EXPERIMENT #4

TO MEASURE THE POWER OF A RESISTIVE LOAD BY ANALOG WATTMETE AND ALSO CALCULATE ITS POWER FACTOR

OBJECTIVE:

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WATTMETER:

Wattmeter is a measuring instrument use to measure electric power. The wattmeter consists of two coils; 'Pressure Coil' and the 'Current Coil'. The Pressure coil also known as a 'Movable Coil' forms a parallel connection in a circuit to which a deflection needle is connected, while the current coil also called a 'Fixed Coil' forms a series connection in a circuit. The current coil of the circuit carries a load current, while the pressure coil carries the current proportional to and in phase with the voltage. A high value resistor is connected in series with the pressure coil. When the current is passed through the coil due to electromagnetism deflection in a needle is produced. The deflection of the needle depends upon the current in the two coils and the power factor.

POWER:

Power is defined as 'Energy transferred in a circuit in a unit time'. Mathematically it can be defined as;

$$P=E/T$$

Unit of power is joules/sec (J/s).

<u>Power is basically of three kinds;</u>

- Active Power
- Reactive power
- Apparent Power

ACTIVE POWER:

For sinusoidal quantities in a two-wire circuit (single-phase system), it is the product of the voltage, current and the cosine of the phase angle between them. For balanced three phase circuits, the total active power is three times of the active power for each terminal (phase).It is a power generated by the source. Mathematically;

$$P=V*I \cos(\text{angle})$$

Its unit is watt.

REACTIVE POWER:

For sinusoidal quantities in a two-wire circuit, reactive power is the product of the voltage, the current, and the sine of the phase angle between them. In a passive network, reactive power represents the alternating exchange of stored energy (inductive or capacitive) between two areas.

Q=V*I Sin (angle)

Its unit is VAR.

APPARENT POWER:

For sinusoidal quantities in either single-phase or three-phase circuits, apparent power is the square root of the sum of the squares of the active and reactive powers.

$$S^2 = P^2 + Q^2,$$

or

$$S = \sqrt{P^2 + Q^2}.$$

Its unit is Volt*amp.

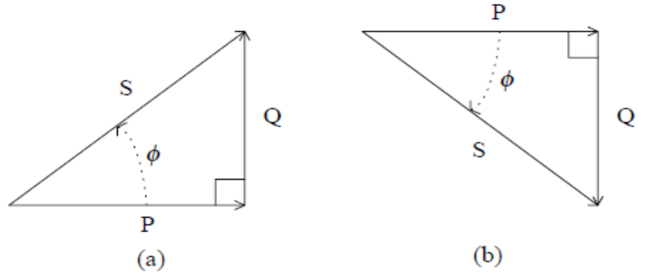
POWER FACTOR:

Power factor is the ratio of the total active power in watts to the total apparent power in volt-amperes. The power factor can get the value in range of 0 and 1. When all the power is reactive with no real power the power factor will be 0.
Mathematically,

Power factor=Real Power/Apparent Power

POWER TRIANGLE:

A power triangle, or P-Q triangle, is obtained by drawing a line proportional to the active power on the real axes and a line proportional to the reactive power following it **(a)** up by 90° for a lagging power factor **(inductive loads)** or **(b)** down by 90° for a leading power factor **(capacitive loads).** Then by connecting the starting and ending points to form a power triangle. In short, a power triangle is a right triangle consisting of active power, reactive power and apparent power.



Power triangles with (a) lagging power factor and (b) leading power factor.

When reactive power is increased the power angle is increased which deceases the value of power factor and vice versa. So to have a good power factor following method should be followed. For the pure resistive load power factor will be 1 as S=P will be obtained.

APPARATUS:

PROCEDURE:

CIRCUIT DIAGRAM:

OBSERVATIONS AND CALCULATIONS:

S.No	Loads	Power Watt	Voltage	Current	Power factor
1.					
2.					
3.					

Table 4.1

CONCLUSION:

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