Experiment Name:

Parallel RC, RL & RLC circuit.

Ojectives:

→ Investigate peak voltage, current & phase relation between the circuit components of parallel RC, RL & RLC circuits.

→ Understand & prove KCL for AC circuit.

→ Understand the technique to measure current using a current sense resistor.

Theory:

In parallel circuit voltage across each parallel terminal is same as the source voltage while current is different in each branch.

To measure the current we can use a sense resistor. It's value is comparatively low as than the circuit components & phase angle is same as the V across the resistor.

Apparatus:

- Resistors: 1×10KΩ, 3×1kΩ, 2×3Ω, 3×10Ω.
- Capacitors: 1×10nF, 1×33nF.
- Inductor: 1×330μH.
- Bread board.
- Function Generator.
- Oscilloscopes.

Circuit Diagram:

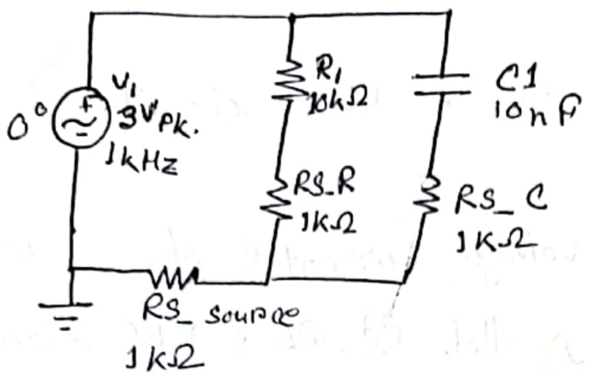

figure: Parallel RC circuit with sense Resistor.

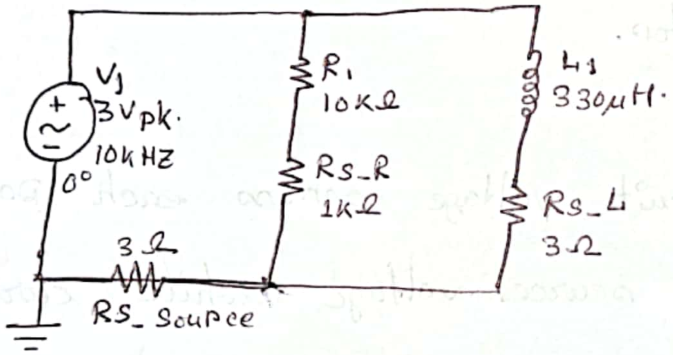

figure: Parallel RL circuit with sense Resistor

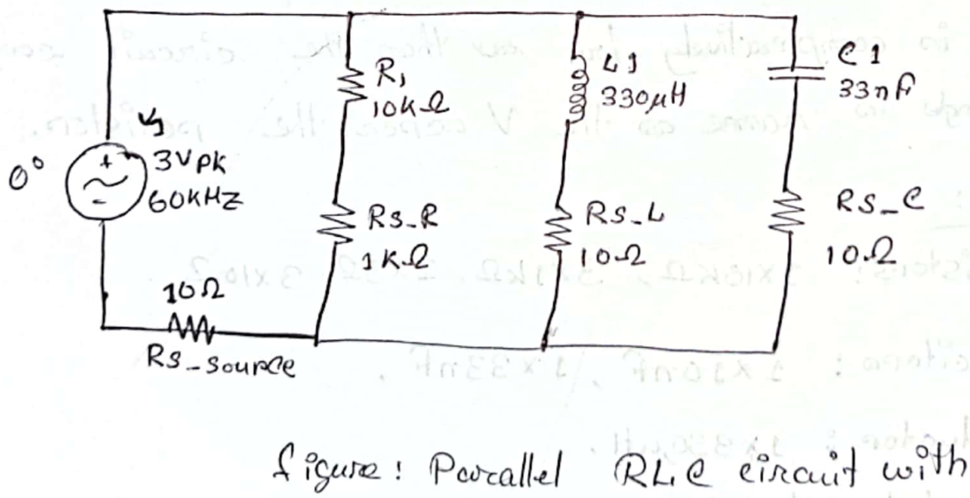

figure: Parallel RLC circuit with Sense Resistor.

Table 1.1

R (measured)	C (measured)	X_C (Theory) $\frac{1}{2\pi f C}$ (Ω)	$Z = \sqrt{R^2+X^2}$ (Ω)	$Z = \tan^{-1}(X/R)$ θ
$R_1 = R_3 = R_4 = 1k\Omega$ $R_2 = 10k\Omega$	10nF	15915.49		

Table 1.2

	I_{Peak} (Theory)	θ (Theory)	$V_{(sense)}$ Peak (Measured)	I_{Peak} (Practical)	Delay ΔT (Measured)	θ(Pract) $[\Delta T \times f \times 360]$	% Diffrence (i)	% Difference θ
i_s	6×10^{-4}A	30	640mV	6.4×10^{-4}A	85μS	30.6	~~0~~0.0%	0.02%
i_R	1.70mA	30	1.74V	~~1.74A~~ 1.74 mA	76μS	27.36	2.35%	8.8%
i_C	1.02×10^{-3}	45	1.5V	1.5×10^{-3}	120μS	43.2	0.0007%	4%

Table 1.3

R (Measured) (Ω)	L (measured) (H)	X_L (Theory) $[2\pi f L]$ (Ω)	$Z = \sqrt{R^2+X^2}$	$Z = \tan^{-1}(X/R)$ ($\angle\theta°$)
	330μH	20.73		

Table: 1.4

	|I Peak| (Theory)	θ (Theory)	V_{sense} (peak) (Measured)	|I Peak| (Practical)	Delay ΔT (Measured)	θ (Practical) ΔT × f × 360	% Difference [i]	% Difference [θ].
i_s	0.30A	80	830mV	0.28A	21.8μS	78.48	6.67%	1.9%
i_R	1.90×10^{-3}	65	1.86V	1.86mA	18.6μS	66.96	2.11%	3.01%
i_L	0.85A	81	2.42V	0.81A	22.2μS	79.92	4.71%	1.33%

Table: 1.5.

R(Ω)	C(F)	L (H)	X_C (Theory) $1/2\pi fC$ (Ω)	X_L (theory) [$2\pi fL$] (Ω)	$Z = \sqrt{R^2 + X^2}$ (Ω)	$Z = \tan^{-1}(X/R)$ ∠0°.
	33×10^{-9}	330×10^{-6}	80.38	124.41		

Table: 1.6

	I_{Peak} (Theory)	θ (Theory)	V_{sense} (Peak) (Measured)	I Peak (Practical)	Delay ΔT (Measured)	θ (Practical) ΔT × f × 360	% Difference (i)	% Diff (θ).
i_s	0.5A	65	4.55V	0.46A	3μS	64.8	8%	0.31
i_R	1.4mA	37	~~300mV~~ 1.35V	~~0.03A~~ 1.35mA	~~799nS~~ 1.66μS	35.856	18.57	3.08
i_L	0.04A	18	300mV	0.03A	799nS	17.26	25	4.11
i_C	0.17A	70	1.69V	0.169A	3.16μS	68.26	0.59	2.49

Questions:

① Function of sense resistor is to determine the current by calculation voltage ~~cal~~ across it. ~~The more the resistance~~ If we used smaller resistance it might burned due to over voltage. This is the disadvantage. ~~Again, the~~ On the other the advantage is that ~~I~~ we'll get more perfect values ~~if the s~~ for current in case of smaller resistance.

②

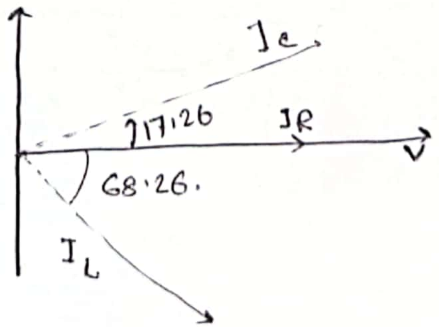

figure: Phasor diagram for RLC circuit.

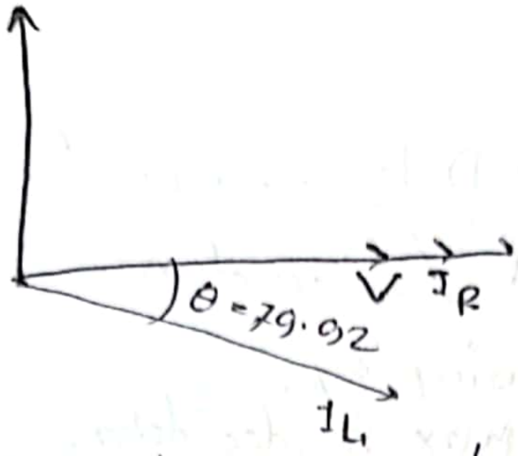

fig: phasor diagram of RL circuit.

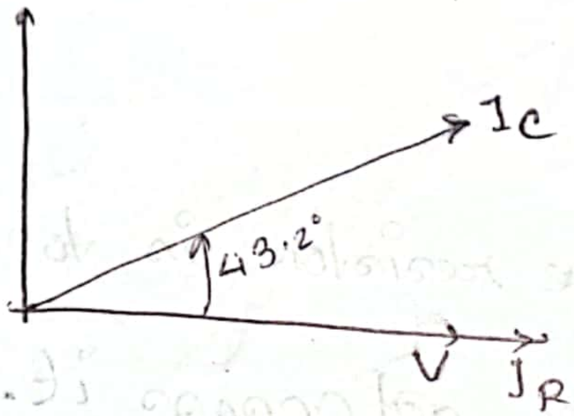

fig: Phasor diagram of RC circuit.

(iv) As we have completed software simulation due to pandemic, we did not noticed ~~man~~ a huge difference between theoretical and practical values. Rather, it was an acceptable ~~differences~~ error. The cause that ~~may be~~ for this error would be:

(a) We couldn't determine the exact peak values using cursor.

(b) There was a fluctuation in oscilloscope values.

(c) Unavoidable human error.

Discussion:

Due to pandemic, we have completed the lab in online. Through software simulation we've completed the circuit & measured the value. The measurement procedure was a bit complex but we've learned from youtube & ~~a~~ honourable instructor. As, the experiment was done in software thus, value of the component was ~~a~~ same as theory & our measured value ~~was at~~ had also minimum percentage of error.