(ES1-3) Electric Field Distribution in a Parallel Plate Capacitor

Aim of experiment

Determination of the relationship between plates spacing, voltage and the field strength

Apparatus

Plate Capacitor- DC Power supply 0-600V- Electric Field Meter- Capacitor Plate with Hole for Electric Field Probe- Digital multimeter- Supporting Mechanism.

Theory of experiment

The capacitor consists of two conductors separated by an insulator (a dielectric material). The capacitance *C* is the amount of charge which can be stored per unit voltage applied to the capacitor.

$$C(Farad) = \frac{Q(Coulomb)}{V(Volt)}$$

where Q is the magnitude of charge stored on each plate; V is the voltage applied on the plate. Capacitance of a capacitor depends on its geometric arrangement. For two parallel plates capacitor its capacitance is given by;

$C = \varepsilon_0 \frac{A}{d}$ for plates separated by air

$C = K\varepsilon_0 \frac{A}{d}$ for plates separated by dielectric

where A, d and ε_o are the overlap area of plates, the distance between the plates, permittivity of free space, and K is the dielectric constant respectively.

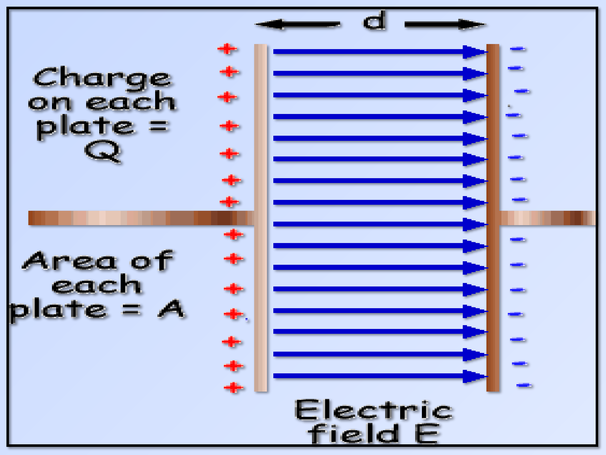

Figure 1. A schematic diagram for parallel plates capacitor

Electric field is formed if the two plates are parallel with separation *d*, and the a voltage difference V is applied to them, according to the relation

$$E = \frac{V}{d}$$

Figure 1 Represents the relation between the applied voltage and the resulted electric field.

With constant voltage V, the field strength E is inversely proportional to the spacing d as shown in *figure 2*.

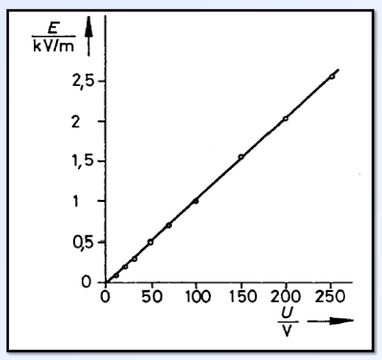

Figure 1

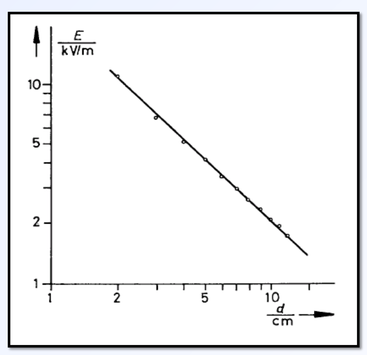

Figure 2

(1)Measuring the electric field strength as a function of the voltage at constant plate spacing

Procedures

1. Connect the circuit such that electric field meter to 0-12V power supply, the voltmeter and the DC voltage power supply are connected to the plates.
2. Arrange the plates of the capacitor with d=10cm spacing between them.
3. Connect the capacitor to power supply (0-150V). By changing the applied voltage slowly, measure the electric field strength at various voltages, and record your readings.
4. Repeat step 3 two more times and record data in a table.
5. Plat a graph relating the voltage and the average electric field, E_{av}, at constant d.

Results

V (V)								
E_1 (V/m)								
E_2 (V/m)								
E_3 (V/m)								
E_{av} (V/m)								

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(2) Measuring the electric field strength as a function of plates spacing at constant voltage

Procedure

1. Adjust the applied voltage to be 100V.
2. Change the spacing gradually from 2 to 12cm and measure the electric field as a function of plates spacing and record your readings.
3. Repeat step 2 two more times and record data in a table.
4. Plot a graph relating the plates spacing and the average electric field strength, $E_{av,}$ at constant voltage.

Results

d (m)								
E_1 (V/m)								
E_2 (V/m)								
E_3 (V/m)								
E_{av} (V/m)								