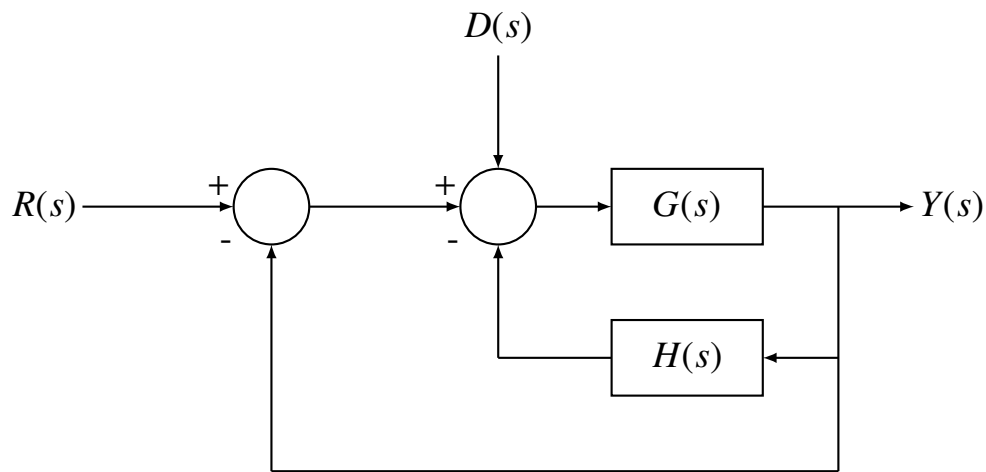


# GATE 2023 EC

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**Question: 42** In the following block diagram,  $R(s)$  and  $D(s)$  are two inputs. The output  $Y(s)$  is expressed as  $Y(s) = G_1(s)R(s) + G_2(s)D(s)$ .  $G_1(s)$  and  $G_2(s)$  are given by

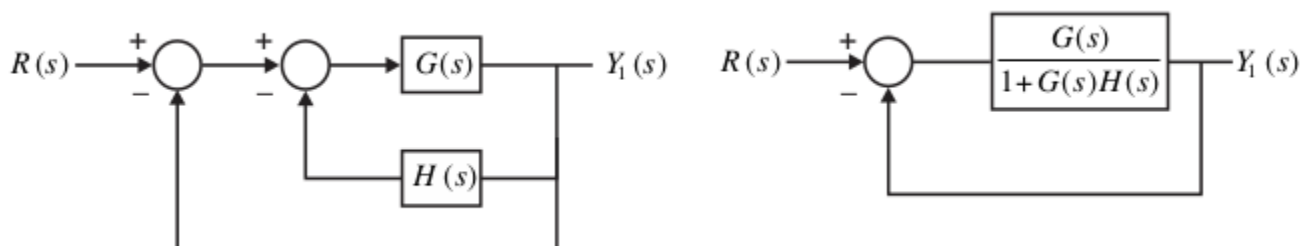


- a)  $G_1(s) = \frac{G(s)}{1+G(s)+G(s)H(s)}$  and  $G_2(s) = \frac{G(s)}{1+G(s)+G(s)H(s)}$
- b)  $G_1(s) = \frac{G(s)}{1+G(s)+H(s)}$  and  $G_2(s) = \frac{G(s)}{1+G(s)+H(s)}$
- c)  $G_1(s) = \frac{G(s)}{1+G(s)+H(s)}$  and  $G_2(s) = \frac{G(s)}{1+G(s)+G(s)H(s)}$
- d)  $G_1(s) = \frac{G(s)}{1+G(s)+G(s)H(s)}$  and  $G_2(s) = \frac{G(s)}{1+G(s)+H(s)}$

**Solution:**

Let  $Y(s) = Y_1(s) + Y_2(s)$ , where  $Y_1(s)$  = output considering only  $R(s)$ ,  $Y_2(s)$  = Output considering only  $D(s)$

When only  $R(s)$  is present:



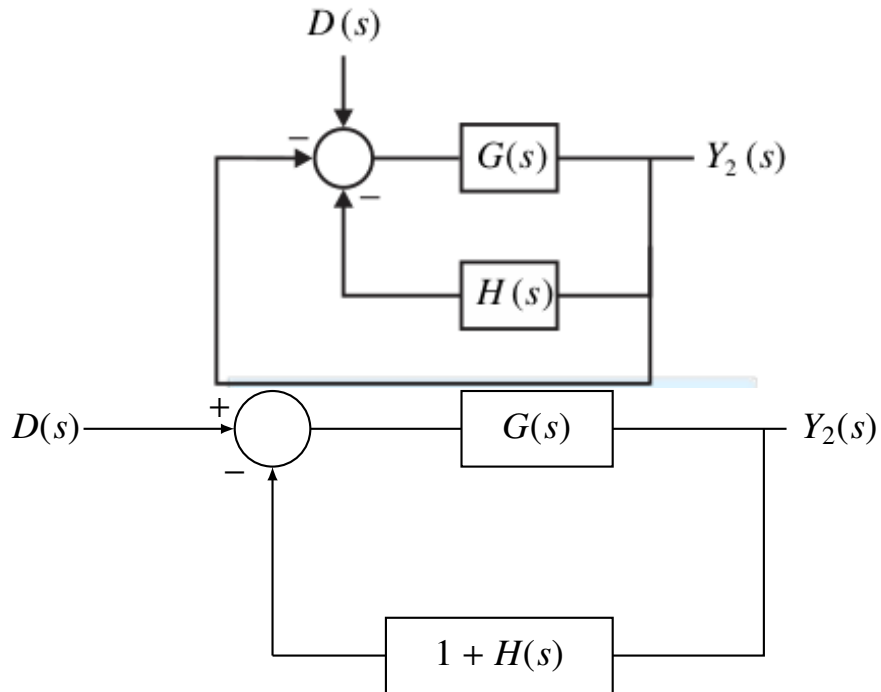
$$\frac{Y_1(s)}{R(s)} = \frac{\frac{G(s)}{1+G(s)H(s)}}{1 + \frac{G(s)}{1+G(s)H(s)}} \quad (1)$$

$$Y_1(s) = \left[ \frac{G(s)}{1 + G(s) + G(s)H(s)} \right] R(s) \quad (2)$$

Hence,

$$G_1(s) = \frac{G(s)}{1 + G(s) + G(s)H(s)} \quad (3)$$

When only  $D(s)$  is present,



$$\frac{Y_2(s)}{D(s)} = \frac{G(s)}{1 + G(s)[1 + H(s)]} \quad (4)$$

$$Y_2(s) = \left[ \frac{G(s)}{1 + G(s)[1 + H(s)]} \right] D(s) \quad (5)$$

Hence,

$$G_2(s) = \frac{G(s)}{1 + G(s) + G(s)H(s)} \quad (6)$$

Option (a) is correct