LAB ASSIGNMENT – 2

Course: Basic Electrical and Electronics Engineering

Course Code: EEE1001

Faculty Name: Prof. Medaramelta Praveenkumar

Slot: L-19+L-20

Name: Priyal Bhardwaj

Registration Number: 18BIT0272

Submission Date: 30.08.2018

Ex. No.:3

Date:

Response of RLC Series Circuit

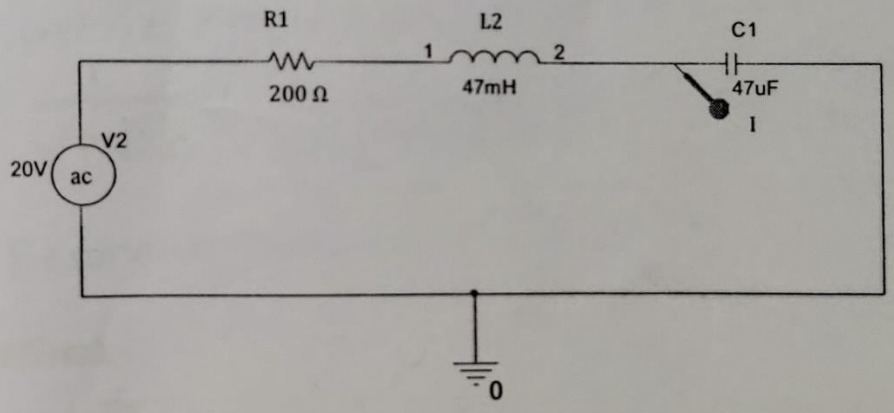
Aim: For the given RLC circuit find the resonant frequency and verify it using simulation.

Apparatus/Tool required:

ORCAD / Capture CIS --> **Analog Library – R, L & C**
Source Library – Vac
Ground (GND) – 0 (zero)

Simulation Settings: **Analysis Type – Transient (Time Domain)**
Run to time: 20ms

Circuit Diagram:



Theory: When the resistor, capacitor and inductor are connected in series forming a series RLC circuit, it is seen that resonance occurs in circuit when the supply frequency causes the voltage across L and C to be equal and opposite in phase.

Formulae :

Inductive Reactance; $X_L = \omega L = 2\pi f L$

Capacitive Reactance; $X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

Total Impedence; $Z = R + j\omega L + \frac{j}{\omega C}$

$\Rightarrow |Z| = \sqrt{R^2 + (X_L - X_C)^2}$

• When $X_L = X_C \rightarrow$ Resonant Frequency $= \frac{1}{2\pi\sqrt{LC}}$

Calculation:

$X_L = X_C \rightarrow 2\pi f L = \frac{1}{2\pi f C} \rightarrow f^2 = \frac{1}{4\pi^2 LC}$

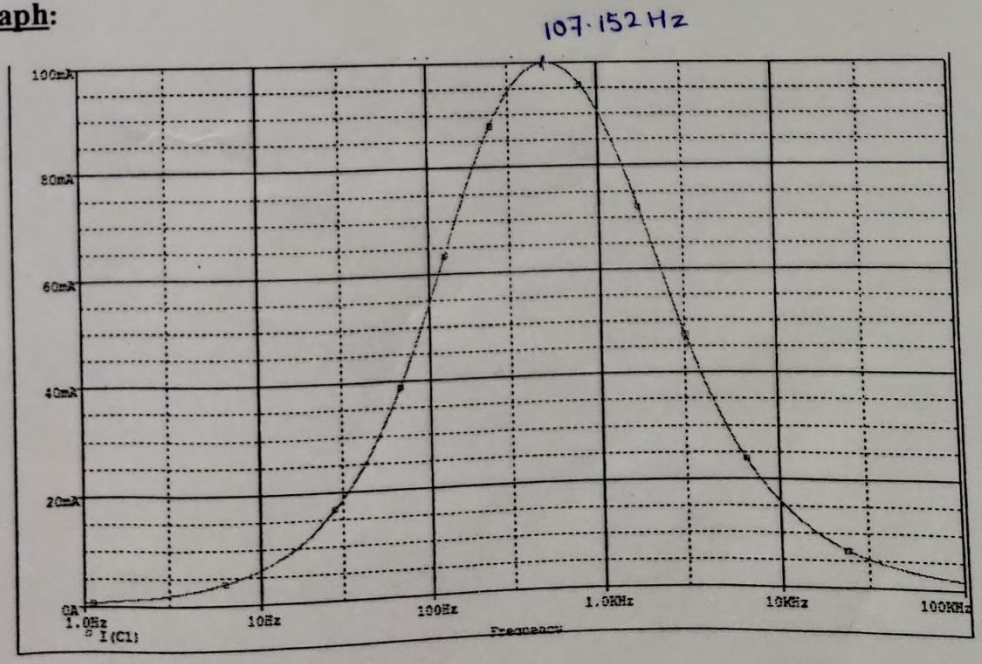
$\Rightarrow f = \frac{1}{2\pi\sqrt{LC}}$

Resonant Frequency (when $X_L = X_C$):

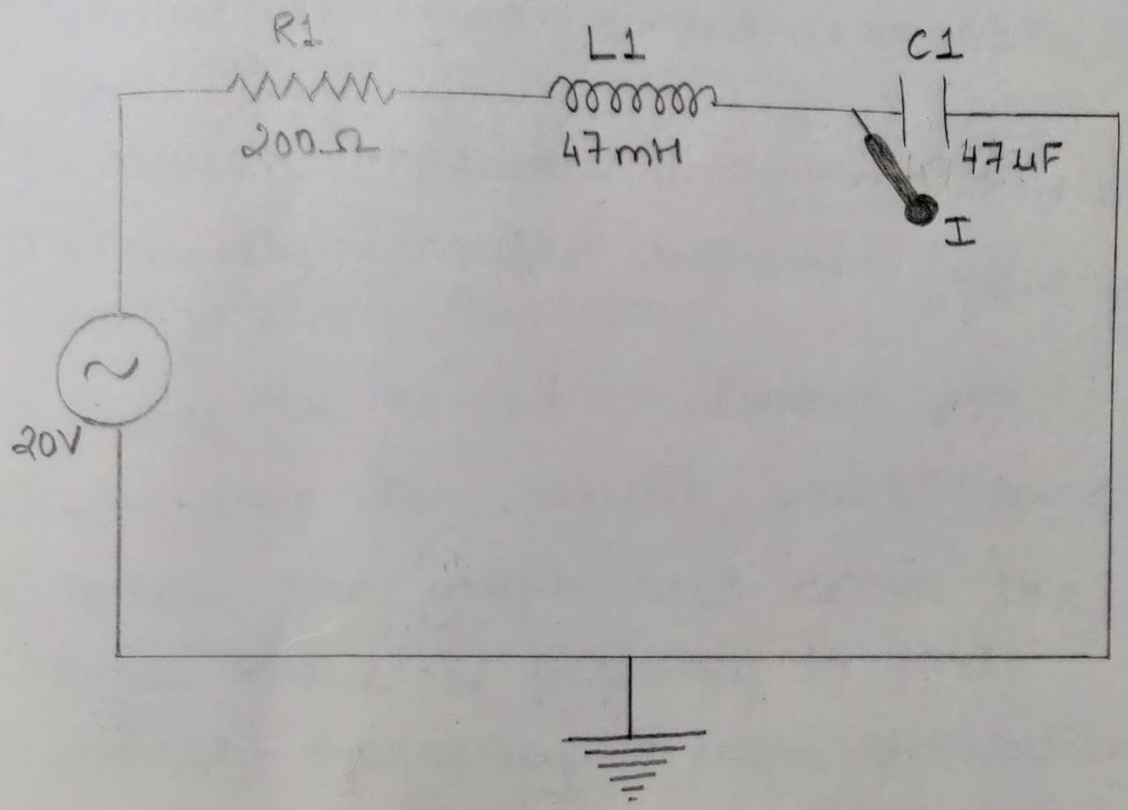
$= \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{47\times47\times10^{-9}}} = \frac{10^4 \times \sqrt{10}}{2\pi\times47} = 107.13\,Hz$

$\Rightarrow$ Resonant Frequency = 107.13 Hz

Model Graph:



Simulation Circuit Diagram and Output:



$X_L = 2\pi f L$

$= 2 \times 3.14 \times 47 \times 10^{-3} \times f$

$= 0.295 f$

$X_C = \frac{1}{2\pi f C} = \frac{1}{2 \times 3.14 \times 47 \times 10^{-6} \times f}$

$= \frac{10^6}{295.16 f} = \frac{3387.99}{f}$

Output :-

f (Hz)	I (mA)
1	5.896
10	51.185
100	99.97
107.152	100
1000	56.52
30000	2.2775

Procedure:-

1) Construct the same circuit as mentioned in the question.
2) Calculate impedence using given formula.
3) Manually calculate resonant frequency using given formulae.
4) Place the circuit in Capture CIS.
5) Simulate the circuit using PSpice.
6) Obtain the graph and derive the peak value of frequency to find resonant frequency through simulation.
7) Note down your observations

Result:- Resonant frequency by :-

(1) Manual Calculation - 107.13 Hz

(2) Simulation - 107.152 Hz

$\Rightarrow$ Manual $\simeq$ Simulation

Difference = 107.152 - 107.130 = 0.022 Hz

Maximum current (I_{max}) at resonant frequency = 100 mA

Inference:- Calculated & simulated results are similar and hence resonant frequency is determined correctly, when $X_L = X_C$.

Reg. No: 18BIT0272 **Name:** PRIYAL BHARDWAJ **Date:** 20/08/2018