- سیستم های کنترل خطی -

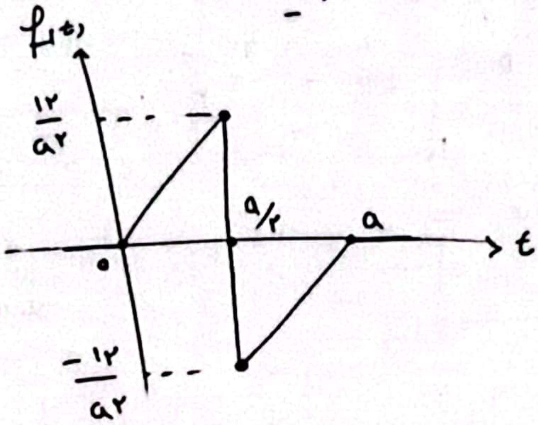
- تکلیف شماره ۱ -

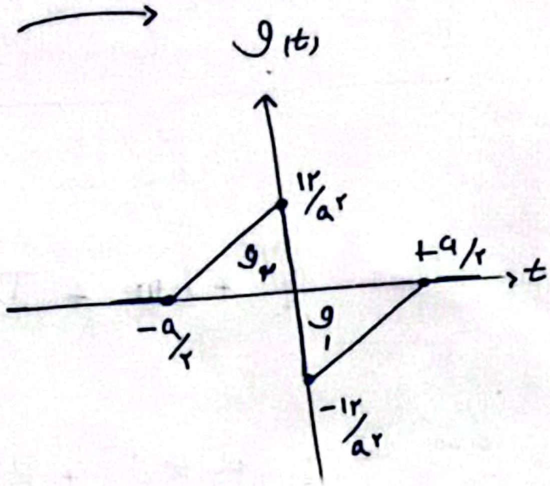
بسمه تعالی

نام و نام خانوادگی : محمد امین بهاءتنش دور

کد دانشجویی : ۴۰۱۱۶۳۵۳

سوال ۱)





$$\rightarrow g(t) = f\left(t + \frac{a}{2}\right) = g_1(t) + g_2(t)$$

$$\rightarrow g_1(t) = \frac{-12}{a^2}\delta(t) + \frac{24}{a^3}t - \frac{12}{a^2}$$

$$\rightarrow G_1(s) = \frac{-12}{a^2} + \frac{24}{s^2a^3} - \frac{12}{sa^2}$$

$$\rightarrow g_2(t) = -g_1(-t) = \frac{12}{a^2}\delta(t) + \frac{24}{a^3}t + \frac{12}{a^2}$$

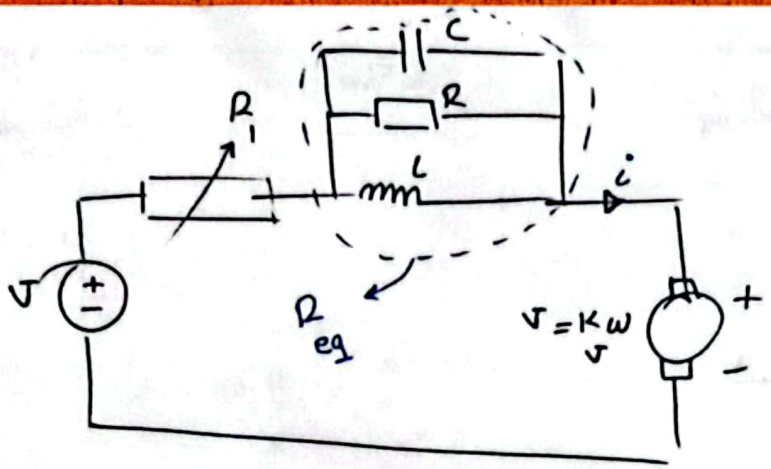
$$\rightarrow G_2(s) = \frac{12}{a^2} + \frac{24}{s^2a^3} + \frac{12}{sa^2}$$

$$\Rightarrow G(s) = G_1(s) + G_2(s) = \frac{48}{s^2a^3}$$

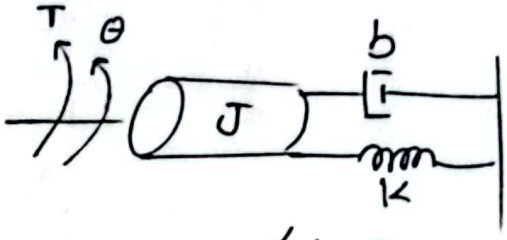
$$\Rightarrow G(s) = L\left[f\left(t + \frac{a}{2}\right)\right] = F(s) \cdot e^{\frac{a}{2}s}$$

$$\Rightarrow F(s) = G(s) \cdot e^{-\frac{as}{2}}$$

$$\Rightarrow \boxed{F(s) = \frac{48}{s^2a^3} e^{-\frac{as}{2}}}$$



بخش الکتریکی



بخش مکانیکی

بخش مکانیکی: $J\frac{dw}{dt} + bw + T + K\theta = \tau_m = K_m i$

بخش الکتریکی: $R_1(t)\,i + R_{eq}\,i + K_v w = V$

لاپلاس بخش الکتریکی ⟹ $R_1(s)\,I(s) + R_{eq}(s)\,I(s) + K_v\,w(s) = V(s)$

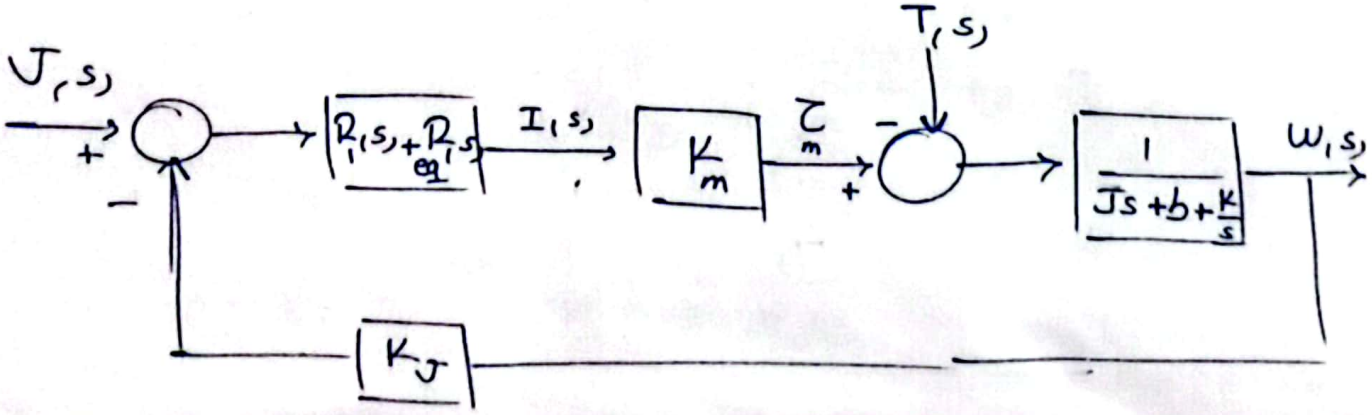
لاپلاس بخش مکانیکی ⟹ $K\theta(s) + b\,w(s) + T(s) + Js\,w(s) = K_m\,I(s)$

می‌دانیم ⟹ $w(s) = s\,\theta(s) \Rightarrow w(s)\left(b + Js + \frac{K}{s}\right) = K_m I(s) - T(s)$

$$\Rightarrow w(s) = \frac{K_m I(s) - T(s)}{Js + b + \frac{K}{s}}$$

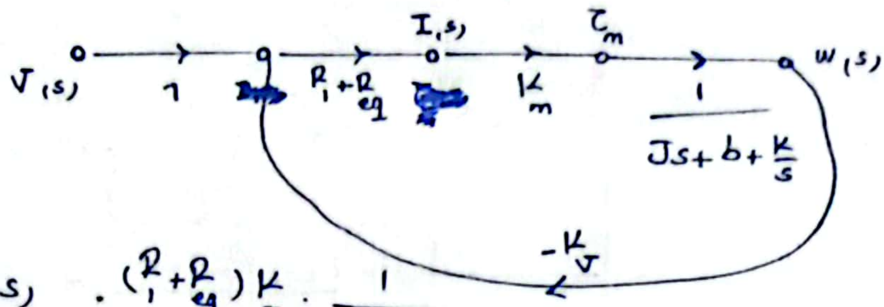
$$\Rightarrow \left(R_1(s) + R_{eq}(s)\right) I(s) + K_v\,w(s) = V(s)$$

مدل سازی و رسم ⟹ بلوک دیاگرام



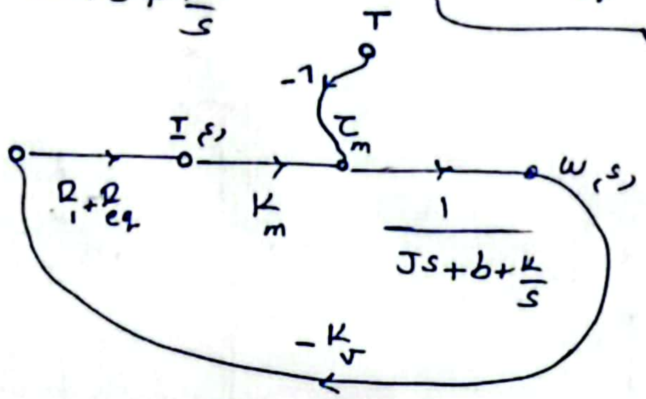
برای محاسبه $G(s)$ از قضیه جمع آثار استفاده می‌کنیم:

(1) تاثیر $V(s)$:



$$\Rightarrow \frac{W(s)}{V(s)} = \frac{(R_1+R_{eq})K_m \cdot \frac{1}{Js+b+\frac{K}{s}}}{1+\frac{K_m K_v (R_1+R_{eq})}{Js+b+\frac{K}{s}}} = \frac{K_m (R_1+R_{eq})}{\underbrace{K_m K_v (R_1+R_{eq}) + Js+b+\frac{K}{s}}_{A(s)}}$$

(2) تاثیر $T(s)$:



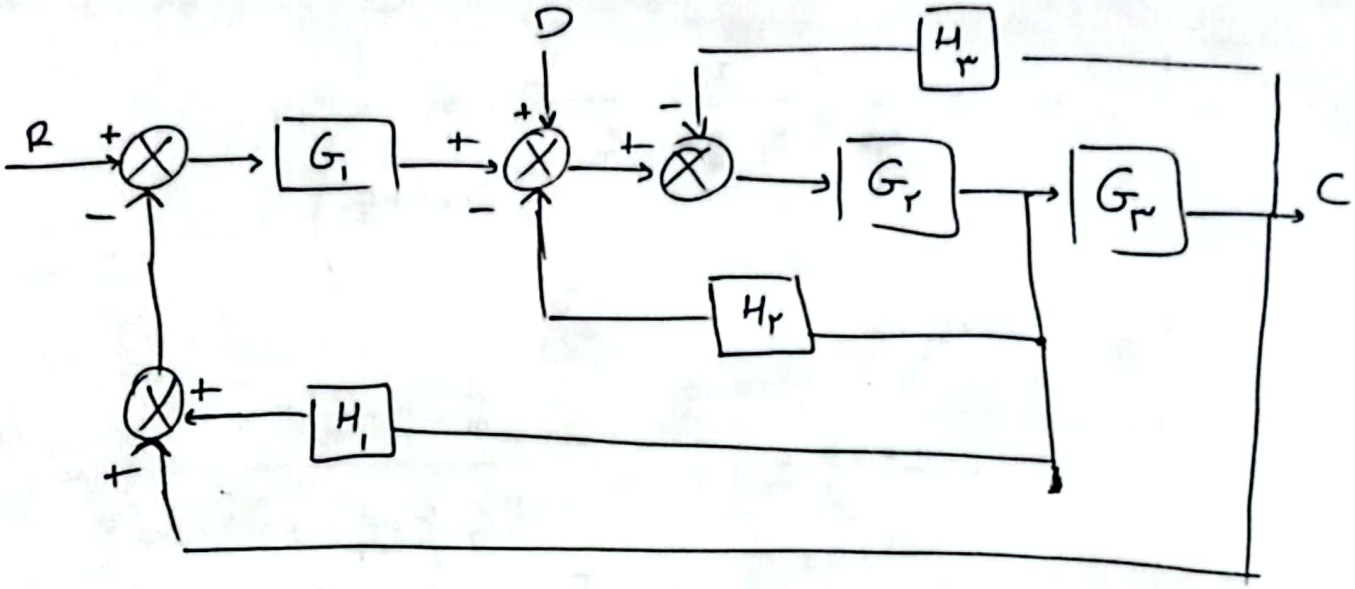
$$\Rightarrow \frac{W(s)}{T(s)} = \frac{\frac{-1}{Js+b+\frac{K}{s}}}{1+\frac{K_m K_v (R_1+R_{eq})}{Js+b+\frac{K}{s}}} = \frac{-1}{\underbrace{K_m K_v (R_1+R_{eq}) + Js+b+\frac{K}{s}}_{A(s)}}$$

$$\xrightarrow[(V(s)=\frac{1}{s})]{(1)+(2)} W(s) = \frac{K_m (R_1+R_{eq})}{sA(s)} - \frac{T(s)}{A(s)}$$

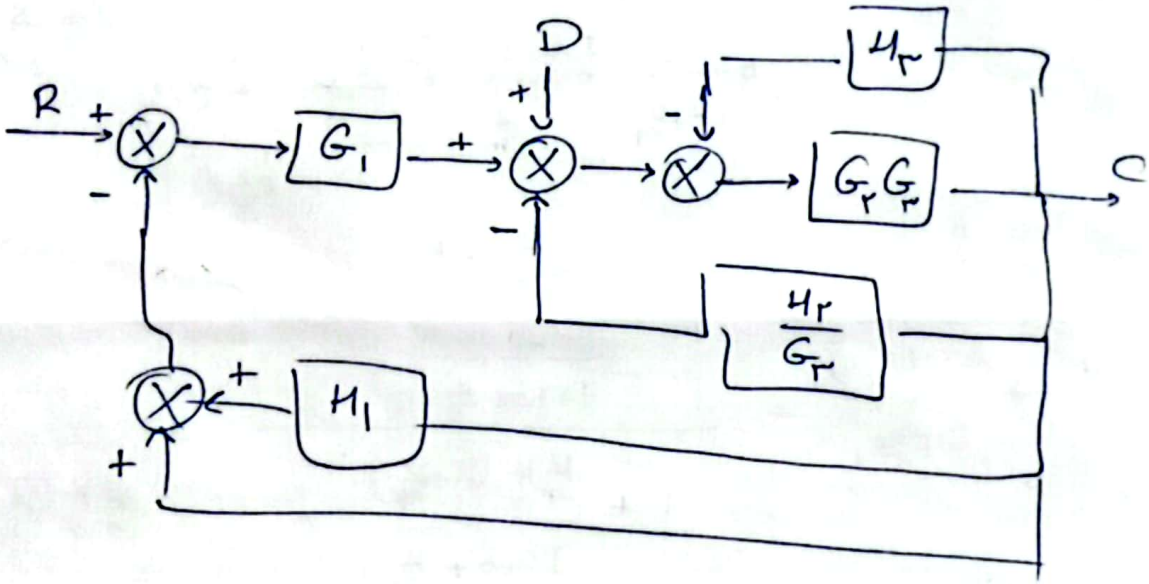
$$\Rightarrow W(s) = \frac{K_m R_1(s)}{sA(s)} + \frac{K_m R_{eq}(s)}{sA(s)} - \frac{T(s)}{A(s)}$$

$$\Rightarrow G(s) = \frac{\theta(s)}{R_1(s)} = \frac{W(s)}{sR_1(s)} = \boxed{\frac{K_m}{s^2 A(s)} + \frac{K_m R_{eq}(s)}{s^2 R_1(s) A(s)} - \frac{T(s)}{sR_1(s)A(s)}}$$

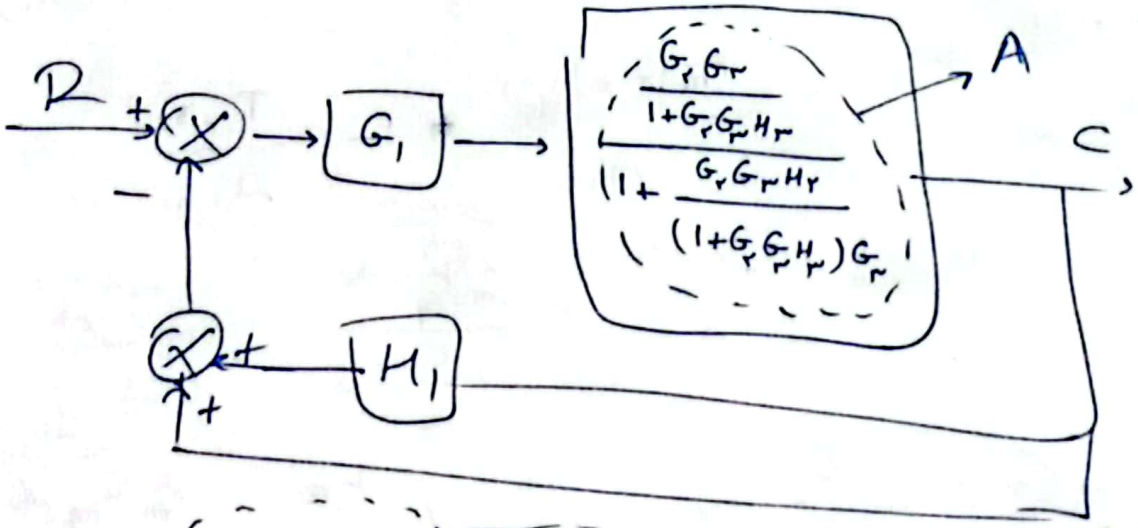
سوال ۴



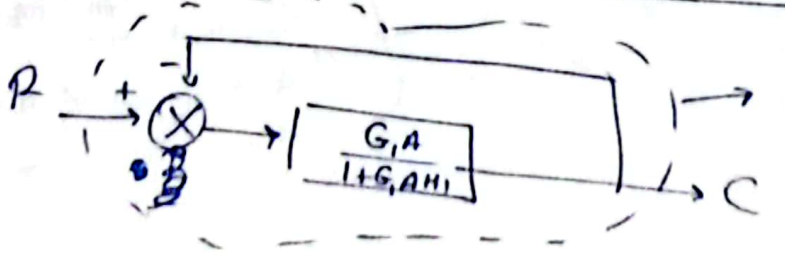
$\Rightarrow$



$\Rightarrow$



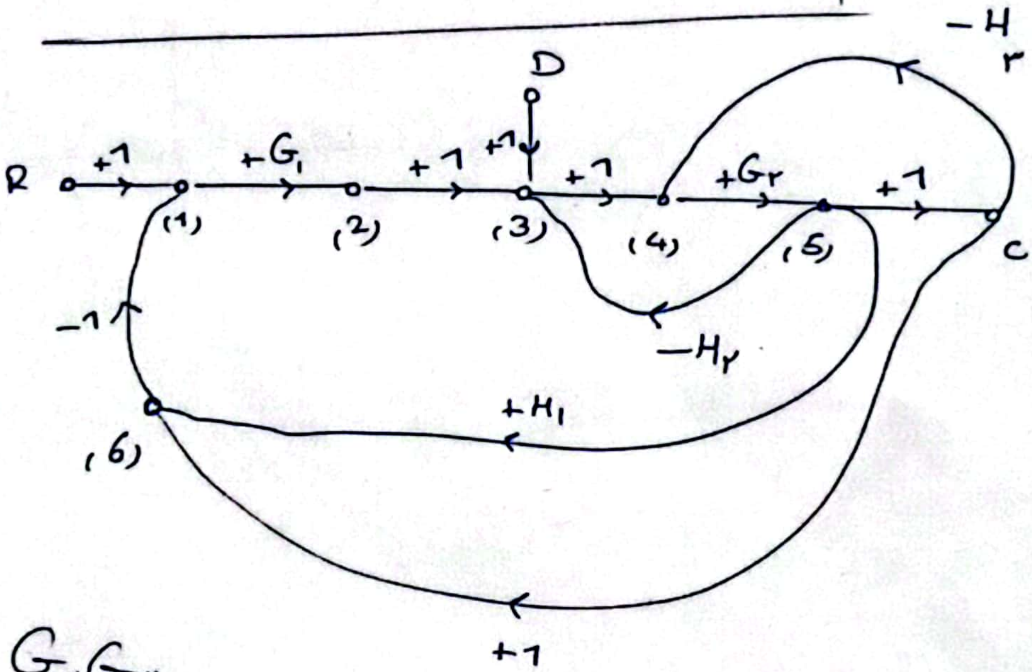
$\Rightarrow$



$$\frac{C}{R} = \frac{Y(s)}{} = \frac{\frac{G_2G_3}{1+G_2G_3H_2}}{1+\frac{G_2G_3H_2}{G_2G_3H_3}}$$

$$\rightarrow \frac{C}{R} = Y_1(s) = \frac{G_1G_2G_3}{1+G_2H_2+G_2G_3H_3+G_1G_2H_1+G_1G_2G_3}$$

نمودار SFG :



$$Z_1(s) = \frac{C(s)}{D(s)} = \frac{G_2G_3}{1+G_2H_2+G_2G_3H_3+G_1G_2H_1+G_1G_2G_3}$$: روش تأثیر اغتشاش D

$$\Longrightarrow \frac{Z(s)}{Y(s)} = G_1 = \frac{R(s)}{D(s)} \longrightarrow$$ برای کاهش D، بهره $G_{1}(s)$ را افزایش دهیم.