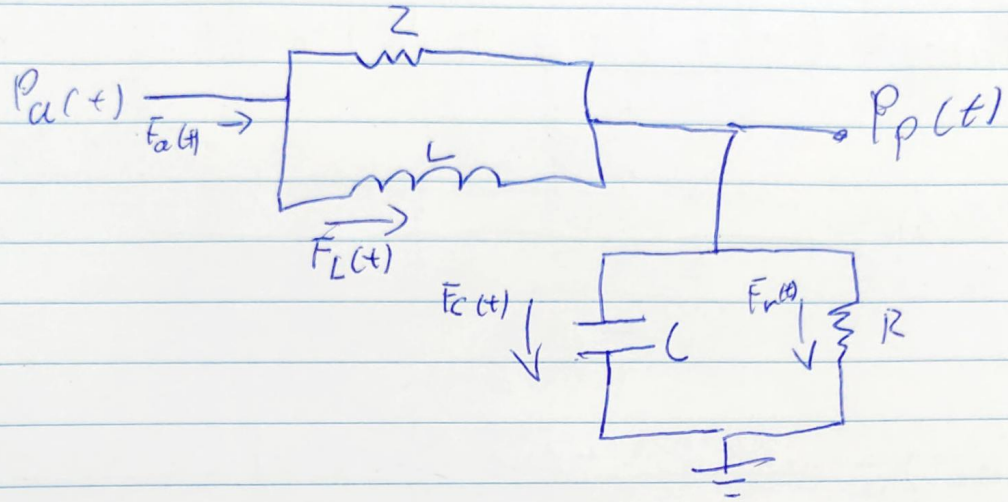
Sistema cardiovascular



$$F_a(t) = F_Z(t) + F_L(t) = F_C(t) + F_R(t)$$

$$F_Z(t) = \frac{P_a(t) - P_p(t)}{Z} \qquad F_C(t) = \frac{C\,dP_p(t)}{dt}$$

$$F_L(t) = \frac{1}{L}\int [P_a(t) - P_p(t)]\,dt \qquad F_R(t) = \frac{P_p(t)}{R}$$

Procedimiento algebraico

$$\frac{P_a(t)}{Z} - \frac{P_p(t)}{Z} + \frac{1}{L}\int [P_a(t) - P_p(t)]\,dt = \frac{C\,dP_p(t)}{dt} + \frac{P_p(t)}{R}$$

$$\frac{P_a(s)}{Z} - \frac{P_p(s)}{Z} + \frac{P_a(s) - P_p(s)}{LS} = CSP_p(s) + \frac{P_p(s)}{R}$$

$$\left(\frac{1}{Z} + \frac{1}{LS}\right) P_a(s) = \left(CS + \frac{1}{R} + \frac{1}{Z} + \frac{1}{LS}\right) P_p(s)$$

$$P_a(s) = \frac{\left(Cs + \frac{1}{R} + \frac{1}{Z} + \frac{1}{Ls}\right) P_o(s)}{\frac{1}{Z} + \frac{1}{Ls}}$$

$$P_a(s) = \frac{\frac{CLRZs^2 + RZLs + RLs + RZ}{RZLs}}{\frac{Ls + Z}{LsZ}}$$

$$P_a(s) = \frac{(CLRZs^2 + Z^2Ls^2 + R^2Ls^2Z + RZ)(LsZ)}{(RZLs)(Ls + Z)}$$

$$P_a(s) = \frac{CL^2RZ^2s^3 + Z^2L^2s^2 + RL^2s^2Z + LRZ^2s}{RZL^2s^2 + RZ^2Ls}$$

$$P_a(s) = \frac{CL^2RZ^2s^3 + Z^2L^2s^2 + RL^2s^2Z + LRZ^2s}{L^2RZs^2 + LRZ^2s}$$

$$\frac{P_o(s)}{P_a(s)} = \frac{L^2RZs^2 + LRZ^2s}{CL^2RZ^2s^3 + Z^2L^2s^2 + RL^2s^2Z + LRZ^2s}$$

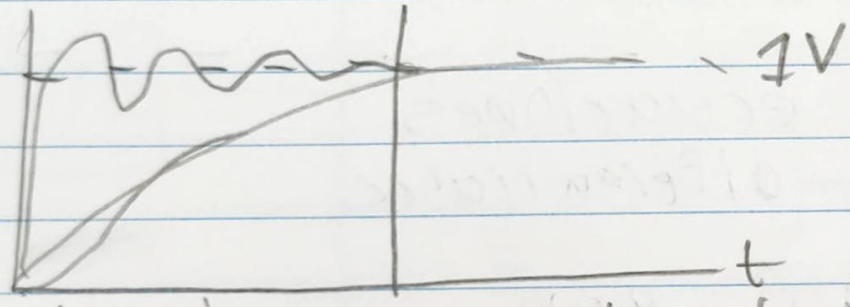
$$= \frac{RLs + RZ}{(LRZs^2 + (Lz + RL)s + Rz} \quad \frac{(LZs)}{(LZs)}$$

Error en estado estacionario

$$e(s) = \lim_{s \to 0} s\, P_a(s) \left[1 - \frac{P_p(s)}{P_a(s)} \right]$$

$$= \lim_{s \to 0} s * \frac{1}{s} \left[1 - \frac{RL s^0 + RZ}{(LRZ s^2 + (LZ + RL) s^0 + RZ} \right]$$

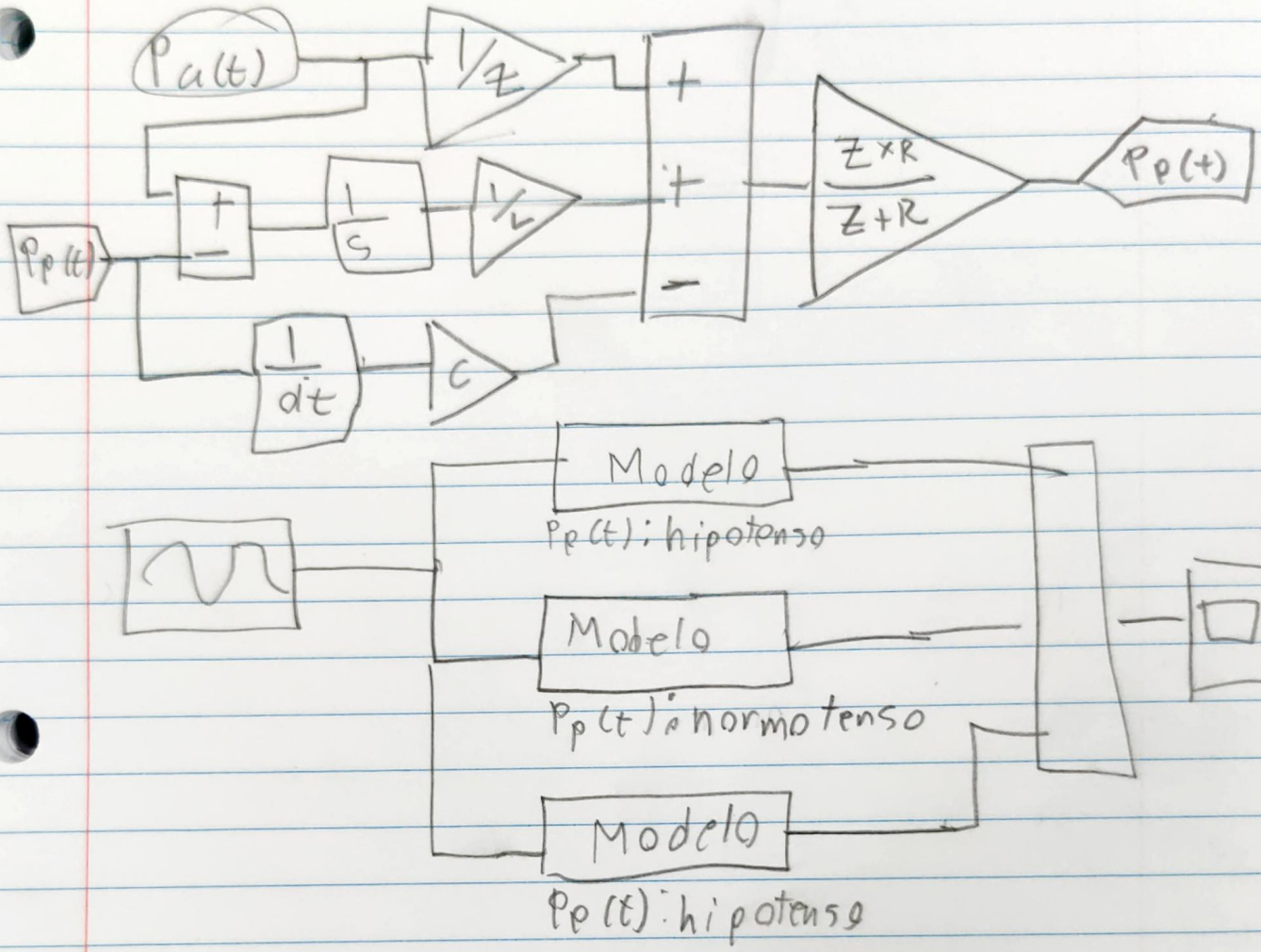
$$= 1 - \frac{RZ}{RZ} = 0 V$$



Modelo de ecuaciones integro-diferenciales

$$P_p(t)\left(\frac{1}{R}+\frac{1}{Z}\right)=\frac{P_a(t)}{Z}+\frac{1}{L}\int[P_a(t)-P_p(t)]dt-\frac{CdP_p(t)}{dt}$$

$$P_p(t)=\left(\frac{P_a(t)}{Z}+\frac{1}{Z}\int[P_a(t)-P_p(t)]dt-\frac{CdP_p(t)}{dt}\right)\frac{ZR}{Z+R}$$


Pa(t)
1/Z
+
+
-
Z×R / Z+R
Pp(t)
Pp(t)
+
-
1/s
1/L
1/dt
C
Modelo
Pp(t): hipotenso
Modelo
Pp(t): normotenso
Modelo
Pp(t): hipotenso