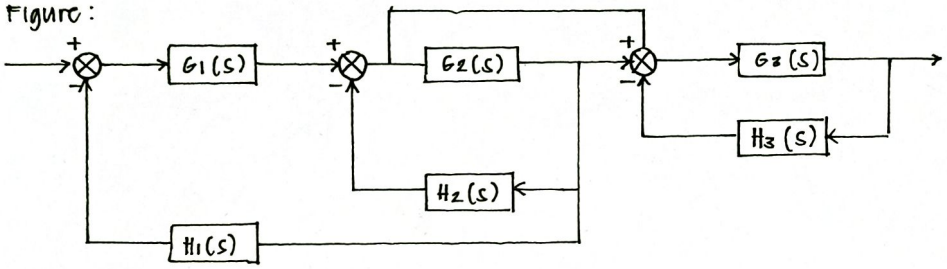
Block Diagram Algebra , Laboratory 3

ME 4205

Prepared by : Mac Gleen V. De Ramos
Cassius Marcellos Clay M. Dimapasoc

Block Diagram 1 :

Figure :



Given :

$G_1(s) = \frac{1}{s^2}$ $\quad H_1(s) = \frac{1}{s}$

$G_2(s) = \frac{1}{s+1}$ $\quad H_2(s) = \frac{1}{s-1}$

$G_3(s) = \frac{1}{s}$ $\quad H_3(s) = \frac{1}{s-2}$

Solution :

$$= \frac{G_2}{1 + G_2 H_2}$$

$$= \frac{1/s+1}{1+\left(\frac{1}{s+1}\right)\left(\frac{1}{s-1}\right)}$$

$$= \frac{1/s+1}{1+\left(\frac{1}{s^2-1}\right)}$$

$$= \frac{1/s+1}{\frac{s^2-1+1}{s^2-1}}$$

$$= \frac{1/s+1}{\frac{s^2}{s^2-1}}$$

$$= \frac{1}{s+1} \cdot \frac{s^2-1}{s^2}$$

$$= \frac{s^2-1}{s^3+s^2}$$

$$= \frac{1}{G_2} + 1$$

$$= \frac{1/1}{s+1} + 1$$

$$= 1 \cdot \frac{s+1}{1} + 1$$

$$= s + 2$$

For G_3 parallel

$$= \frac{G_3}{1 + G_3H_3}$$

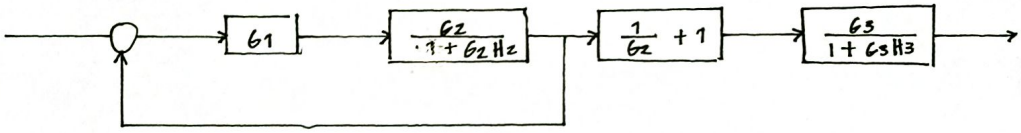
$$= \frac{1/s}{1 + 1/s^2 - 2s}$$

$$= \frac{1/s}{s^2 - 2s + 1/s^2 - 2s}$$

$$= \frac{1}{s} \cdot \frac{s^2 - 2s}{s^2 - 2s + 1}$$

$$= \frac{s^2 - 2s}{s^3 - 2s^2 + s}$$

Reduced Diagram



$$= \left(\frac{1}{G_2} + 1\right)\left(\frac{G_3}{1 + G_3H_3}\right)$$

$$= \left(\frac{s^2 - 2s}{s^3 - 2s^2 + s}\right)(s + 2)$$

$$= \frac{s^3 - 2s^2 + 2s^2 - 4s}{s^3 - 2s^2 + s}$$

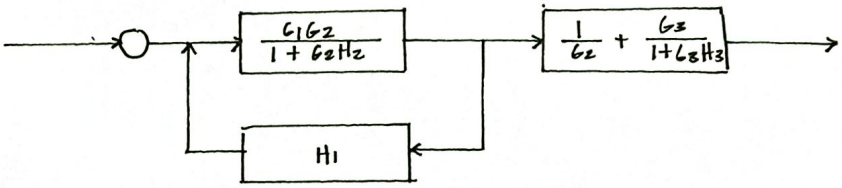
$$= \frac{s^3 - 4s}{s^3 - 2s^2 + s}$$

For :

$$G_1\left(\frac{G_2}{1 + G_2H_2}\right)$$

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

$$= \frac{s^2 - 1}{s^5 + s^4}$$



$$= \frac{G_1G_2}{1+G_2H_2} \Big/ 1 + \frac{G_1G_2}{1+G_2H_2} \times H_1$$

$$= \frac{s^2-1/s^5+s^4}{1+(s^2-1/s^5+s^4)(1/s)}$$

$$= \frac{s^2-1/s^5+s^4}{1+(s^2-1/s^6+s^5)}$$

$$= \frac{s^2-1/s^5+s^4}{s^6+s^5+s^2-1/s^6+s^5}$$

$$= \left(\frac{s^2-1}{s^5+s^4}\right) \times \left(\frac{s^6+s^5}{s^6+s^5+s^2-1}\right)$$

$$= \frac{s^8+s^7-s^6-s^5}{s^{11}+s^{10}+s^7-s^5+s^{10}+s^9+s^6-s^4}$$

$$\rightarrow \boxed{\frac{G_1G_2}{1+G_2H_2} \cdot H_1} \rightarrow \boxed{\frac{G_3}{1+G_3H_3} \times \left[\frac{1}{C_2}+1\right]} \rightarrow$$

$$= \frac{s^8+s^7-s^6-s^5}{s^{11}+2s^{10}+s^9+s^7+s^6-s^5-s^4} \times \frac{s^3-4s}{s^3-2s^2+s}$$

$$= \frac{s^{11}+s^{10}-5s^9-5s^8+4s^7+4s^6}{s^{14}-2s^{12}+2s^{10}-s^9-2s^8+2s^7+s^6-s^5}$$

$$R(s) \rightarrow \boxed{\frac{s^{11}+s^{10}-5s^9-5s^8+4s^7+4s^6}{s^{14}-2s^{12}+2s^{10}-s^9-2s^8+2s^7+s^6-s^5}} \rightarrow C(s)$$