Ex.No.3	**SINUSOIDAL STEADY STATE RESPONSE OF SERIES RLC CIRCUIT**
Date:	

AIM: To study the behaviour of the given RLC series circuit for the following conditions and to plot the steady-state response.

(i) f < fr

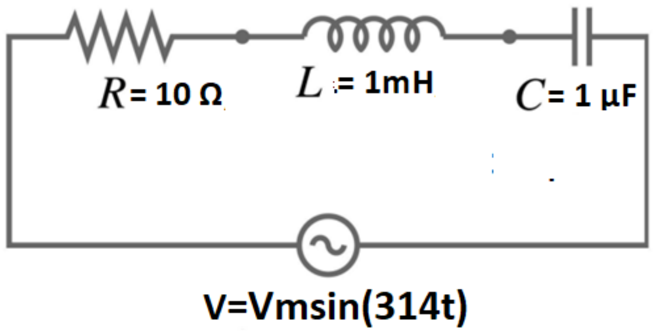
(ii) f = fr

(iii)f > fr

SOFTWARE REQUIRED:

LTspice software

THEORY & CIRCUIT DIAGRAM:



THEORY

The Series RLC circuit as shown in the above figure can be used as a series bandpass filter. In the series RLC circuit, larger reactance determines the net reactance of the circuit.

Case i:

If XL > XC the circuit behaves like an inductive circuit and the current lags behind the supply voltage.

Case ii:

If XC > XL, the circuit behaves like a capacitive circuit and the circuit current leads the voltage when The Sinusoidal Steady State Response of RLC circuit is plotted.

SERIES RESONANCE:

When a circuit is supplied with a voltage of fixed amplitude but varying frequencies, there is a frequency at which the inductive and capacitive components of the circuit cancel each other out. This frequency is called the resonant frequency (fr) point, and at this point, the circuit has maximum current flow and minimum impedance.

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$fr = \frac{1}{2\pi\sqrt{1 \times 10^{-3} \times 1 \times 10^{-6}}}$$

= 5032.9Hz

Given: R= 10 Ω, L= 1mH, C= 1 µF and Vm = 100 V, f = 50 Hz,

CALCULATIONS

1. Calculation Inductive and Capacitive reactance
   XL = ωL = 2 π fL
   XC = (1/ωC) = (1/ 2 π fC)

2. Calculation of total Impedance
   Case i: when f < fr then $X_C > X_L$
   $$Z = \sqrt{(R^2 + (X_C - X_L)^2}$$

   Case ii: when f = fr then $X_C = X_L$

   Z=R

   Case iii: when f > fr then $X_L > X_C$

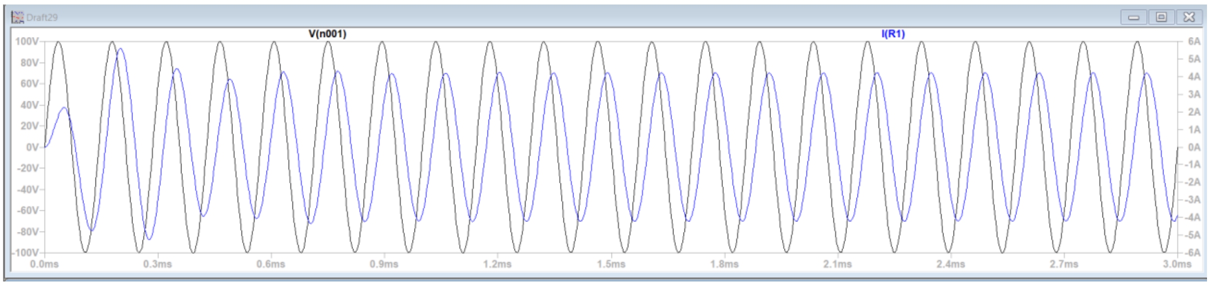
   $$Z = \sqrt{(R^2 + (X_L - X_C)^2}$$
3. Calculation of circuit current
   $$I = \frac{V}{z}$$
4. Calculation of phase angle and circuit power factor
   $\emptyset = \tan^{-1}\frac{X}{R}$ $\quad \text{pf} = \cos(\emptyset)$

Case	frequency	X_L Ω	X_C Ω	Z Ω	I_m A	Ø degrees	pf
f < fr	f = 2000Hz	12.566	79.5775	67.7535	1.476	81.512	0.1476(lead)
f = fr	f = 5032.9Hz	31.623	31.623	10	10	0	1 (unity)
f > fr	f = 7000Hz	43.9823	22.7364	23.4817	4.26	65.01	0.422(lag)

PROCEDURE:
1. Open LTspice. Go to File -> New Schematic.
2. On the File Menu, click on Edit Component.
3. Place the voltage sources, resistor, inductor , capacitor and ground on to schematic and make necessary connections as shown in the given Figure
4. As shown in the figures below, Right click on the voltage source V1 and click Advanced option and then Select SINE (Voffset Vamp Freq Td Theta Phi Ncycles) and Set the values as (DC offset = 0, Amplitude =100 and Freq as required).
5. Right click on the resistor, inductor and capacitor and set the value as 10 Ω, 0.001 H and 1µF respectively.
6. Set the required frequency and do the transient analysis with the stop time of 3m sec and plot the supply voltage and resistor current
   Case 1: set the input frequency = 2000 Hz
   Case 2: set the input frequency =5032.9Hz
   Case 3: set the input frequency =7000Hz

SAMPLE OUTPUT

Note: paste your outputs here.



OBSERVATION TABLE

		Theoretical value	Practical value
Case 1	Im		
	Ø		
Case 2	Im		
	Ø		
Case 3	Im		
	Ø		

RESULTS

Thus, a series RLC circuit has been designed and implemented in LTspice software, and the current amplitude and phase angle were observed for all three cases and tabulated, which match the theoretical values.