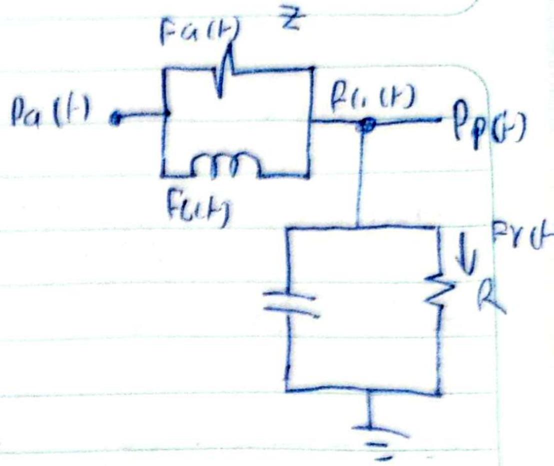
Ecuación Principal

$$Fa(t) = Fz(t) + FL(t) = Fc(t) + FR(t)$$



$$Fz(t) = \frac{Pa(t) - Pp(t)}{Z}$$

$$FL(t) = \frac{1}{L}\int [Pa(t) - Pp(t)]\, dt$$

$$Fc(t) = \frac{C\, dPp(t)}{dt}$$

$$FR(t) = \frac{Pp(t)}{R}$$

Procedimiento algebraico

$$\frac{Pa}{Z} - \frac{Pp(t)}{Z} + \frac{1}{L}\int (Pa(t) - Pp(t)]\, dt = \frac{C\, dPp(t)}{dt} + \frac{Pp(t)}{R}$$

$$\frac{Pa(s)}{Z} - \frac{Pp(s)}{Z} + \frac{Pa(s) - Pp(s)}{Ls} = CsPp(s) = \frac{Pp(s)}{R}$$

$$\left(\frac{1}{Z} + \frac{1}{Ls}\right) Pa(s) = \left(Cs + \frac{1}{R} + \frac{1}{Z} + \frac{1}{Ls}\right) Pp(s).$$

$$Pa(s) =$$

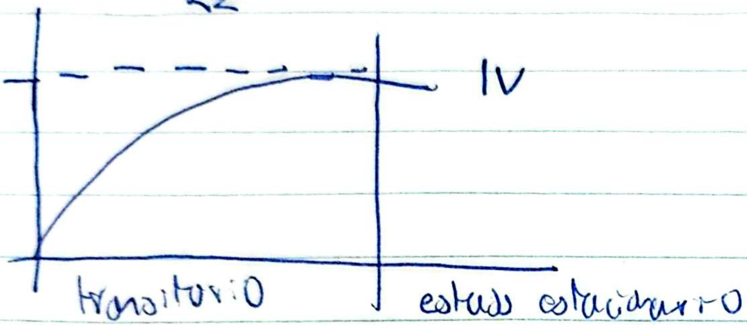
$$\frac{Ls+Z}{LZs} Pa(s) = \frac{CLRZs^2 + LZs + RLs + RZ}{RLZs} Pp(s)$$

$$\frac{Pp(s)}{Pa(s)} = \frac{\frac{Ls+Z}{LZs}}{\frac{CLRZs^2 + (LZ + RL)s + RZ}{RLZs}} = \frac{RLs + RZ}{CLRZs^2 + (LZ + RL)s + RZ}$$

$$e(s) = \lim s\, Pa(s) \left[1 - \frac{Pp(s)}{Pa(s)} \right]$$

$$= \lim_{s \to 0} \cancel{s} \cdot \frac{1}{\cancel{s}} \left[1 - \frac{RLs + RZ}{CLRZs^2 + (LZ + RL + RZ} \right]$$

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



Estabilidad en lazo abierto.

$$\lambda_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$a = CLRZ$

$b = LZ + RL$

$C = RZ$

$$\lambda_{1,2} = \frac{-(LZ + RL) \pm \sqrt{(LZ + RL)^2 - 4CLRZ\,RZ}}{2CLRZ} = \frac{(-)}{(+)}$$

El sistema tiene una respuesta estable.

Porque $Re\,\lambda_{1,2} < \emptyset$

Modelo de ecuaciones integro diferenciales

$$Pp(t)\left(\frac{1}{R} + \frac{1}{Z}\right) = \left(\frac{Pa(t)}{Z}\right) + \frac{1}{L}\int [Pa(t) - Pp(t)]\,dt - \frac{C\,dPp(t)}{dt}$$

$$Pp(t) = \left(\frac{Pa(t)}{Z} + \frac{1}{2}\int [Pa(t) - Pp(t)]\,dt - \frac{C\,dPp(t)}{dt}\right)\frac{ZR}{Z + R}$$