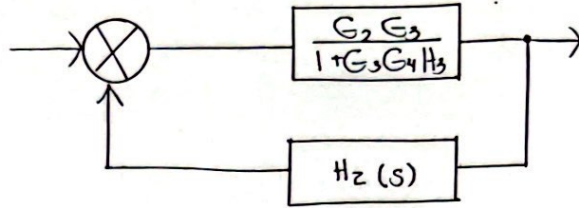
$$= \frac{G_2 G_3}{1 + G_3 G_4 H_3 + G_2 G_3 H_2} = T_{F4}$$

$$G_2 G_3 \left(\frac{1}{s+1} \right) \left(\frac{1}{s} \right) = \frac{1}{s^2 + s} n$$

$$G_2 G_3 H_2 = \frac{1}{s^2 + s} \left(\frac{1}{s-1} \right) = \frac{1}{s^3 - s} j$$

$$\frac{\frac{G_2 G_3}{1 + G_3 G_4 H_3 + G_2 G_3 H_2}}{\frac{1}{1 + \frac{1}{s^2 + s} + \frac{1}{s^2 + s}}} = \frac{9/h}{1 + \frac{1}{s^2 + s} + \frac{1}{s^2 + s}} = \frac{(2s^3 - 4s^2)(s^2 - 5)}{s^2 + s [(2s^3 - 4s^2)(s^2 - 5) + (s^2 + s) + (2s^3 - 4s^2)]}$$

$$= \frac{2s^6 - 4s^5 - 2s^4 + 4s^3}{s^2 + s (2s^6 - 4s^5 - 2s^4 + 7s^3 - 4s^2 - 5s)} = \frac{2s^6 - 4s^5 - 2s^4 + 4s^3}{2s^8 - 2s^7 - 6s^6 + 5s^5 + 3s^4 - 5s^3 - s^2} \cdot T_{F4}$$

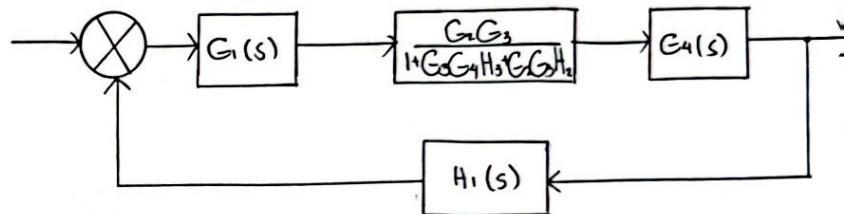


SERIES $G_1(s) = \frac{G_2 G_3}{1 + G_3 G_4 H_3 + G_2 G_3 H_2} = G_4$

$$G_1 G_4 = \frac{1}{s+1} \left(\frac{1}{2s} \right) = \frac{1}{2s^2 + 2s} n$$

$$T_{F5} = \frac{G_1 G_2 G_3 G_4}{1 + G_3 G_4 H_3 + G_2 G_3 H_2} = \frac{1}{2s^2 + 2s} \left(\frac{2s^6 - 4s^5 - 2s^4 + 4s^3}{2s^8 - 2s^7 - 6s^6 + 5s^5 + 3s^4 - 5s^3 - s^2} \right)$$

$$= T_{F5} = \frac{2s^6 - 4s^5 - 2s^4 + 4s^3}{4s^{10} - 16s^9 - 2s^8 + 16s^6 - 4s^5 - 12s^4 - 2s^3}$$



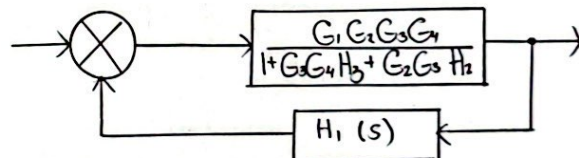
PARALLEL: $\frac{G_1 G_2 G_3 G_4}{1 + G_3 G_4 H_3 + G_2 G_3 H_2} = H_1$

$$\frac{\frac{G_1 G_2 G_3 G_4}{1 + G_3 G_4 H_3 + G_2 G_3 H_2}}{1 + \frac{G_1 G_2 G_3 G_4}{1 + G_3 G_4 H_3 + G_2 G_3 H_2} (H_1)} \times \frac{1 + G_3 G_4 H_3 + G_2 G_3 H_2}{1 + G_3 G_4 H_3 + G_2 G_3 H_2}$$

$$T_{F6} = \frac{G_1 G_2 G_3 G_4}{1 + G_3 G_4 H_3 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_1}$$

$$G_1 G_2 G_3 G_4 = \frac{1}{s^2 + s} \left(\frac{1}{2s^2 + 2s} \right) = \frac{1}{2s^4 + 4s^3 + 2s^2} r$$

$$G_1 G_2 G_3 G_4 H_1 = \frac{1}{2s^4 + 4s^3 + 2s^2} \left(\frac{1}{s} \right) = \frac{1}{2s^5 + 4s^4 + 2s^3} t$$



$$\begin{aligned}
 & \frac{G_1 G_2 G_3 G_4}{1 + G_3 G_4 H_3 + G_2 G_3 H_2 + G G_2 G_3 G_4 H_1} \cdot \frac{1}{2s^4 + 4s^3 + 2s^2} \\
 &= \frac{1}{2s^3 - 4s^2} + \frac{1}{s^3 - s} + \frac{1}{2s^5 + 4s^4 + 2s^3} \\
 &= \frac{(2s^3 - 4s^2)(s^3 - s)(2s^5 + 4s^4 + 2s^3)}{2s^4 + 4s^3 + 2s^2 [(2s^3 - 4s^2)(s^3 - s)(2s^5 + 4s^4 + 2s^3) + (s^3 - s)(2s^5 + 4s^4 + 2s^3) + (2s^3 - 4s^2)(2s^5 + 4s^4 + 2s^3)(s^3 - s)]} \\
 &= \frac{4s^{11} - 16s^9 - 8s^8 + 12s^7 + 8s^6}{2s^4 + 4s^3 + 2s^2 (4s^{11} - 16s^9 - 2s^8 + 16s^7 - 2s^6 - 16s^5 - 4s^4 + 4s^3)}
 \end{aligned}$$

$$T_{16} = \frac{4s^{11} - 16s^9 - 8s^8 + 12s^7 + 8s^6}{8s^{15} + 16s^{14} - 24s^{13} - 68s^{12} - 8s^{11} + 56s^{10} - 8s^9 - 76s^8 - 40s^7 + 8s^6 + 8s^5}$$