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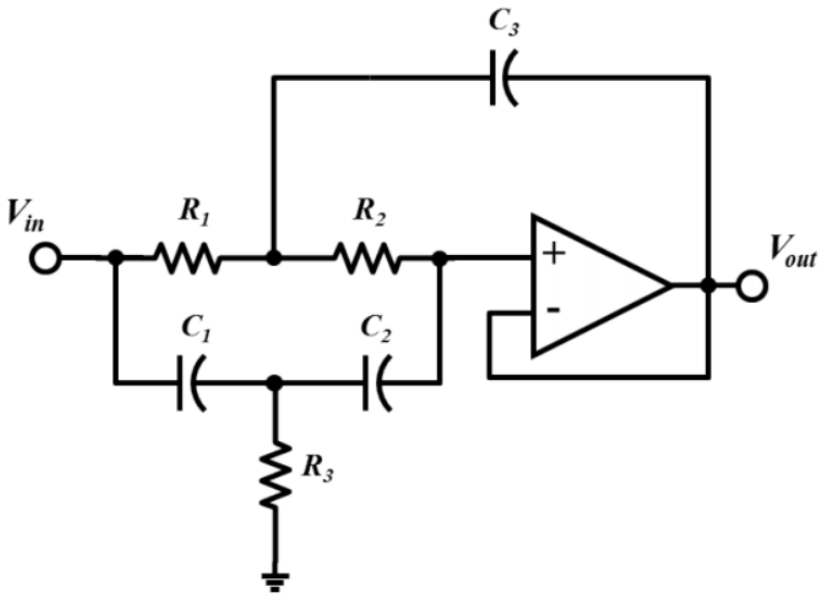
Proiect TS



1.

$u = x_1 + x_2 + y$

$y = u - x_1 - x_2$

$D=1$

$U = x_1 + R_2 * R_3$

$u_{rs} = u - x_1$

$x_3 + y = x_3 + u - x_1 - x_2$

$C_1 \, dx_1/dt = C_2 \, dx_2/dt + (u-R_1)/R_3$

$C_2 \, dx_2/dt + x_3/R_2 = 0$

$(U - x_3 - u + R_1 + R_2)/R_1 = C_3 \, dx_3/dt + x_3/R_2$

$(U - x_3 - u + R_1 + R_2)/R_1 - x_3/R_2 = C_3 \, dx_3/dt$

$C_1 \, dx_1/dt = (-x_3/R_2) + (u-R_1)/R_3$

$$A = \begin{pmatrix} -1/(R_3C_1) & 0 & -1/(R_2C_1) \\ 0 & 0 & -1/(R_2C_2) \\ 1/(R_1C_3) & 1/(R_1C_3) & -1/C_3*(1/R_1 + 1/R_2) \end{pmatrix}$$

$$C = \begin{pmatrix} -1 & -1 & 0 \end{pmatrix}$$

$D = 1$

$$B = \begin{pmatrix} 1/(R_3C_1) \\ 0 \\ 0 \end{pmatrix}$$

$dx_1/dt = -(1/R_3C_1) * x_1 - (1/R_2C_1) * x_3 + (1/R_3C_3) * x_3$

$dx_2/dt = -(1/R_2C_2) * x_3$

$dx_3/dt = (1/R_1C_3) * x_1 + (1/R_1C_3) * x_2 - 1/R_1C_3 - (1/R_2C_3) * x_3$

$y = -x_1 - x_2 + u$

2. $$H(s) = (-1 \ -1 \ 0) * \begin{pmatrix} S+1/R_3C_1 & 0 & 1/R_2C_1 \\ 0 & s & 1/R_2C_2 \\ -1/R_1C_3 & -1/R_1C_3 & s+-1/R_1C_3+-1/R_2C_3 \end{pmatrix} * \begin{pmatrix} 1/(R_3C_1) \\ 0 \\ 0 \end{pmatrix}$$

$$H(s) = (-1 \ -1 \ 0) * \begin{pmatrix} s^2 + (1/R_1C_3 + 1/R_2C_3)s + 1/R_1R_2C_2C_3 & x & x \\ 1/R_1R_2C_2C_3 & x & x \\ x & x & x \end{pmatrix} * \begin{pmatrix} 1/(R_3C_1) \\ 0 \\ 0 \end{pmatrix}$$

$$\frac{}{\text{Det}(sI - A)}$$

+1

$$\text{Det}(sI - A) = s^3 + (1/(R_1C_3) + 1/(R_2C_3) + 1/(R_3C_1) * s^2 + (1/(R_1R_3C_1C_3) + 1/(R_2R_3C_1C_3) + 1/(R_1R_2C_1C_3) + 1/(R_1R_2C_2C_3) * s + 1/(R_1R_2R_3C_1C_2C_3)$$

$$H(s) = \frac{s^3 + (1/(R_1C_3) + 1/(R_2C_3)) * s^2 + (1/(R_1R_3C_1C_3) + 1/(R_2R_3C_1C_3)) * s + 1/(R_1R_2R_3C_1C_2C_3)}{s^3 + (1/(R_1C_3) + 1/(R_2C_3) + 1/(R_3C_1) * s^2 + (1/(R_1R_3C_1C_3) + 1/(R_2R_3C_1C_3) + 1/(R_1R_2C_1C_3) + 1/(R_1R_2C_2C_3) * s + 1/(R_1R_2R_3C_1C_2C_3)}$$

3.

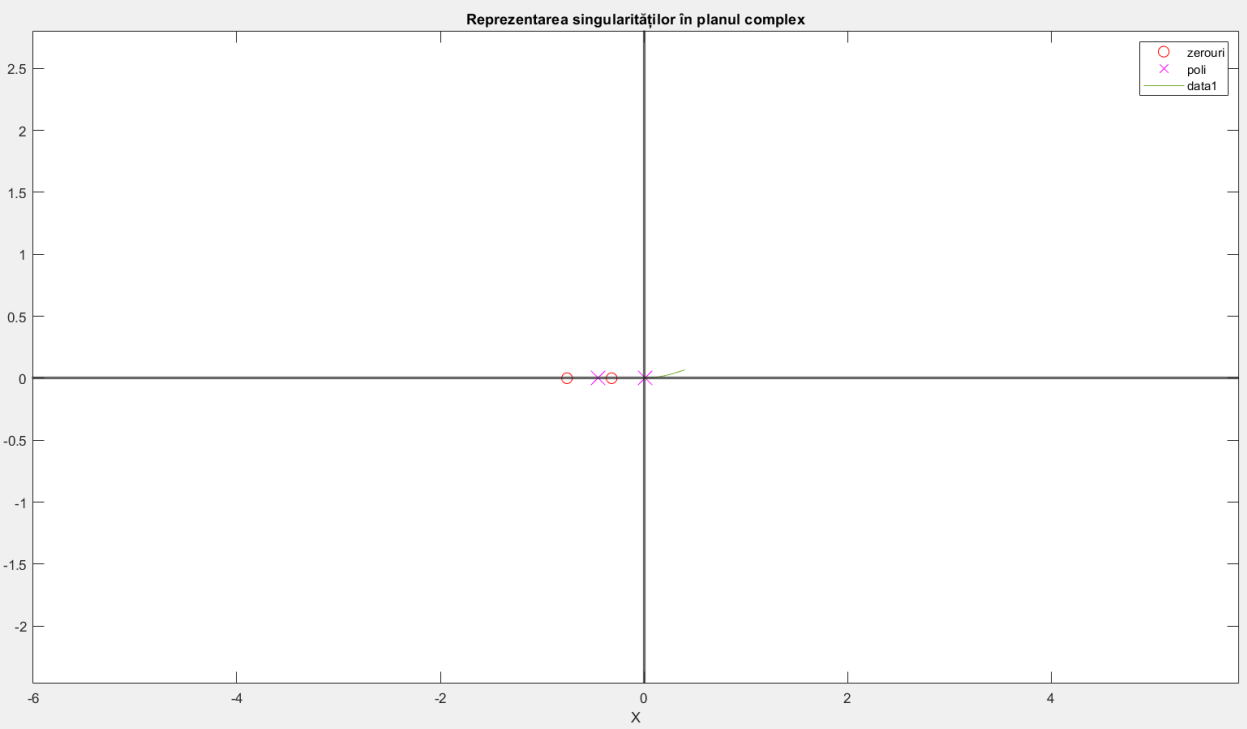
```
R1=10 * 10e3;
R2=10 * 10e3;
R3=4.7 * 10e3;
C1=2.2 * 10e-6;
C2=2.2 * 10e-6;
C3=4.7 * 10e-6;
A=[-1/(R3*C1), 0, -1/(R2*C1); 0,0,-1/(R2*C2);1/(R1*C3),
1/(R1*C3), (-1/C3)*(1/R1+1/R2)];
B=[1/(R3*C1);0;0];
C=[-1,-1,0];
D=[1];
sys=ss(A,B,C,D);
[num,den]=ss2tf(A,B,C,D);
H=tf(num,den)
pole(H)
zero(H);
```

```
Polii sistemului:

   -0.7562 + 0.0000i
   -0.3182 + 0.1497i
   -0.3182 - 0.1497i

Zerourile sistemului:
```

```
  -0.4536 + 0.0000i
   0.0141 + 0.4539i
   0.0141 - 0.4539i
```

Reprezentarea singularitatilor in planul complex:

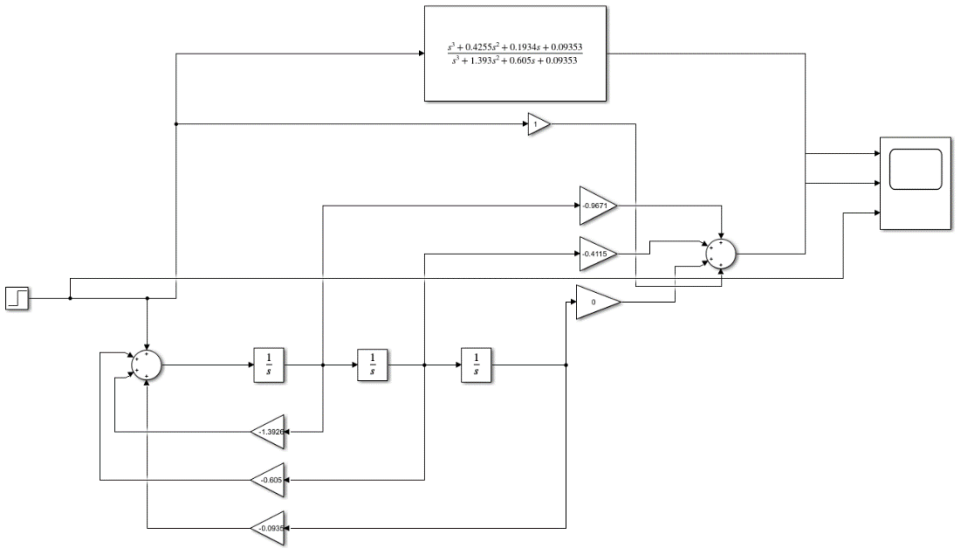
```
p1=plot(-0.7562,0,'ro','MarkerSize',8);grid
hold on
plot(-0.3182,0.1497i,'ro','MarkerSize',8)
plot(-0.3182,-0.1497i,'ro','MarkerSize',8);
xlim([-35 10])
ylim([-10 10])
plot(-100:100,1,'k')
xline(0,'LineWidth',2)
yline(0,'LineWidth',2)
p2=plot(-0.4536,0,'mx','MarkerSize',15);
plot(0.0141,0.4539i,'mx','MarkerSize',15)
plot(0.0141,-0.4539i,'mx','MarkerSize',15)
legend([p1 p2],'zerouri','poli')
title("Reprezentarea singularit??ilor în planul complex")
xlabel('X');
ylabel('jY');
```

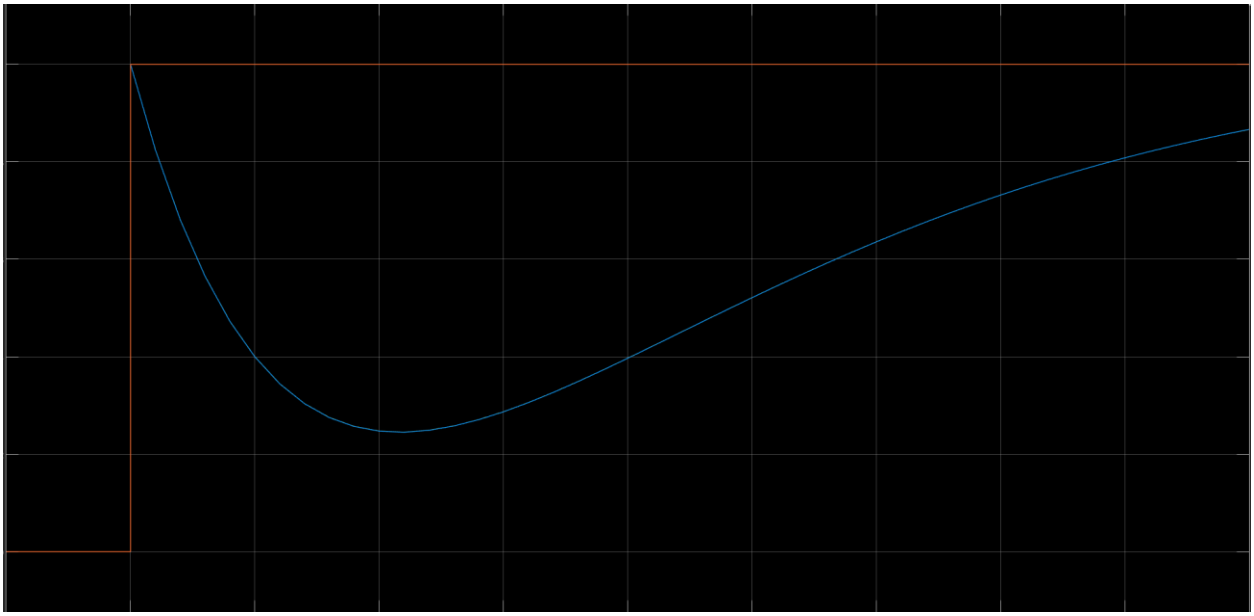


4.

```
[num,den] = tfdata(min, 'v');
[A_FCC, B_FCC, C_FCC, D] = tf2ss(num,den);
A_FCO = A_FCC';
B_FCO = C_FCC';
C_FCO = B_FCC';

sys_fco = ss(A_FCO, B_FCO, C_FCO, D)
```

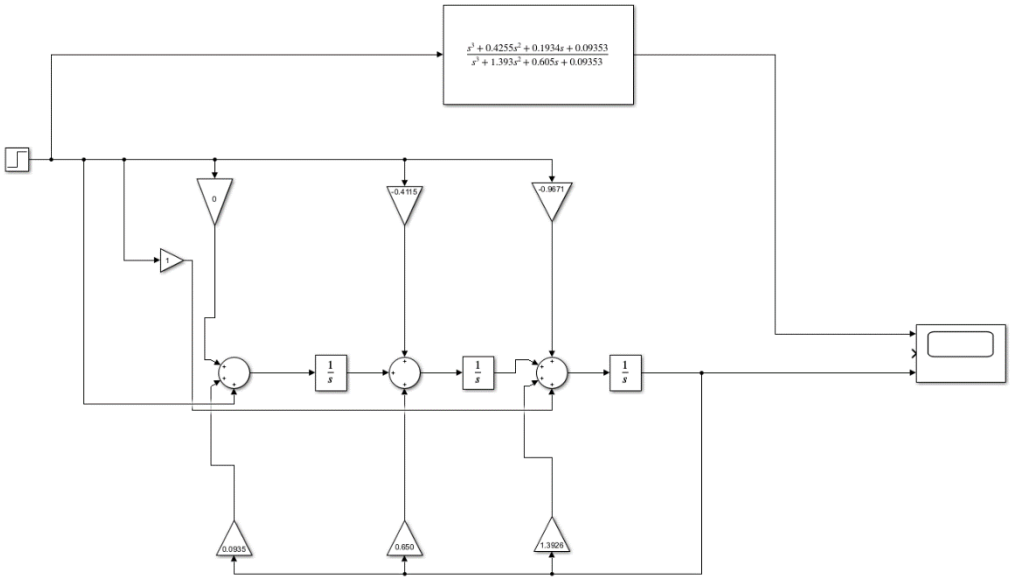
FCC:

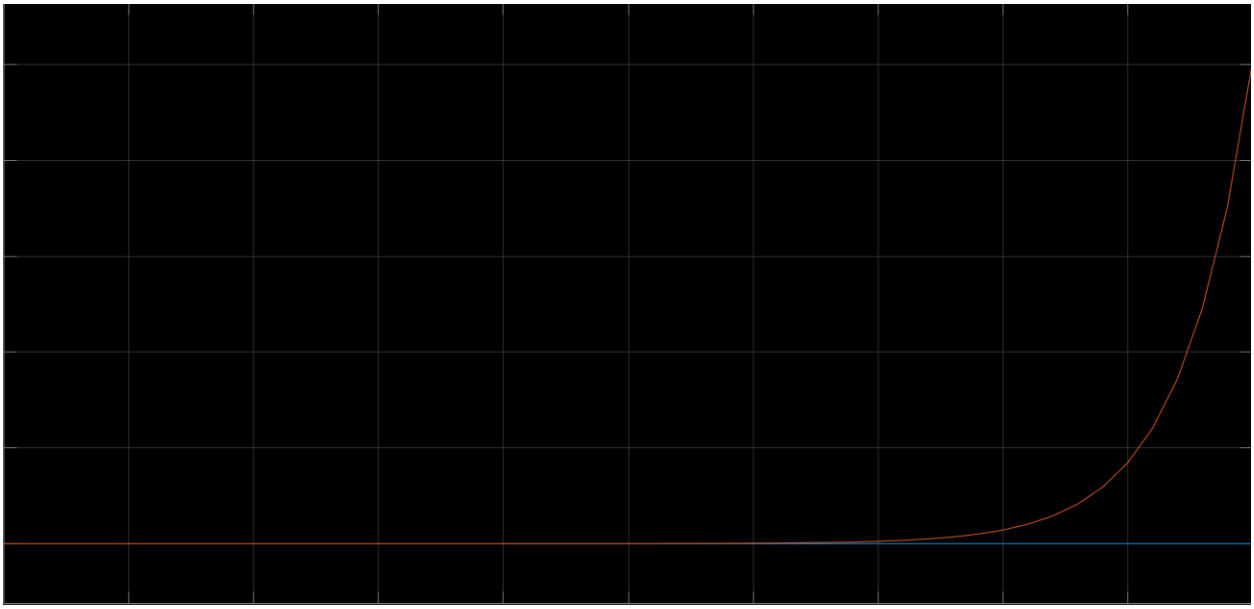




Este correct deoarece, semnalul de intrare este suprapus cu cel al functiei initiale.

FCO:





Este correct deoarece, semnalul de intrare este suprapus cu cel al functiei initiale.

5.

```
num_ext = [num zeros(1,5)];
gamma = deconv(num_ext,den);
min = zpk(minreal(H));
```

Hmin = (s + 0.4536) * (s^2 − 0.002811 * s + 0.2062)/(s + 0.7562) * (s^2 + 0.06364 * s + 0.1237)

6.

Sensitivitatea interna:

Det(Λi − A) = 0

$$\begin{pmatrix} \Lambda + 96{,}71 & 0 & -45.45 \\ 0 & \Lambda & -45.45 \\ 21.27 & 21.27 & \Lambda + 42.55 \end{pmatrix} = \Lambda^3 + 139.26 * \Lambda^2 + 1\,933.44 * \Lambda + 97\,606.5$$

Λ^3 1 , 1 933.44

Λ^2 139.26 97 606.5

Λ x 0

Λ^0 y 0

$$x = -\frac{\begin{vmatrix} 1 & 1\,933.44 \\ 139.26 & 97\,606.5 \end{vmatrix}}{139.26}$$

x = 1 232.54

$$y = -\frac{\begin{vmatrix} 139.26 & 97\,606.5 \\ 1\,232.54 & 0 \end{vmatrix}}{1\,232.54}$$

y = 97 606.5

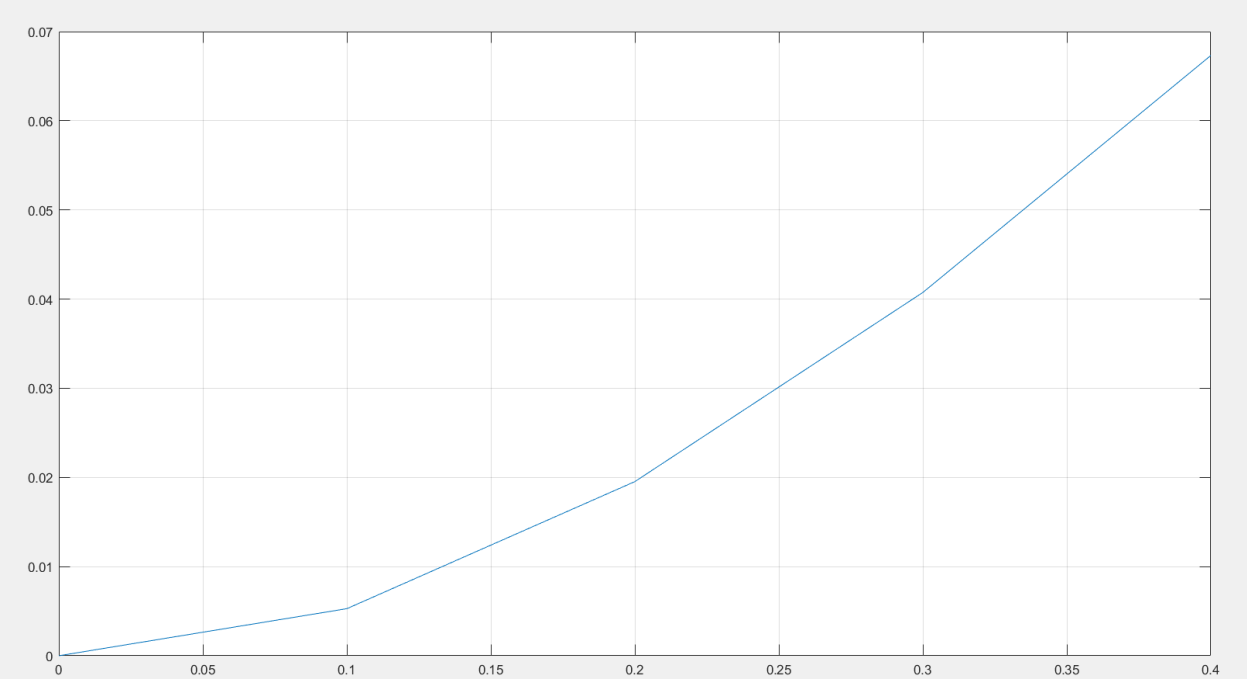
In polinomul caracteristic, nu exista nici o schimbare de sens la radacini, rezulta un sistem stabil intern.

Sensitivitatea externa:

Stabilitatea interna impica stabilitatea externa, deci sistemul este de asemenea stabil extern.

7.

```
Q = eye(length(A));
P = lyap(A' ,Q)
eig(P)
sys = ss(A, B, C, D);
t = 0:0.1:0.4;
step_f = @(t)(t>=0);
st = step_f(t);
[~, time, x] = lsim(sys, st, t);

Vx = zeros(length(t), 1);
for i = 1:length(t)
    Vx(i) = x(i,:) * P * x(i, :)';
end
plot(t, Vx);
grid;
```



8.

H=

$$\frac{(s+0.4536)\ (s^2 - 0.02811s + 0.2062)}{(s+0.7562)\ (s^2 + 0.6364s + 0.1237)}$$

Răspunsul indicial
Răspunsul la rampă

$n^2+0.6364n+0.1237$ $\quad n+0.7562$

$$\frac{A}{n+0.7562}+\frac{Bn+C}{n^2+0.6364n+0.1237}=\frac{(n+0.4536)\cdot(n^2-0.002811n+0.2062)}{}$$

$$An^2+0.6364An+0.1237A+Bn^2+Cn+0.7562nB+0.7562C$$

$$\begin{cases} A+B=0.4255 \\ 0.6364A+C+0.7562nBB+=0.1934 \\ 0.1237A+0.7562C=0.09353 \end{cases}$$

$B=0.4255-BA$

$C=\dfrac{0.09353-0.1237A}{0.7562}$

0.7562

$0.6364A+\dfrac{0.09353-0.1237A}{0.7562}+$

$0.7562 \quad 0.7562 \quad 0.7562 \quad 0.7562$

$+0.3217-0.7562A=0.1934$

$0.4812A+0.09353-0.1237A+0.2432-1.512A=0.146$

$-1.15A+0.3358=0.146$

$-1.15A=-0.189$

~~$A=0.16$~~ $\quad A=0.1643$

$B=0,2612$

$C=0.0958$

$$\begin{cases} A+B+D=1 \\ 0.6364A + C + 0.7562B + 0.6364D + 0.7562D = 0.4255 \\ 0.1237A + 0.7562C + 0.1237D + 0.7562 \cdot D = 0.1934 \\ 0.0935D = 0.0935 \end{cases}$$

$\boxed{D=1}$ $\quad A+B=0$

$A=-B$

$$0.1237 \cdot A + 0.7562 \cdot C + 0.8799 = 0.1934$$

$$0.7562\,C = \frac{-0.6865 - 0.1237A}{0.7562}$$

$$0.6364A - 0.7562A + - \frac{0.6865 + 0.1237A}{0.7562} + 0.8799 = 0.1934$$

$$-0.1198A - \frac{0.6865 + 0.1237A}{0.7562} + 0.8799 = 0.1934$$

$$-0.0905A - 0.6855 + 0.1237A + 0.8553 = 0.1452$$

$$0.0332A = 0.1674$$

$\boxed{A = 5,0421}$ $\quad \boxed{B = -5,0421}$

$\boxed{C = -1.7326}$

$$\frac{0.1643}{n+0.7562} + \frac{0.2612 \cdot n + 0.0968}{n^2 + 0.636 \cdot n + 0.1237}$$

$$h(t) = \mathcal{L}^{-1}\left\{\frac{0.1643}{n+0.7562}\right\} + \mathcal{L}^{-1}\left\{\frac{0.2612 \cdot n + 0.0968}{n^2 + 0.636 \cdot n + 0.1237}\right\}$$

$$= 0.1643 \cdot e^{-0.7562t} + \mathcal{L}^{-1}\left\{\frac{(n+0.3517)}{}\right.$$

$$+ \mathcal{L}^{-1}\left\{\frac{0.2612 \cdot (n+0.318)}{(n+0.318)^2 + 0.0226} + \frac{0.0138}{(n+0.318)^2 + 0.0226}\right\}$$

$$= 0.1643 \cdot e^{-0.7562t} + 0.2612 \cdot \left[\cos(0.1503t) \cdot e^{-0.318t}\right.$$

$$\underbrace{+ \sin(0.1503t) \cdot e^{-0.318t}}$$

Funcția pondere

$$y(t) = \mathcal{L}^{-1}\{H(n) \cdot \tfrac{1}{n}\}$$

$$A n^3 + 0.6364 \cdot n^2 \cdot A + 0.1237 n A + B \cdot n^3 + C \cdot n^2 + 0.7562 \cdot n^2 \cdot B +$$

$$0.7562 \cdot n \cdot C + n^3 \cdot D + 0.6364 n^2 D + 0.1237 \cdot n \cdot D + 0.7562 \cdot n^2 \cdot D +$$

$$0.7562 \cdot n \cdot D + 0.0935 D = \text{Numărătorul funcției de transfer}$$

$$\begin{cases} A+B+D=1 \\ 0.6364A + C + 0.7562B + 0.6364D + 0.7562D = 0.4255 \\ 0.1237A + 0.7562C + 0.1237D + 0.7562 \cdot D = 0.1934 \\ 0.0935D = 0.0935 \end{cases}$$

$\boxed{D=1}$ $\quad A+B=0$

$A=-B$

$$0.1237 \cdot A + 0.7562 \cdot C + 0.8799 = 0.1934$$

$$0.7562\,C = \frac{-0.6865 - 0.1237A}{0.7562}$$

$$0.6364A - 0.7562A + - \frac{0.6865 + 0.1237A}{0.7562} + 0.8799 = 0.1934$$

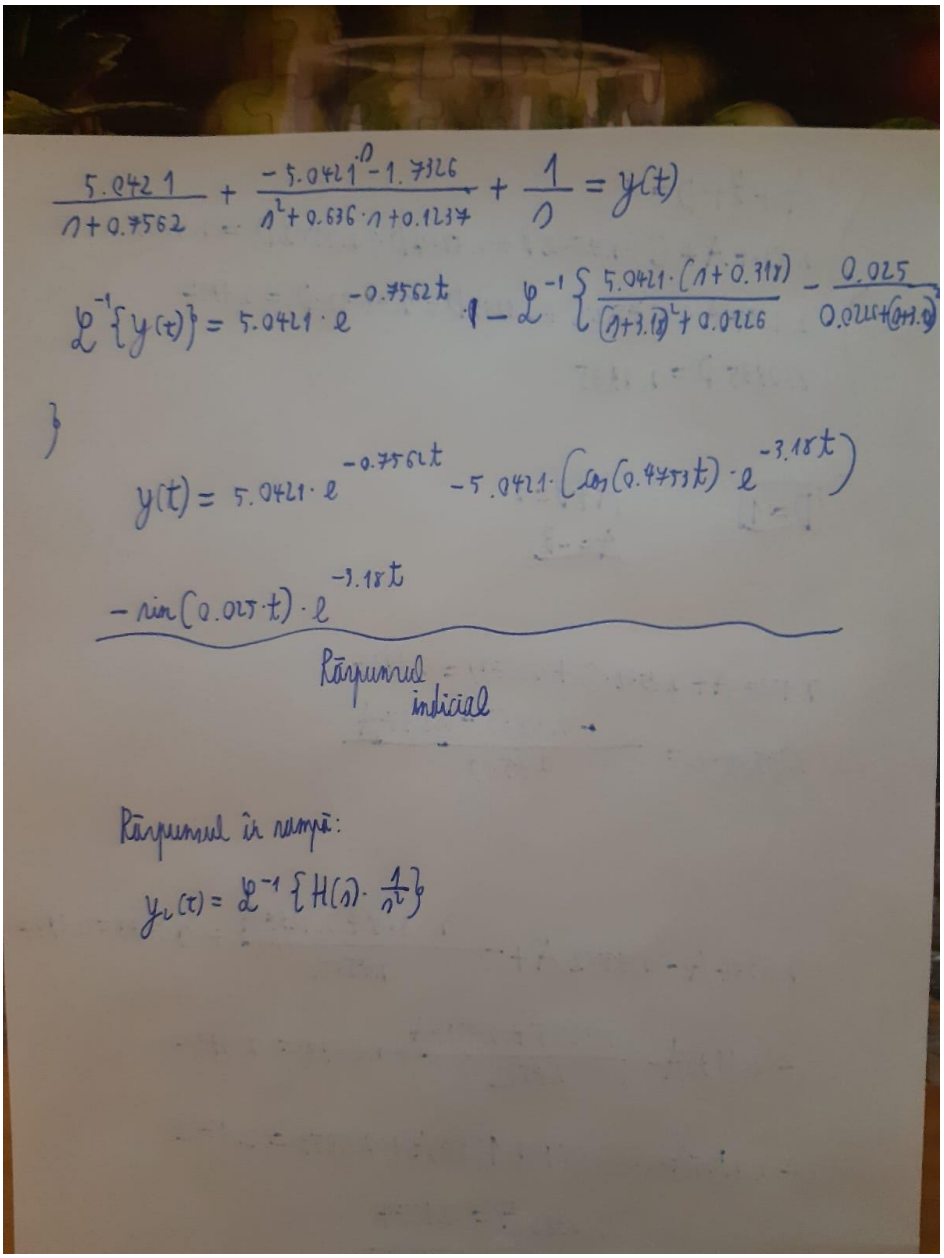
$$-0.1198A - \frac{0.6865 + 0.1237A}{0.7562} + 0.8799 = 0.1934$$

$$-0.0905A - 0.6855 + 0.1237A + 0.6653 = 0.1462$$

$$0.0332A = 0.1674$$

$\boxed{A = 5,0421}$ $\quad \boxed{B = -5,0421}$

$\boxed{C = -1.7326}$



9.

$$\frac{(T^0 + 1)\ (s^2 + 2 * \varsigma\ * w_n * s + w_n^2)}{(T^\wedge + 1)\ (s^2 + 2 * \varsigma\ * w_n * s + w_n^2)}$$

Rezultam de aici;

T^0 = 1/0.4536

$T^{\wedge}$ = 1/0.7562

$w_n^0=\sqrt{0.2062}$ = 0.4540

$w_n^{\wedge}=\sqrt{0.1237}$=0.3517

2 * ς^0 * w_n =-0.02811 rezulta: ς^0=-0.0309

2 * $\varsigma^{\wedge}$ * w_n=0.6364 rezulta: $\varsigma^{\wedge}$=0.9047

Factorul de proportionalitate:

K =H(0)= (0.4536 * 0.2062)/(0.7562 * 0.1237) = 1

Eroarea stationara de pozitie:

$€_{ssp}$=1 – H(0)=1-1=0

Eroarea stationara de viteza(in cazul finit, deoarece $€_{ssp}$=0):

$€_{ssv}= \lim_{t\to\infty}(u(t)-y(t)) \epsilon$ R