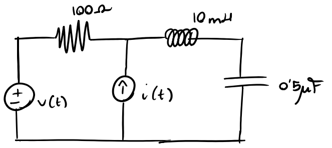
25.-

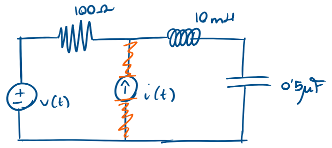


¿$v_o(t)$?

$v(t) = \sqrt{2}\cos(10^4 t + \frac{\pi}{4})(V) \Longrightarrow v(t) = \sqrt{2} e^{j(10^4 t + \frac{\pi}{4})} \Longrightarrow V = \sqrt{2} e^{j\frac{\pi}{4}}$

$i(t) = \sqrt{2}\cos(2\cdot 10^4 t + \frac{\pi}{4})(mA) \Longrightarrow i(t) = \sqrt{2} e^{j2\cdot10^4 t + \frac{\pi}{4}} \Longrightarrow I = \sqrt{2} e^{j\pi/4}$

Por el principio de superposición:



$Z_R = 100\,\Omega$

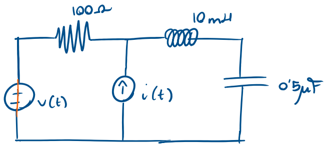
$Z_L = jwL = 10^4 \cdot 10^{-2} j = 100 j\,\Omega$ — 200 con $i(t)$

$Z_C = \frac{1}{jwC} = \frac{2}{j\cdot 10^4 \cdot 10^{-6}} = -200 j\,\Omega$ — -100 con $i(t)$

$Z_t = 100(1-j) = 100\sqrt{2} e^{-j\frac{\pi}{4}}$ — $100\sqrt{2} e^{+j\frac{\pi}{4}}$ con $i(t)$

$I = \frac{V}{Z_t} = \frac{\sqrt{2} e^{j\frac{\pi}{4}}}{100\sqrt{2} e^{-j\frac{\pi}{4}}} = 0'01 e^{j\frac{\pi}{2}} \Longrightarrow V_c = I \cdot Z_c = 0'01 j (-200 j) = 2$

$v_c(t) = 2\cos(10^4 t)(V)$



$Z_t = Z_R \| (Z_L + Z_C) = 100 \| (200j - 100j) = 100 \| 100j$

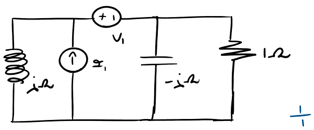
$\frac{1}{Z_t} = \frac{1}{100} + \frac{1}{100j} = \frac{j+1}{100j} \Longrightarrow Z_t = 50 + 50j = 50\sqrt{2} e^{+j\frac{\pi}{4}}$

$V = I \cdot Z_t = 50\sqrt{2} e^{+j\frac{\pi}{4}} \cdot \sqrt{2} e^{j\frac{\pi}{4}} = 100 e^{j\frac{\pi}{2}} \Longrightarrow I_c = \frac{V}{Z_{L+Zc}} = \frac{100 e^{j\frac{\pi}{2}}}{100 e^{j\frac{\pi}{2}}} = 1 \Longrightarrow V_o = I_c \cdot Z_c = 100 e^{-j\frac{\pi}{2}} / 10^3 (mA) = 0'1 e^{-j\frac{\pi}{2}}$

$v_o(t) = 0'1\cos(2\cdot 10^4 t - \frac{\pi}{2})$

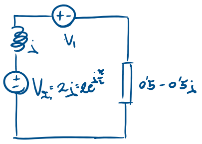
Con lo que $v_o(t) = 2\cos(10^4 t) + 0'1\cos(2\cdot 10^4 t - \frac{\pi}{2})\ (V)$ //

32.-



$V_1 = 1\,(V) \quad I_1 = 2\,(A)$

$\frac{1}{1} + \frac{1}{-j} = \frac{-j+1}{-j} \Longrightarrow Z_{RC} = 0'5 - 0'5j$

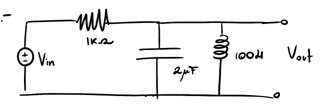


$1 - 2j = V_T \Longrightarrow I_T = \frac{1-2j}{0'5+0'5j} = -1-3j = 3'16 e^{-j1'89}$

$\overline{P}_{V_1} = \frac{|V||I|}{2}\cos(\alpha_1 - \alpha_2) = 1'58 \cdot \cos(1'89) = -0'49 \Longrightarrow$ No suministra

$\overline{P}_{V_2} = \frac{2\cdot 3'16}{2}\cos(\alpha_1 - \alpha_2) = 3W \Longrightarrow$ Suministra 3W

33.-



¿$T(w)$? Diagrama de Bode

$Z_R = 10^3\,\Omega \quad Z_L = \frac{1}{jw100}\,\Omega \quad Z_C = jw2\cdot10^{6}$

$Z_L \| Z_C = \frac{1}{jw100 + \frac{1}{jw2\cdot10^6}} = \frac{jw2\cdot10^{-6}}{-w^2 200\cdot 10^{-6} - 1} = -\frac{jw2}{w^2 200 + 10^6}$

$Z_T = Z_R + (Z_L \| Z_C) = 10^3 - \frac{jw2}{w^2 200 + 10^6} = \frac{2\cdot10^5 w^2 + 10^{-3} - jw2}{w^2 200 + 10^6}$

$V_o = I \cdot (Z_L \| Z_C) = \frac{V_i}{Z_T} \cdot (Z_L \| Z_C) = \frac{\frac{-jw2}{w^2 200 + 10^{-6}}}{\frac{2\cdot10^5 w^2 + 10^{-3} - jw2}{200 w^2 + 10^{-6}}} V_i = \frac{-400 w^3 j - 2\cdot10^6 w j}{(2\cdot10^5 w^2 + 10^{-3} - jw2)(w^2 200 + 10^{-6})}$

$V_o = I \cdot (Z_L \| Z_C) = \frac{V_i}{Z_R + \frac{Z_L Z_C}{Z_L + Z_C}} \cdot \frac{Z_L Z_C}{Z_L + Z_C} = \frac{Z_L Z_C \quad V_i}{Z_R(Z_L + Z_C) + Z_L Z_C} = \frac{jwL \cdot \frac{1}{jwC}\quad V_i}{R(jwL + \frac{1}{jwC}) + L\frac{1}{C}} = \frac{L\frac{1}{C}\quad V_i}{jwRL + \frac{R}{jwC} + L\frac{1}{C}} = \frac{jwL}{-w^2 RLC + R + jwL} V_i$

luego $\frac{jwL}{-w^2 RLC + jwL + R}$ será la función de transferencia

$\rightarrow -w^2RLC + jwL + R$

Aplicamos cambio de variable $s = jw \Longrightarrow s^2 = -w^2$

$$H(s) = \frac{sL}{s^2RLC + sL + R} = \frac{100s}{0'2s^2 + 100s + 100} = \frac{s}{2\cdot10^{-4}(s^2 + 500s + 5\cdot10^3)}$$

$$H(s) = \frac{5\cdot10^3 s}{s^2 + 500s + 5\cdot10^3} = \frac{500\,s}{(s+10'2)(s+489'8)} = 5\cdot10^2 s \cdot \frac{10'2}{s+10'2}\cdot\frac{1}{10'2}\cdot\frac{489'8}{s+489'8}\cdot\frac{1}{489'8} = 0'1s\,\frac{10'2}{s+10'2}\,\frac{489'8}{s+489'8}$$

Factores: $H_1(s) = 0'1 \quad H_2(s) = s \quad H_3(s) = \frac{10'2}{s+10'2} \quad H_4(s) = \frac{489'8}{s+489'8}$

Polo simple

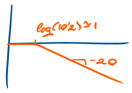
$H_1(w) = 0'1 \longrightarrow 20\log|0'1| = -20\,dB$

$\searrow \arg(0'1) = 0$

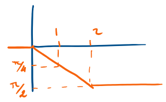
$H_2(w) = s \longrightarrow 20\log|s| \Longrightarrow$ Pendiente de 20

$\searrow \arg(jw) = \frac{\pi}{2}$

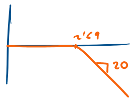
$H_3(w) = \frac{10'2}{s+10'2} \longrightarrow 20\log|H_3(w)|$



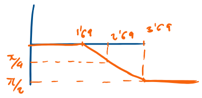
$\searrow \arg(H_3(w))$



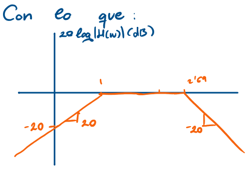
$H_4(w) = \frac{489'8}{s+489'8} \longrightarrow 20\log|H_4(w)|$

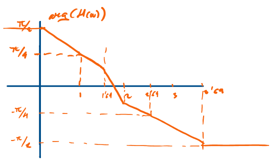


$\searrow \arg(H_4(w))$

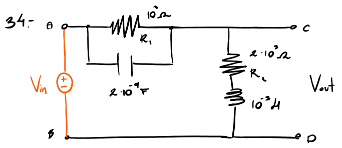


Con lo que:





34.-



$H(w)$, polos y ceros

$$Z_T = (Z_{R_1}\|Z_C) + Z_{R_2} + Z_L = \frac{Z_{R_1}Z_C}{Z_{R_1}+Z_C} + Z_{R_2} + Z_L = \frac{R_1\frac{1}{jwC}}{R_1 + \frac{1}{jwC}} + R_2 + jwL = \frac{R_1}{jwCR_1+1} + R_2 + jwL = \frac{R_1 + jwCR_1R_2 + R_2 - w^2CR_1L + jwL}{jwCR_1+1}$$

$$I = \frac{V_{in}}{Z_t} \Longrightarrow V_{out} = I\cdot(Z_{R_2}+Z_L) = \frac{V_{in}}{\frac{Z_{R_1}Z_C}{Z_{R_1}+Z_C} + Z_{R_2} + Z_L}(Z_{R_2}+Z_L)$$

$$V_{out} = \frac{R_2 + jwL}{\frac{R_1}{(jwCR_1+1)} + R_2 + jwL}V_{in} = \frac{R_2 + jwL}{\frac{R_1 + jwCR_1R_2 + R_2 - w^2CR_1L + jwL}{jwCR_1+1}}V_{in} = \underbrace{\frac{jwCR_1R_2 + R_2 - w^2CLR_1 + jwL}{R_1 + jwCR_1R_2 + R_2 - w^2CR_1L + jwL}}_{T(w)}V_{in}$$

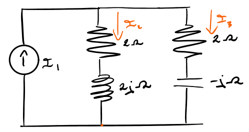
Cambio de variable $s = jw \Longrightarrow s^2 = -w^2$

$$T(w) = \frac{jwCR_1R_2 + R_2 - w^2CLR_1 + jwL}{R_1 + jwCR_1R_2 + R_2 - w^2CR_1L + jwL} \Longrightarrow T(s) = \frac{s^2CLR_1 + (CR_1R_2+L)s + R_2}{s^2CR_1L + (L+CR_1R_2)s + R_1+R_2} = \frac{2\cdot10^{-9}s^2 + 5\cdot10^{-3}s + 2\cdot10^3}{2\cdot10^{-9}s^2 + 5\cdot10^{-3}s + 3\cdot10^3} = \frac{(s+5\cdot10^5)(s+2\cdot10^6)}{(s+10^6)(s+1'5\cdot10^6)} = 0'5\cdot10^6\,\frac{s+0'5\cdot10^6}{0'5\cdot10^6}\;2\cdot10^6\,\frac{s+2\cdot10^6}{2\cdot10^6}\;\frac{1}{10^6}\;\frac{10^6}{s+10^6}\;\frac{1}{1'5\cdot10^6}\;\frac{1'5\cdot10^6}{s+1'5\cdot10^6}$$

Ceros — Polos

$T_1(w) = 1'5 \qquad T_2(w) = \frac{jw+0'5\cdot10^6}{0'5\cdot10^6} \quad T_3(w) = \frac{jw+2\cdot10^6}{2\cdot10^6} \quad T_4(w) = \frac{10^6}{jw+10^6} \quad T_5(w) = \frac{1'5\cdot10^6}{jw+1'5\cdot10^6}$

36.-



$I_1 = 6e^{j0}$

$Z_t = (2\Omega + 2j\Omega)||(2\Omega - j\Omega) = \frac{(2+2j)(2-j)}{4+j} = \frac{4-2j+4j+2}{4+j} = \frac{6+2j}{4+j} = \frac{2\sqrt{10}e^{j0'32}}{\sqrt{17}e^{j0'24}} = 1'53e^{j0'8}\ (\Omega)$

$V = I_1 \cdot Z_t = 6 \cdot 1'53e^{j0'8} = 9'18e^{j0'8} \Longrightarrow V_0 = 9'18\,V \quad I_0 = 6A$

$\alpha_V = 0'8 \qquad \alpha_I = 0$

$I_2 = \frac{V}{2+2j} = \frac{9'18e^{j0'8}}{2\sqrt{2}e^{j1/4\pi}} = 3'25e^{j0'01} \Longrightarrow I_{20} = 3'25A \qquad \alpha_{I_2} = 0'01$

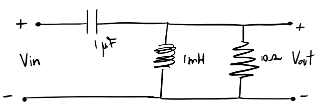
$I_3 = \frac{V}{2-j} = \frac{9'18e^{j0'8}}{\sqrt{5}e^{-j0'46}} = 4'11e^{j1'26} \Longrightarrow I_{30} = 4'11A \qquad \alpha_{I_3} = 1'26$

Luego $\quad \overline{P(t)}_{I_1} = \frac{V_0 I_{10}}{2}\cos(\alpha_V - \alpha_I) = 27'54\cos(0'8) = 19'187\,W$

$\overline{P(t)}_{R_1} = \frac{V_0 I_{10}}{2}\cos(\alpha_V - \alpha_I) = \frac{I_{10}^2 \cdot \cancel{R}}{\cancel{2}}\cancel{\cos(0)}^{1} = 10'5625\,W$

$\overline{P(t)}_{R_2} = 16'89\,W \qquad \overline{P(t)}_L = \overline{P(t)}_C = 0\,W$ por definición

39.-



$Z_t = Z_C + \frac{Z_L Z_R}{Z_L + Z_R} = \frac{1}{j\omega C} + \frac{Rj\omega L}{j\omega L + R} = \frac{j\omega L + R - \omega^2 RCL}{-\omega^2 LC + j\omega CR}$

$I = \frac{V_{in}}{Z_t} = \frac{-\omega^2 LC + j\omega CR}{j\omega L + R - \omega^2 RCL} V_{in}$

$V_{out} = I \cdot (R||L) = \frac{-\omega^2 LC + j\omega CR}{j\omega L + R - \omega^2 RCL} V_{in} \cdot \frac{j\omega LR}{j\omega L + R} = \frac{-10^{-9}\omega^2 + 10^{-5}j\omega}{10^{-3}j\omega + 10 - 10^{-8}\omega^2} V_{in} \cdot \frac{10^{-2}j\omega}{10^{-3}j\omega + 10} = \frac{-10^{-11}\omega^3 j - 10^{-7}\omega^2}{-10^{-6}\omega^2 + 10^{-2}j\omega - 10^{-11}j\omega^3 + 10^{-2}j\omega + 100 - 10^{-7}\omega^2} V_{in} = -\omega^2 \frac{10^{-11}j\omega + 10^{-7}}{-10^{-11}j\omega^3 - 9\cdot 10^{-7}\omega^2 + 2\cdot 10^{-2}j\omega + 100} V_{in}$

Cambio de variable: $s = j\omega \Rightarrow s^2 = -\omega^2 \Rightarrow s^3 = -j\omega^3$

$-\omega^2 \frac{10^{-11}j\omega + 10^{-7}}{-10^{-11}j\omega^3 - 9\cdot 10^{-7}\omega^2 + 2\cdot 10^{-2}j\omega + 100} \Longrightarrow T(s) = s^2 \frac{10^{-11}s + 10^{-7}}{10^{-11}s^3 + 9\cdot 10^{-7}s^2 + 2\cdot 10^{-2}s + 100} = s^2 \frac{s + 10^4}{s^3 + 9\cdot 10^4 s^2 + 2\cdot 10^9 s + 10^{13}} = s^2 \frac{s + 10^4}{(s + 5'89\cdot 10^4)(s + 0'7\cdot 10^4)(s + 2'39\cdot 10^4)}$

Cero $\quad$ Polo $\quad$ Polo $\quad$ Polo

$T(\omega) = 10^{-9} s^2 \cdot \frac{s + 10^4}{10^4} \cdot \frac{5'84\cdot 10^4}{s + 5'84\cdot 10^4} \cdot \frac{0'7\cdot 10^4}{s + 0'7\cdot 10^4} \cdot \frac{2'39\cdot 10^4}{s + 2'39\cdot 10^4}$