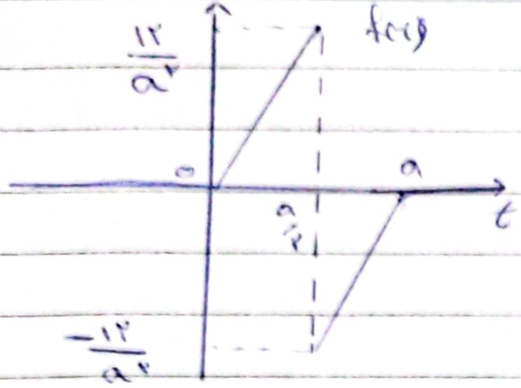
۴۰۱۱۷۹۶۳ یاسمین خورشیدی

Subject: تمرین ۱ کنترل خطی Year: Month: Day:



؟ $f(t) \longrightarrow F(s)$ ①

$$f(t)=\begin{cases}\frac{24}{a^3}t & t<\frac{a}{2}\\ & t=\frac{a}{2}\\ \frac{24}{a^3}t-\frac{24}{a^2} & t>\frac{a}{2}\end{cases}$$

(*) چون صورت سوال گفته $f(t)$ تابع است این ترم را صرف نظر می‌کنیم

$$f(t)=\frac{24}{a^3}t\left[u(t)-u\left(t-\frac{a}{2}\right)\right]+\left(\frac{24}{a^3}t-\frac{24}{a^2}\right)\left[-u(-t+a)\overset{-(-}{\hat{+}}u\left(-t+\frac{a}{2}\right)\right)$$

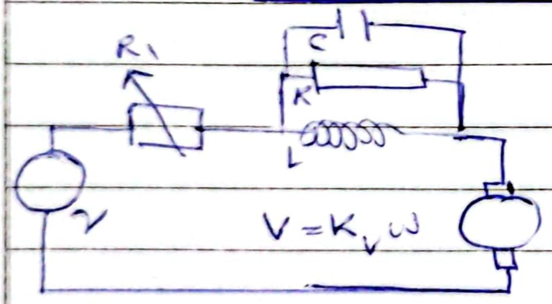
$$\xrightarrow{\mathcal{L}} F(s)=\frac{24}{a^3}\times\frac{1}{s^2}\left[1-e^{-\frac{a}{2}s}\right]+\left(\frac{24}{a^3}\times\frac{1}{s^2}-\frac{24}{a^2}\times\frac{1}{s}\right)\left[-e^{-as}+e^{-\frac{a}{2}s}\right]$$

(*) $\mathcal{L}[u(-t)]=\frac{1}{-1}F\left(\frac{s}{-1}\right)=-\frac{1}{-s}=\frac{1}{s}$

$$\Longrightarrow F(s)=\frac{+24}{a^3s^2}\left[1-e^{-as}\right]-\frac{24}{a^2s}\left[e^{-\frac{a}{2}s}-e^{-as}\right]$$

---

②

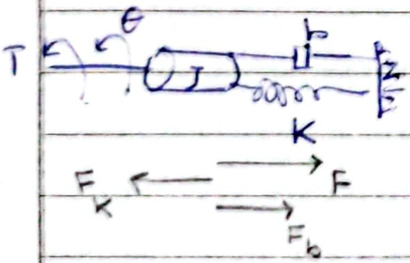


$$v_C=v_R=v_L=Ri_R=L\frac{di_L}{dt}$$

$$i=i_L+i_R+i_C=i_L+\underset{\to\frac{v_C}{R}}{i_R}+C\frac{dv_C}{dt}$$

$$v=R_1i+v_C+v_{emf}\xrightarrow{\mathcal{L}}$$

$$V(s)=R_1I(s)+\left(\frac{1}{Cs}\parallel \underbrace{R\parallel Ls}_{\frac{RLs}{R+Ls}}\right)I(s)+V_{emf}(s)$$



$$\boxed{\begin{aligned}V_{emf}&=K_v\omega\\ T_m&=K_mi\end{aligned}}$$

$$\frac{\frac{RL}{C(R+Ls)}}{(R+Ls)\times\frac{1}{Cs}+\frac{RLs\times Cs}{(R+Ls)\times Cs}}=\frac{RL}{RLCs+RC+LCs}$$

$$V_s=\left[R_1+\frac{RL}{(RLC+LC)s+RC}\right]I_s+\underset{\to K_v s\Theta_s}{V_{emf}(s)} \qquad ①$$

″ ″ ″ ″

$$T_m(t)=b\frac{d\theta}{dt}+J\frac{d^2\theta}{dt^2}+K\theta+T_d \rightsquigarrow 0 \quad \xrightarrow{\mathcal{L}}$$

$$K_mI_s=bs\Theta_s+Js^2\Theta_s+K\Theta_s$$

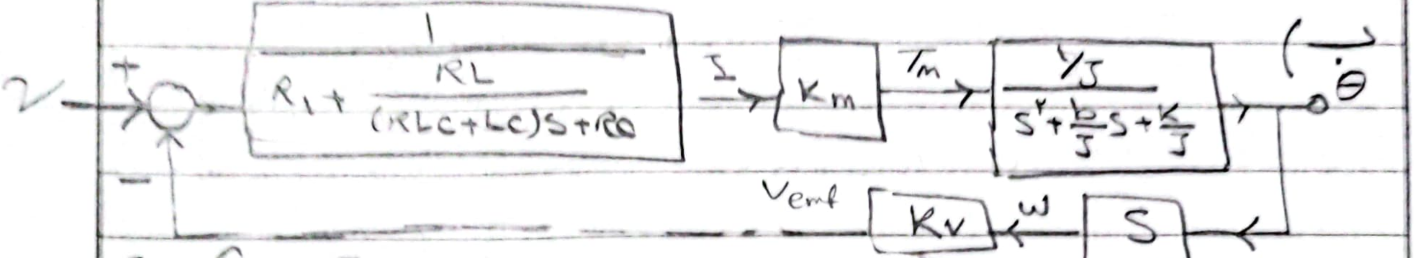
$$=(Js^2+bs+k)\Theta_s$$

① $V_S = \left[R_1 + \frac{RL}{(RLC+LC)S+RC}\right] I_S + K_V S \theta_S$ ؟

② $\theta_S = \frac{K_m}{JS^2+bS+K} I_S$ $\Rightarrow$

$$V_S = \left[R_1 + \frac{RL}{(RLC+LC)S+RC} + \frac{K_m K_V S}{JS^2+bS+K}\right] I_S$$

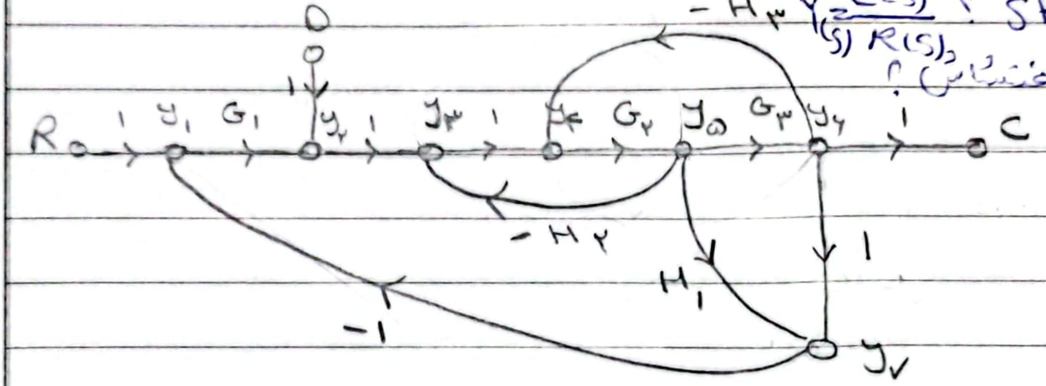
ب)



ج) $G(S) = \frac{\theta}{R_1} = \frac{\theta_S}{I_S} \times \frac{I_S}{V_S} \times \frac{V_S}{V_R} \times I R_1$ = ادامه در صفحه آخر [illegible]

۳) آ) SFG ؟ $Y(S) = \frac{C(S)}{R(S)}$

ب) رفع اغتشاش ؟



آ)

$M_1 = 1.G_1.1.1.G_2.G_3.1 = G_1G_2G_3$ و $N=1$

$L_1 = G_1.1.1.G_2.G_3.1.-1 = -G_1G_2G_3$

$L_2 = G_1.1.1.G_2.H_1.-1 = -G_1G_2H_1$

$L_3 = 1.G_2.-H_2 = -G_2H_2$

$L_4 = G_2.G_3.-H_3 = -G_2G_3H_3$

حلقه بی تماس نداریم

$\Delta = 1 - \sum_{i=1}^{4} L_i = 1 + G_1G_2G_3 + G_1G_2H_1 + G_2H_2 + G_2G_3H_3$

$\Delta_K = \Delta_1 = 1$ تمامی حلقه‌ها با مسیر پیشرو در تماس اند.

$M = \sum_{K=1}^{N} \frac{M_K \Delta_K}{\Delta}$ $\rightarrow$ $Y(S) = \frac{G_1G_2G_3}{1+G_1G_2G_3+G_1G_2H_1+G_2G_3H_3+G_2H_2}$

Subject: Year Month Day

سوال ۲ ج.

$$G(s) = \frac{K_m}{Js^2+bs+K} \times \frac{1}{R_1 + \frac{RL}{(RLC+LC)s+RC}} \times \frac{\frac{R_1 + \frac{RL}{(RLC+LC)s+RC} + \frac{K_m K_v s}{Js^2+bs+K}}{R_1}}{} \times I_s$$

$$= \underbrace{\frac{K_m}{Js^2+bs+K}}_{②} \times \frac{1}{R_1 + \underbrace{\frac{RL}{(RLC+LC)s+RC}}_{①}} \times \left[\frac{R_1 + ①}{R_1} + \frac{K_v s\,②}{R_1}\right] \times I_s$$

$$= \left[\frac{②}{R_1} + \frac{②}{①}\,\frac{K_v s}{R_1}\right] \frac{I_s}{s} \underset{⊛}{=} \frac{②\times① + ② K_v s}{R_1 \times ①} \times \frac{1}{s(R_1 + ① + K_v s②)}$$

$$I_s = \frac{1}{R_1 + ① + K_v s②} \times \underset{\swarrow\; v_{in} = u(t)}{\frac{1}{s}} \; ⊛$$

ورودی پله

R_1 در تابع تبدیل دخالت دارد.

$R \to 0$

خلاصه حل سوال ۲ ج

$Ls \parallel R \parallel \frac{1}{Cs} = Z_{RLC}(s)$

$T_m = K_m i$

$V = K_v \omega$, $\omega = \frac{d\theta}{dt}$ $\to K_v s \theta_s$

① $\to V_s = R_1(s) I_s + Z_{RLC} I_s + K_v \omega$

② $\to K_m I_s = \underbrace{(Js^2+bs+K)}_{M(s)}\theta_s \longrightarrow \theta_s = \frac{K_m}{M} I_s$

①,② $\Longrightarrow V_s = \left(R_1(s) + Z_{RLC} + \frac{K_v K_m s}{M}\right) I_s$

$$G(s) = \frac{\theta}{R_1} = \frac{\theta_s}{I_s} \times \frac{I_s}{V_s} \times \frac{V_s}{V_{R_1}} \times I_{R_1} \longrightarrow I_s$$

$$= \frac{K_M}{M} \times \frac{1}{R_1(s) + Z_{RLC} + \frac{K_v K_M s}{M}} \times \frac{R_1 + Z_{RLC} + \frac{K_v K_m s}{M}}{R_1} \times I_s$$

$$G(s) = \frac{K_M}{M R_1} \times I_s \longrightarrow G(s) = \frac{K_M}{M R_1 s\left(R_1 + Z_{RLC} + \frac{K_v K_M s}{M}\right)}$$

$R_1 \simeq 0$ مثلاً کوچک است.

$$V_s = \frac{1}{s} \Rightarrow I_s = \frac{1}{s\left(R_1 + Z_{RLs} + \frac{K_v K_M s}{M}\right)}$$

جواب

Pasha

ب) $M = \frac{D(s)}{C(s)} = \frac{M'_1 \Delta'_1}{\Delta} = \frac{G_2 G_3}{\Delta}$ باید min شود

از طرفی چون این عبارت

در بهره کلی موثر است $M'_1 = 1.1.G_2.G_3.1 = G_2 G_3$

یعنی : $\Delta'_1 = 1$

$\left.\begin{matrix} \frac{R}{C} \geq 1 & \text{ورودی به خروجی} \\ \frac{D}{C} \leq 1 & \text{اغتشاش به خروجی} \end{matrix}\right\} \Rightarrow \Delta = G_2 G_3$

$\Rightarrow Y(s) = G_1 M$

$\Rightarrow 1 + G_1 G_2 G_3 + G_1 G_2 H_1 + G_2 G_3 H_3 + G_2 H_3 = G_2 G_3$

این اتحاد باید برقرار شود $\frac{1}{G_2 G_3} + G_1 + \frac{G_1 H_1}{G_3} + H_3 + \frac{H_3}{G_2} = 1$

---

④ با توجه به SFG باید T_1 برابر T_2 شود $T_1 = \frac{y_5}{y_2} \qquad T_2 = \frac{y_5}{y_1}$

$N = 2$

$T_1 : \; M_1 = G_1 G_2 G_3$

$M_2 = G_4 G_3$

$L_1 = -G_1 H_1$

$L_2 = -G_3 H_2$

$L_3 = -G_1 G_2 G_3 H_3$

$L_4 = -H_4$

بی‌تماس $\left\{ \begin{matrix} L_{12} = G_1 H_1 G_3 H_2 \\ L_{14} = G_1 H_1 H_4 \end{matrix} \right.$

$\Delta = 1 + G_1 H_1 + G_3 H_2 + G_1 G_2 G_3 H_3 + H_4 + G_1 G_3 H_1 H_2 + G_1 H_1 H_4$

$\Delta_1 = 1 - 0 = 1$

$\Delta_2 = 1 - 0 = 1$

$T_1 = \frac{M_1 \Delta_1 + M_2 \Delta_2}{\Delta} \longrightarrow$ جایگذاری و محاسبه با متلب

$M_1 \Delta_1 + M_2 \Delta_2 = \frac{1}{s}(2s+1)\left(\frac{1}{s^2+1}\right) + \frac{1}{s^2+1} \times \frac{s}{s+1} = \frac{3s^2 + 3s + 1}{s(s+1)(s^2+1)}$

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

ادامه توسط متلب