

$$F_1(s) = \int_{-\infty}^{\infty} f(t) e^{-st} dt$$

$$f(t) = \begin{cases} \frac{rf}{a^n} t & 0 \leq t < \frac{a}{r} \\ \frac{rf}{a^n} (t-a) & \frac{a}{r} \leq t < a + \frac{a}{r} \end{cases} \xrightarrow{\mathcal{L}} \int_0^{\frac{a}{r}} \frac{rf}{a^n} t e^{-st} dt + \int_{\frac{a}{r}}^{a+\frac{a}{r}} \frac{rf}{a^n} (t-a) e^{-st} dt$$

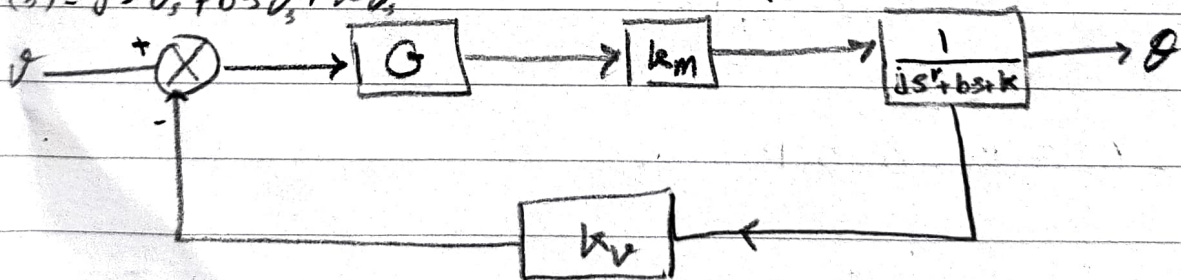
$$F(s) = \frac{rf}{a^n} \left[\left(-\frac{te^{-st}}{s} - \frac{e^{-st}}{s^2} \right) \Big|_0^{\frac{a}{r}} - \left((t-a) \frac{e^{-st}}{s} - \frac{e^{-st}}{s^2} \right) \Big|_{\frac{a}{r}}^{a+\frac{a}{r}} \right]$$

$$= \frac{rf}{a^n} \left(-a e^{-sa/r} \frac{1}{s} + \frac{1-e^{-sa}}{s^2} \right)$$

$$T - b\dot{\theta} - k\theta = J\ddot{\theta} \quad (\text{الف})$$

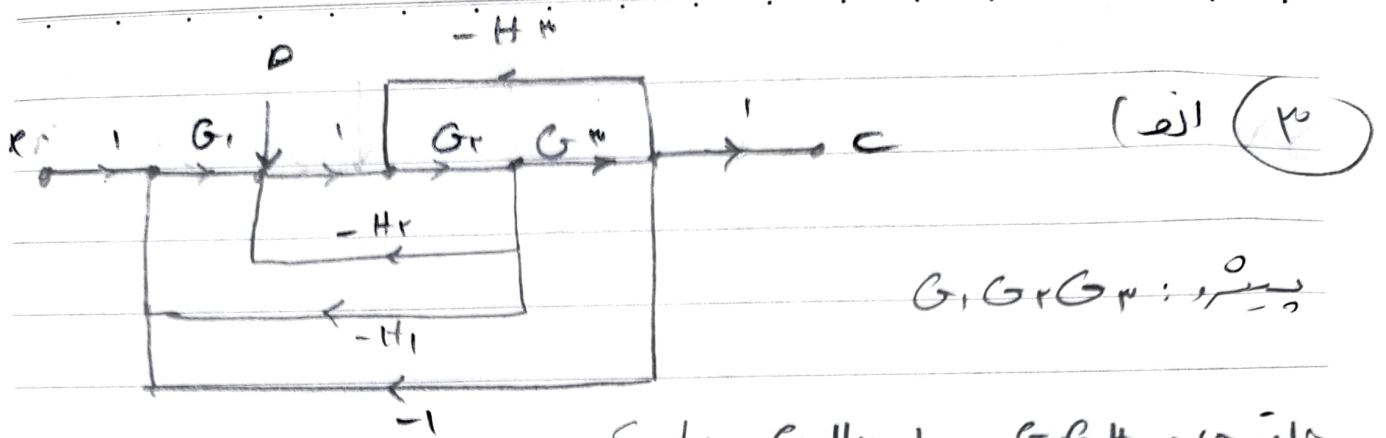
$$\frac{1}{G} \quad T = k_m I \quad V_{\text{emp}} = k_v s \theta_s \quad V_s = \left(R_s + \frac{s/c}{s^2 + \frac{s}{CR} + \frac{1}{LC}} \right) I_s + V_{\text{emf}_s} \quad (\text{ب})$$

$$T(s) = Js^2 \theta_s + bs \theta_s + k \theta_s$$



$$I(s) = \frac{V_s - k_v s \theta_s}{R_s + R_{eq}} = \frac{(Js^2 + bs + k) \theta_s}{k_m} \quad R_{eq} = \frac{1}{G} - R_s \quad (\text{ج})$$

$$\mathcal{L} V_{in} = \frac{1}{s} \Rightarrow \frac{\theta(s)}{R_s} = \frac{k_m}{R_s s (k_m k_v s + (R_s + R_{eq})(Js^2 + bs + k))}$$



پیشرو: $G_1 G_r G_m$

حلقه ها: $L_1 = -G_r H_r$ $L_2 = -G_r G_m H_r$
 $L_3 = -G_1 G_r G_m$ $L_4 = -G_1 G_r H_1$

$$\Delta = 1 - (-G_r H_r - G_1 G_r H_1 - G_1 G_r G_m - G_r G_m H_r)$$

$$\Delta_1 = 1 \quad \frac{C(s)}{R(s)} = \frac{G_1 G_r G_m}{1 + G_r G_m H_r + G_1 G_r H_1 + G_1 G_r G_m + G_r H_r}$$

(ب) ماحذف R ←

پیشرو: $G_r G_m$

حلقه ها: $L_1 = -G_1 G_r H_1$ $L_2 = -G_r H_r$ $L_3 = -G_r G_m H_r$

بی تقابلی نیستند $L_4 = -G_1 G_r G_m$

$$\Delta = 1 - (-G_r H_r - G_1 G_r H_1 - G_r G_m H_r - G_1 G_r G_m)$$

$$\Delta_1 = 1 \quad \frac{C(s)}{D(s)} = \frac{G_r G_m}{1 + G_r G_m H_r + G_1 G_r H_1 + G_1 G_r G_m + G_r H_r}$$

البر $\rightarrow \infty$: از بقیه حلقه ها می توان صرف نظر کرد و البر $\rightarrow 0$ از بین می رود

```
1 s = zpk('s');
2 G1 = 1 / s;
3 G2 = 2*s + 1;
4 G3 = 1 / (s^2 + 1);
5 G4 = s / (s + 1);
6 H1 = 3 / s;
7 H2 = (s - 1) / (s + 3);
8 H3 = s / (s^2 + 3*s + 1);
9 H4 = 1 / (s + 2);
10
11 systemnames = 'G1 G2 G3 G4 H1 H2 H3 H4';
12 inputvar = '[Y1]';
13 outputvar = '[G3 - H4]';
14 input_to_G1 = '[Y1 - H1 - H3]';
15 input_to_G2 = '[G1]';
16 input_to_G3 = '[G4 + G2 - H2]';
17 input_to_G4 = '[Y1 - H1 - H3]';
18 input_to_H1 = '[G1]';
19 input_to_H2 = '[G3 - H4]';
20 input_to_H3 = '[G3 - H4]';
21 input_to_H4 = '[G3 - H4]';
22
23 sysoutname = 'sys';
24 cleanupsysic = 'yes';
25 sysic
26 sys.InputName = {'Y1'};
27 sys.OutputName = {'YS'};
28 sys = minreal(sys);
29 poles = pole(sys);
30 disp('Poles of the system:');
31 disp(poles);
32
```

Command Window

```
>> untitled2
Poles of the system:
-2.4444 + 0.0000i
-0.9276 + 0.0000i
-0.3896 + 0.0000i
 0.0262 + 1.9612i
 0.0262 - 1.9612i
-3.0414 + 0.5200i
-3.0414 - 0.5200i
-0.1041 + 0.7989i
```