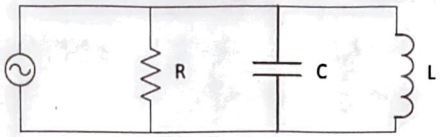
1) (35 pontos) Analisando o circuito paralelo abaixo que apresenta uma frequência de ressonância (f_R) de 10 kHz, considerando R = 47Ω e C = 200 nF:



a) Determine o valor da Indutância L deste circuito;

b) Encontre a f_{cs} e f_{ci} e B_w;

c) Determine o valor da Impedância total do circuito para uma frequência f = 5 x f_R;

a) $f_r = \frac{1}{2\pi\sqrt{LC}} \Rightarrow 10\cdot10^3 \times 2\pi = \frac{1}{\sqrt{LC}}$

$\sqrt{LC} = \frac{1}{20\cdot10^3\pi} \Rightarrow LC = \frac{1}{(20\cdot10^3\pi)^2}$

$L = \frac{1}{200\cdot10^{-9}(20\cdot10^3\pi)^2} \Rightarrow L = 1{,}27\,mH$ (10)

b) $Bw = \frac{1}{2\pi RC} = \frac{1}{2\pi \cdot 47 \cdot 200\cdot10^{-9}} \Rightarrow Bw = 16{,}93\,kHz$ (5)

$f_{cs} = \frac{1}{4\pi C}\left[\frac{1}{R} + \sqrt{\frac{1}{R^2} + \frac{4C}{L}}\right] = \frac{1}{4\pi 200\cdot10^{-9}}\left[\frac{1}{47} + \sqrt{\frac{1}{47^2} + \frac{4\times200\cdot10^{-9}}{1{,}27\cdot10^{-3}}}\right]$

$f_{cs} = 397887{,}36\left[21{,}28\cdot10^{-3} + \sqrt{452{,}7\cdot10^{-6} + 629{,}92\cdot10^{-6}}\right]$ (5)

$f_{cs} = 21558{,}8\,Hz$ ou $21{,}56\,kHz$.

$f_{ci} = \frac{1}{4\pi C}\left[-\frac{1}{R} + \sqrt{\frac{1}{R^2} + \frac{4C}{L}}\right] = 397887{,}36\left[-21{,}28\cdot10^{-3} + \sqrt{452{,}7\cdot10^{-6} + 629{,}92\cdot10^{-6}}\right]$

$f_{ci} = 4624{,}72$ ou $4{,}62\,kHz$ (5)

c) $Z_{eq} = R \,//\, Z_C \,//\, Z_L$

$= 47 \,//\, -j\frac{1}{2\pi\times50\cdot10^3\times200\cdot10^{-9}} \,//\, j2\pi\times50\cdot10^3\times1{,}27\cdot10^{-3}$

$= 47 \,//\, -j15{,}92 \,//\, j400$

$Z_{eq} = 47 // -j16 // j400$

$$-\frac{j16 \times j400}{-j16 + j400} = \frac{6400}{j384} = \frac{6400}{384 \angle 90} = 16{,}67 \angle -90^\circ$$

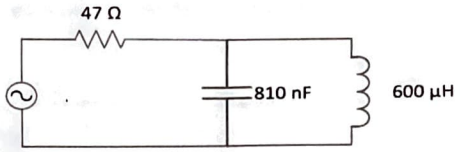
$-j16{,}67\ \Omega$

$$Z_{eq} = \frac{47 \times 16{,}67 \angle -90^\circ}{47 - j16{,}67} = \frac{783{,}5}{49{,}87 \angle -19{,}53^\circ}$$

$Z_{eq} = 15{,}71 \angle 19{,}53^\circ\ \Omega$ ou

$14{,}8 + j5{,}25\ \Omega$ (10)

2) (30 pontos) Analisando o circuito abaixo, que opera na frequência de 1kHz e que drena uma corrente total $\dot{I}_T = 2{,}5\angle 30°\ A$:



a) Determine a tensão nos terminais do resistor;

b) Determinar a impedância equivalente total do circuito;

c) Calcular a tensão fornecida pela fonte do circuito.

$Z_C = -j\frac{1}{2\pi fC} = -j\frac{1}{2000\pi \times 80 \times 10^{-9}} = -j\,196{,}49\ \Omega \cong -j\,196{,}5\ \Omega$ (5)

$Z_L = j2\pi fL = j\,2000\pi \cdot 600 \times 10^{-6} = j\,3{,}77\ \Omega$

$Z_P = -j\,196{,}5 \,//\, j\,3{,}77 = \frac{-j\,196{,}5 \times j\,3{,}77}{-j\,196{,}5 + j\,3{,}77} = \frac{740{,}81}{-j\,192{,}73}$

$Z_P = \frac{740{,}81 \times j\,192{,}73}{-j\,192{,}73 \times j\,192{,}73} = \frac{j\,142776{,}31}{37144{,}85} = \frac{142776{,}31\angle 90°}{37144{,}85}$

$Z_P = 3{,}84\angle 90° = j\,3{,}84\ \Omega$ (5)

a) $V_R = I_T \times R = 47 \times 2{,}5\angle 30°$ (5)

$V_R = 117{,}5\angle 30°\ V$

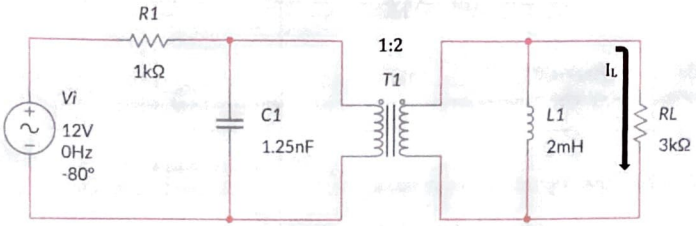
b) $Z_{eq} = R + Z_P = 47 + j\,3{,}84 \Rightarrow$

$Z_{eq} = 47 + j\,3{,}84\ \Omega = 47{,}16\angle 4{,}67°\ \Omega$ (10)

c) $V_T = I_T \times Z_{eq} = 2{,}5\angle 30° \times 47{,}16\angle 4{,}67°$ (5)

$V_T = 118\angle 34{,}67° \cong 118\angle 35°\ V$

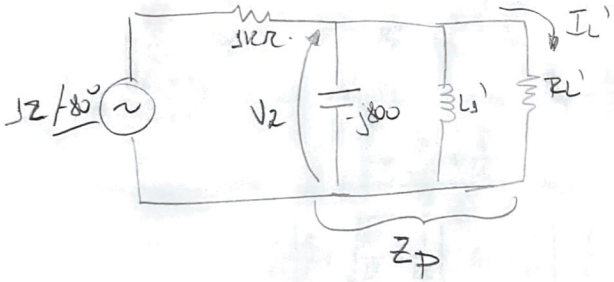
3) (35 pontos) O circuito abaixo opera na frequência angular de 1M rad/s. Determine a corrente na resistência de carga RL sabendo que $V_i(t) = 12\angle -80°\ V$.



$Z_{C1} = -j\frac{1}{\omega C} = -j\frac{1}{1\times10^6 \times 1{,}25\times10^{-9}} = -j800\ \Omega.$

$Z_{L1} = j\omega L = j\,1\times10^6 \times 2\times10^{-3} = j2000\ \Omega.$

10



$R_L' = \left(\frac{1}{2}\right)^2 \times 3000$

$R_L' = 750\ \Omega$

$L_1' = \left(\frac{1}{2}\right)^2 \times j2000$

$L_1' = j500\ \Omega.$

$Z_P = -j800 \,//\, j500 \,//\, 750$

$= \frac{750 \times j500}{750 + j500} = \frac{j375k}{750 + j800} = \frac{375k\angle 90°}{901{,}39\angle 33{,}7°} = 416{,}10\Omega\angle 56{,}3°$

$\frac{(230{,}83 + j346{,}11)\times -j800}{230{,}83 + j346{,}11 - j800} = \frac{-j\,184664 + 276888}{230{,}83 - j\,454} =$ 10

$Z_P = \frac{333{,}82\Omega\angle -33{,}7°}{509{,}31\angle -63{,}05°} = 655\angle 29{,}35° = 570{,}93 + j321{,}04$

$V_2 = \frac{Z_P}{Z_P + R_1} \times V_i = \frac{655\angle 29{,}35 \times 12\angle -80}{1000 + 570{,}93 + j321{,}04} = \frac{7860\angle -50{,}65°}{1603{,}4\angle 11{,}55}$ 10

Boa Prova!!

$V_2 = 4{,}9\angle -62{,}2\ V$

$I_L' = \frac{V_2}{R_L} = \frac{4{,}9\angle -62{,}2}{750} \Rightarrow I_L' = 6{,}53\angle -62{,}2\ mA$

$$\frac{1}{2} = \frac{I_L}{I_L'} \Rightarrow I_L = I_L' = \frac{6{,}153\angle -62{,}2^\circ}{2}$$

5

$$I_L = 3{,}26\angle -62{,}2^\circ \text{ mA}$$