Experiment No (4):

Measuring capacitance of the capsacitor

To show that the behavior of a capacitance in an a.c circuit is analogous to that of a resistor which obeys Ohm's law and hence to measure capacitance.

Aim: to investigate how the reactance of a capacitance varies with frequency and determine the capacitance of capacitor.

Apparatus:

1- AC power supply source 2- AC of Ammeter (mA)
3--high resistance AC voltmeter Voltmeter (V)
2- 4-Capacitor (1μF , 0.5 μF and more 4- Connection wire

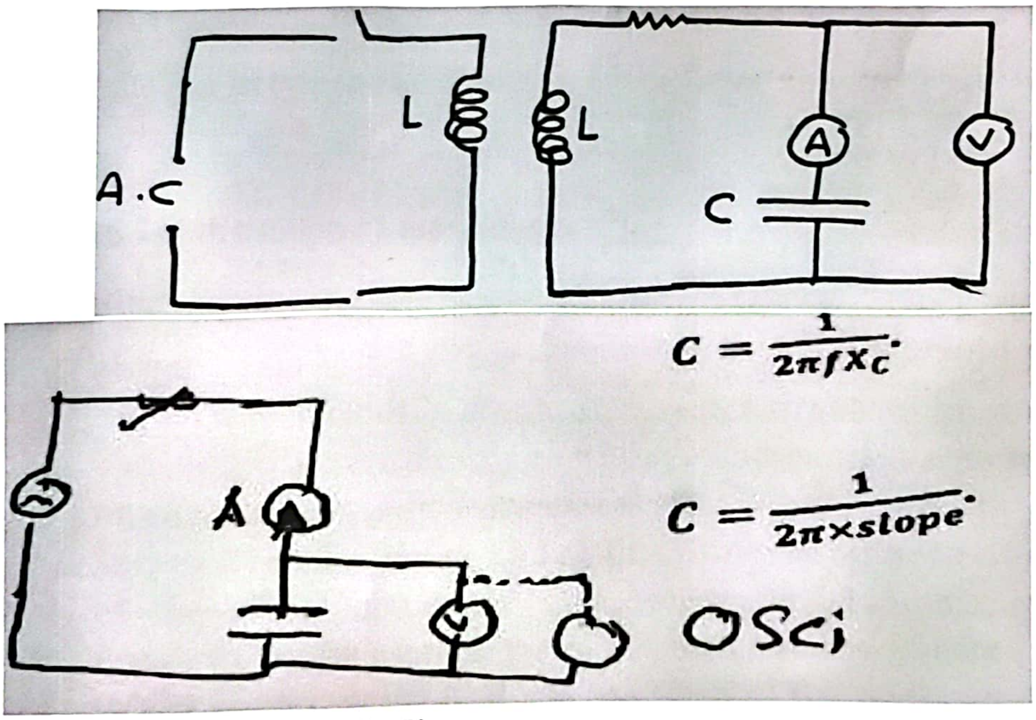


Figure: electric circuit diagram

Method:

The capacitive reactance can be obtained simply by using Ohms law in the same way if we measure any resistance (Ohms law) in the DC circuit therefore

$$X_C = \frac{V}{I} \qquad (1)$$

Where (V) represent the voltage applied on the capacitor and (I) is the current passed through the capacitor

The capacitive reactance depends on the capacitance and the current frequency. If the frequency of the (A.C) current becomes constant the capacitive reactance also becomes constant and do not change with the change of each voltage and current resistance under the Ohms law conditions.

The relation between the capacitive reactance and the frequency is:

$$X_C = \frac{1}{2\pi f c} \qquad (2)$$

Where f is the current frequency.

Procedure:

1- signal generator and select low frequency $f = 500\,Hz$ adjust the output voltage of the signal generator until conveniently high reading voltage and current obtained on the ammeter and voltmeter scales.
2- Increase the frequency and again adjust the output voltage of the signal generator until convenient readings are obtained on the ammeter and voltmeter scales .procced in this way until the fullest use has been of the scales on the various measuring instruments.
3- Tabulate the reading in this table:

$f(Hz)$	I/A	$V/volt$	$X_C = \frac{V}{I}(\Omega)$	$\frac{1}{f}$ sec

By using the equation

Since $X_C = \frac{1}{2\pi f c}$ **where f is the frequency ,** X_C **is reactance of capacitance**

C is the capacitance, the value of capacitance can be found from $C = \frac{1}{2\pi f X_C}$

4- Plot the graph With value of X_C **/ on the (Y axis) against the corresponding values of** $\frac{1}{f(Hz)}$ **(on the X axis).**

$slope = \frac{X_C}{\frac{1}{f}}$ **hence** $C = \frac{1}{2\pi f X_C} = \frac{1}{2\pi \frac{X_C}{\frac{1}{f}}} = \frac{1}{2\pi \times slope}$

$$C = \frac{1}{2\pi \times slope}$$

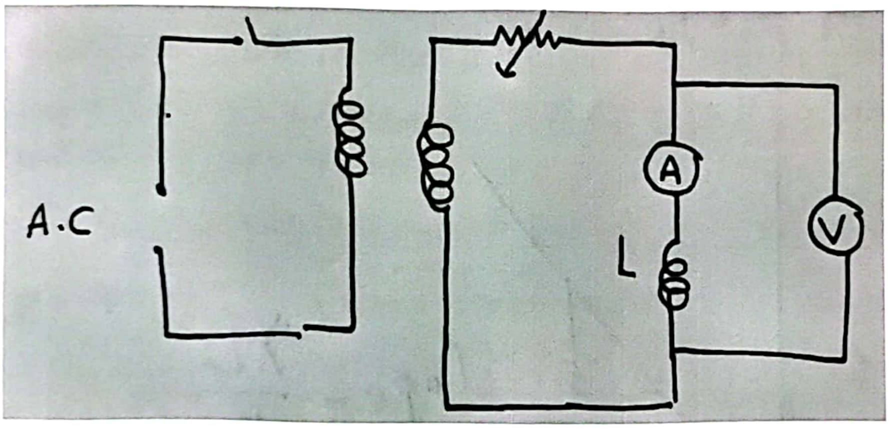
5- Deduce from the graph how the reactance of a capacitance varies with frequency and from one of them calculate the capacitance of the capacitor

Experiments No (5)

To show that the behavior of an inductance in an a.c circuit is analogous to that of a resistor which obeys Ohms law and hence to measure inductance.

Apparatus

A source of low voltage alternating current, e.g. a step-down mains transformer giving $(2 - 12)V$, a.c. ammeter $0 - 0.1A$, a high resistance a.c. voltmeter $0 - 10V$, variable resistance $0 - 1000\Omega$,circuit key, coil of inductance about $100\ mH$, variable inductances in suitable ranges from $55mH$ up to $1.5H$.



Method

Connect up the circuit as shown in the diagram. See that all the circuit connections are complete before interesting the mains plug.

Set the variable resistance R to its maximum value. Switch on the current and record the readings of the ammeter and voltmeter. Vary R and take further readings making as full use as possible of the ammeter and voltmeter scales.

Tabulate the results:

$r.m.s.$ current I/A	
$r.m.s.$ voltage V/V	

Plot a graph with values V/V as ordinates (Y axis) against the corresponding values of I/A as abscissae (X axis).

Experimental detail

Note the relative positions of ammeter and voltmeter as given in the corresponding experiment on capacitance (Experiment 33).

Theory and calculation

The fact that the graph is a straight line through the origin verifies that the $r.m.s.\ p.d$ across an inductance is directly proportional to the $r.m.s.$ current through it i.e. that Ohm's law applies.

From two convenient points, P and Q, on the straight line obtain the slope $\frac{PN}{QN}$ This is the average numerical value of the ratio $\frac{V}{I}$ for the coil (inductor) in the circuit and is the magnitude of the inductive reactance X_L of the coil. Since $X_L = 2\pi f L$ Where f is the frequency of the current ($50\ Hz$) and L is the self-inductance of the coil, usually called the inductance, the value of L can be found fro

$$Slope = \frac{\Delta v}{\Delta i} \qquad L = \frac{X_L}{2\pi f} = \frac{\frac{\Delta v}{\Delta i}}{2\pi f} = \frac{Slope}{2\pi f} \qquad L = \frac{Slope}{2\pi f}$$