EEL101: Basic Electrical Lab

Experiment No: 5 Date:

Batch No.		Team Number	
	Team Member 1	**Team Member 2**	**Team Member 3**
Name			
ID No			

Aim: Measurement and correction of power factor.

Objective:

The objective of this experiment is to measure the power factor of an RL circuit and investigate the impact of power factor correction using a capacitor. Additionally, the experiment aims to explore the relationship between power factor, apparent power and real power in the circuit.

Apparatus Required:

1. RL circuit (resistor and inductor connected in series)
2. Power supply (Single phase 230 VAC)
3. Digital Ammeter
4. Digital Voltmeter
5. Digital wattmeter
6. Capacitor (for power factor correction)
7. Connecting wires

Theory:

1. Power Factor (PF): Power factor is a dimensionless quantity that represents the ratio of real power (P) to apparent power (S) in an electrical circuit. It is a crucial parameter in alternating current (AC) circuits and is defined by the formula: PF= Power/(V_{rms} * I_{rms}).

2. RL Circuit: An RL circuit consists of a resistor (R) and an inductor (L) connected in series. In AC circuits, the presence of inductance causes a phas[shift between voltage and current waveforms, leading to a displacement power factor. This results in a portion of the apparent power being reactive (Q), contributing to the overall power factor.

3. Power Triangle: The relationship between real power (P), reactive power (Q), and apparent power (S) in an AC circuit is often visualized using the power triangle. Real power is the horizontal component, reactive power is the vertical component, and apparent power is the hypotenuse of the triangle. The power factor is the cosine of the angle between the real power and apparent power vectors.

4. Measurement of Power Factor: Power factor can be measured using a power factor meter or power analyzer. These devices provide readings of real power, reactive power, and apparent power, allowing for the calculation of the power factor using the formula mentioned earlier.

5. Power Factor Correction: Power factor correction is the process of improving the power factor of an electrical system, typically by introducing a capacitor. In an RL circuit, the capacitor generates a leading current, compensating for the lagging current caused by the inductor. This minimizes the reactive power and improves the power factor.

Procedure:

1. **Setup the Resistive Circuit:**
   a. Connect the circuit as shown in Fig. 1.
   b. Ensure all connections are secure and use appropriate safety measures.
   c. Switch on the mains power supply and slowly increase the voltage from auto-transformer/variac.
   d. Measure the value of RMS voltage, RMS current and power from a digital voltmeter, ammeter and wattmeter respectively.
   e. Take 5 sets of readings for the current value between 1 ampere to 2 Ampere.

2. **Setup the Resistive Inductive Circuit:**
   a. Connect the circuit as shown in Fig. 2 by introducing a variable inductive load in series with the variable resistance.
   b. Ensure all connections are secure and use appropriate safety measures.
   c. Switch on the mains power supply and slowly increase the voltage from auto-transformer/variac.
   d. Measure the value of RMS voltage, RMS current and power from a digital voltmeter, ammeter and wattmeter respectively.
   e. Take 5 sets of readings for the current value between 1 ampere to 2 Ampere.

3. **Setup the Resistive-inductive-capacitive Circuit:**
   a. Connect the circuit as shown in Fig. 3 by introducing a capacitor in series with the RL.
   b. Ensure all connections are secure and use appropriate safety measures.
   c. Switch on the mains power supply and slowly increase the voltage from auto-transformer/variac.
   d. Measure the value of RMS voltage, RMS current and power from a digital voltmeter, ammeter and wattmeter respectively. e. Take 5 sets of readings for the current value between 1 ampere to 2 Ampere.

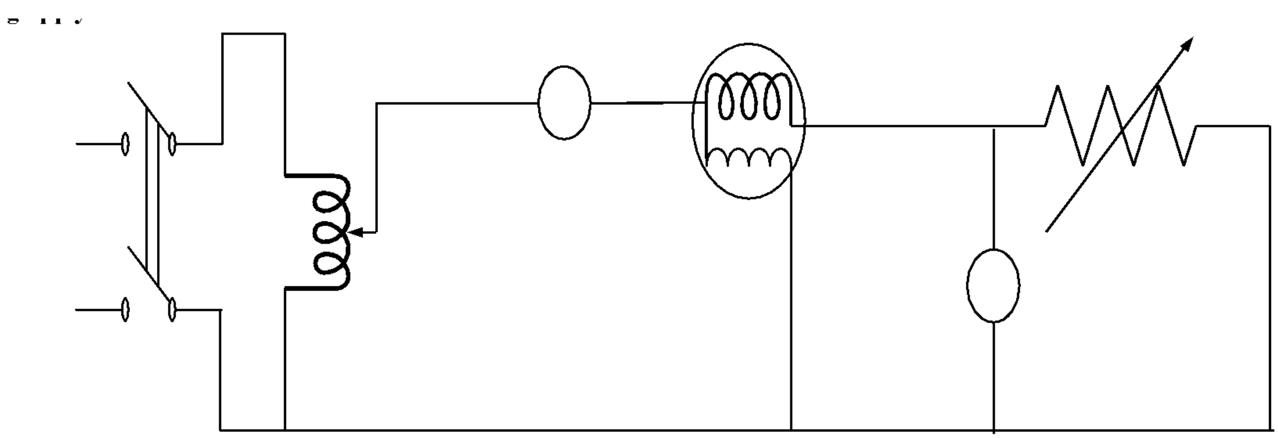

Fig. 1 Voltage, current and power measurement in a resistive circuit

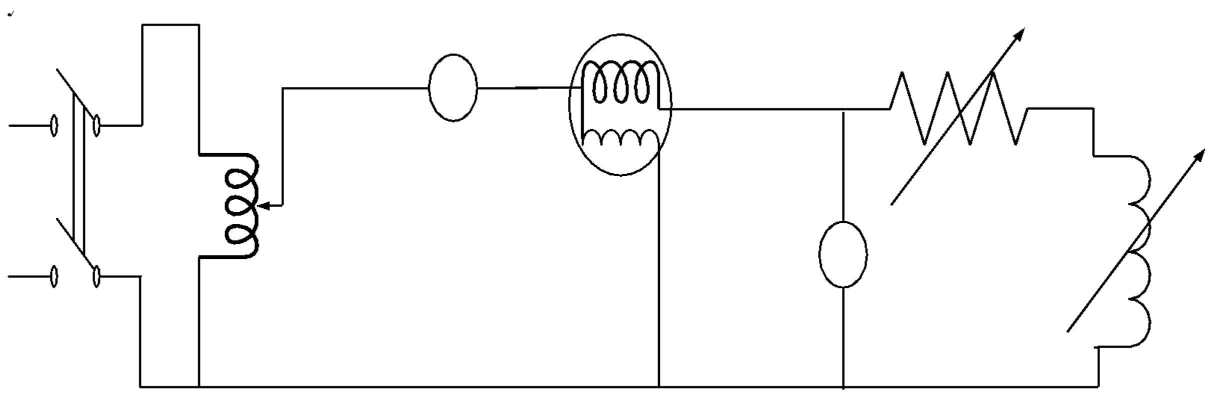

Fig. 2 Voltage, current and power measurement in a resistive-inductive circuit

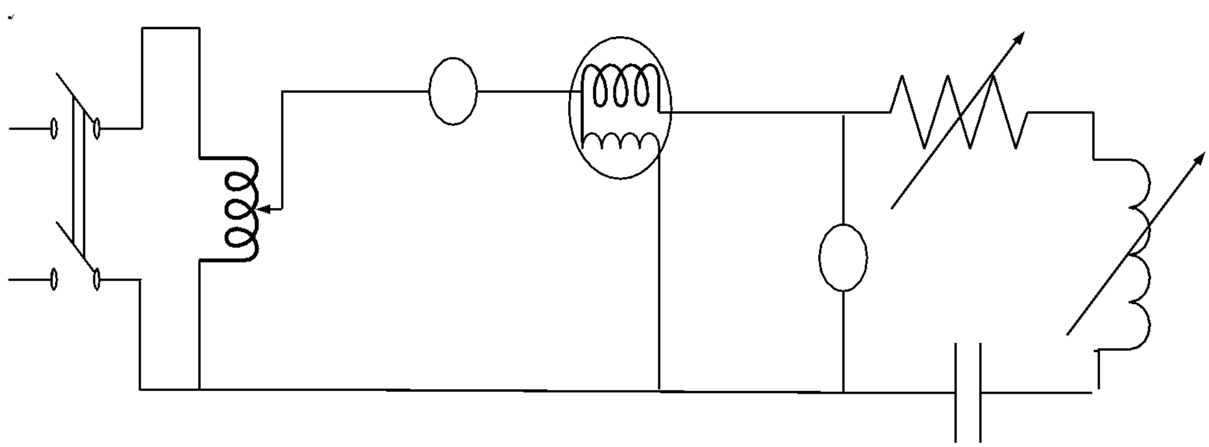

Fig. 3 Voltage, current and power measurement in a resistive-inductive-capacitive circuit

Observation Table:

For Resistive Circuit:

S.No	Voltage (Volts)	Current (Amps)	Power (Watts)	PF=$Power/(Voltage * Current)$
1.				
2.				
3.				
4.				
5.				

For Resistive-Inductive Circuit:

S.No	Voltage (Volts)	Current (Amps)	Power (Watts)	PF=$Power/(Voltage * Current)$
1.				
2.				
3.				
4.				

5.				

For Resistive-Inductive-Capacitive Circuit:

S. No	**Voltage (Volts)**	**Current (Amps)**	**Power (Watts)**	**PF=**$Power/(Voltage * Current)$
1.				
2.				
3.				
4.				
5.				

Safety Precautions:

a. Ensure proper insulation and secure connections to prevent electrical hazards.

b. Follow safety guidelines and wear appropriate protective equipment.

Post Lab Questions:

1. Effectiveness of Power Factor Correction:

a. Did the introduction of the capacitor improve the power factor of the RL circuit?

b. How did the correction affect the real power, reactive power, and apparent power in the circuit?

c. Discuss any observed changes in the overall efficiency of the circuit after power factor correction.

2. **Significance of Power Factor Correction:**

a. Explain the significance of power factor correction in practical electrical systems.

b. In what types of applications or industries is power factor correction most crucial?