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CTI ENG 2020

LAB 4 - 8.05.2020

Group 3.1
$G = 3 \quad N = 10$
$\Rightarrow U = 17V$

$R_L = 21.1\Omega$; $L = 0.1H$

$\omega = 2\pi f$; $X_C = \frac{1}{\omega C}$, $X = X_L - X_C$; $Z = \sqrt{R_t^2 + X^2}$; $tg\varphi = \frac{X}{R_t}$; $I = \frac{U}{Z}$, $U_1 = I \cdot R$; $U_2 = I \cdot Z_2$; $U_3 = I \cdot X_C$

$X_L = \omega L \quad R_t = R + R_L \qquad Z_2 = \sqrt{R_L^2 + X_L^2}$

U [V]	f [Hz]	Z [Ω]	I [mA]	U_1 [V]	U_2 [V]	U_3 [V]	R [Ω]	C [μF]	X_C [Ω]	X_L [R]	P [mW]	φ [deg]	Type of circuit
17	500	2871.49	5.92	0.59	1.86	18.84	100	0.1	3183.1	314.16	4.24	-87.58	capacitive
17	500	344.45	49.35	4.94	15.54	31.42	100	0.5	636.62	314.16	294.98	-69.42	capacitive
17	500	121.17	140.3	14.03	44.18	44.66	100	1	318.31	314.16	2383.66	-1.96	capacitive
17	500	158.3	107.39	10.74	33.81	22.79	100	1.5	212.21	314.16	1396.59	40.09	inductive
17	500	196.7	86.43	8.64	27.21	13.76	100	2.0	159.15	314.16	904.54	52.0	inductive
17	500	274.58	61.91	6.19	19.49	4.19	100	4.7	67.73	314.16	464.20	63.83	inductive

$R = 100\Omega$
$I = \frac{U_R}{R} \qquad Z = \frac{U}{I}$

f[Hz]	100	200	300	400	500	600	700	800	900	1000
U[V]	5	5	5	5	5	5	5	5	5	5
U_R[mV]	320	713	1324	2440	3850	3110	2140	1590	1270	1070
I[mA]	3.2	7.13	13.24	24.4	38.5	31.1	21.4	15.9	12.7	10.7
Z[Ω]	1562.5	701.26	377.64	204.92	129.87	160.77	233.64	314.47	393.7	467.3

1. a) $U_{rms} = \frac{V_p}{\sqrt{2}}$, $V_p = \frac{V_{pp}}{2}$ $\Rightarrow V_{pp} = U_{rms} \cdot 2\sqrt{2} = 10\sqrt{2}\,V$

b) $L = 0.1H$, $f = 500Hz$ resonance: $X_L = X_C \Rightarrow \omega L = \frac{1}{\omega C} \Rightarrow C = \frac{1}{(2\pi f)^2 L} = 1.01\mu F$

$\omega = 2\pi f$

c) first line: $X_C > X_L \Leftrightarrow 3183.1 > 314.16 \Rightarrow$ capacitive behavior

last line: $X_C < X_L \Leftrightarrow 67.73 < 314.16 \Rightarrow$ inductive behavior

2. a) The resonance frequency seems to be about 500 Hz, since $Z \simeq R + R_L$, meaning $X \simeq 0$, so $X_C \simeq X_L$

The impedance at resonance in both tables are almost equal, also the current and voltage on the resistor are at maximum value

b) The minimum theoretical value would be reached at $Z = R + R_L = 121.1\,V$, at resonance (considering a resistance of inductor)

5. $f_0 = 500\,Hz$

$C = 1\mu F = 10^{-6} F$ $\quad X_C = X_L \Rightarrow \frac{1}{\omega C} = \omega L \Rightarrow L = \frac{1}{\omega^2 C} = \frac{1}{(2\pi f)^2 C} = 0.101\,H$

6. Considering $L = 0.101\,H$ and $f_{res} = 500\,Hz$

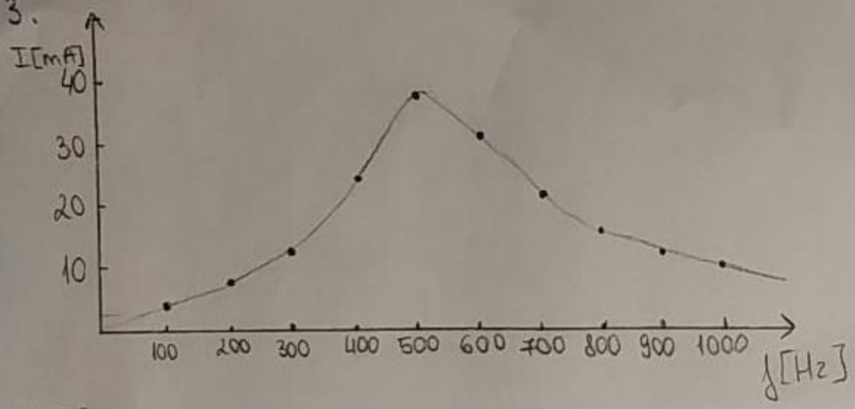
$X_L = \omega L = 2\pi f L = 317.3\,\Omega$

7. Considering $C = 1\mu F$ and $f_{res} = 500\,Hz$

X_C should be $\simeq X_L$

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} = 318.3\,\Omega \simeq X_L$

3.



4.