```
(*Thermodynamical Properties*)

T0 = 22 + 273; (*Ambient Temperature _Kelvin*)
P0 = 1 * 10^5; (*Ambient Pressure _Pa*)

Ts = 30 + 273; (*Source Air Temerature _deg C*)
Ps = 3 * 10^5; (*Air source Pressure _Pa*)
ρs = 3.44; (*Air source density _kg/m^3 at T=30deg*)
γ = 1.41; (*Heat capacity ratio of air at T=20 deg*)
Rair = 287 ; (*Air Specific Constant _J/kg.K at 25deg and 100kPa*)

TA1 = 25 + 273 ; (*Pressure Chamber1 temperature _Kelvin*)
TA2 = 25 + 273 ; (*Pressure Chamber2 temperature _Kelvin*)

AP.ch1 = Pi * (0.3 / 2) ^2 ;
(*Pressure Chamber1 Cross Sectionnal Area _m^2*)
AP.ch2 = Pi * (0.3 / 2) ^2 ;
(*Pressure Chamber2 Cross Sectionnal Area _m^2*)
h01 = 1; (*Pressure Chamber1 hight _m*)
h02 = 1; (*Pressure Chamber2 hight _m*)

(*Pneumatic Valve Constants: only Guess for now*)
b1 = 0.5;
c1 = 1;
b2 = 0.5;
c2 = 1;


(*Initial Conditions*)
h1 = h01 / 2;
h2 = h02 / 2;
```

$u_1 = 0;$

$u_2 = 0;$

$P_1 = P_0;$

$P_2 = P_0;$

(*Air Flow Control*)

(*Chamber 1: Gas Flow Rate:*)

$$\alpha_{11} = \text{if}\left[\frac{P_1}{P_S} > b_1,\ \sqrt{1 - \left(\frac{\frac{P_1}{P_S} - b_1}{1 - b_1}\right)\text{^}2}\ ,\ 1\right];$$

$$\alpha_{12} = \text{if}\left[\frac{P_0}{P_1} > b_1,\ \sqrt{1 - \left(\frac{\frac{P_0}{P_1} - b_1}{1 - b_1}\right)\text{^}2}\ ,\ 1\right];$$

$$m_1{}' = \text{if}\left[u_1 > 0,\ u_1 * c_1 * P_s * \rho_s * \sqrt{\frac{T_0}{T_s}} * \alpha_{11},\ u_1 * c_1 * P_s * \rho_s * \sqrt{\frac{T_0}{T_1}} * \alpha_{12}\right]$$

(*Chamber 2: Gas Flow Rate:*)

$$\alpha_{21} = \text{if}\left[\frac{P_2}{P_S} > b_2,\ \sqrt{1 - \left(\frac{\frac{P_2}{P_S} - b_2}{1 - b_2}\right)\text{^}2}\ ,\ 1\right];$$

$$\alpha_{22} = \text{if}\left[\frac{P_0}{P_2} > b_2,\ \sqrt{1 - \left(\frac{\frac{P_0}{P_2} - b_2}{1 - b_2}\right)\text{^}2}\ ,\ 1\right];$$

$$m_2{}' = \text{if}\left[u_2 > 0,\ u_2 * c_2 * P_s * \rho_s * \sqrt{\frac{T_0}{T_s}} * \alpha_{21},\ u_2 * c_2 * P_s * \rho_s * \sqrt{\frac{T_0}{T_s}} * \alpha_{22}\right]$$

(*Pipe System Properties*)

(*T_{water} = 20deg.C*)

$\mu_{water} = 1.0 * 10\text{^}{-3};$

(*Dynamic viscosity of water _Pa.s at T=20deg *)

$\rho_{water} = 998;$ (*density of water _kg/m^3 at T=20deg*)

$l_{pipe} = 1;$ (*Water Pipe Length _m*)

$d_{pipe} = 10 / 1000;$ (*water Pipe Diameter _m*)

$A_{pipe} = Pi * (d_{pipe} / 2)\text{^}2;$ (*Water Pipe Cross Sectionnal Area*)

(*Hydraulic System Dynamics*)

$h_1{}' = \dfrac{-Q_1}{A_{P.ch1}}$ (*Water level rate for Chamber 1 _m/s*)

$h_2{}' = \dfrac{Q_2}{A_{P.ch2}}$ (*Water level rate for Chamber 2 _m/s*)

$$P_1{}' = \frac{\gamma}{(h_{01} - h_1)} * \left(R_{air} * \frac{m_1{}'}{A_{P.ch1}} + P_1 * h_1{}'\right)$$

(*Pressure rate in P.Ch.1 _Pa/s*)

$$P_2{}' = \frac{\gamma}{(h_{02} - h_2)} * \left(R_{air} * \frac{m_2{}'}{A_{P.ch2}} + P_2 * h_2{}'\right)$$

(*Pressure rate in P.Ch.2 _Pa/s*)

(*J=kg.m2/s2 // Pa/s =kg/m.s2.s= J.kg/s.m2=kg2/m.s3*)

(* $\frac{Pa}{s} = \frac{1}{m} * \frac{kg.m2}{s2} * \frac{J}{kg.K} * \frac{kg/s}{m2} = \frac{1}{m} * \frac{PV}{\square}$ *)

$$Re = \frac{Q_1 * d_{pipe}}{A_{pipe} * \frac{\mu_{water}}{\rho_{water}}}$$

(*Water Reinolds Number inside the Pipe*)

(*Pressure Drop for: 1-Laminar Flow, 2-Turbulent Flow*)

$$P_1 - P_e = if\left[Re < 2300, \frac{128 * \mu_{water} * l_{pipe}}{(\pi * d_{pipe}\text{^}4)}, \frac{0.3164}{R_e\text{^}0.25} * \frac{l_{pipe}}{d_{pipe}} * \frac{\rho_{water}}{2} * \frac{Q_1}{\left(\frac{\pi}{4} * d_{pipe}\text{^}2\right)}\right]$$

(*Pressure Drope due to pipes Inductance*)

$$P_e - P_2 = \frac{l_{pipe} * \rho_{water}}{A_{pipe}} * Q_1{}'$$