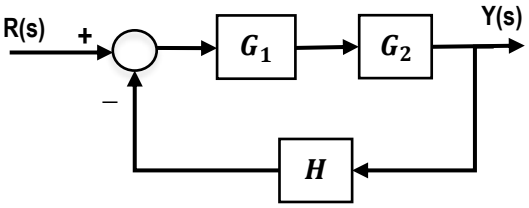
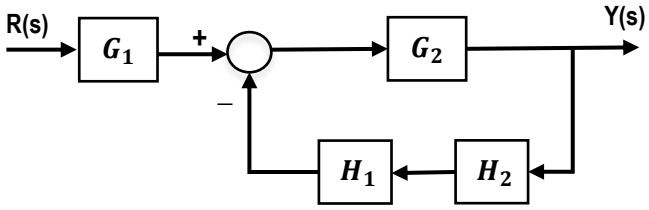
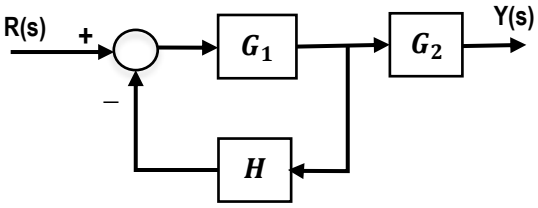
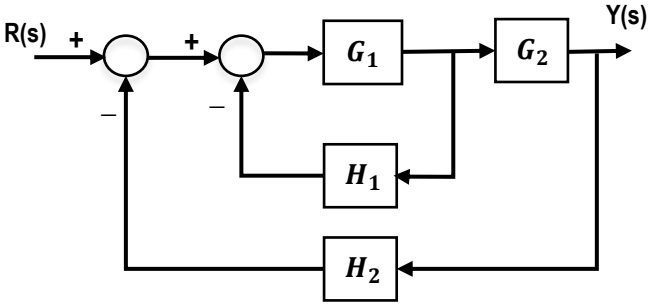
Worksheet 2

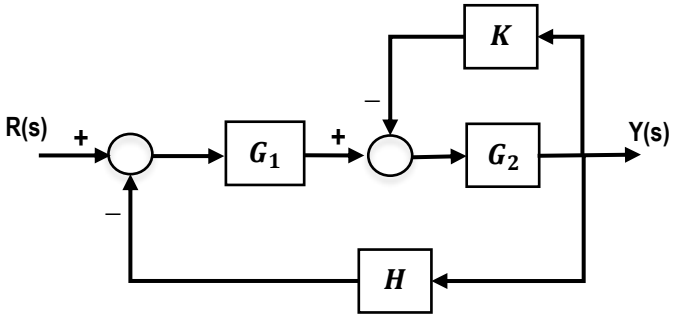
1) Simplify and determine the overall transfer function $\frac{Y(s)}{R(s)}$ for each system.

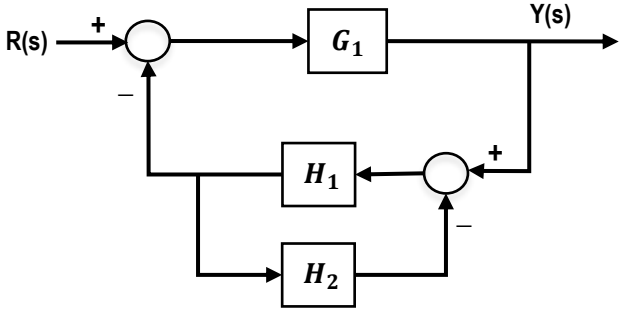


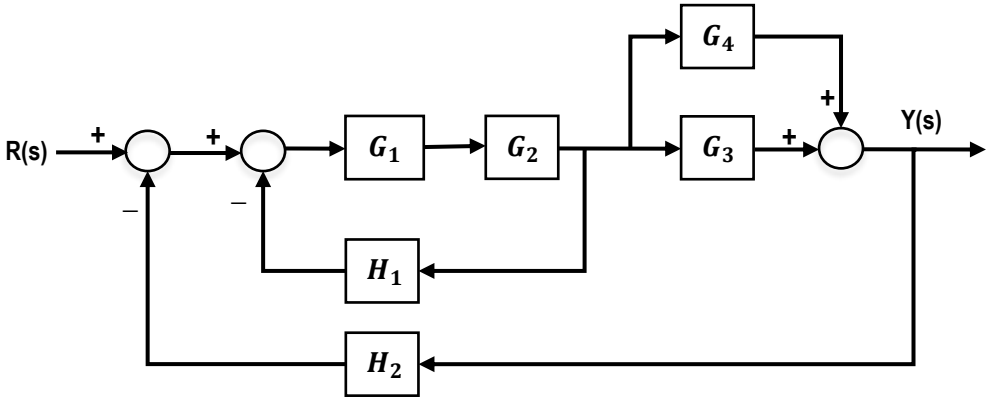




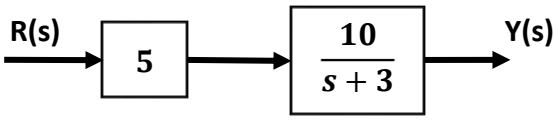


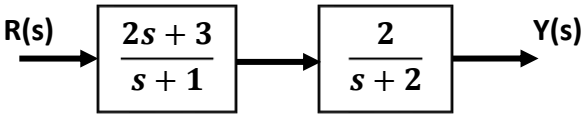


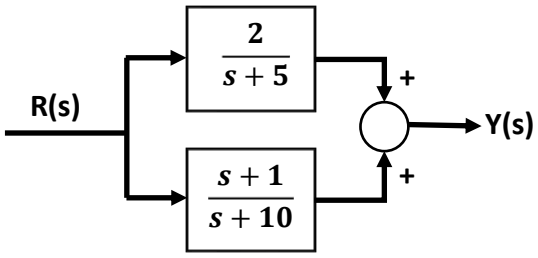


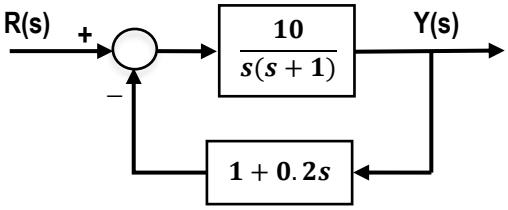


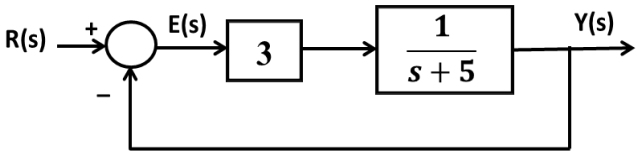
2) What is the overall transfer function $\frac{Y(s)}{R(s)}$?

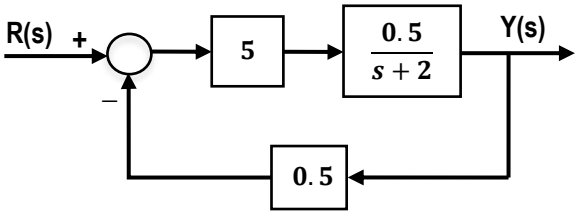


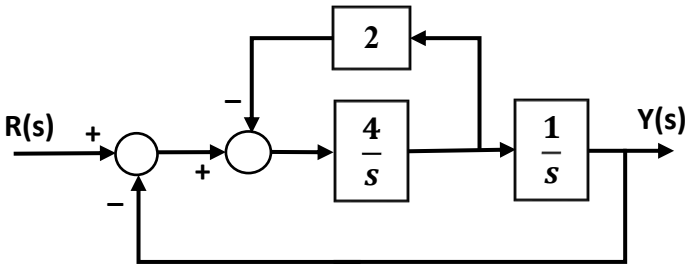


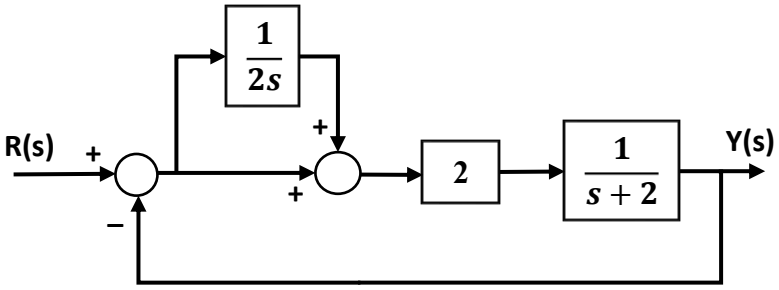




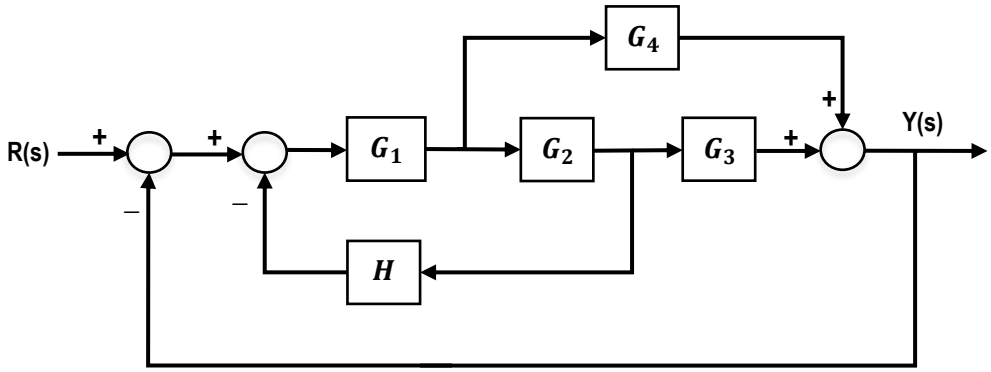




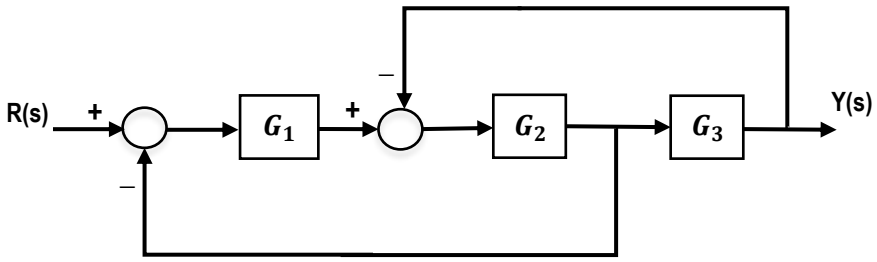




3) Find the overall transfer function $\frac{Y(s)}{R(s)}$ of the system by utilizing the block diagram transformation techniques.



4) Find the overall transfer function $\frac{Y(s)}{R(s)}$ of the system by utilizing the block diagram transformation techniques. Then replace the transfer function values to find the numerical form of the transfer function.

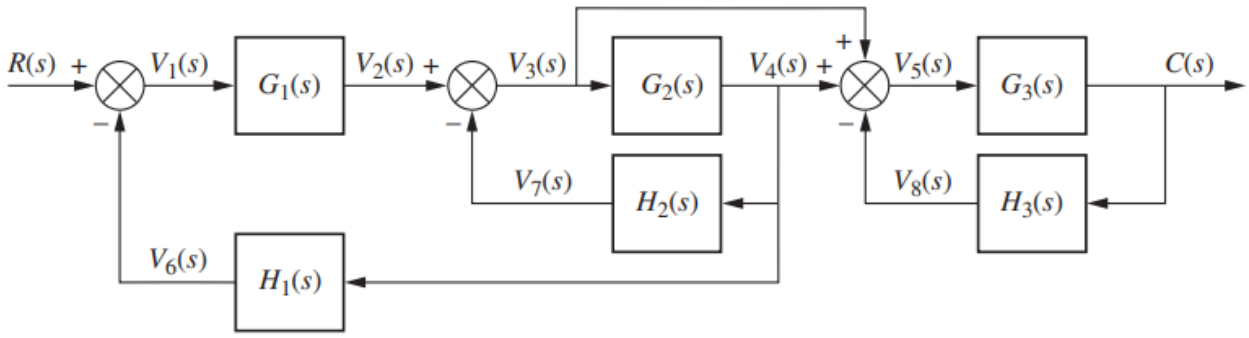


$$G_1(s) = 10$$

$$G_2(s) = \frac{1}{s+2}$$

$$G_3(s) = \frac{s+2}{s+10}$$

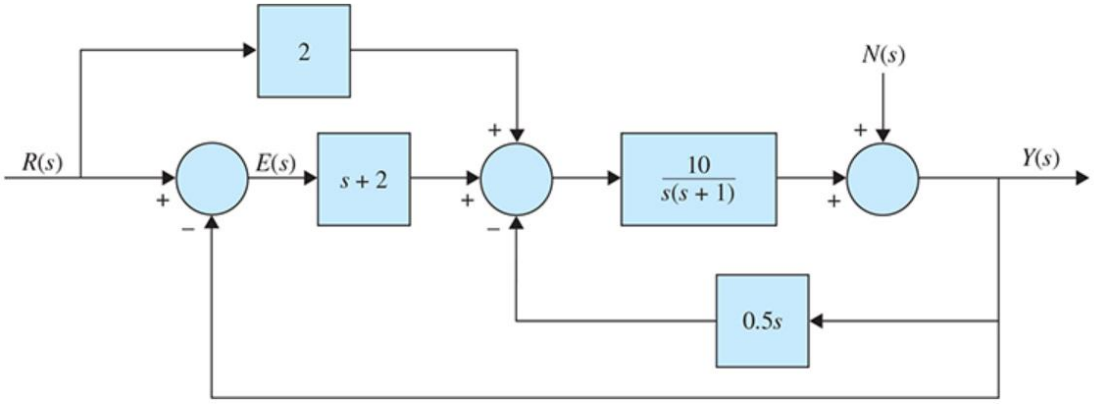
5) Reduce the system shown below to a single transfer function.



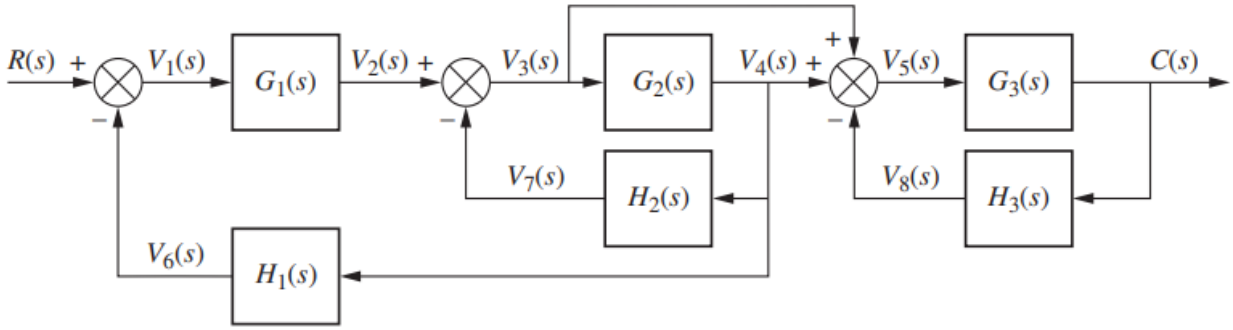
6) The block diagram of a feedback control system is shown below. Find the following transfer functions:

$$\frac{\boldsymbol{Y(s)}}{\boldsymbol{R(s)}}\Big|_{N=0} \quad , \quad \frac{\boldsymbol{Y(s)}}{\boldsymbol{E(s)}}\Big|_{N=0} \quad , \quad \frac{\boldsymbol{Y(s)}}{\boldsymbol{N(s)}}\Big|_{R=0}$$

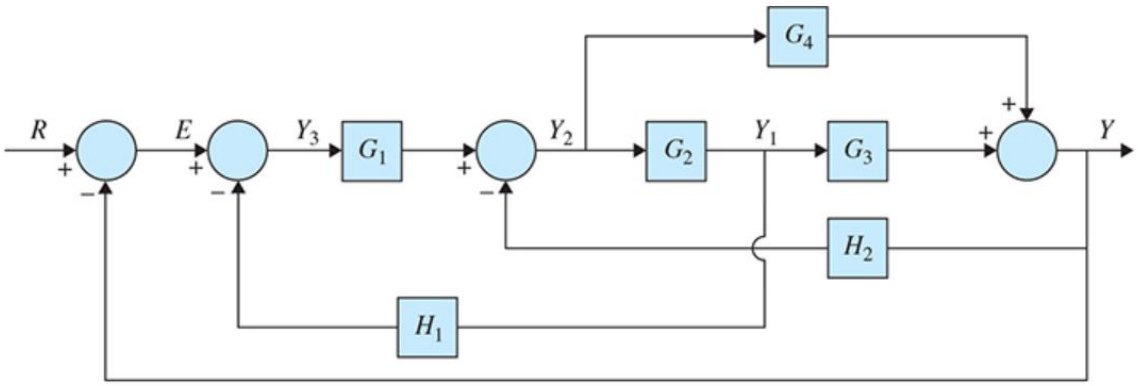
Find the $Y(s)$ when $R(s)$ and $N(s)$ are applied simultaneously.



7) Convert the following block diagram to a signal-flow graph.

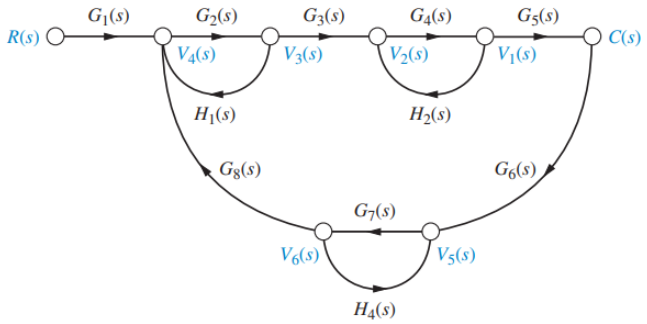


8) Convert the following block diagram to a signal-flow graph.

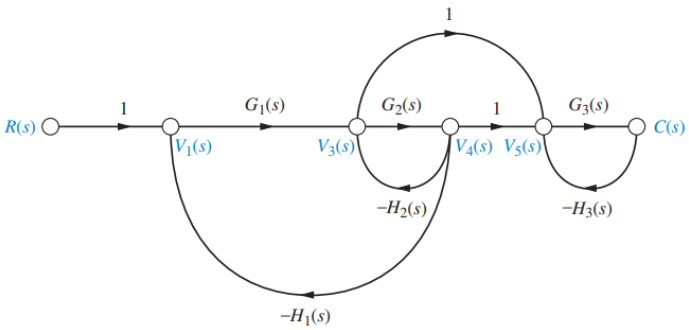


9) Apply Mason's gain formula to find the transfer function, $C(s)/R(s)$, for the given signal-flow graphs.

a)



b)



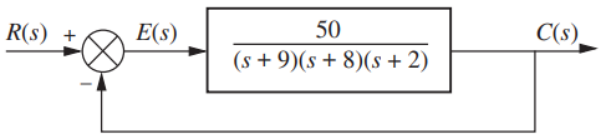
10) Draw a signal-flow graph (state diagram) for the following state-space equation.

a)
$$\begin{cases} \dot{\boldsymbol{q}} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \boldsymbol{q} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \boldsymbol{r} \\ y = [0 \quad 1 \quad 0]\boldsymbol{q} \end{cases}$$

b)
$$\begin{cases} \dot{\boldsymbol{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \boldsymbol{x} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} \boldsymbol{r} \\ y = [1 \quad 2 \quad 0]\boldsymbol{x} \end{cases}$$

11) Represent the open-loop transfer function separately in cascade and complete the feedback loop with the signal path from output to input. Draw the SFG to be in one-to-one correspondence to the lock diagram. Find the state-space representation of the feedback control system from the SFG.

a)



b)