OPEN LOOP SIMULATION CODE

```
commandwindow
clear all
clc
close
bdclose('all')

V = 2.1;
F = 0.085
k = 0.04
steptime = 0.5

Ufinal = 1.5
open('asss_1')
sim('asss_1')
[t,x,y] = sim('asss_1',[0 100])
plot(t,y)
ylabel('concentration(mol/m^3)')
xlabel('time(mins)')
```

CLOSED LOOP SIMULATION CODE

```
commandwindow
clear all
clc
close
bdclose('all')
V = 2.1;
F = 0.085
k = 0.04
steptime = 0.15;
Ufinal = 2.5
Kc = 0.5
tauD =0.1
tauI = 0.3
P = Kc
I = Kc/tauI
D = Kc*tauD

open('asss_closedloop')
[t,x,y] = sim  ('asss_closedloop',[0 150])
plot(t,y)
hold on
ssvalue = Ufinal*1
francis = length(y)
ssvalueg = ssvalue*ones(francis,1)
plot(t,ssvalueg)
legend('dynamic response', 'set point')
ylabel('concentration(mol/m^3)')
xlabel('time(mins)')
```

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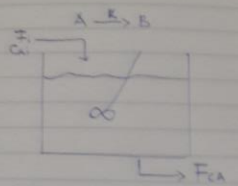

Accumulation = In − out + generation

$$M_a \frac{d_a}{dt} = F_i C_{Ai} - F C_A - K C_A V$$

$$M_a \frac{V dC_A}{dt} = F_i C_{Ai} - F C_A - K C_A V$$

but V = Constant ; ∴ $F_i = F$

$$M_a \frac{V dC_A}{dt} = \left[F(C_{Ai} - C_A) - K C_A V \right]$$

$$\frac{V dC_A}{dt} = F(C_{Ai} - C_A) - K C_A V \text{ — Dynamic model}$$

$$\frac{V dC_{As}}{dt} = F(C_{Ais} - C_{As}) - K C_{As} V$$

$$\frac{V d(C_A - C_{As})}{dt} = F(C_{Ai} - C_{Ais}) - F(C_A - C_{As})$$

Let $C_A - C_{As} = \bar{C}_A$

$C_{Ai} - C_{Ais} = \bar{C}_{Ai}$

$$\frac{V d\bar{C}_A}{dt} = F\bar{C}_{Ai} - F\bar{C}_A - KV\bar{C}_A$$

$$\frac{V d\bar{C}_A}{dt} = F(\bar{C}_{Ai} - \bar{C}_A) - KV\bar{C}_A$$

$$V\left[S\bar{C}_{A(s)} - \cancel{\bar{C}_{A(0)}}^{\,0}\right] = F(\bar{C}_{Ai(s)} - \bar{C}_{A(s)}) - KV\bar{C}_{A(s)}$$

$$VS\bar{C}_{A(s)} = F\bar{C}_{Ai(s)} - F\bar{C}_{A(s)} - KV\bar{C}_{A(s)}$$

$$VS\bar{C}_{A(s)} + F\bar{C}_{A(s)} + KV\bar{C}_{A(s)} = F\bar{C}_{Ai(s)}$$

$$\bar{C}_{A(s)}\left[Vs + F + Kv\right] = F\bar{C}_{Ai(s)}$$

$$G(s) = \frac{\text{Output}}{\text{input}}$$

$$G(s) = \frac{\bar{C}_{A(s)}}{C_{Ai(s)}}$$

$$G(s) = \frac{F}{Vs + F + KV}$$

$$G(s) = \frac{F}{V(S+K) + F}$$

$$G(s) = \frac{0.085}{2.1(s + 0.04) + 0.085}$$

$$G(s) = \frac{0.085}{2.1s + 0.084 + 0.085}$$

$$G(s) = \frac{0.085}{2.1s + 0.169}$$

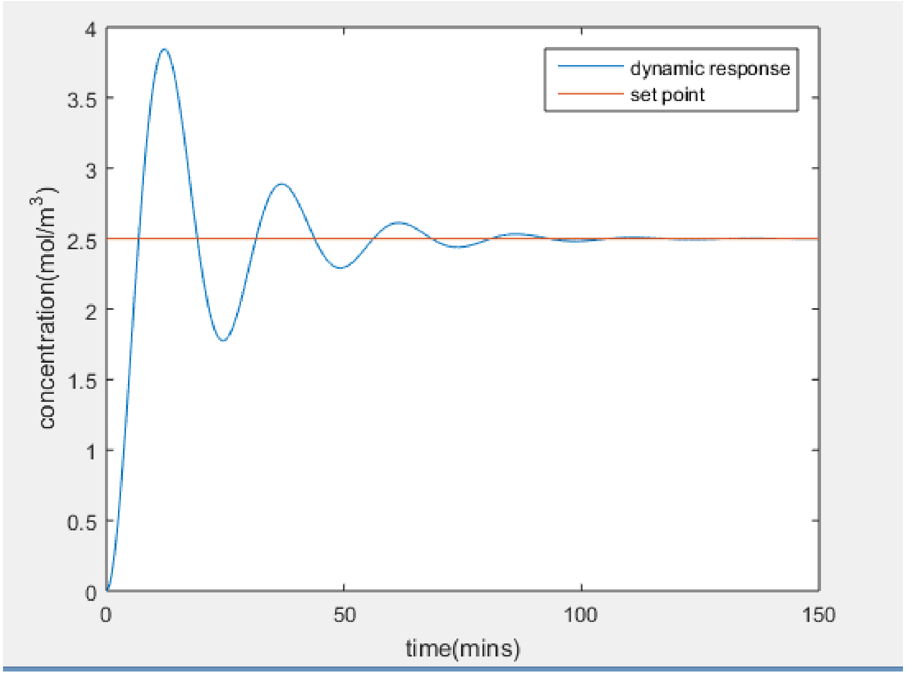

FIG. 1 - CLOSED LOOP DYNAMIC RESPONSE OF THE SYSTEM

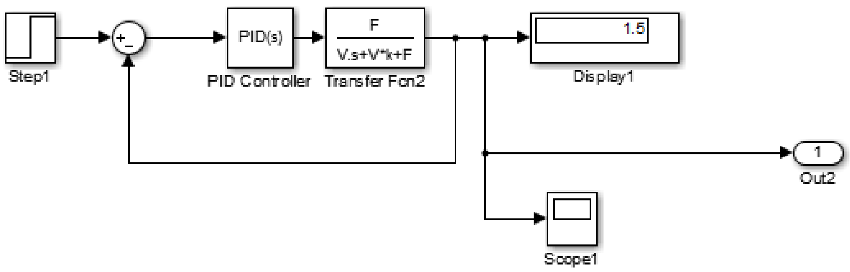

FIG. 2 - SIMULINK MODEL FOR THE CLOSED LOOP

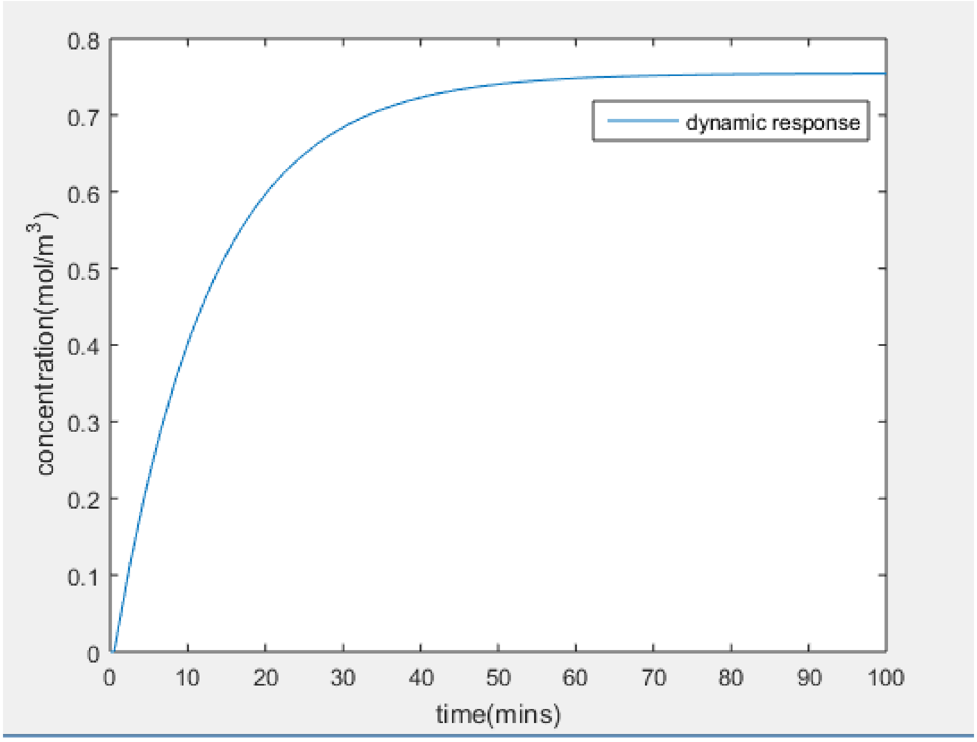

FIG. 3 - OPEN LOOP RESPONSE OF THE SYSTEM

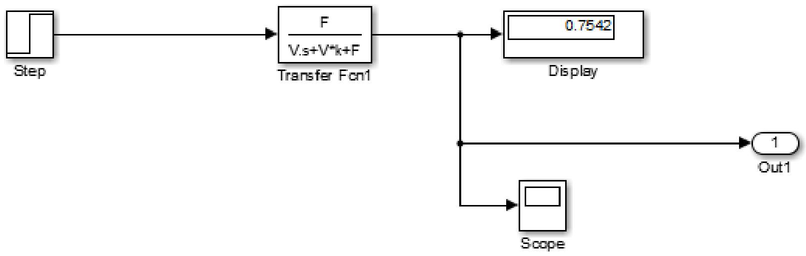

FIG. 4 - OPEN LOOP SIMULINK MODEL