FACULATY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ENEE 2101

Circuits Laboratory

Experiment.9 Prelab

AC & DC Power Analysis and Design

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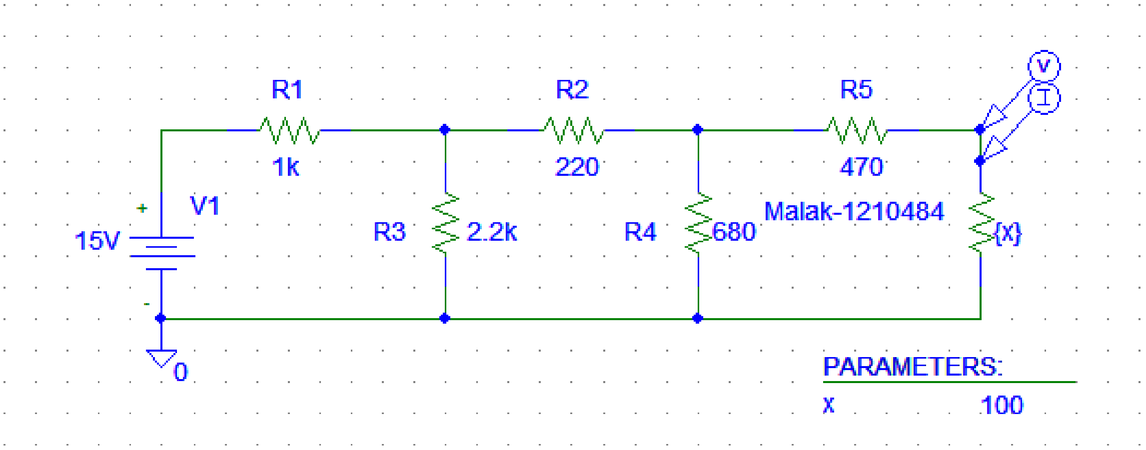
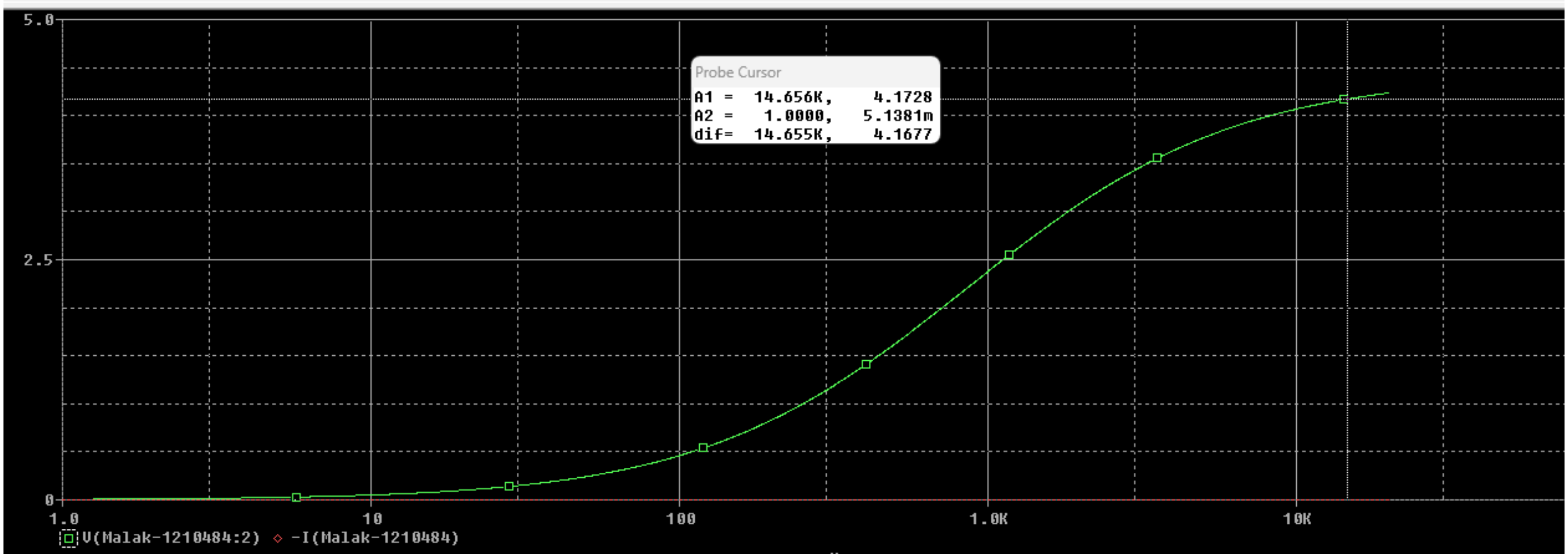
1-Make a DC sweep for RL in the circuit of Figure 9.5 to produce a plot of (PLOAD vs. RL) for the range of values of RL shown in Table 9.2, use cursors to find the value of RL that results in maximum power transfer to RL.





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A1 =    14.656K,     4.1728
A2 =     1.0000,     5.1381m
dif=    14.655K,     4.1677
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2. For the circuit of Figure 9.6:

- Use phasor analysis to calculate VL and IL, assume the input voltage Vin = 8 VPP∠0°.
- Calculate the complex power of the load” SL.
- Calculate the parallel capacitance needed to correct the load power factor to unity.

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→ Exp. 9:

2) • find V_L and I_L when $V_{in} = 8\,V_{pp} \angle 0°$

• $V_{rms} = \frac{V_{PP}}{2\sqrt{2}} = \frac{8}{2\sqrt{2}} \Rightarrow \boxed{V_{rms} = 2.82\,V}$

→ to Calculate $I_L = \frac{V_{rms}}{Z}$; $V_{rms} = V_{in}$

to Find $Z = R_1 + R_2 + j\omega L$

$$= 680 + 100 + j(\underbrace{2\pi(1000)}_{2\pi f = \omega}(\underbrace{150\times10^{-3}}_{L}))$$

∴ $Z = 780 + j942 = 1223 \angle 50.4°$

$I_L = \frac{V_{in}}{Z} = \frac{2.82 \angle 0}{1223 \angle 50.4} \Rightarrow \boxed{I_L = 2.306\times10^{-3} \angle -50.4 \text{ mA}}$

→ to calculate $V_L = I_L Z_L$

$V_L = I_L Z_L$

$= 2.306\times10^{-3} \angle -50.4 \times 942 \angle +90$

$\boxed{∴ V_L = 2.17 \angle 39.6}$

• Complex power of the load S_L

$S_L = V_{in} I_L^{*}$, $I_L^{*} = I_L \angle -\theta_i = 2.306\times10^{-3} \angle 50.4$

$= 2.82 \angle 0 * 2.306\times10^{-3} \angle 50.4$

$= 6.5\times10^{-3} \angle 50.4 = 0.00415 + \underset{Q_c}{0.005}$

• parallel capacitance C

$Q_C = S_L \cdot \sin\theta_s$

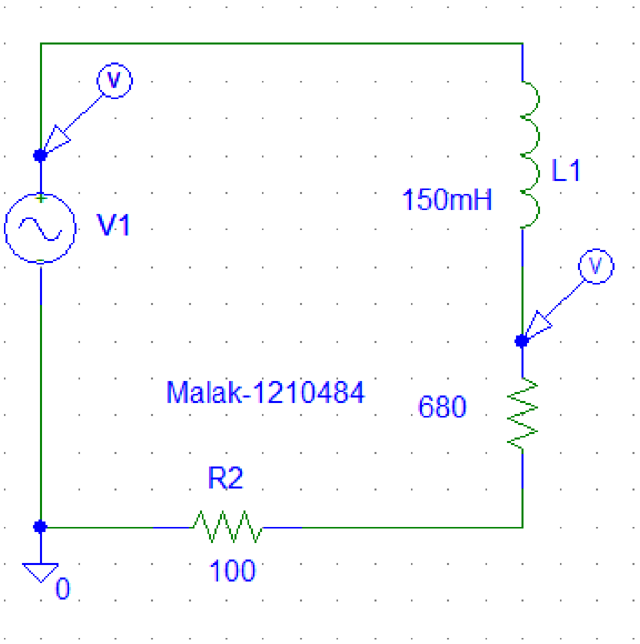
$= 6.5\times10^{-3} (\sin(50.4)) \Rightarrow Q_L = 0.005$ Same

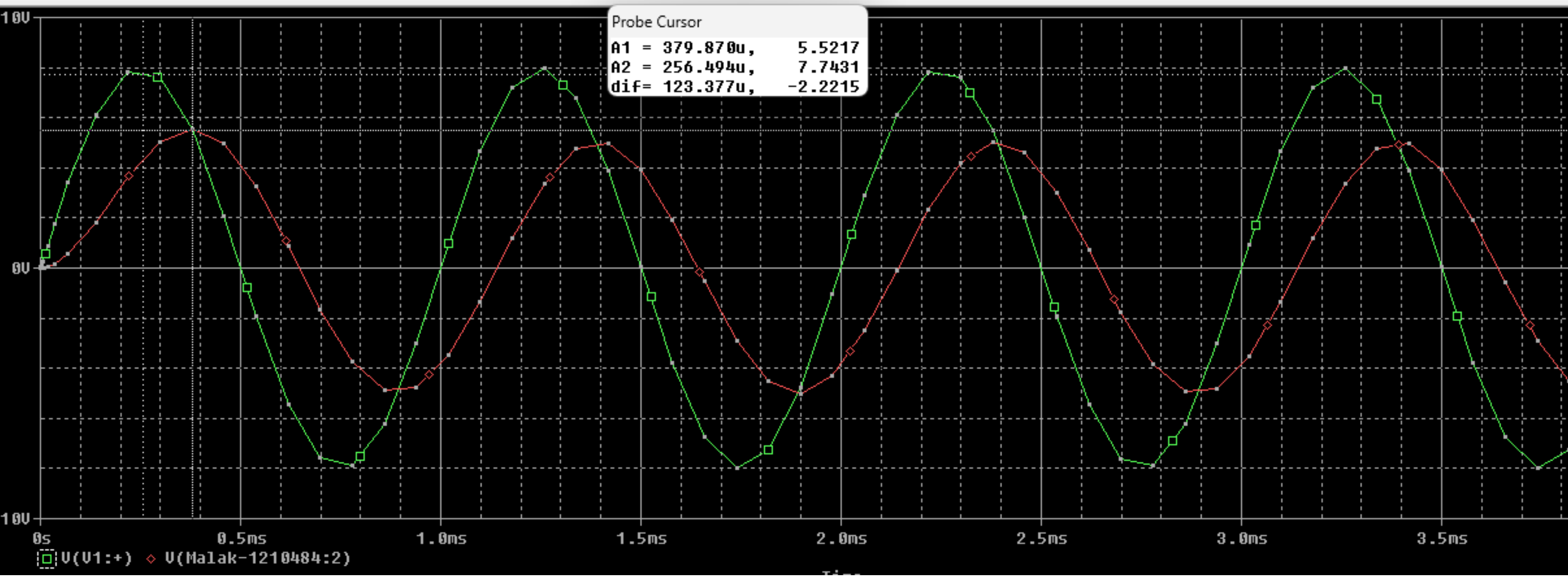
$\Rightarrow Q_c = \frac{V^2_{rms}}{\omega C} \Rightarrow X_C = \frac{V^2_{rms}}{Q} \Rightarrow X_c = \frac{(2.82)^2}{0.005}$

∴ $X_c = 1590.48\,\mu F$

$X_C = \frac{1}{2(3.14)(1000)C} \Rightarrow \boxed{C = 1.0\times10^{-7}}$

- Use PSPICE to do transient analysis of the circuit in Figure 9.6, show IL(t) and VL(t) on one graph, you will need different Y-axis, and measure the power factor (from the time difference between the two waveforms).





Probe Cursor

```
A1 = 379.870u,     5.5217
A2 = 256.494u,     7.7431
dif= 123.377u,    -2.2215
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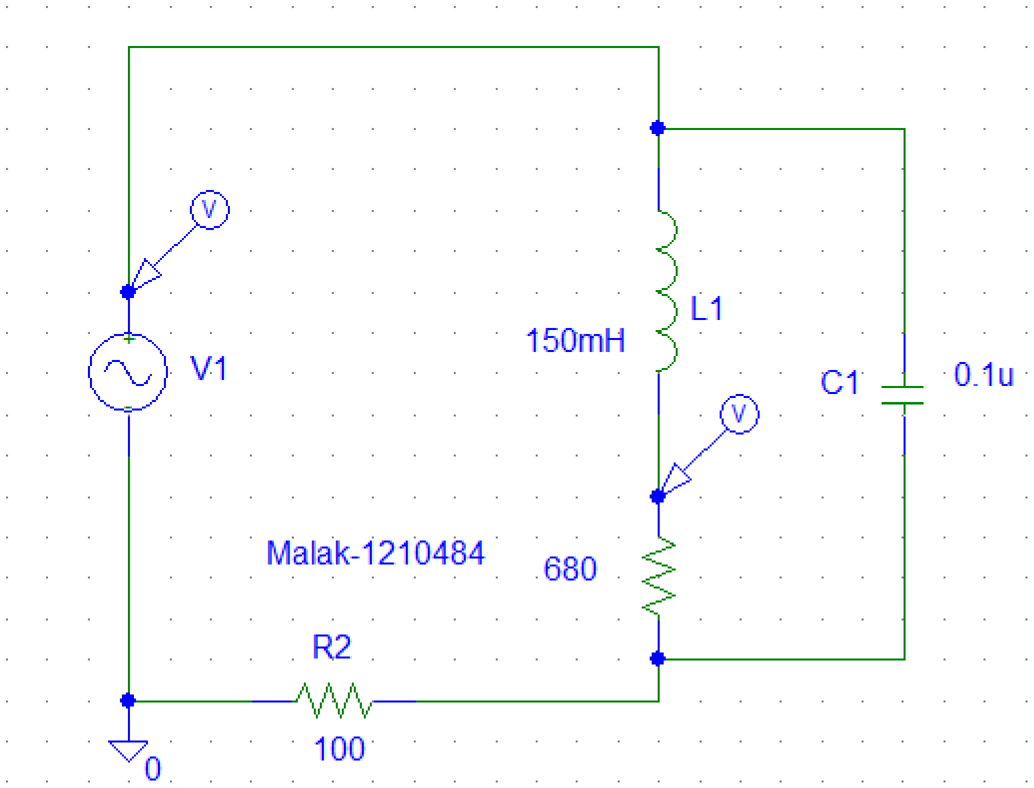
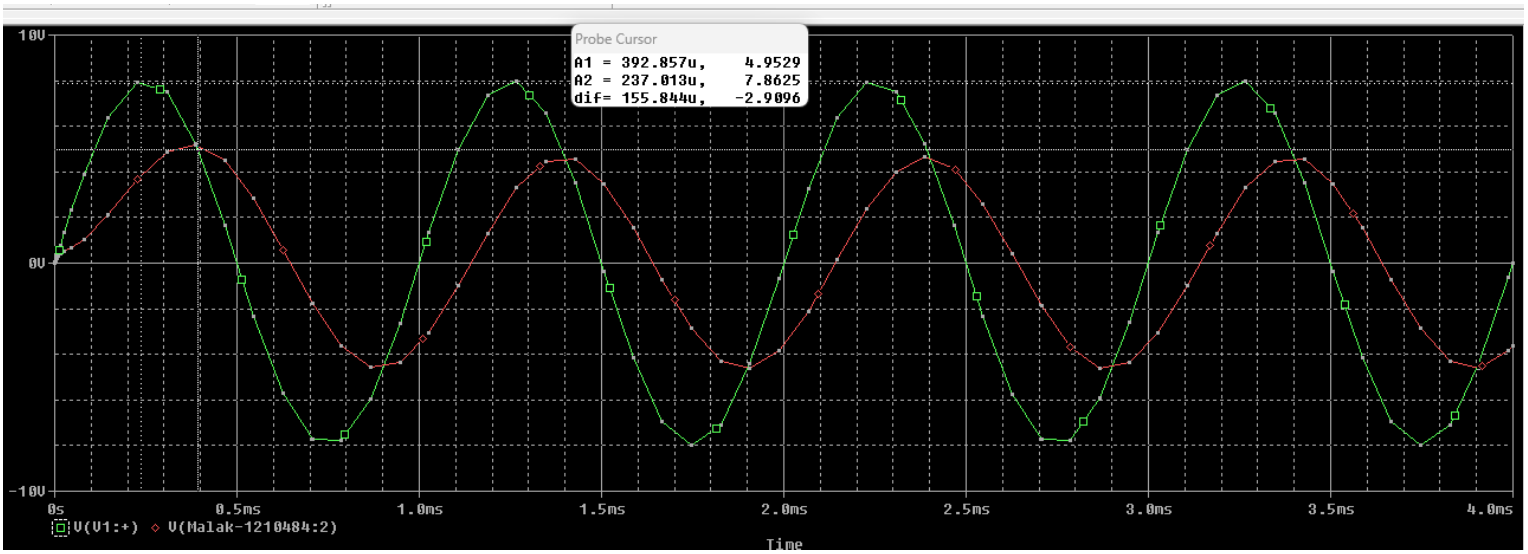
$$\Delta t = (379.870\text{-}256.494)\ \mu s = 123.377\ \mu s$$

$$\theta = 360 * f * \Delta t = 360 * 1000 * 123.377 * 10\text{^-}6 = 44.41°$$

$$P.F = \cos\theta = \cos 44.41° = 0.71$$

- Repeat the previous step with the added capacitor to show power factor improvement.





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Probe Cursor
A1 = 392.857u,     4.9529
A2 = 237.013u,     7.8625
dif= 155.844u,    -2.9096
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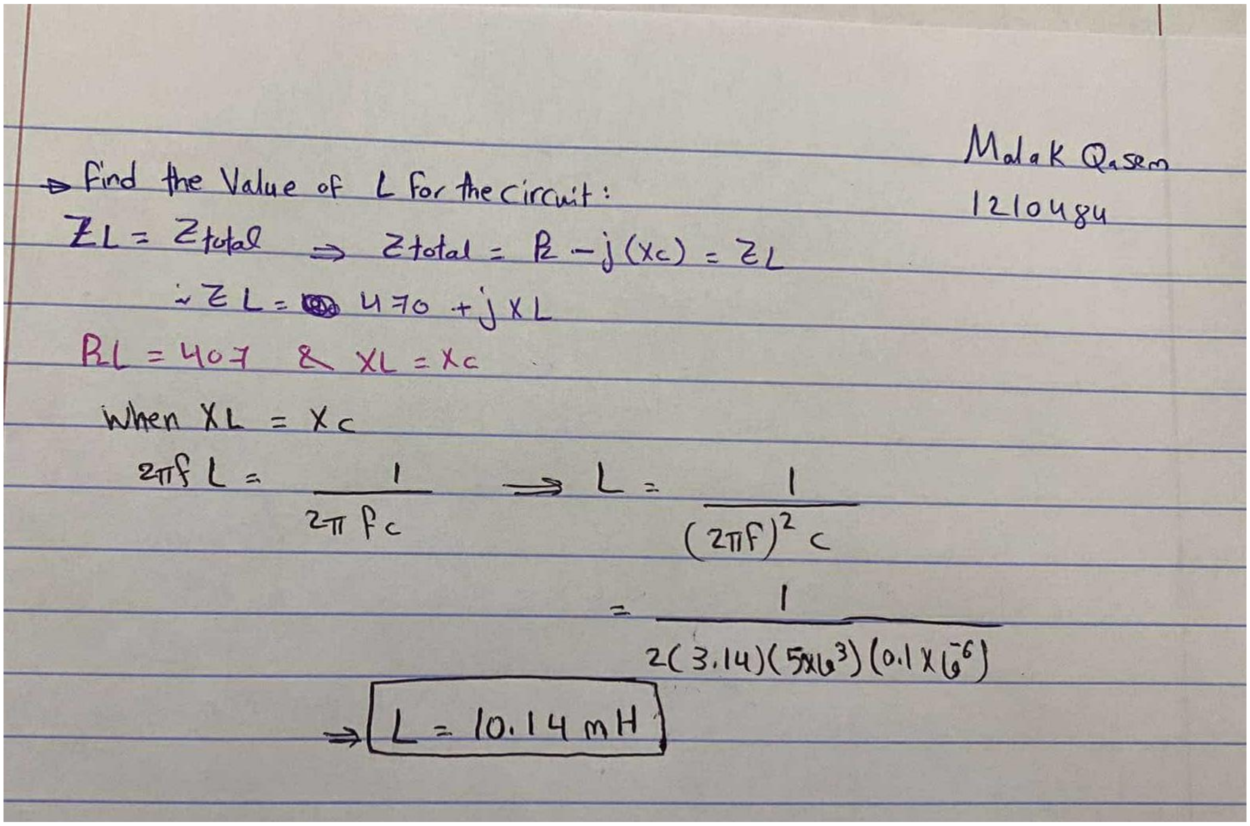
Δt = (392.857-237.013) µs=155.844 µs

θ = 360 ∗ f ∗ Δt = 360 ∗ 1000 ∗ 123.377 ∗ 10^-6 = 56.10°

P.F = cos θ = cos 56.10° = 0.56

3. For the circuit of Figure 9.8, design a load that is when connected to the output terminals of the circuit will extract maximum average power, then calculate magnitude of P Max.



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⇒ Find the Value of L for the circuit:

$Z_L = Z_{total} \Rightarrow Z_{total} = R - j(X_C) = Z_L$

$\therefore Z_L = 470 + jX_L$

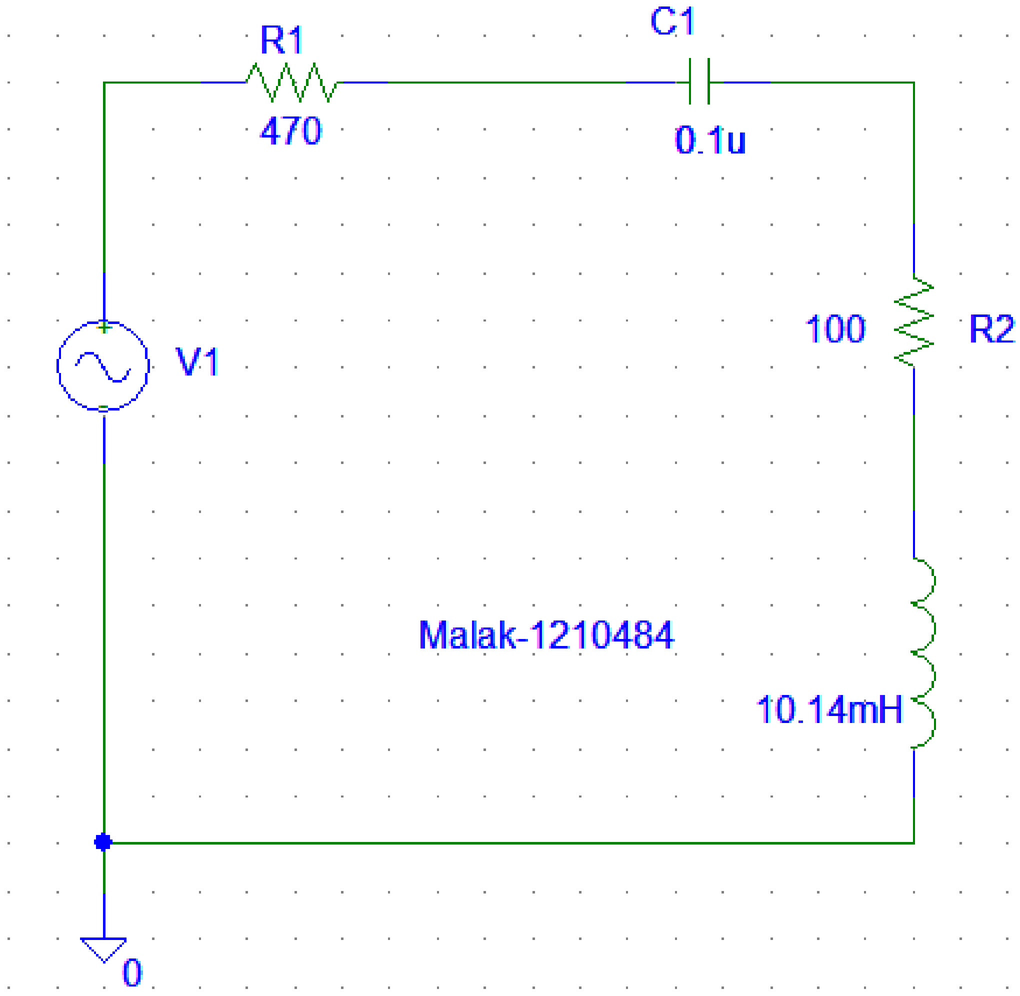
$R_L = 407$ & $X_L = X_C$

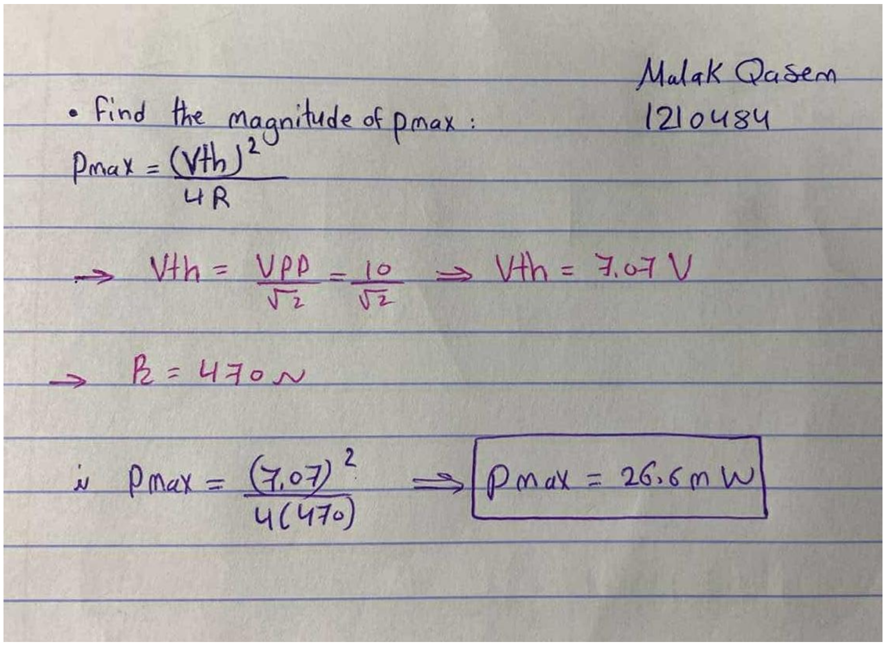
when $X_L = X_C$

$$2\pi f L = \frac{1}{2\pi f c} \rightarrow L = \frac{1}{(2\pi f)^2 c}$$

$$= \frac{1}{2(3.14)(5\times10^{3})(0.1\times10^{-6})}$$

$$\Rightarrow \boxed{L = 10.14\,mH}$$





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• Find the magnitude of pmax :

$$p_{max} = \frac{(V_{th})^2}{4R}$$

→ $V_{th} = \frac{V_{PP}}{\sqrt{2}} = \frac{10}{\sqrt{2}} \Rightarrow V_{th} = 7.07\ V$

→ $R = 470\ \Omega$

$\therefore\ p_{max} = \frac{(7.07)^2}{4(470)} \Longrightarrow \boxed{p_{max} = 26.6\ mW}$