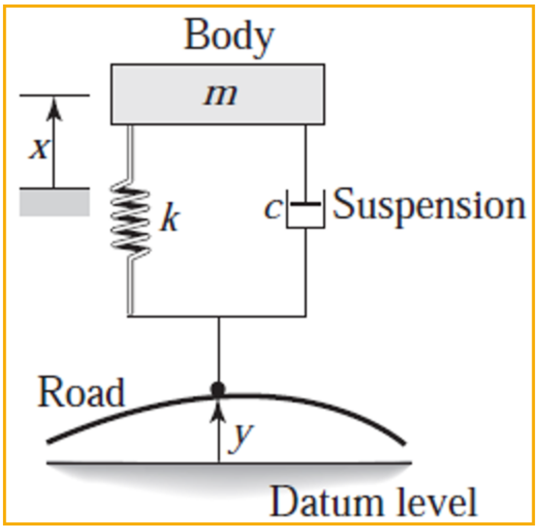
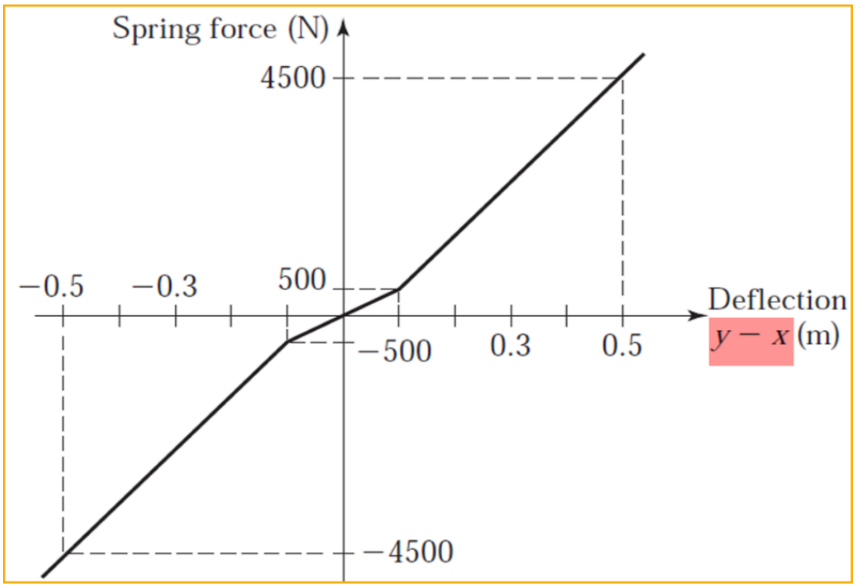
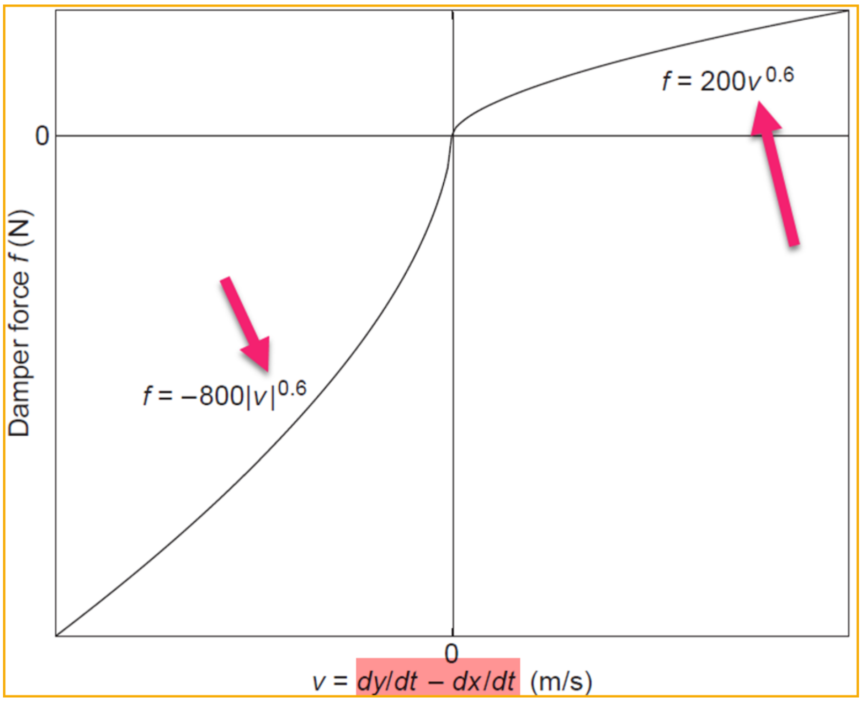
MODELARE ŞI SIMULARE- 2024

LABORATOR NR. 7 – SISTEME MECANICE (4), SISTEME FLUIDICE (3), SISTEME NELINIARE (2), SIMULINK (6)

7.1 Se cere modelul Simulink pentru sistemul mecanic de mai jos. Se cunoaşte că resortul şi amortizorul au caracteristicile prezentate mai jos. Intrarea sistemului este y(t) si este data mai jos. Se cunoaşte m=400 kg.






Damper force f (N)
0
f = 200v^0.6
f = −800|v|^0.6
0
v = dy/dt − dx/dt (m/s)

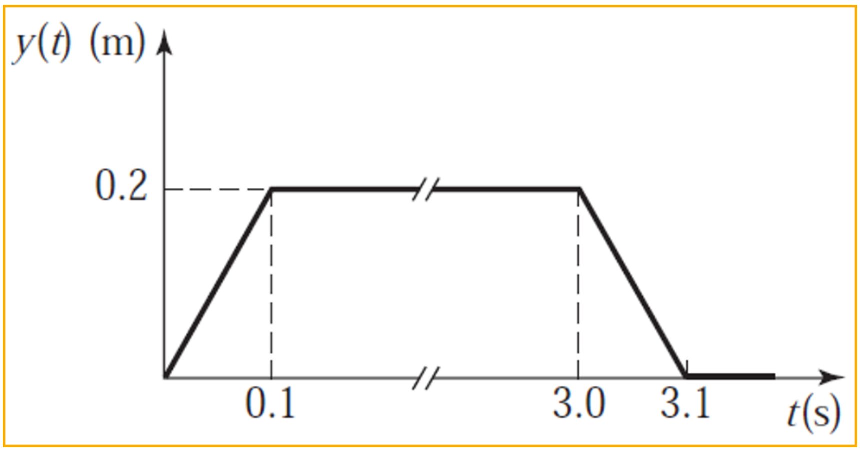
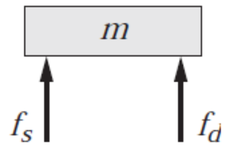

y(t) (m)
0.2
0.1
3.0
3.1
t(s)

DIAGRAMA DE ECHILIBRU, ECUATIA DINAMICA, DIAGRAMA BLOC

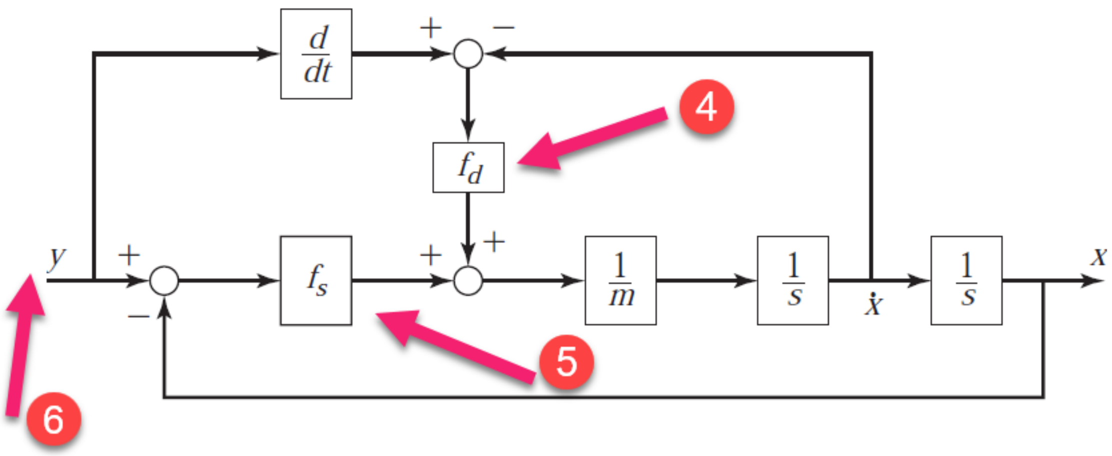
1



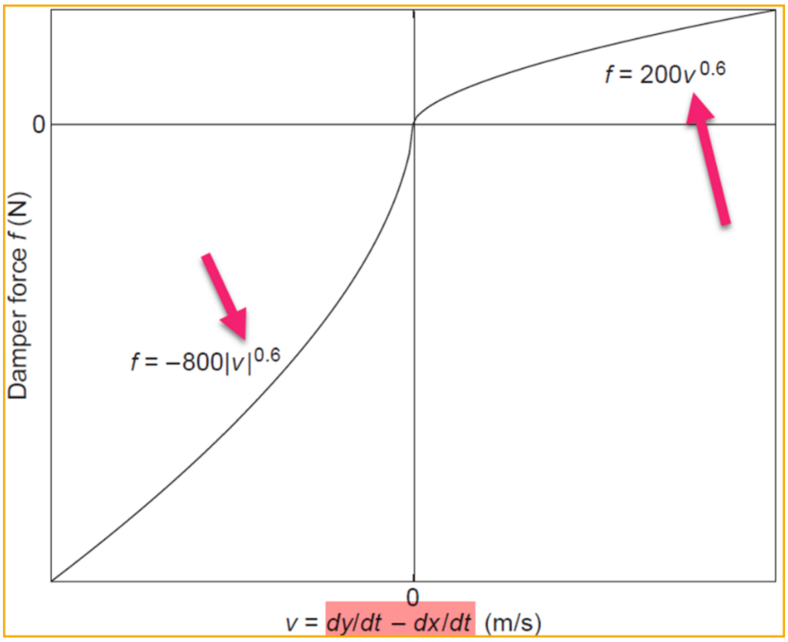
2

$$m\ddot{x} = f_s + f_d$$

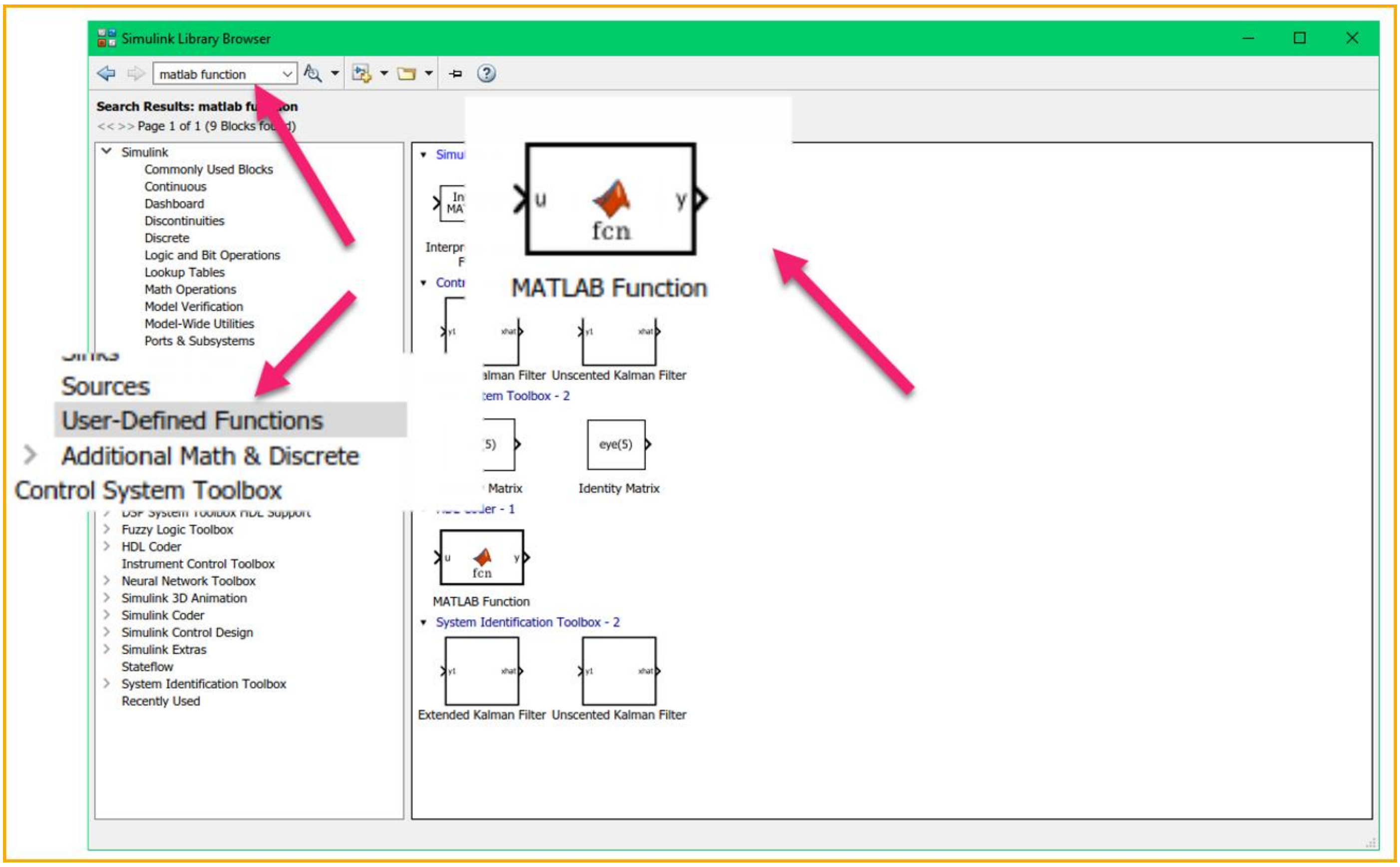
3



4. f_d



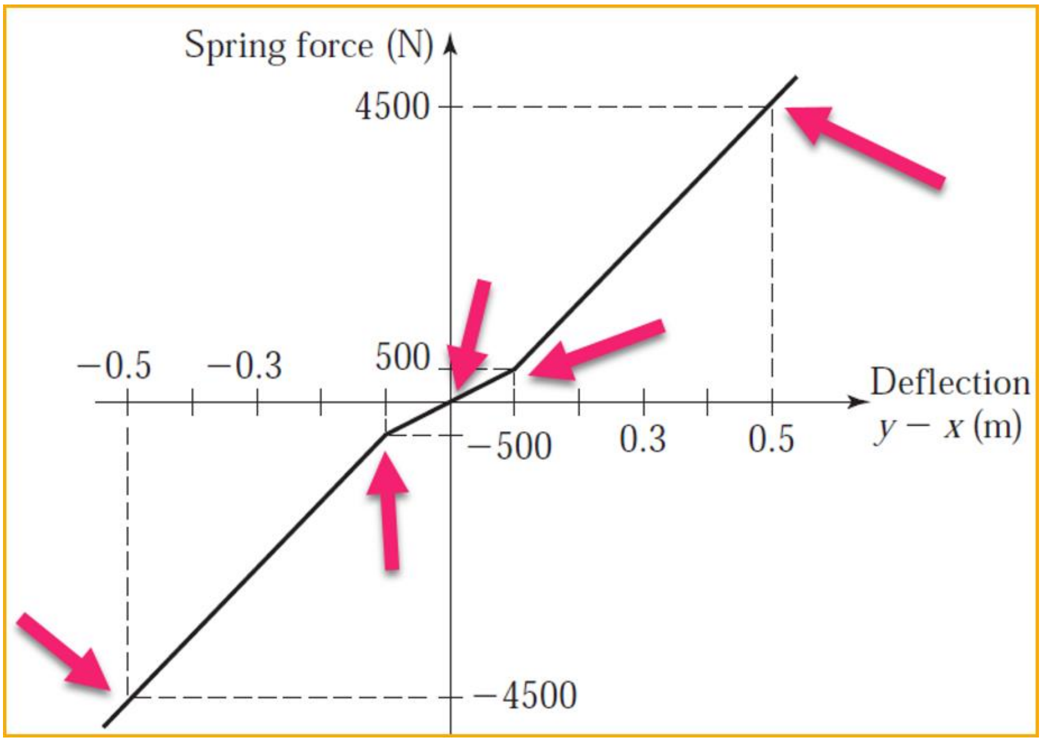
Blocul SIMULINK "Matlab function" (user-defined functions)



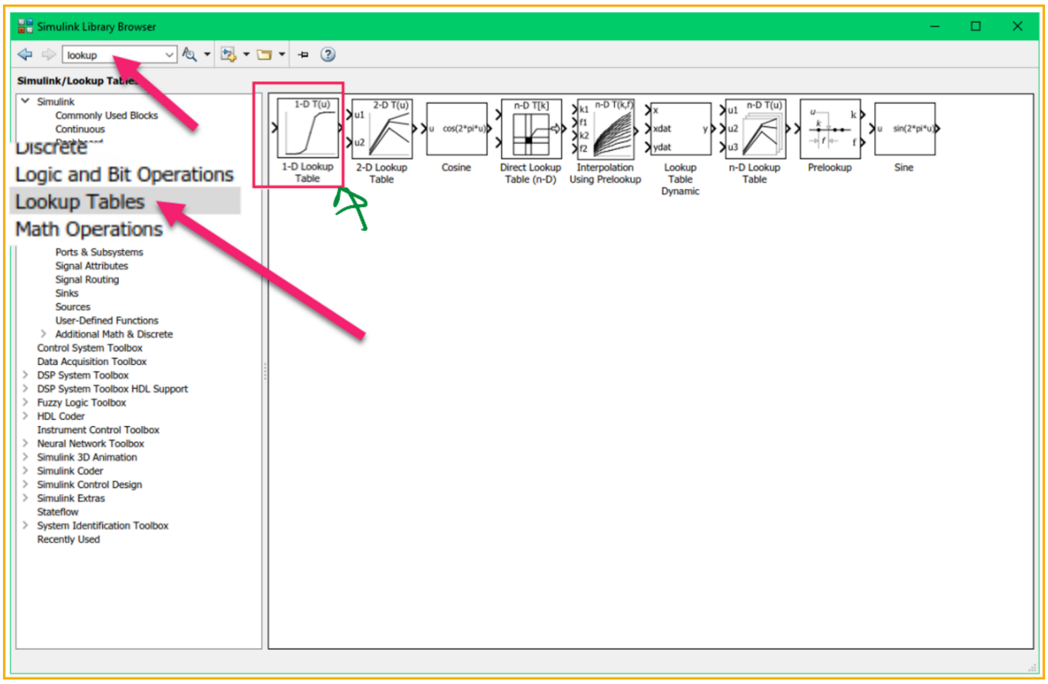
Funcţia noastră:

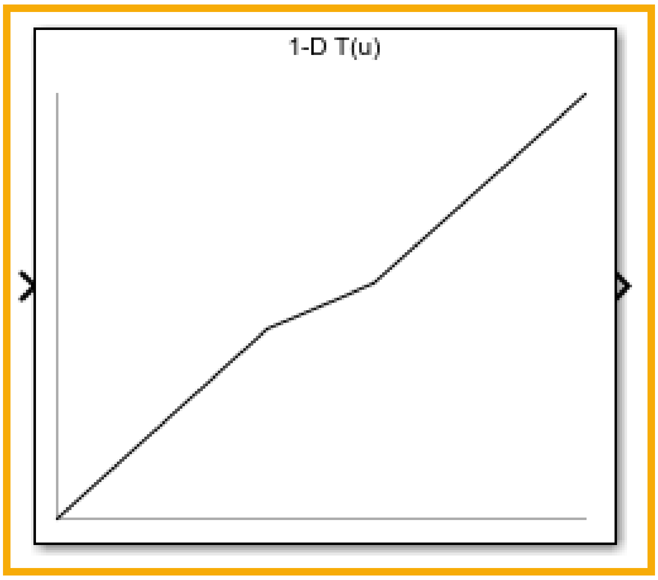
```
function f = damper(v)
if v <= 0
   f = -800*(abs(v)).^(0.6);
else
   f = 200*v.^(0.6);
end
```

5. f_s

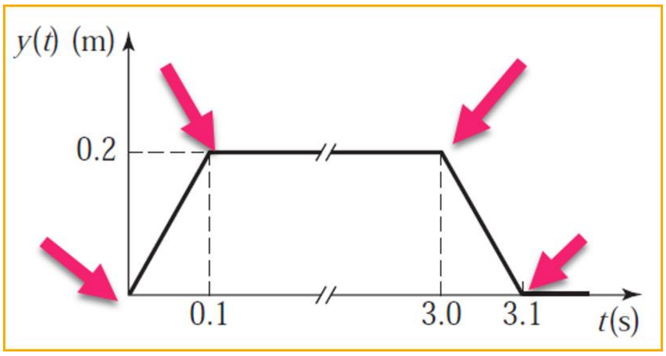


Blocul SIMULINK "1-D Lookup table" (Lookup tables)

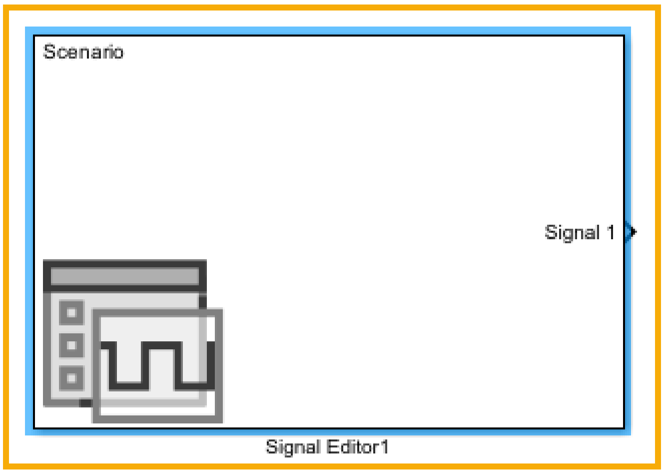


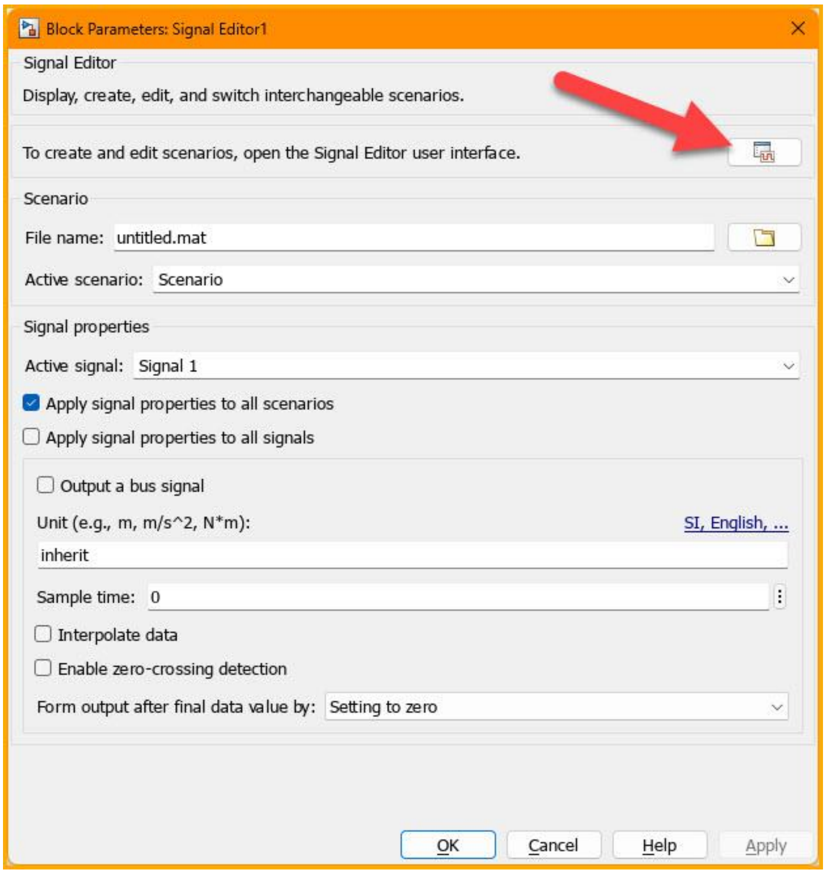

1-D T(u)

6. y(t)

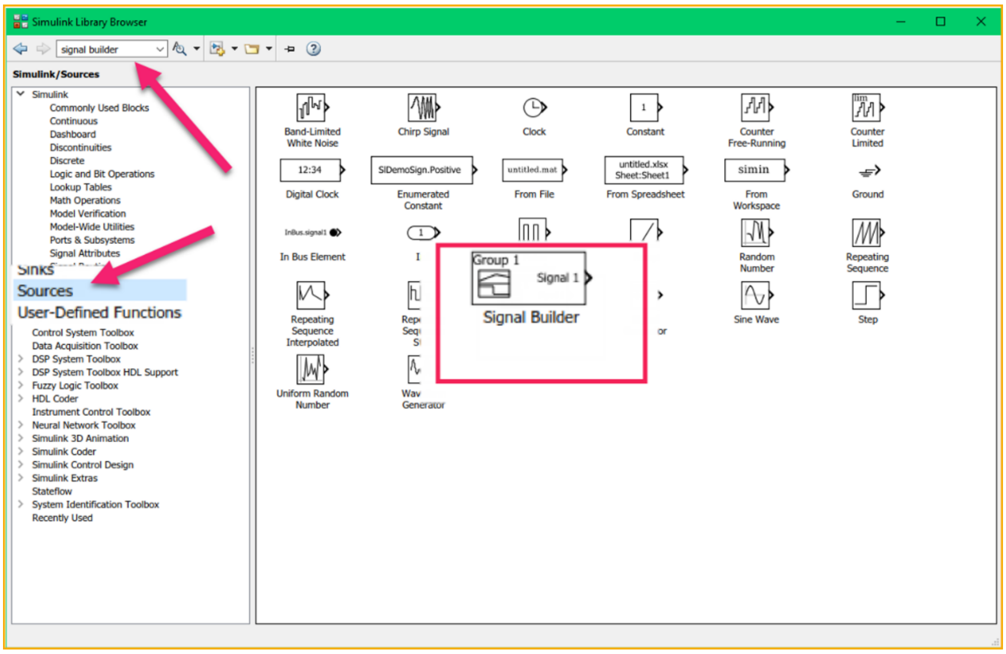


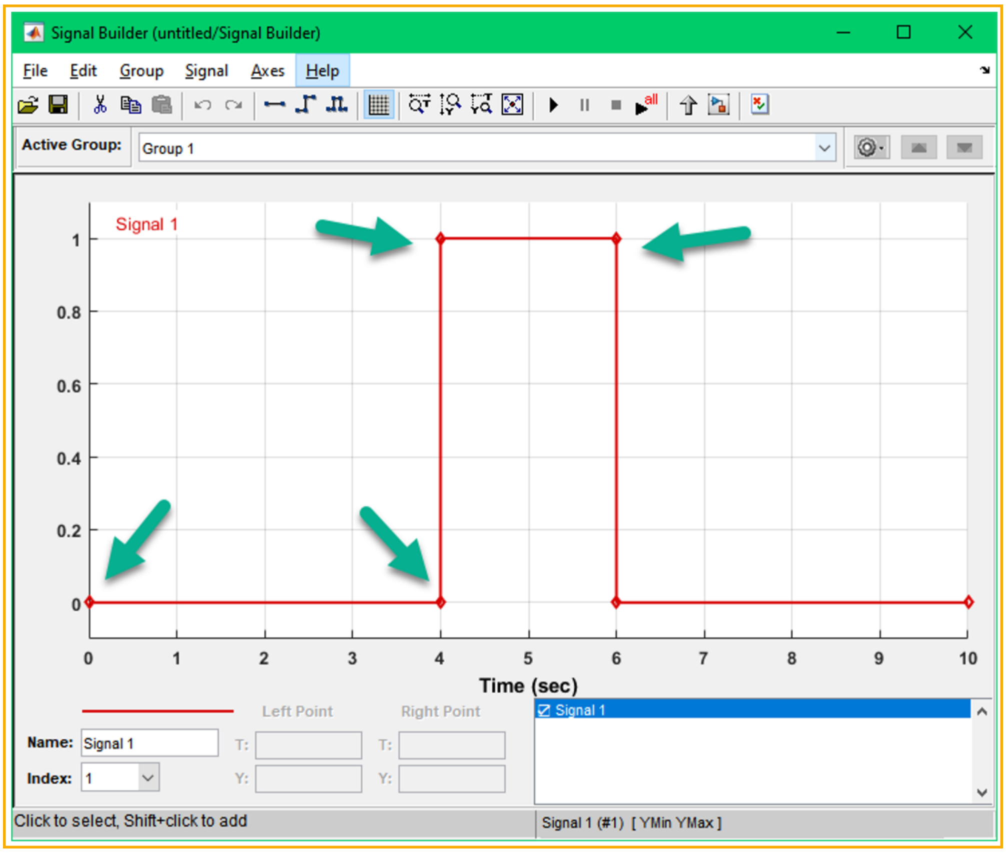
Blocul SIMULINK “Signal editor” (Sources, MATLAB 2024b)





Pentru generarea lui *y(t)* se mai poate folosi Blocul SIMULINK “Signal builder” (Sources) (disponibil in versiuni mai vechi).





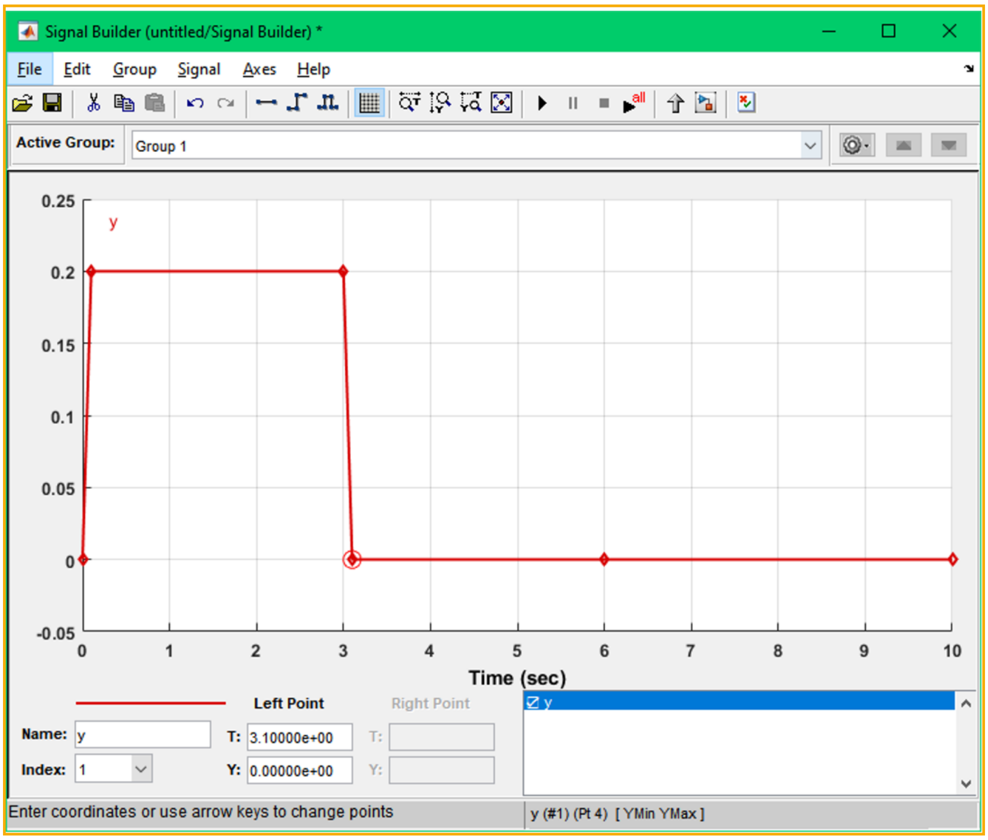
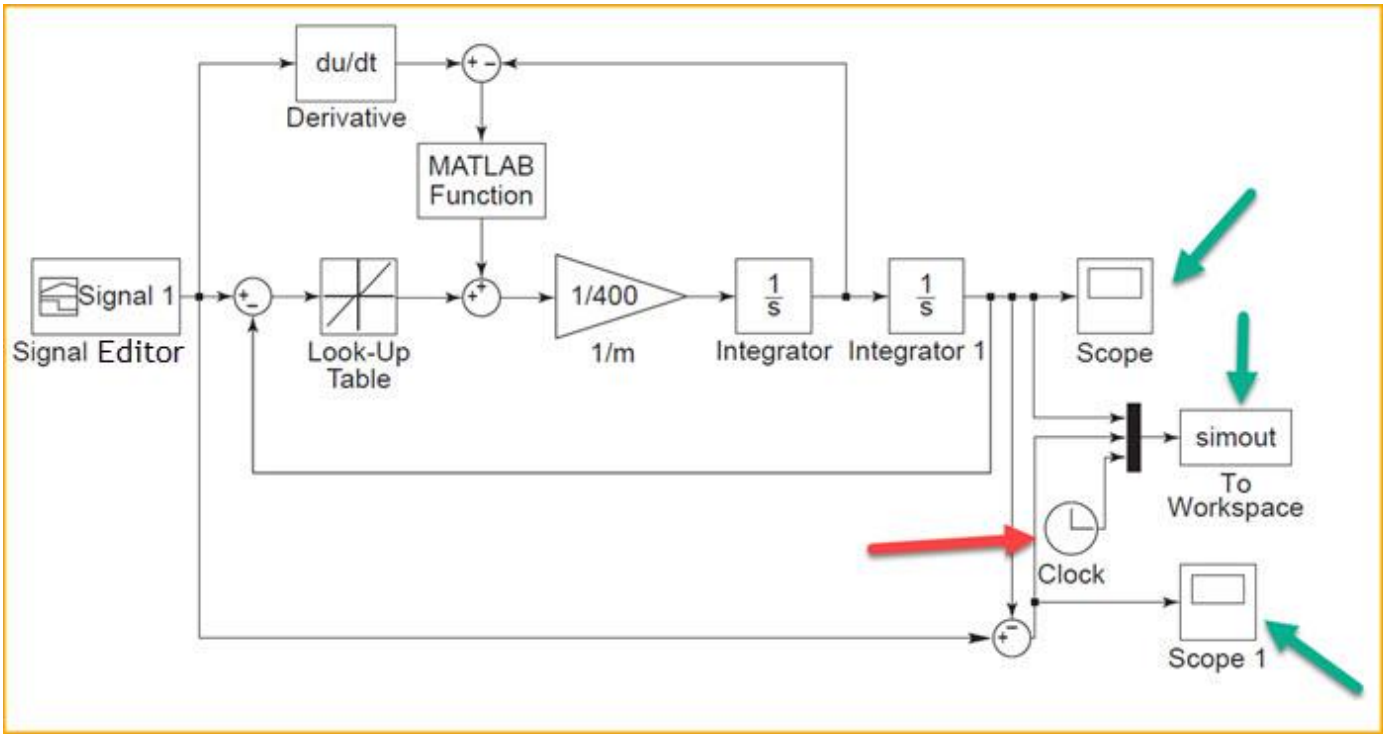
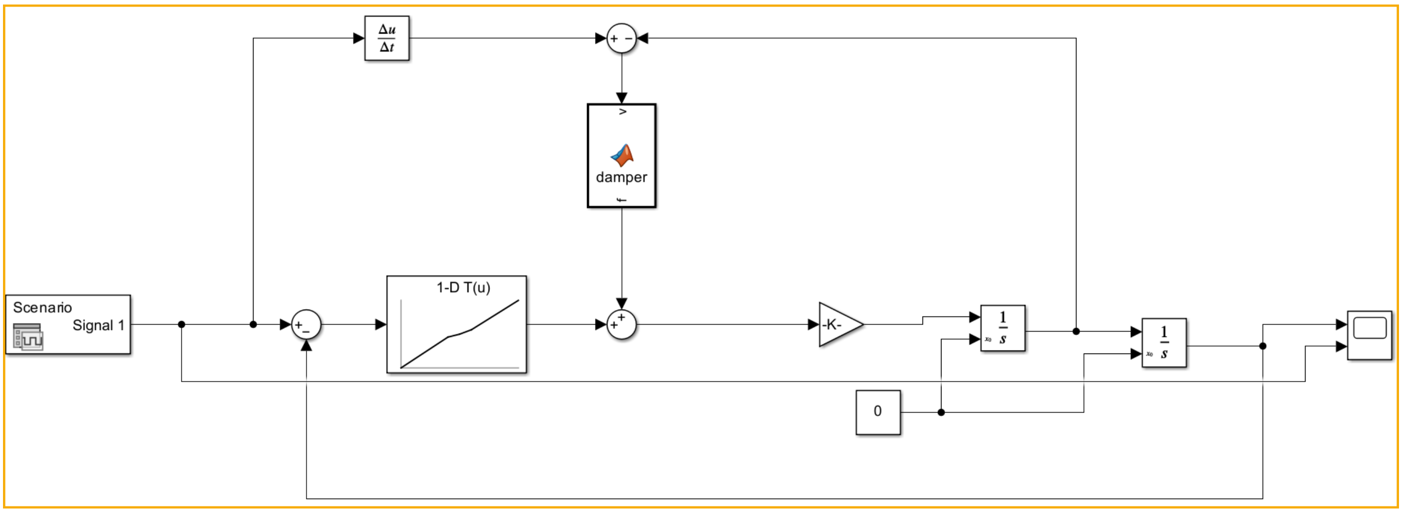
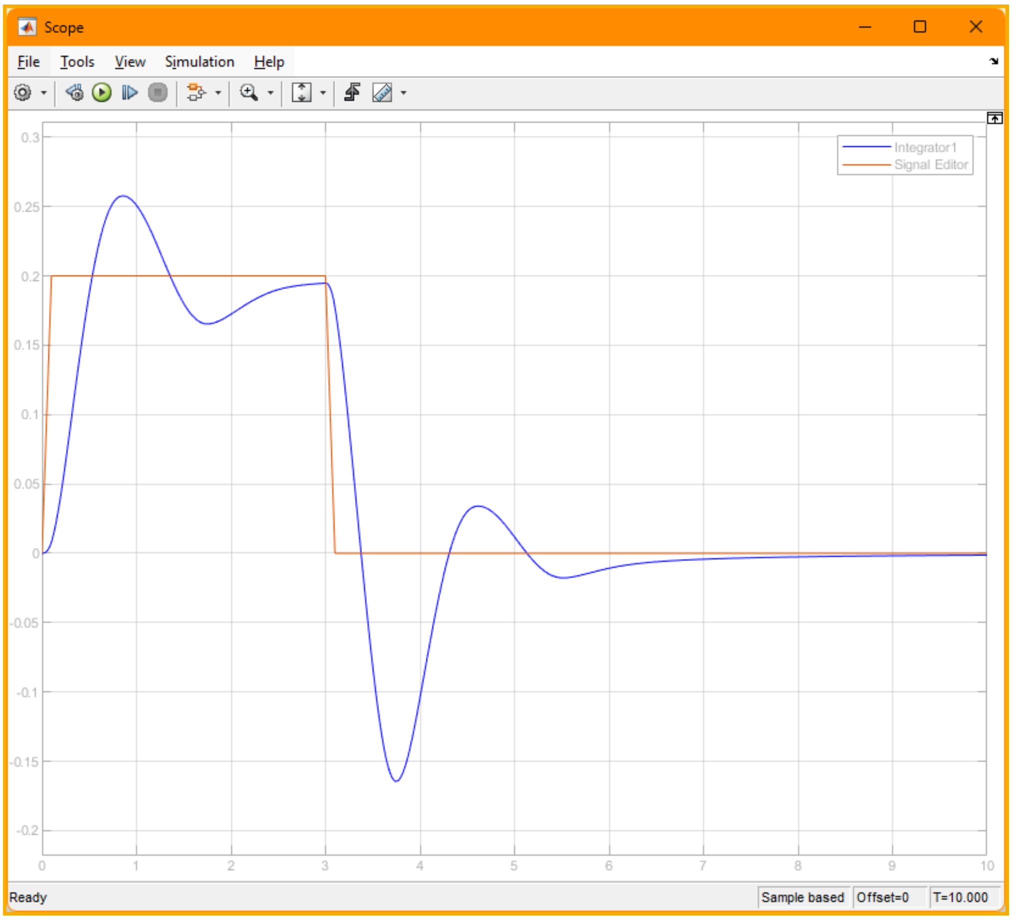

Signal Builder (untitled/Signal Builder) *
File Edit Group Signal Axes Help
Active Group: Group 1
y
0.25
0.2
0.15
0.1
0.05
0
-0.05
0 1 2 3 4 5 6 7 8 9 10
Time (sec)
Left Point
Right Point
Name: y
Index: 1
T: 3.10000e+00
Y: 0.00000e+00
Enter coordinates or use arrow keys to change points
y (#1) (Pt 4) [YMin YMax]

Diagrama Simulink



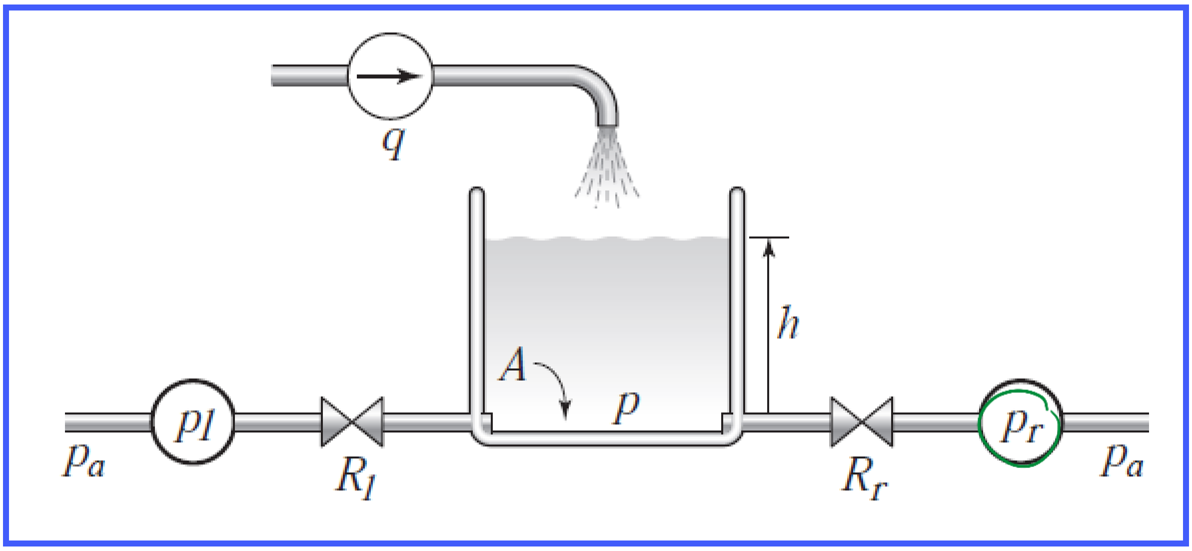



Scope
File Tools View Simulation Help
Integrator1
Signal Editor
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0 1 2 3 4 5 6 7 8 9 10
Ready
Sample based
Offset=0
T=10.000

7.2 Se cer modelul matematic si modelul Simulink pentru sistemul hidraulic de mai jos. Se cunoaşte că dependenţele debit-variatie de presiune sunt neliniare:

$$\boldsymbol{q = \frac{1}{R} SSR(\Delta p)}$$

$$\boldsymbol{SSR(u) = \begin{cases} \sqrt{u}, \text{dacă } u \geq 0 \\ -\sqrt{|u|}, \text{dacă } u \leq 0 \end{cases}}$$

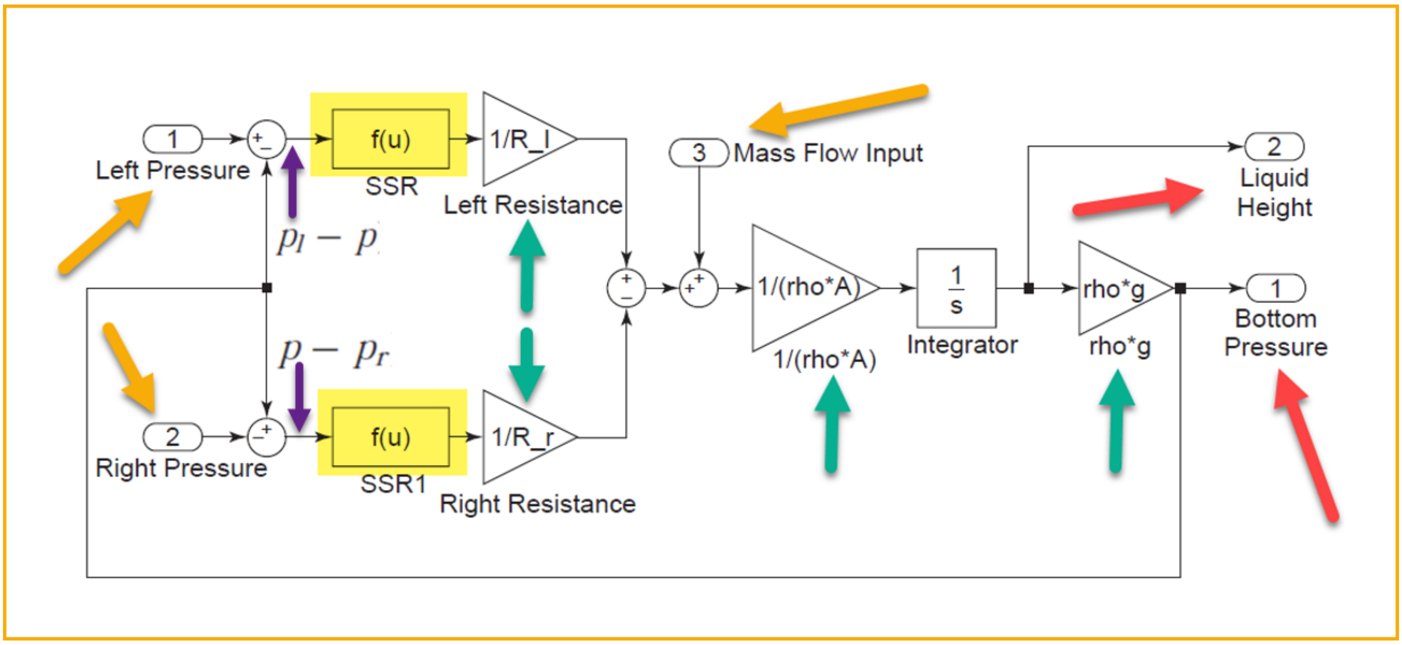


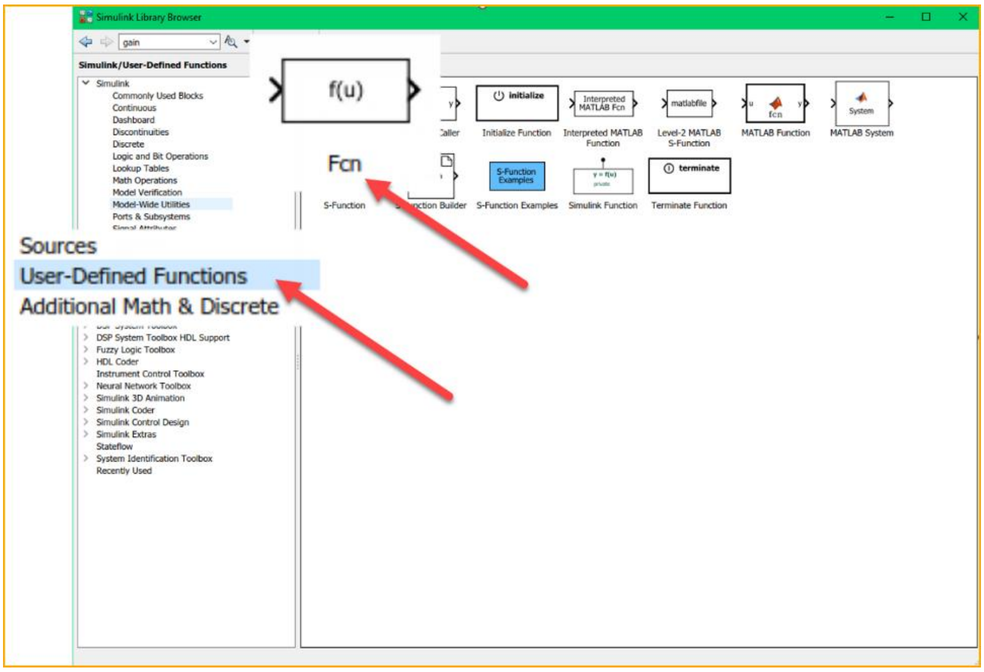
Observaţie.

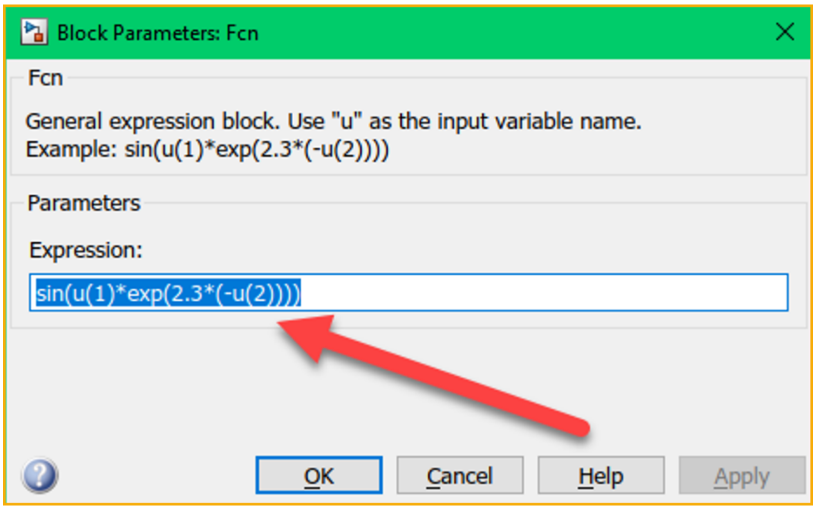
În Matlab, SSR(u)= sgn(u)*sqrt(abs(u)).

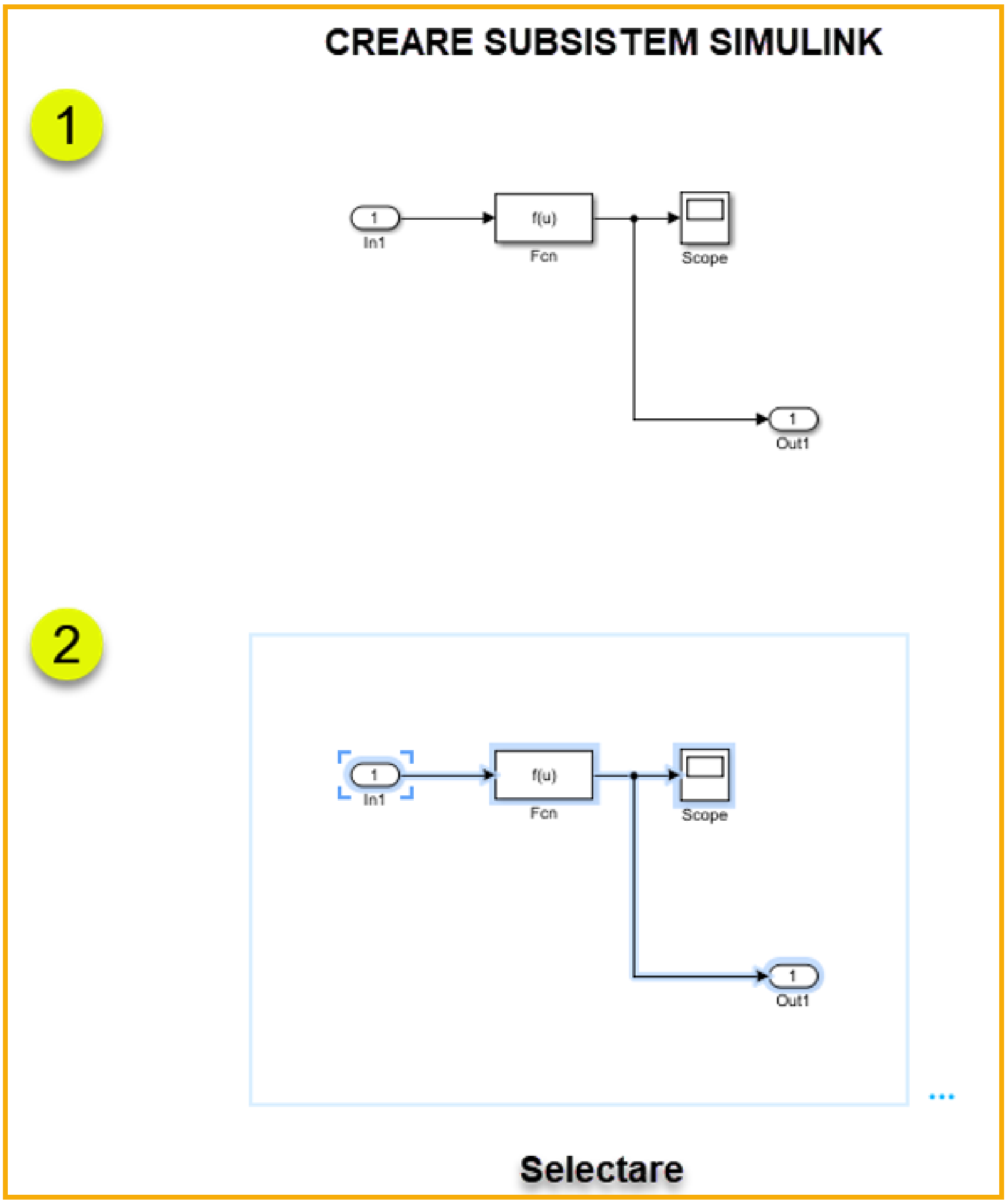
$$\rho A \frac{dh}{dt} = q + \frac{1}{R_l}\mathrm{SSR}(p_l - p) - \frac{1}{R_r}\mathrm{SSR}(p - p_r)$$

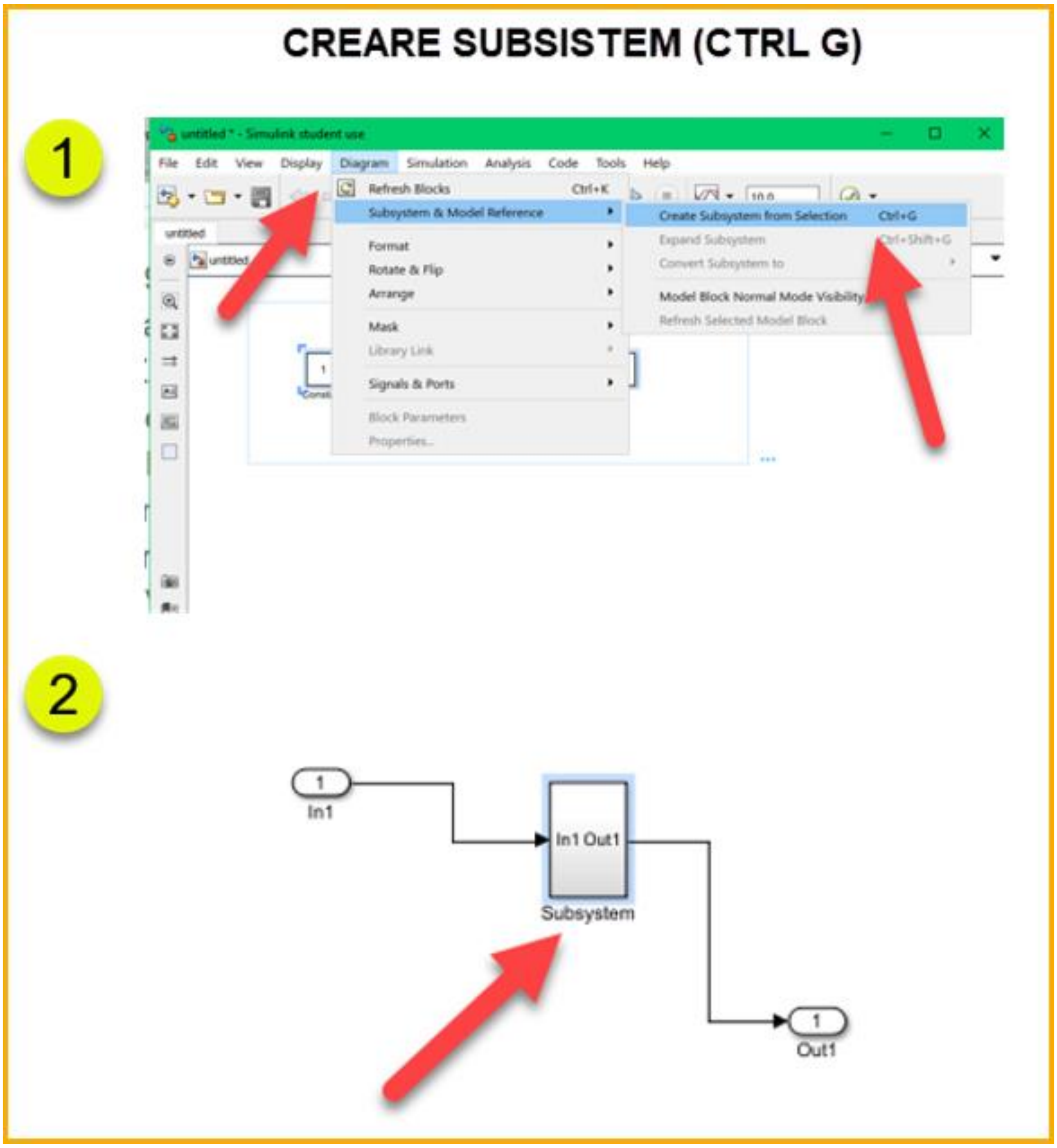
Diagrama bloc/Simulink? Intrările/ieşirile sunt $p_l, p_r, q \;/\; p, h$

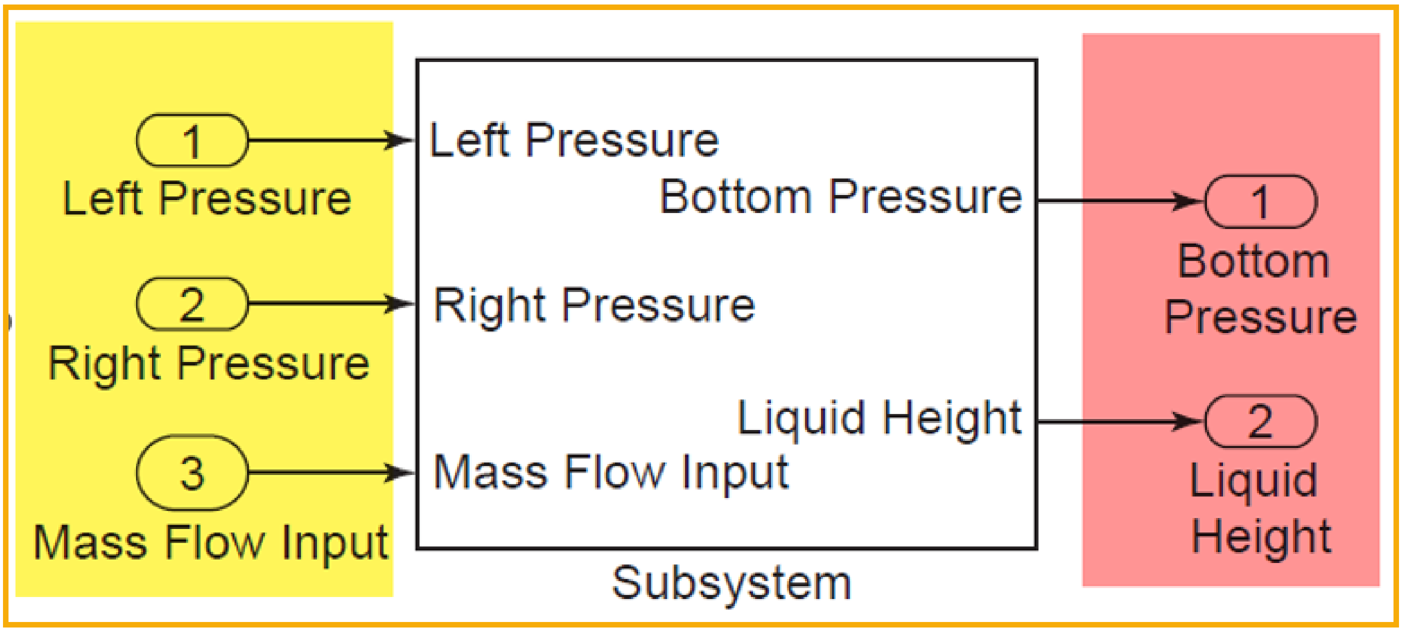




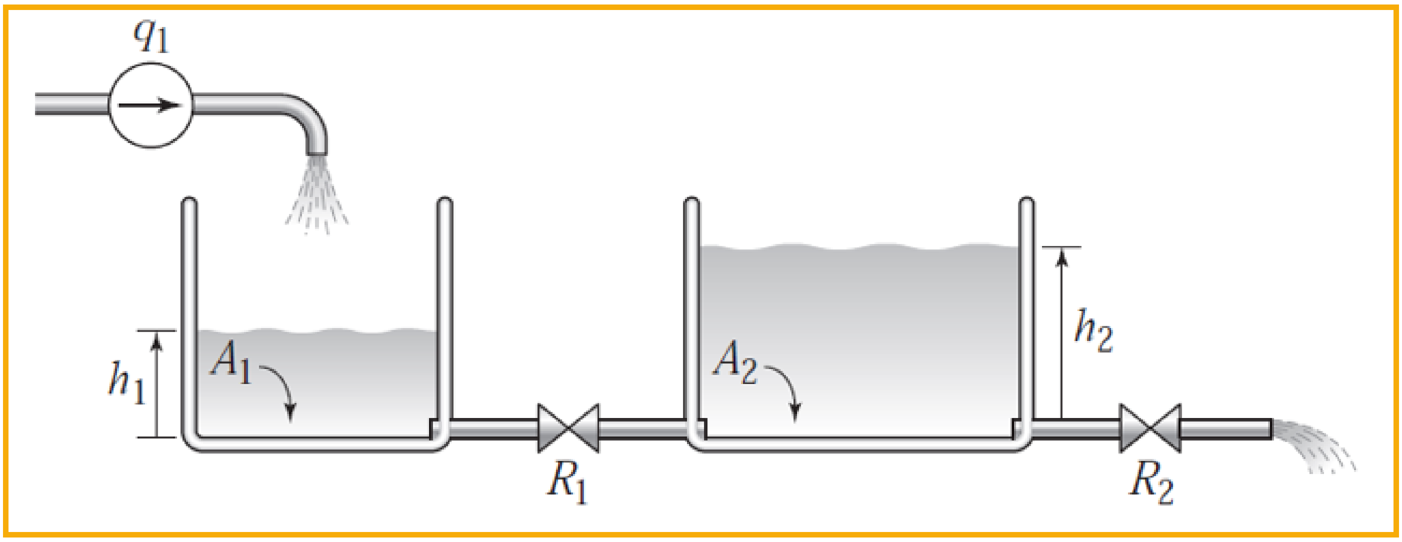

Block Parameters: Fcn
Fcn
General expression block. Use "u" as the input variable name.
Example: sin(u(1)*exp(2.3*(-u(2))))
Parameters
Expression:
sin(u(1)*exp(2.3*(-u(2))))
OK
Cancel
Help
Apply


CREARE SUBSISTEM SIMULINK
1
1
In1
f(u)
Fcn
Scope
1
Out1
2
1
In1
f(u)
Fcn
Scope
1
Out1
Selectare

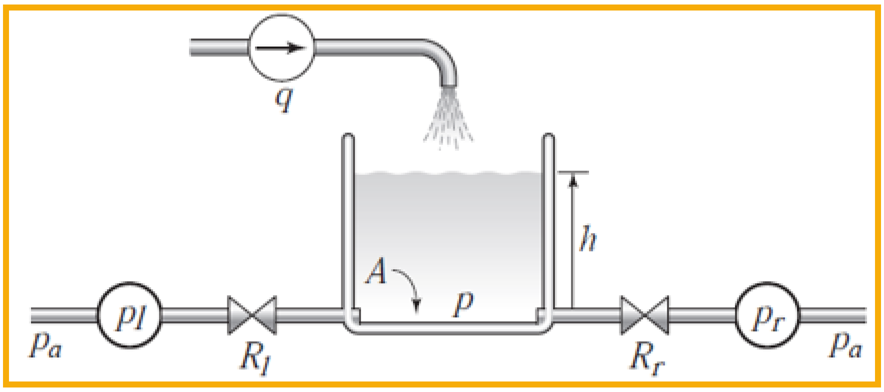

CREARE SUBSISTEM (CTRL G)
1
untitled * - Simulink student use
File Edit View Display Diagram Simulation Analysis Code Tools Help
Refresh Blocks Ctrl+K
Subsystem & Model Reference
Create Subsystem from Selection Ctrl+G
Expand Subsystem Ctrl+Shift+G
Convert Subsystem to
Model Block Normal Mode Visibility
Refresh Selected Model Block
Format
Rotate & Flip
Arrange
Mask
Library Link
Signals & Ports
Block Parameters
Properties...
2
In1
In1 Out1
Subsystem
Out1

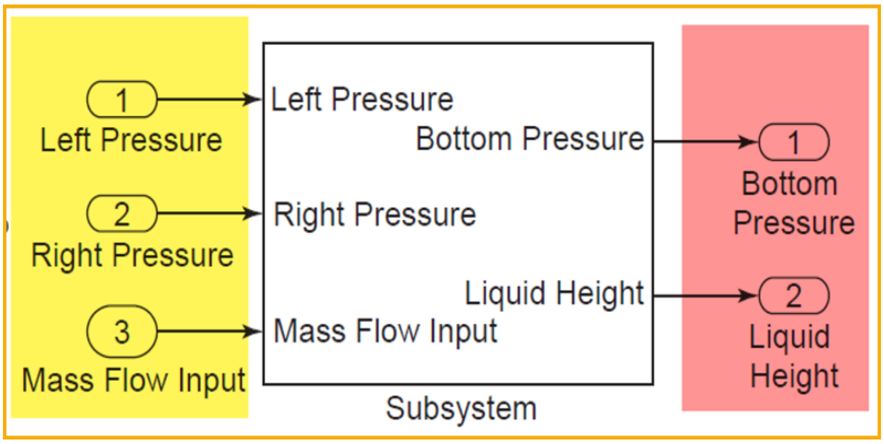

1
Left Pressure
2
Right Pressure
3
Mass Flow Input
Left Pressure
Bottom Pressure
Right Pressure
Liquid Height
Mass Flow Input
Subsystem
1
Bottom Pressure
2
Liquid Height

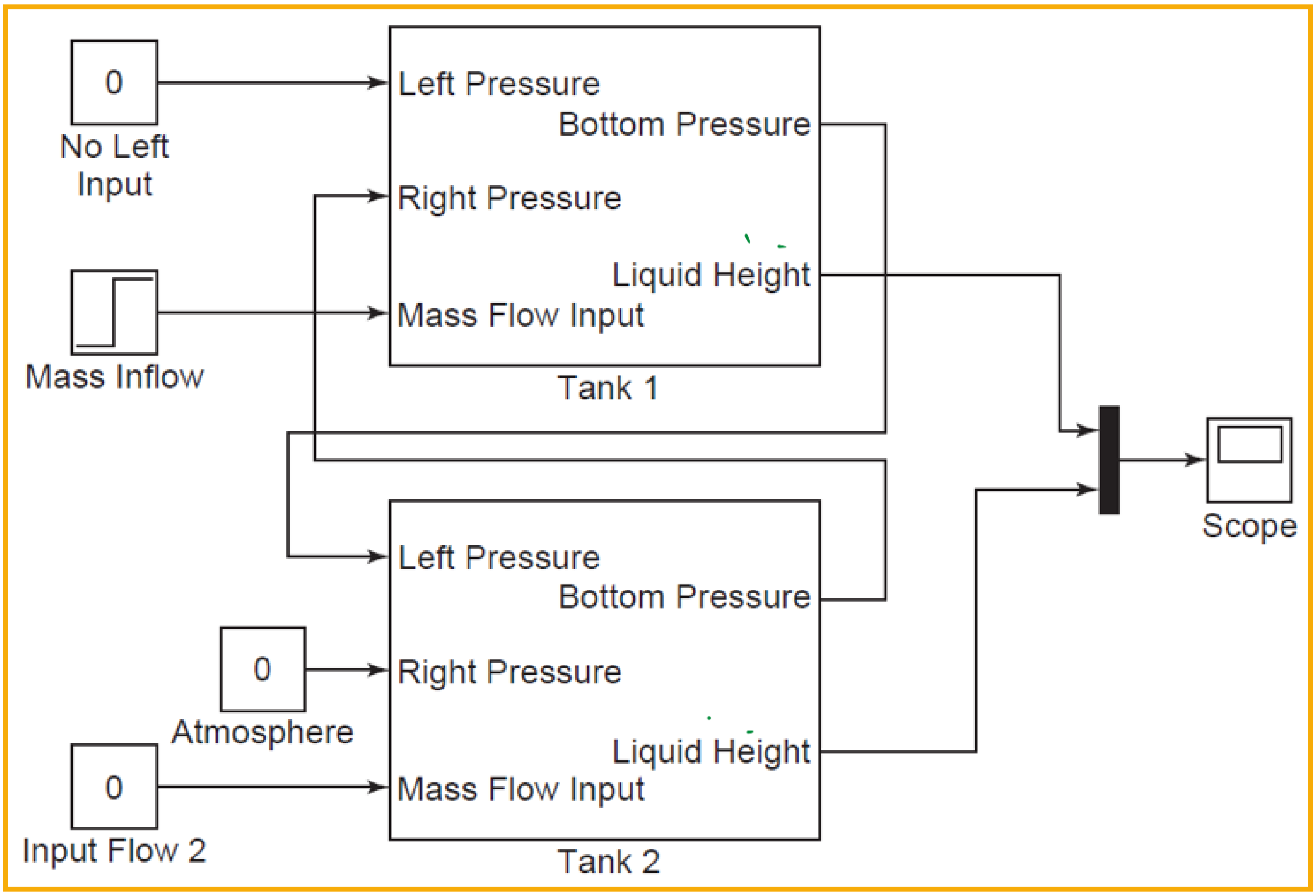
PRO 7.3 Se cere modelul Simulink pentru sistemul hidraulic de mai jos. Se cunosc: $A_1 = 2, A_2 = 5, R_1 = 20, R_2 = 50, h_{1_0} = 1, h_{2_0} = 10$. Intrarea este o treaptă unitară.

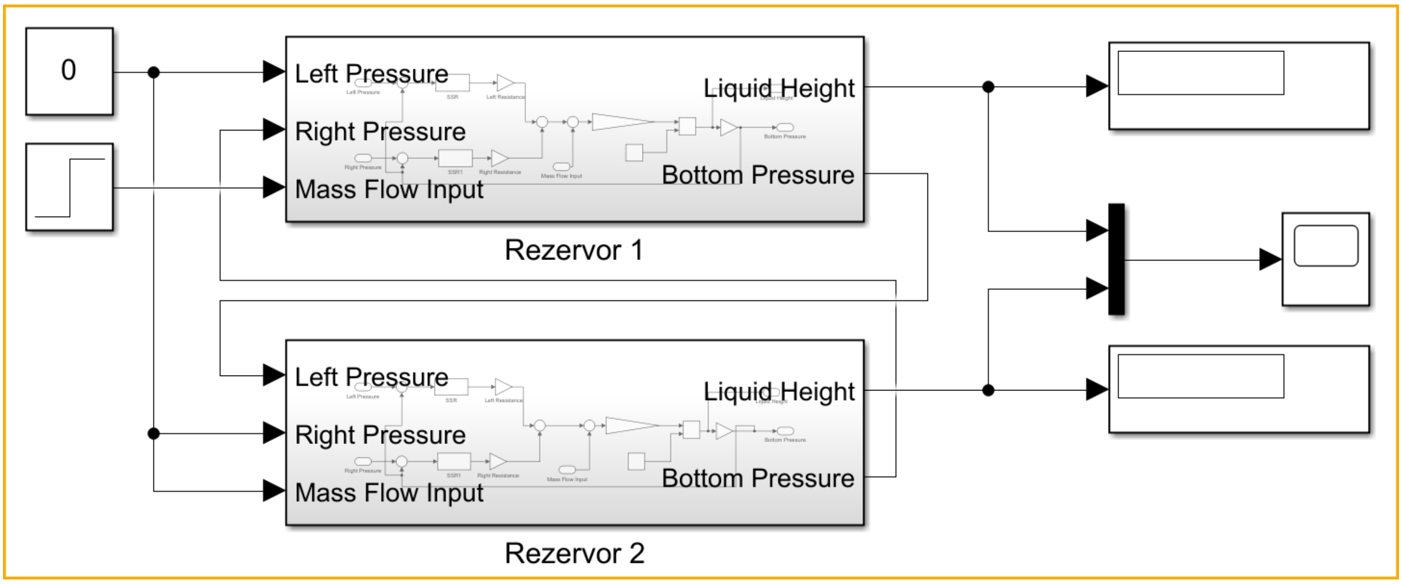


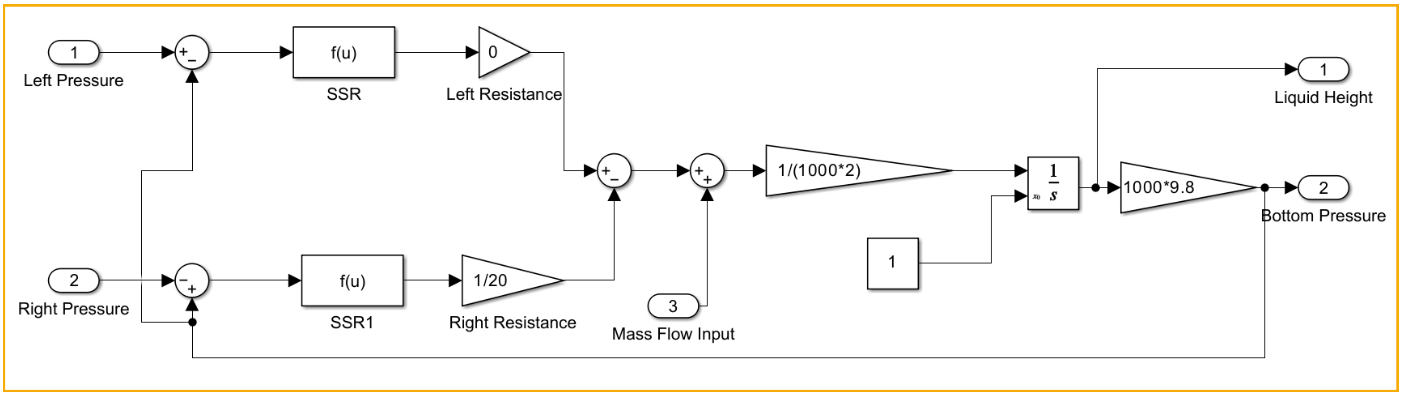
Observaţie. Avem (şi folosim) modelul Simulink de la problema anterioara:

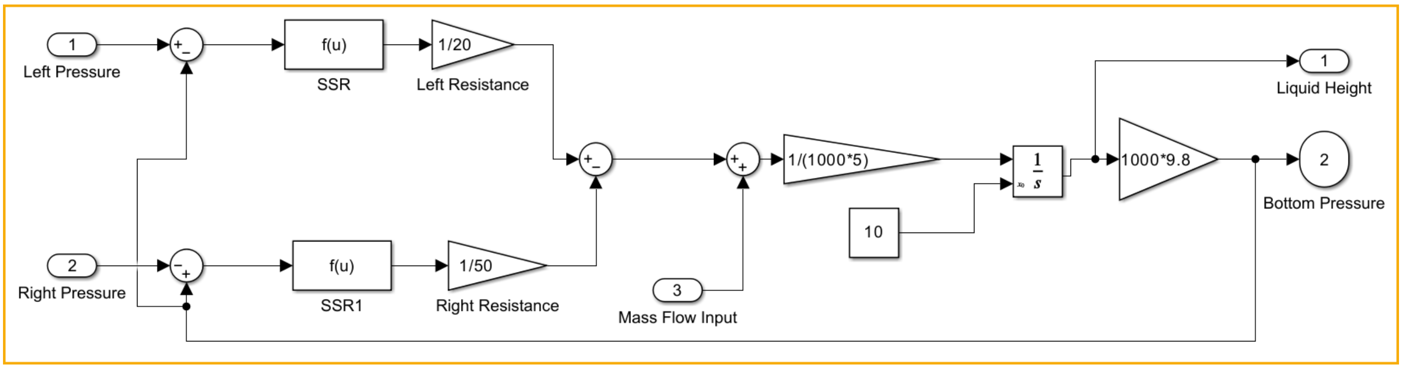


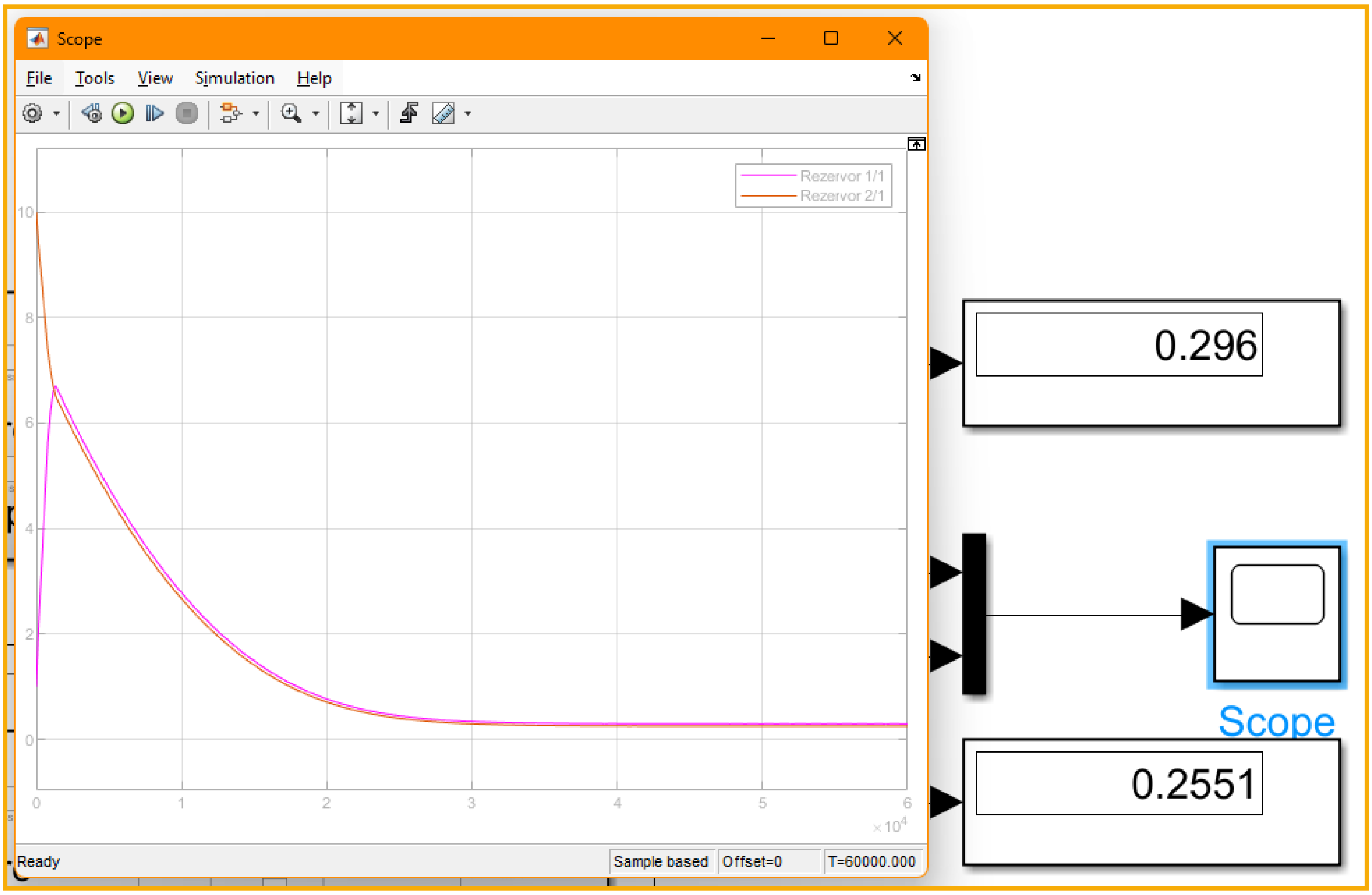



0
No Left Input
Mass Inflow
Left Pressure
Bottom Pressure
Right Pressure
Liquid Height
Mass Flow Input
Tank 1
Scope
Left Pressure
Bottom Pressure
0
Atmosphere
Right Pressure
Liquid Height
0
Mass Flow Input
Input Flow 2
Tank 2


0
Left Pressure
Right Pressure
Mass Flow Input
Liquid Height
Bottom Pressure
Rezervor 1
Left Pressure
Right Pressure
Mass Flow Input
Liquid Height
Bottom Pressure
Rezervor 2


Left Pressure
SSR
Left Resistance
Liquid Height
1/(1000*2)
1000*9.8
Bottom Pressure
Right Pressure
SSR1
1/20
Right Resistance
Mass Flow Input


Left Pressure
SSR
1/20
Left Resistance
Liquid Height
1/(1000*5)
1000*9.8
Bottom Pressure
Right Pressure
SSR1
1/50
Right Resistance
Mass Flow Input


Scope
File Tools View Simulation Help
Rezervor 1/1
Rezervor 2/1
Ready
Sample based
Offset=0
T=60000.000
0.296
0.2551
Scope

PRO 7.4 Pentru sistemul hidraulic de mai jos, se cunosc valorile de regim staţionar: $\overline{Q}, \overline{H_1}, \overline{H_2}, \overline{H_3}, \overline{H_1} = \overline{H_2}$. La t=0, debitul de intrare variază de la $\overline{Q}$ la $\overline{Q} + q_i$. Dacă h_1, h_2, h_3 sunt variaţii mici, se cere funcţia de transfer $\frac{Q_o(s)}{Q_i(s)}$. Toate rezistentele sunt liniare. În plus, se cere modelul Simulink, folosindu-se subsistemul creat la o problemă anterioară.