



THE ISLAMIC UNIVERSITY OF GAZA

FACULTY OF ENGINEERING

Electrical Circuits Lab 2

Report for the Third laboratory

Student Name	Ahmad Al Halimy
University ID	120253623
Major	Electrical Engineering
Course Name	Electrical Circuits Lab 2
Instructor	Eng. Saeed Abu Jamea
Date	17-4-2026

Parallel AC Circuit

1- Objectives

- **Parallel Analysis:** To investigate the behavior and characteristics of parallel **RC**, **RL**, and **LC** circuits in an AC environment.
- **Impedance-Frequency Relationship:** To determine how frequency changes affect the total impedance (Z) and branch currents.
- **Phasor Diagrams:** To construct phasor diagrams and analyze the phase relationships between voltage and currents.
- **KCL Verification:** To verify Kirchhoff's Current Law (KCL) by calculating the vector sum of branch currents.
- **Resonance & Tank Circuits:** To study the resonance phenomenon in parallel **LC** circuits and its effect on total impedance.

2- Theory

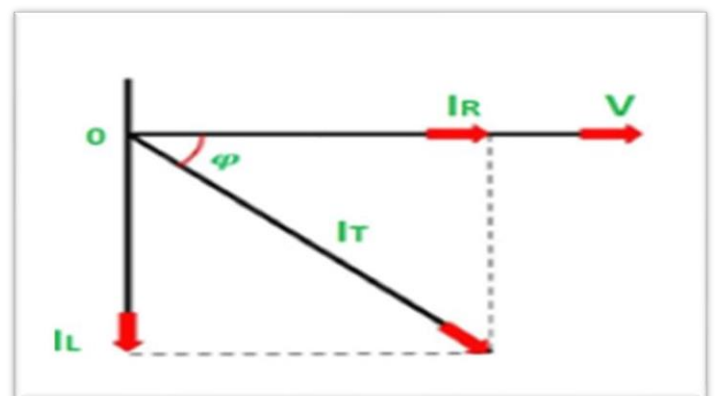
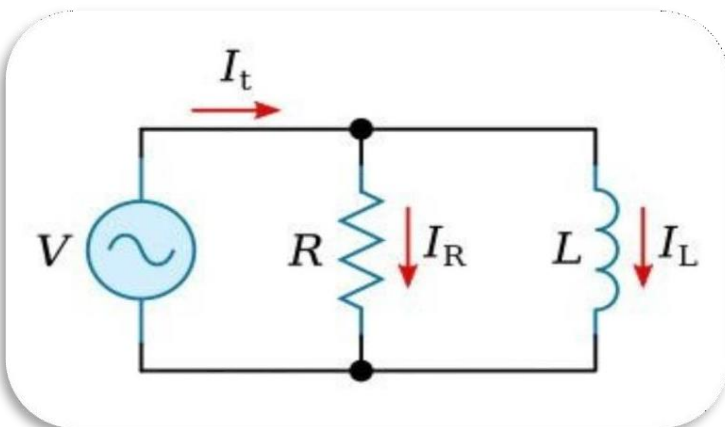
Parallel circuits are based on the principle:

"The voltage is constant, and the current is phase-divided."

Circuit Type	General Behavior	Phase Relationship	Key Characteristic
Parallel RL	Inductive: Total current (I_T) lags the voltage.	I_L lags V by 90degree	Z increases as Frequency F increases.
Parallel RC	Capacitive: Total current (I_T) leads the voltage.	I_C leads V by 90 degree	Z decreases as Frequency F increases.
Parallel LC	Resonant: Known as the "Tank Circuit".	I_L and I_C are 180degree out of phase.	At resonance ($X_L = X_C$), Z is maximum (Ideal Open Circuit).

1. Parallel RL Circuit:

- In a parallel RL circuit, the voltage across all components is identical ($V_{in} = V_R = V_L$). However, the currents flowing through the resistor and inductor differ in phase.



$$I_R = \frac{V_{in}}{R} \quad \text{,,,} \quad I_L = \frac{V_{in}}{X_L} \quad \text{,,,} \quad X_L = 2\pi fL$$

$$|I_T| = \sqrt{(I_R)^2 + (I_L)^2}$$

$$Z = \frac{R * jX_L}{R + jX_L} = \frac{V_{in}}{I_T} \text{ (Impedance)}$$

$$Y = \frac{1}{R} + \frac{1}{jX_L} = \frac{1}{R} - j \frac{1}{X_L} = G + jB$$

$$\phi = \tan^{-1} \frac{I_L}{I_R} = \cos^{-1} \frac{I_R}{I_T} = \sin^{-1} \frac{I_L}{I_T} = \tan^{-1} \frac{R}{X_L}$$

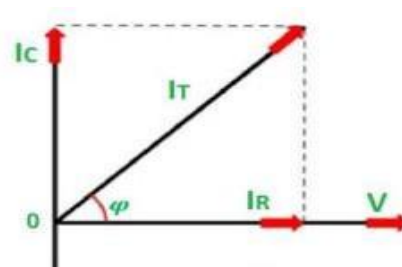
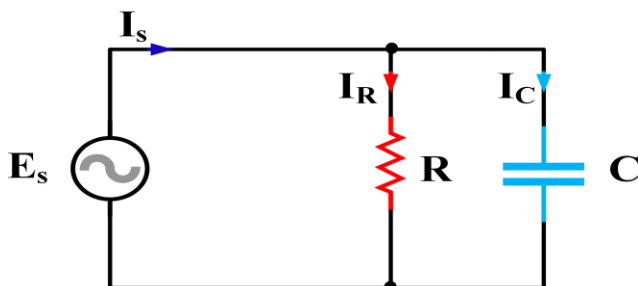
Change	IR	IL	Vin	Phase Angle (φ)
Increase R	Decrease	Increase	Constant	Increase

Change	XL	IL	IR	Phase Angle (φ)
Increase Frequency (F)	Increase	Decrease	Increase	Decrease

2. Parallel RC Circuit

➤ A parallel RC circuit acts as a basic frequency filter where the capacitor current leads the voltage.

- **Phase Relationship:** IC leads the voltage by 90



$$I_R = \frac{V_{in}}{R} \quad , \quad I_C = \frac{V_{in}}{X_C} \quad , \quad X_C = 1/2\pi fC$$

$$|I_T| = \sqrt{(I_R)^2 + (I_C)^2}$$

$$Z = \frac{R * jX_C}{R + jX_C} = \frac{V_{in}}{I_T}$$

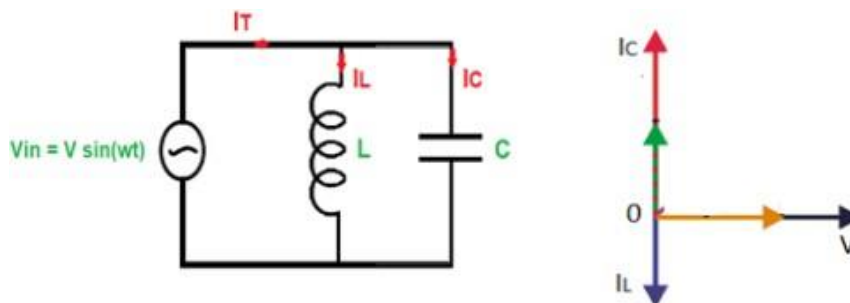
$$\varphi = \tan^{-1} \frac{I_C}{I_R} = \cos^{-1} \frac{I_R}{I_T} = \sin^{-1} \frac{I_C}{I_T}$$

3. Parallel LC Circuit (Tank Circuit)

This circuit is unique because it can store and oscillate energy between the inductor and the capacitor.

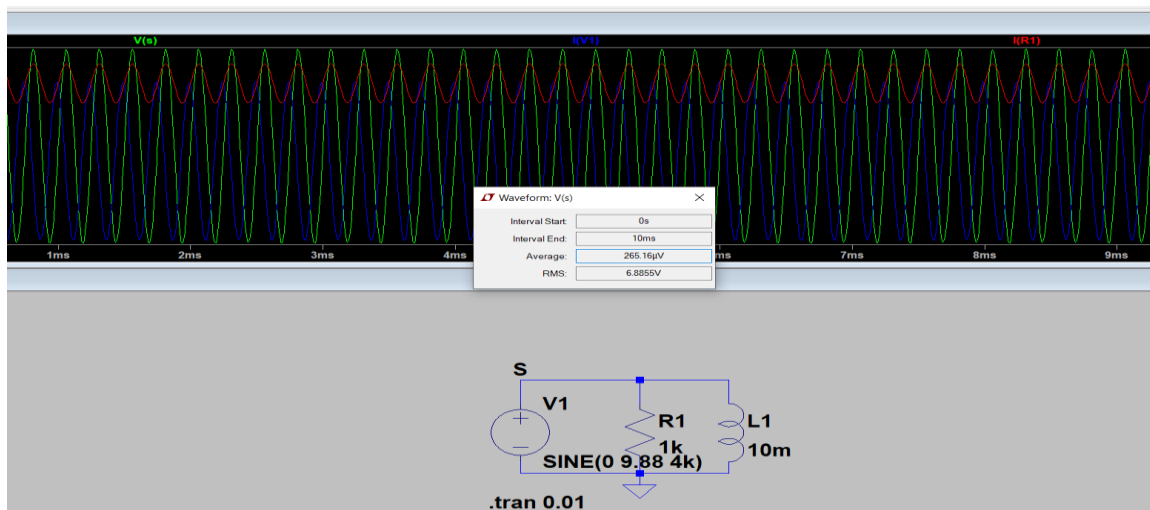
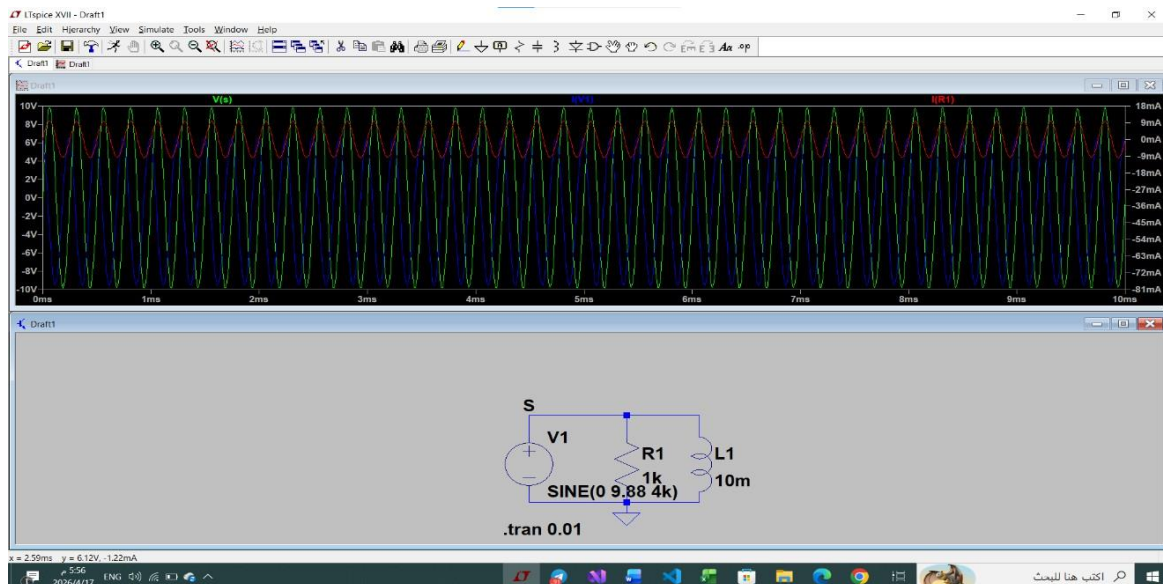
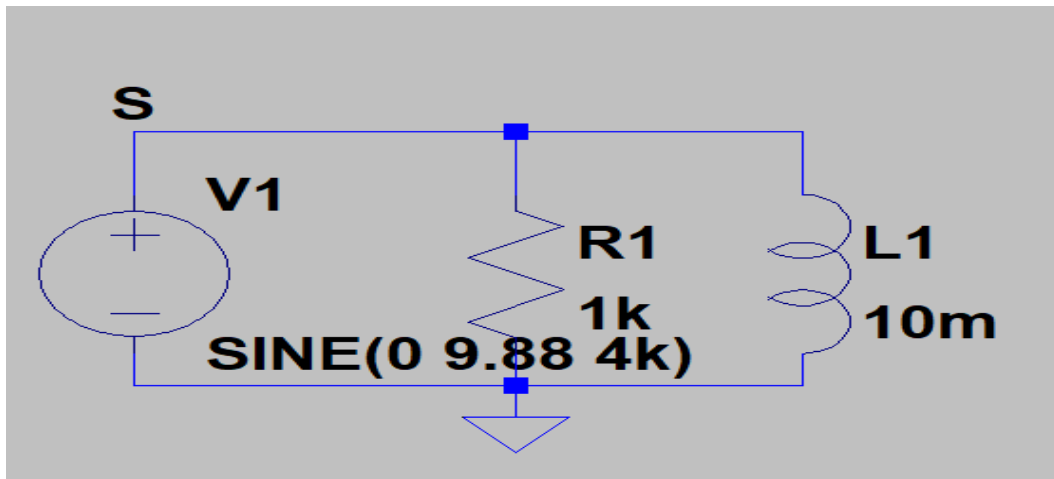
- **Resonance Condition:** At the resonant frequency, the inductive and capacitive currents cancel each other out ($I_L = I_C$) but in opposite directions).
- **Characteristics:** The circuit draws **zero net current** from the source (ideally).
- The total impedance (Z) becomes **infinite**.
- **Total Current Vector:**

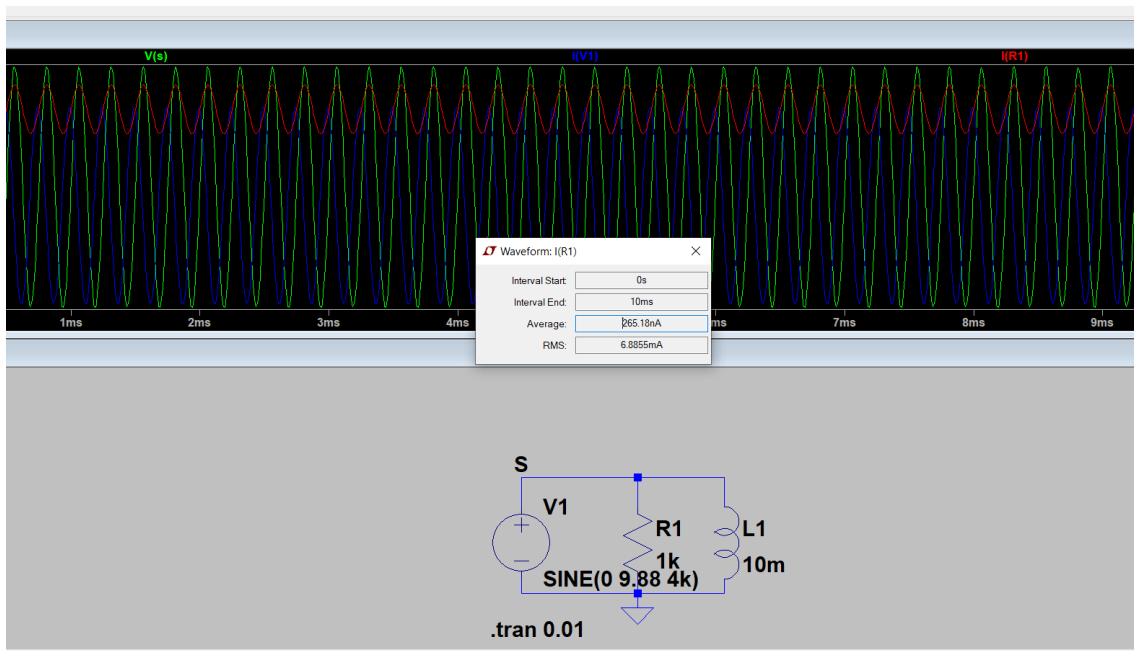
$$\vec{I_{in}} = \vec{I_L} + \vec{I_C}$$



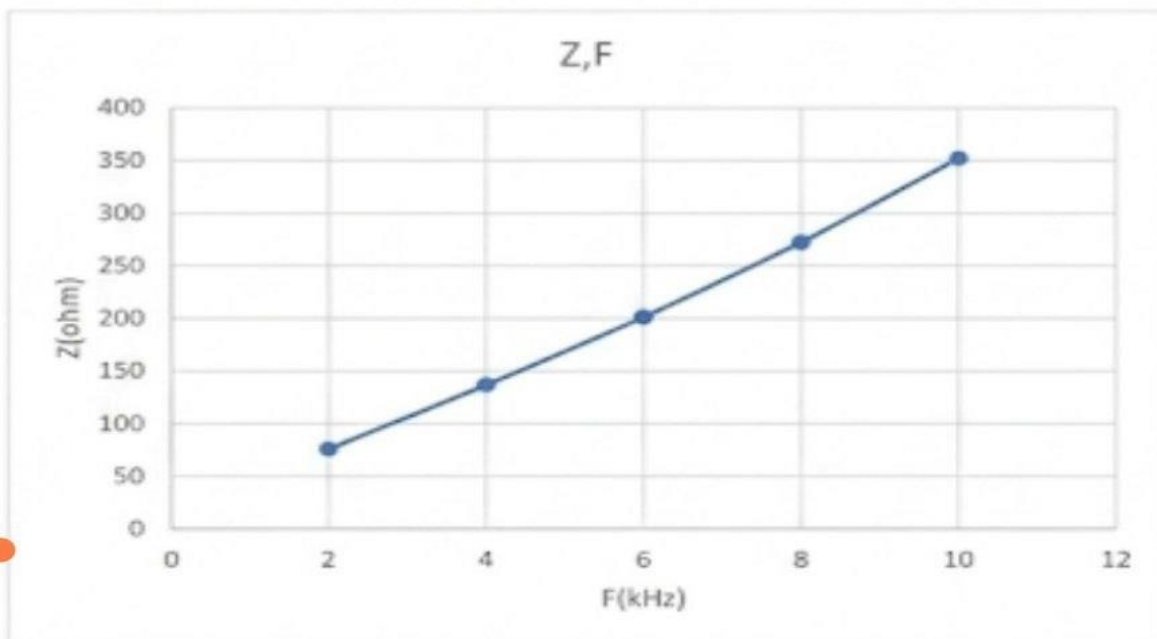
3.Simulation:

1- RL Parallel Circuit :

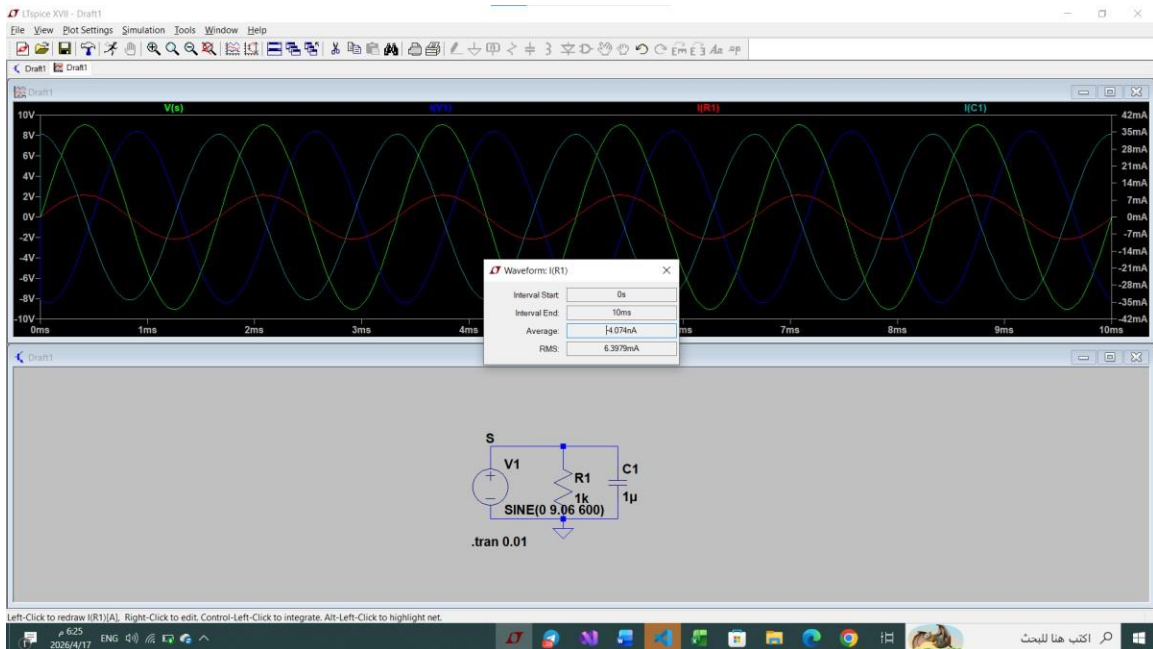
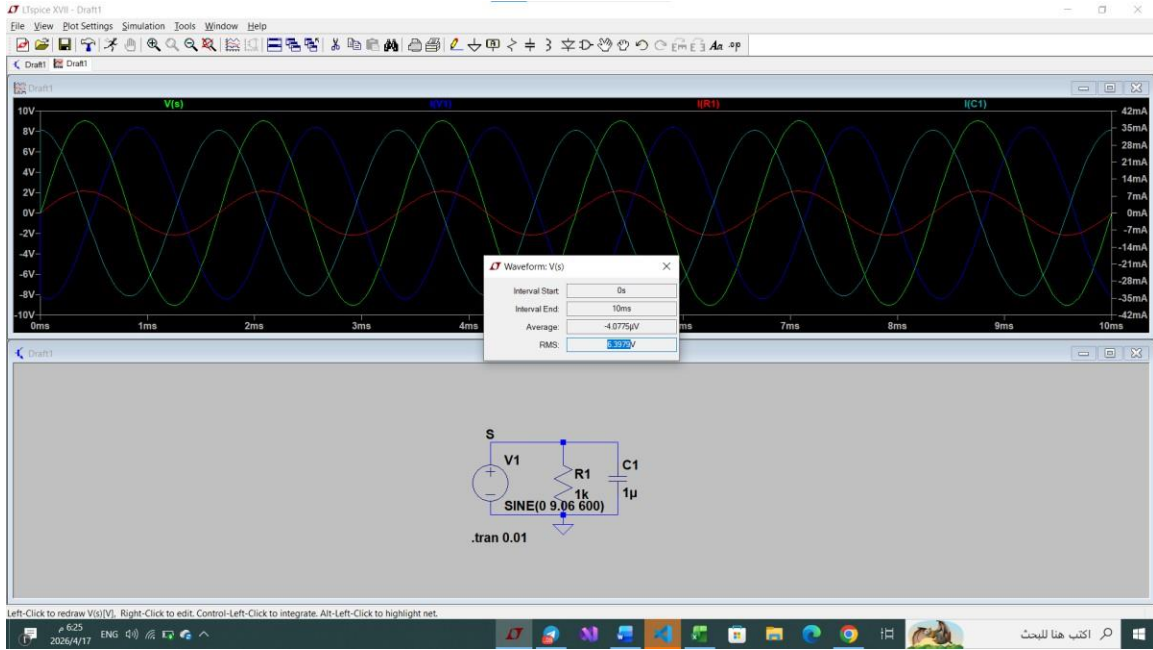




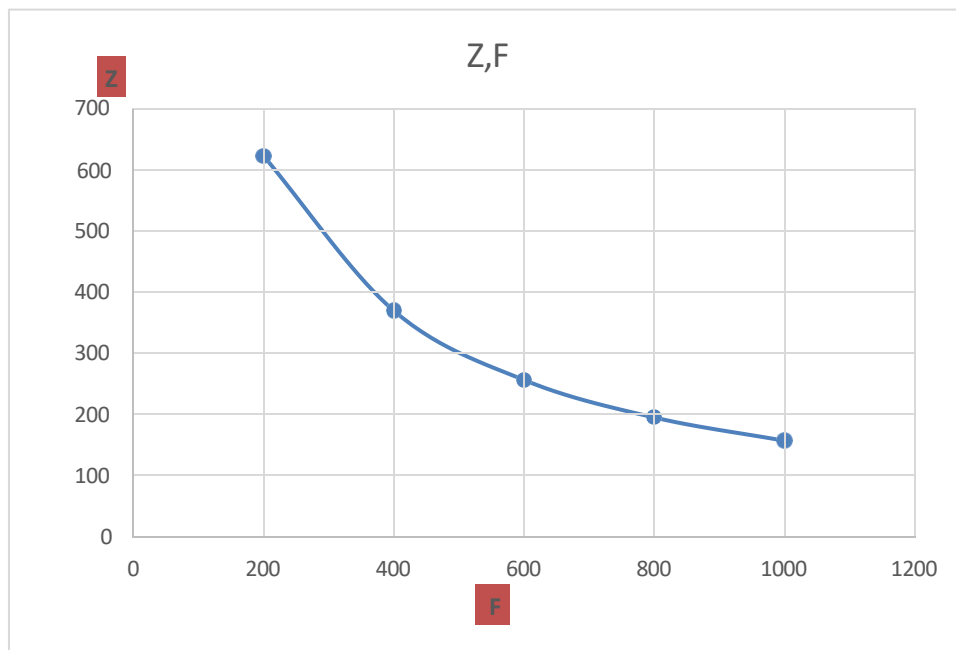
F(KHZ)	IS (mA)	Ir (mA)	IL (mA)	Vs (v)	Z (ohm)	Phase angel
2	96.233	6.9523	95.981	6.952	72.24 Ω	85.857
4	48.182	6.885	47.688	6.8855	142.89 Ω	81.784
6	31.093	6.844	30.331	6.8444	220.11 Ω	77.284
8	22.474	6.843	21.419	6.8436	304.48 Ω	72.282
10	16.958	6.844	15.536	6.8446	403.58 Ω	66.228



2- RC Parallel Circuit :



(Hz) F	Is (mA)	Ir (mA)	Ic (mA)	Vs (v)	Z (ohm)	Phase angel
200	10.288	6.4058	8.049	6.4058	622.64	51.488
400	17.326	6.405	16.099	6.405	369.67	68.304
600	24.956	6.3979	24.122	6.3979	256.37	75.147
800	32.774	6.395	32.145	6.3951	195.13	78.748
1000	40.682	6.392	40.177	V6.3923	157.13	80.96

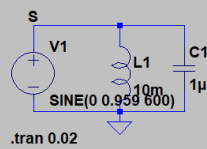
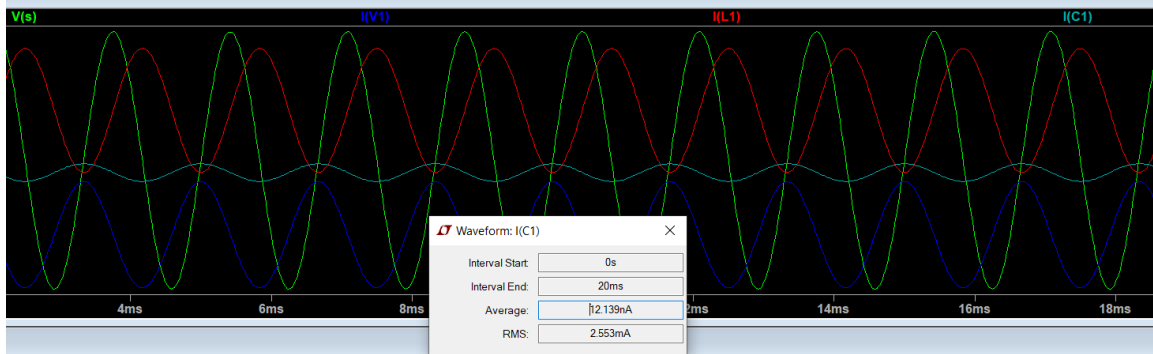
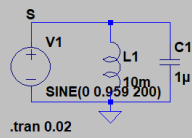
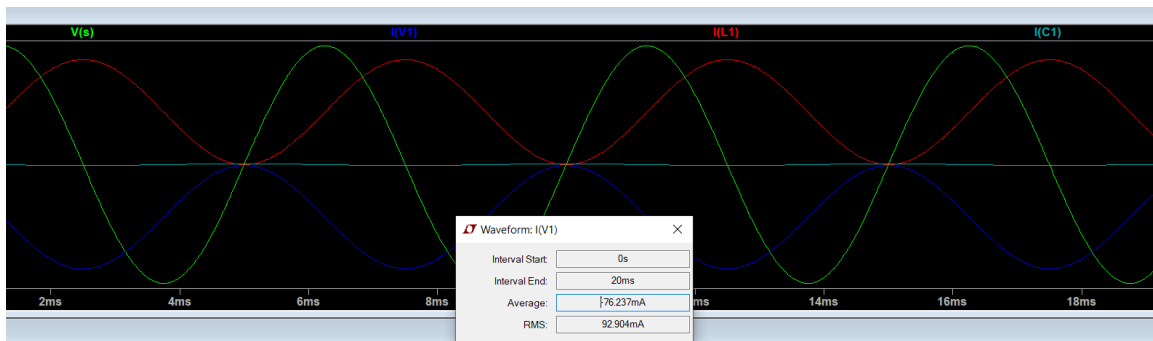


Conclusion :

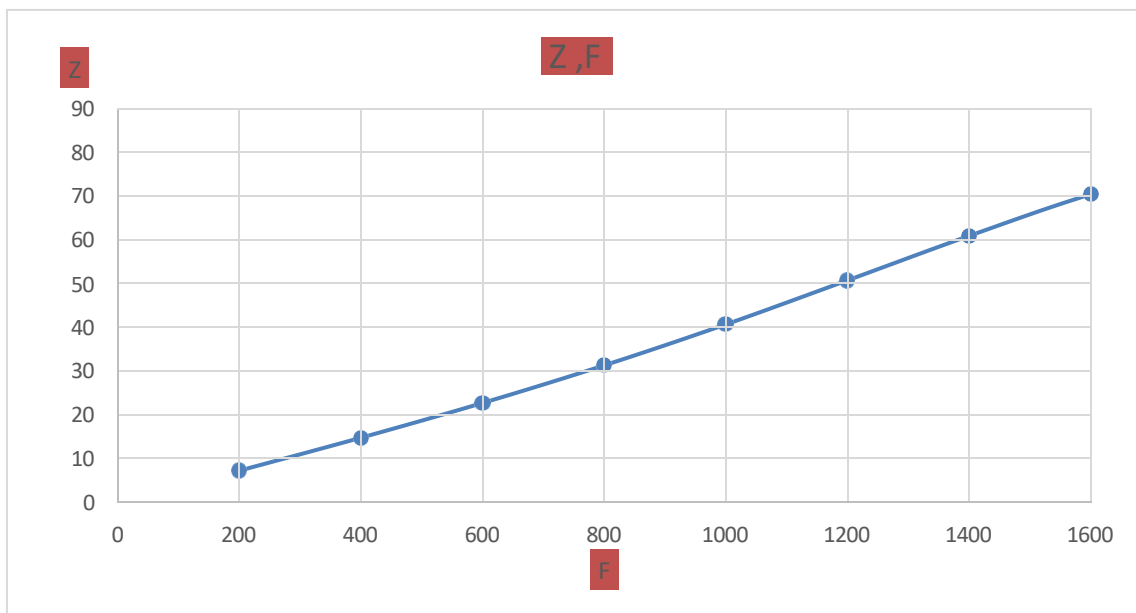
1- Inverse relationship: There is a non-linear inverse relationship between frequency and the total impedance of the circuit. As the frequency increases, the impedance decreases Z

2- Capacitor behavior: This decrease is due to the nature of capacitor operation in parallel; the capacitive reactance X_C decreases with increasing frequency, causing the capacitor to pass a larger current I_C at high frequencies.

3- LC Prallel Circuit:



(Hz) F	Is (mA)	IL (mA)	Ic (mA)	Vs (V)	Z (ohm)	angle Phase
200	92.904	93.393	0.851	0.677	7.287	-89.47°
400	45.698	46.659	1.7021	0.677	14.817	-88.79°
600	29.702	31.102	2.553	0.676	22.759	-88.08°
800	21.527	23.307	3.4004	0.675	31.355	-87.32°
1000	16.552	18.628	4.2448	0.674	40.72	-86.45°
1200	13.253	15.506	5.0854	0.673	50.78	-85.34°
1400	11.027	13.279	5.954	0.672	60.941	-83.84°
1600	9.5273	11.658	6.8008	0.675	70.431	-81.67°
1800	8.6004	10.28	7.5863	0.669	77.787	-78.38°
2000	8.229	9.2559	8.4088	0.668	81.176	-72.41°



Conclusion:

- The results demonstrate a **direct relationship** between frequency F and total impedance Z in the **LC parallel circuit**, where impedance increases as frequency rises.
- Additionally, the circuit transitioned from **capacitive** behavior (negative phase angle) to **inductive** behavior (positive phase angle) at higher frequencies, confirming that the circuit is approaching its resonance point.

4. Conclusion

The characteristics of the three circuits were successfully verified using **simulation tools**. Despite the lack of physical lab access due to the current situation, the results accurately matched theoretical models. This study provided a precise analysis of impedance and current behavior, essential for understanding resonance and filter applications.