ORIGINAL RESEARCH PAPER

Engineering

VERIFICATION OF CAPACITANCE OF A CAPACITOR IN SERIES AND PARALLEL COMBINATION

KEY WORDS:

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AIM :
To verify the capacitance using steel(glasses) in series and parallel combination.

MATERIAL REQUIRED: Four steel glasses, a multimeter, crocodile clips.

THEORY:
When two glasses are put together with one inserted into the other, they act as a capacitor due to opposite charges induced on the two surfaces. Considering two such capacitors we will proceed further.

When the two capacitors (glasses), say C1, C2 are placed with one over the other they are in series combination, whereas when the top and bottom of the two are connected using crocodile clips giving similar polarity on the top and bottom of the two then they are said to be in parallel combination.

Using multimeter, we will find the capacitance of the different arrangements.

INTRODUCTION
What is a capacitor? Any two conductors separated by an insulator (or a vacuum) form a capacitor.

In most practical applications, each conductor initially has zero net charge and electrons are transferred from one conductor to the other. This is basically the charging of the conductor. Then the two conductors have charges with equal magnitude and opposite sign and the net charge on the capacitor as a whole is zero.

When we say that a capacitor has a charge 'q' we mean that the conductor at the higher potential has a charge 'q' and the conductor at lower potential is '-q'.

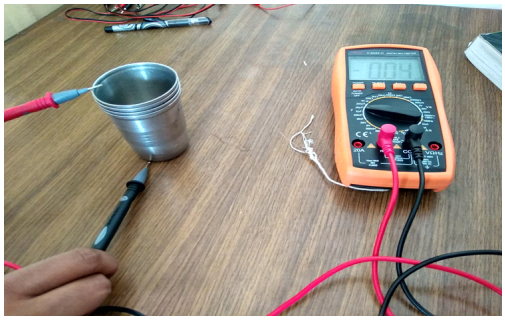
CAPACITANCE:
In practical, we cannot handle a free charge or hold them fixed at desired position. A practical way to handle a charge would be to put it on a conductor. But every conductor has its maximum limit of storing electric charge. Therefore, a capacitor is used to store charge and its capability to store charge is known as its capacitance.

Capacitance is denoted by 'C' and,
$C=Q/V$

where 'Q' is charge stored and 'V' is the potential difference.

COMBINATION OF CAPACITORS
1. Series combination: In simple language it is a type of combination in which the positive plate of one capacitor is connected with negative plate of the other. In this the charge on all the plates is same but the potential is divided in the inverse ratio of the capacity.

In series combination of two capacitors the equivalent capacitance is given by,
$V=V1+V2$
And $v=q/c$, $\frac{Q}{C}=\frac{Q1}{C1}+\frac{Q2}{C2}$

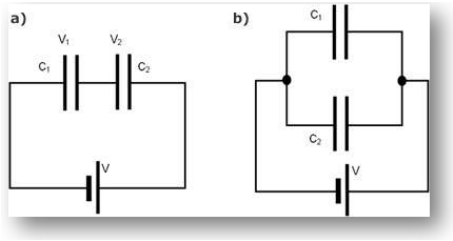


$C=(C1.C2)/(C1+C2)$

2. Parallel combination: In this type of arrangement the potential difference for all individual capacitors is the same but the total charge 'q' is distributed in the ratio of their capacities.

In parallel combination, the equivalent capacitance is given as,
$Q=Q1+Q2$
As $Q=C/V$, $\frac{C}{V}=\frac{C1}{V1}+\frac{C2}{V2}$

As $V1=V2=V$
$C=C1+C2$



DIELECTRIC:

A dielectric material is a type of insulator which becomes polarized when it comes in contact with an electric field. It can easily support an electrostatic field even though it is not a conductor of electricity. Here in our study the dielectric present is air.

The electric field between the plates of parallel plate capacitor is directly proportional to capacitance C of the capacitor. The strength of electric field is reduced due to presence of dielectric and if the total charge on the plates is kept constant then the potential difference is reduced across the capacitor plates.
In this way dielectric increases the capacitance of capacitor.

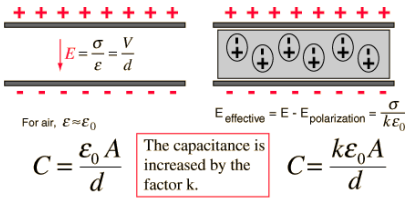


Figure 1.3 Parallel Plate capacitor with dielectric

RESULT:

Individual capacitance of the capacitors is

C1	6.44 micro farad
C2	7.85 micro farad

CAPACITANCE IN SERIES COMBINATION

Equivalent capacitance= 5.65 micro farad

CAPACITANCE IN PARALLEL COMBINATION:

Equivalent Capacitance = 12.48 micro farad

Hence verified that the capacitance of two capacitors when arranged in parallel combination is more than in series combination.

COMBINATION	THEORITICAL	EXPERIMENTAL
C1(only)	6.44 micro farad	6.44 micro farad
C2(only)	7.85 micro farad	7.85 micro farad
SERIES	3.40 micro farad	5.65 micro farad
PARALLEL	14.29 micro farad	12.48 micro farad

All these reading are the maximum values countered atleast once during the experiment.

Theoretical values are calculated using the formula of series and parallel combination of capacitors.

In parallel combination, the equivalent capacitance is given as,

Q=Q1+Q2

As Q=C/V, $\frac{C}{V} = \frac{C1}{V1} + \frac{C2}{V2}$

As V1=V2=V

C=C1+C2

In series combination of two capacitors the equivalent capacitance is given by,

V=V1+V2

And v=q/c, $\frac{Q}{} = \frac{Q1}{} + \frac{Q2}{}$,

C= (C1.C2)/(C1+C2)