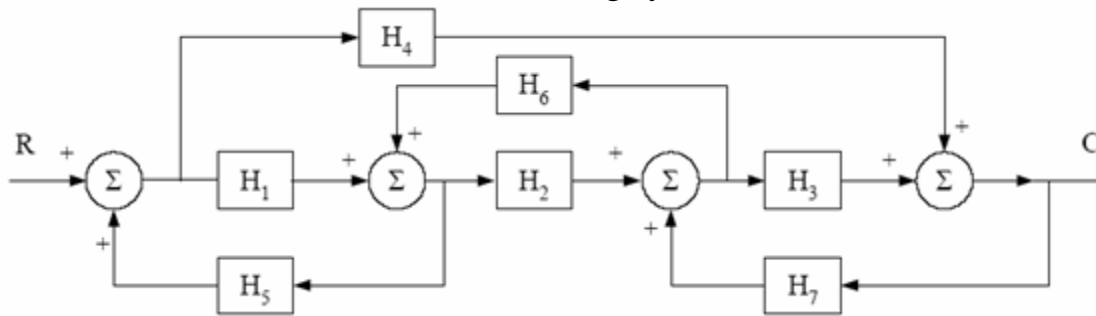


**AMERICAN UNIVERSITY OF BEIRUT**  
**ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT**  
**EECE 340**  
**Homework IV – Block Diagram System Representation**  
**Solution**

**Problem 1**

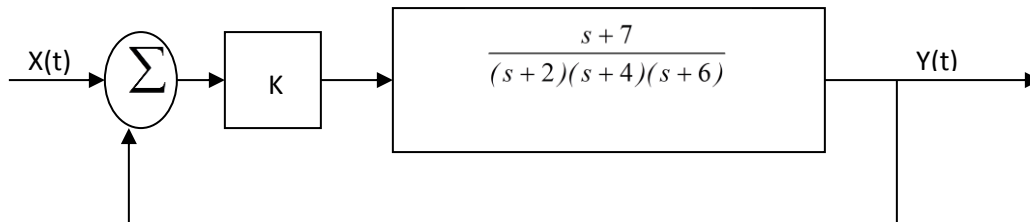
Find the transfer function of the following system.



$$TF = \frac{H_1 H_2 H_3 + H_4 [1 - H_2 H_6]}{1 - [H_1 H_5 + H_3 H_7 + H_2 H_6 + H_4 H_5 H_6 H_7] + [H_1 H_3 H_5 H_7]}$$

**Problem 2**

Consider the unit feedback system shown below

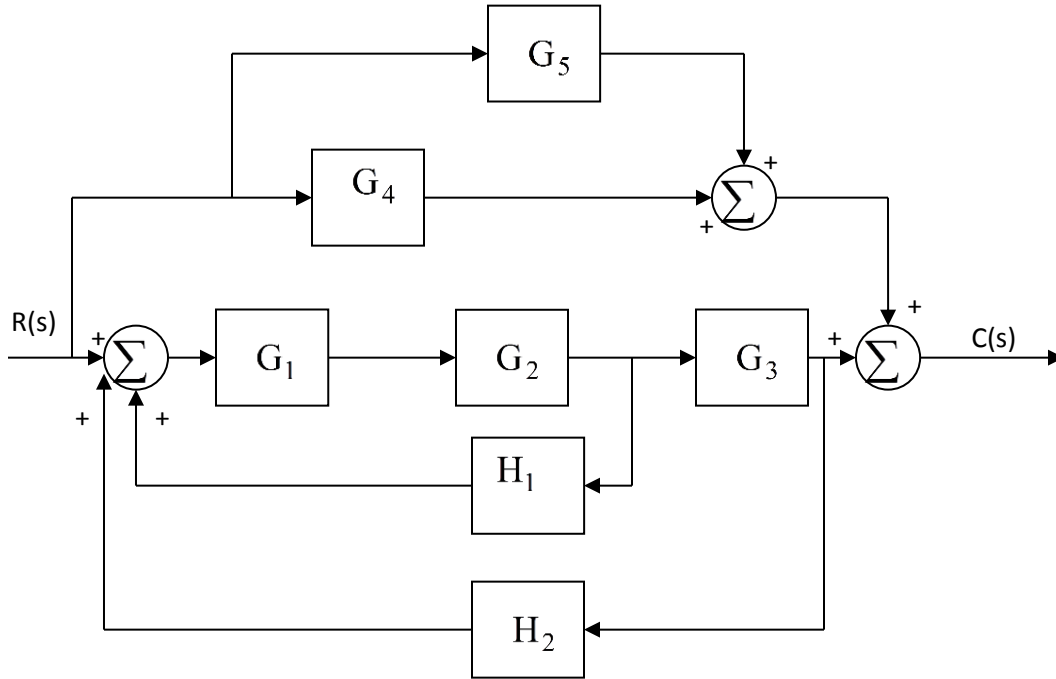


- a. Determine the error signal E(s). (3 pts)

$$E(s) = \frac{X(s)}{1 + G(s)} = \frac{K(s+2)(s+4)(s+6)X(s)}{(s+2)(s+4)(s+6) + K(s+7)}$$

**Problem 3**

The block diagram representation of an LTI system is shown below. Determine the transfer function of this system.

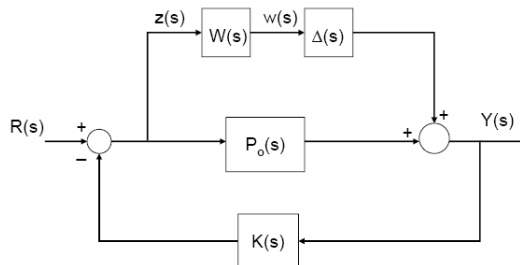


Using Carson's rule,

$$\frac{C(s)}{R(s)} = \frac{(G_5 + G_4)(1 - G_1G_2H_1 - G_1G_2G_3H_2) + (G_1G_2G_3)}{(1 - G_1G_2H_1 - G_1G_2G_3H_2)}$$

**Problem 4**

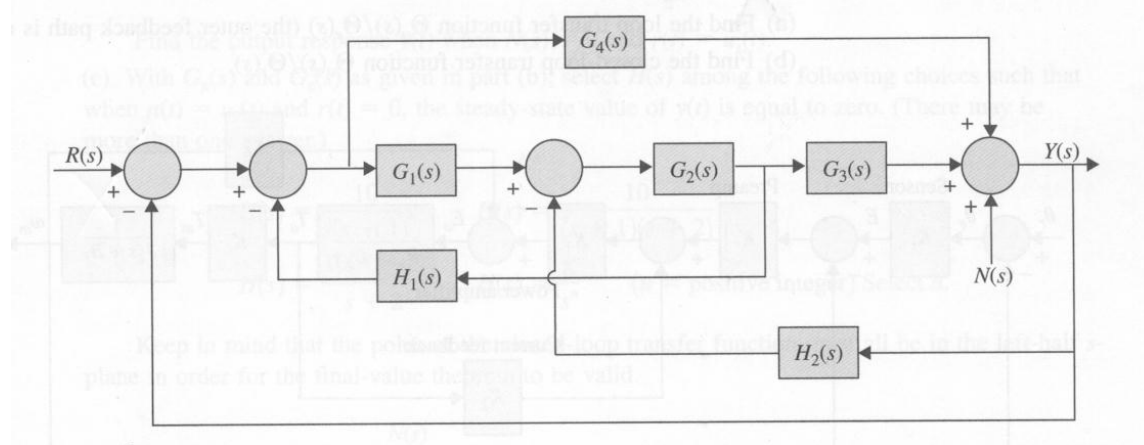
The block diagram of a LTI system is shown below



Determine the transfer function of this system

**Problem 5**

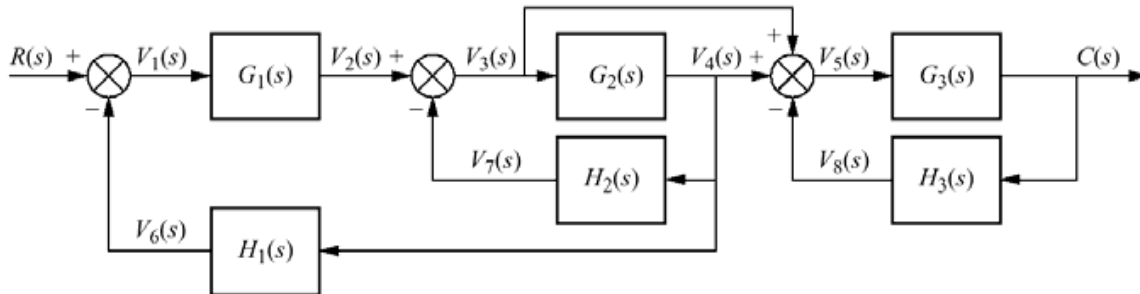
Find the output  $Y(s)$  of the LTI system shown below



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

**Problem 6**

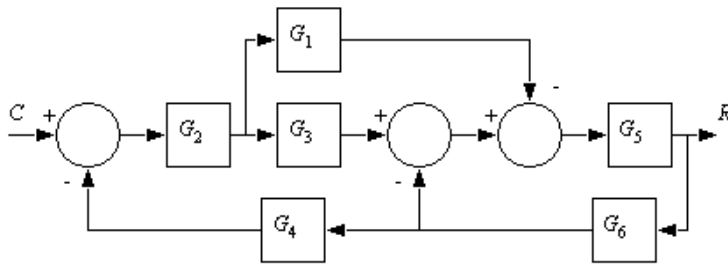
For the system shown below, determine the system transfer function



$$\frac{C(s)}{R(s)} = \frac{G_1 G_2 G_3 + G_1 G_3}{1 + G_1 G_2 H_1 + G_2 H_2 + G_3 H_3 + G_1 G_2 G_3 H_1 H_3 + G_2 G_3 H_2 H_3}$$

### **Problem 7**

The block diagram of an LTI system, with input  $C(s)$  and output  $R(s)$ , is shown below



Determine the system transfer function

$$\text{TF} = \frac{R(s)}{C(s)} = \frac{G_2 G_3 G_5 - G_2 G_1 G_5}{1 + G_2 G_3 G_5 G_6 G_4 + G_5 G_6 - G_1 G_2 G_4 G_5 G_6}$$