Course Name:	**EEEEL**	**Semester:**	**I/II**
Date of Performance:	/ /20--	**Batch No:**	C-5(3)
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Faculty Sign & Date:		**Grade/Marks:**	

Experiment No: 5
Title: Power factor improvement (series)

Aim and Objective of the Experiment:

To improve power factor of a single phase inductive AC circuit using capacitor in series with it.

Requirements:

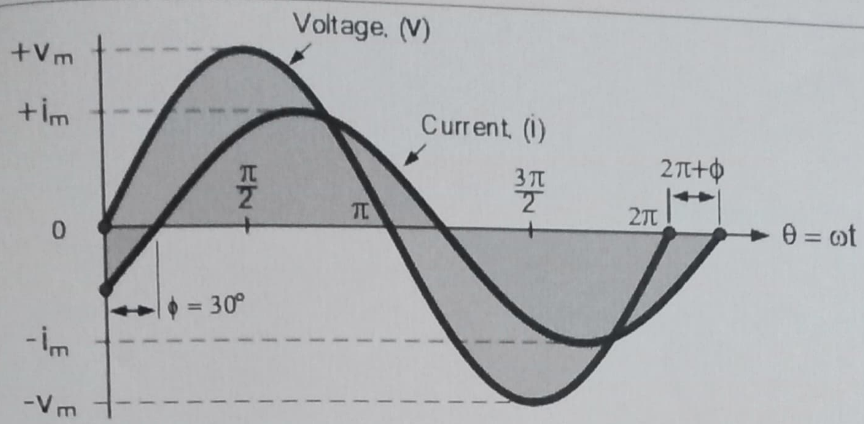
Inductor box, 1 KΩ-3W Resistor, Capacitor box, AC Ammeter and AC Voltmeter.

COs to be achieved:

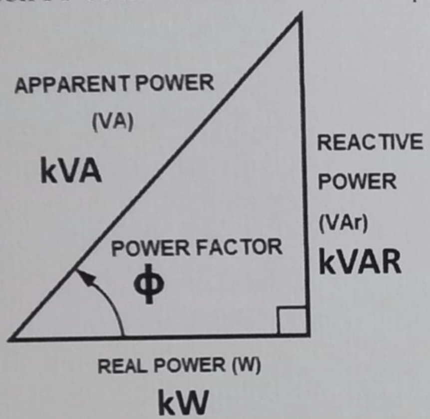
CO2: Demonstrate and analyze steady state response of single phase and three phase circuits

Theory:

When we need to convert electrical energy to mechanical energy, electric motors are used for it. These AC motors converts electric energy in two forms namely mechanical energy in the form of rotary motion and other is magnetic field. Magnetizing currents are lagging to the supply voltage. This magnetic energy is not a mechanical energy so it is kind of wastage, but without which motor will not run and convert electric energy into mechanical energy. Such form of energy is called as reactive power. Reactive power must be as less as possible so that the load will utilize maximum power and current requirement will be less for the same amount power. As the current requirement is less, so wire thickness will be small in diameter. Installation cost and energy cost will be also reduced. To reduce reactive power of the circuit, different power factor improvement methods are used. One of the most familiar method is the use of capacitor bank. We can use capacitor in series with the load or across the load. Following diagrams are illustrating effect of PF on active power.



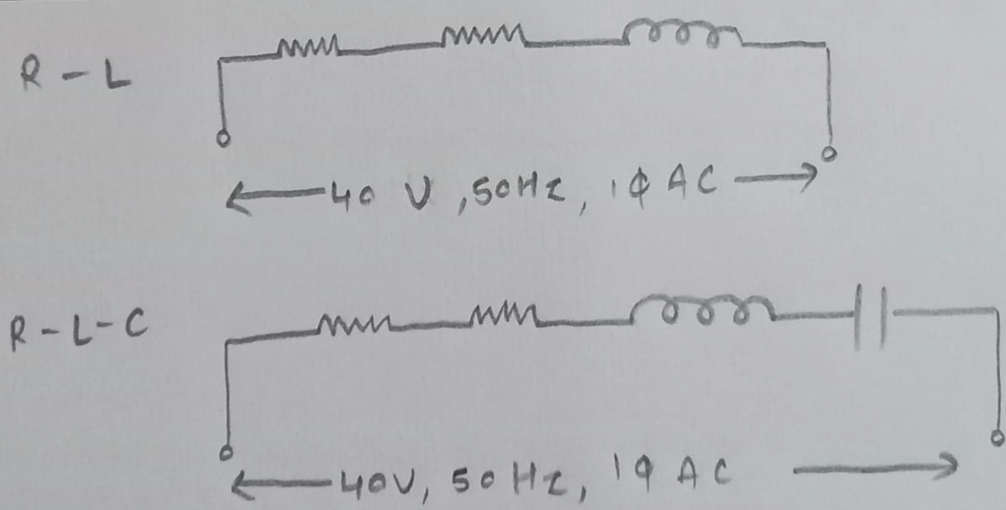
When power factor is between zero and unity, then real power consumed by the load depends upon PF of the circuit. Greater the power factor is always better to consume power.



$$\text{Power Factor} = \frac{\text{True Power}}{\text{Apparent Power}}$$

$$\text{Power Factor} = \cos \Phi = \frac{\text{kW}}{\text{kVA}}$$

Circuit Diagram:



Stepwise-Procedure:

1. Connect series R and L circuit across 230V, 1ø, 50 Hz AC supply and note down circuit voltage and current.
2. Calculate practical value of circuit power factor by taking ratio of active power (P) and apparent power (S).
3. Connect required value of capacitor in series with R-L load and switch on power supply to note circuit current.
4. Calculate practical value of circuit power factor by taking ratio of active power (P) and apparent power (S).
5. Compare theoretical and practical values of PF before connecting the capacitor and after connecting capacitor.

Observation Table:

Sr No	Type of load	Voltage (V)		Current (mA)		P (W)		S (VA)		Power factor	
		Th	Pr	Th	Pr	Th	Pr	Th	Pr	Th	Pr
	R-L	~~5~~0 4	40	15.87	15.6	0.496	0.487	0.684	0.684	0.781	0.78
	R-L-C	~~5~~0 4	40	18.27	17.3	0.657	0.622	0.730	0.7 692	0.9	0.89

Sample Calculations:

Theoretical Calculations to find circuit current and PF of the inductive load:

$X_L = 2\pi f L$
$= 2 \times 3.14 \times 50 \times 5$
$= 1570\ \Omega$

$Z = 1.970 + j1570\ \Omega$
$= 2519.087 \angle 38.5\ \Omega$

$I_{old} = \dfrac{V_{SI}}{Z} = \dfrac{40 \angle 38.5}{2519.087 \angle 38.5}$
$= 0.01587$
$= 15.87$

$\therefore PF = \cos\phi = 0.782$

Practical calculations to find PF of the inductive load:

$P.F_{new} = 0.9$
$\phi = \cos^{-1}(0.9) = 25.841$

$V_{SI} = 40 \angle 38.5\ V$
$= 31.28 + j24.9\ V$
$V_{SII} = 40 \angle 25.84\ V$
$= 36 + 17.43j\ V$

$V_{cap} = jV_{SI} - jV_{SII}$
$= 24.9 - 17.43$
$= \boxed{7.47}$

Calculations to find value of the capacitor to be connected with the load:

$$I_N = \frac{V_{sn}}{R+r} = \frac{36}{1970} = 0.018 = 18.27\,mA.$$

$$X_C = \frac{V_{cap}}{I_N} = \frac{7.47}{0.018} = 408.86\,\Omega$$

$$X_L = \frac{1}{\omega C} = \frac{1}{2\times\pi\times 50\times C}$$

$$C = \frac{1}{2\pi\times 50\times 40.886} \qquad \boxed{C = 7.78\,\mu F}$$

Output Snap shots:

Post Lab Subjective/Objective type Questions:

1. What are benefits of connecting capacitor across the load to improve circuit PF?

→ Reduce powerloss:- A lower power factor causes more current, leading to higer powerloss. By improving power factor current is reduced & power loss is reduced

2) increases load capacity:- A low power factor causes more current, leading to higer power loss. By improving power factor, current is reduced and powerloss is reduced.

3) Voltage stabilization;- Reducing the reactive component of current results in more stable voltage profile across the crait.

Conclusion:

We improve the p.f to reduce reactive power and lower energy bill. Power factor was improved after connecting a capacitor in series.

Signature of faculty in-charge with Date: