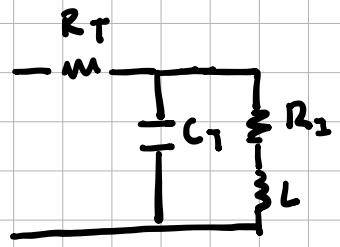
Actividad eléctrica del utero enfocado en la contracción



R_T = Impedancia eléctrica del tejido

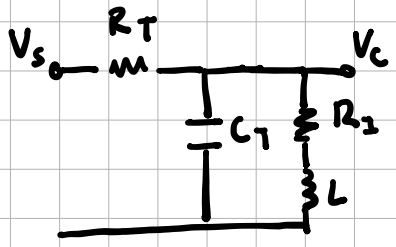
C_T = Despolarización y repolarización de las fibras musculares

L = Propagación del potencial de acción

R_I = Oposición del flujo de iones

Patología = Endometriosis

Función de transferencia



$$H(S) = \frac{V_C(S)}{V_B(S)}$$

$$\frac{1}{C}\int i(t)\,d(t)$$

$$L\frac{di(t)}{dt}$$

Considerando lo anterior

$$\frac{V_c(t) - V_s(t)}{R_T} + C_T\frac{dV_c(t)}{dt} + i(t) = 0$$

LVK

$$L\frac{di(t)}{dt} + R_i\, i(t) = V_c(t)$$

$$i(t) = -\frac{V_c(t) - V_s(t)}{R_T} - C_T\frac{dV_c(t)}{dt}$$

$$L\frac{d}{dt}\left(-\frac{V_c - V_s}{R_T} - C_T\frac{dV_c}{dt}\right) + R_i\left(-\frac{V_c - V_s}{R_T} - C_T\frac{dV_c}{dt}\right) = V_c$$

$$LC_T \frac{d^2V_c}{dt^2} + \left(\frac{L}{R_T} + R_i C_T\right)\frac{dV_c}{dt} + \frac{R_i + R_T}{R_T}\int V_c(t) = \frac{L}{R_T}\frac{dV_s}{dt} + \frac{R_i}{R_T}\int V_s(t)$$

Aplicando Laplace

$$LC_T s^2 V_c(s) + \left(\frac{L}{R_T} + R_i C_T\right) s\, V_c(s) + \frac{R_i + R_T}{R_T} V_c(s) = \frac{L}{R_T} s\, V_s(s) + \frac{R_i}{R_T} V_s(s)$$

Despejando $H(s)$

$$H(s) = \frac{{}^{L}/_{R_T}\, s + \frac{R_i}{R_T}}{LC_T s^2 + ({}^{L}/_{R_T} + R_i C_T)s + {}^{R_i + R_T}/_{R_T}} \quad (R_T)$$

$$H(s) = \frac{Ls + R_i}{R_T L C_T s^2 + (L + R_i C_T R_T)s + (R_i + R_T)}$$

Error estacionario

Caso

$$e(s) = \lim_{s \to 0} s \cdot H(s)\left[1 - H(s)\right]$$

$R_I = 4.7\,K$
$R_T = 56\,K$
$L = 1.5\,mH$
$C = 560\,\mu F$

$$1 - \frac{Ls + R_i}{R_T L C_T s^2 + (L + R_i C_T R_T)s + (R_i + R_T)}$$

$$e(s) = 0.092$$

Control

$$1 - \frac{Ls + R_i}{R_T L C_T s^2 + (L + R_i C_T R_T)s + (R_i + R_T)}$$

$R_I = 500$
$R_T = 56\,K$
$L = 1.5\,mH$
$C = 2200\,\mu F$

$$e(s) = 0.04$$

Estabilidad en lazo abierto

$R_I = 4.7\,K$
$R_T = 56\,K$
$L = 1.5\,mH$
$C = 560\,\mu F$

$$H(s) = \frac{Ls + R_i}{\underbrace{R_T L C_T}_{a} s^2 + \underbrace{(L + R_i C_T R_T)}_{b} s + \underbrace{(R_i + R_T)}_{c}}$$

$$\lambda = \frac{-(L + R_i C_T R_T) \pm \sqrt{(L + R_i C_T R_T)^2 - 4(R_i + R_T)(R_T C_T L)}}{2 R_T L C_T}$$

$\lambda_1 = -0.411$
$\lambda_2 = -3,133332.953$

Tipo de respuesta = Estable sobreamortiguada