PHYSICS PRACTICAL:

AIM:-

To determine the dielectric constant of unknown solid material.

Materials required →

Capacitor, battery, wires, dielectric material (teflon, paper, glass).

THEORY →

Dipole moment → It occurs when there is a separation of charge. They can occur between two ions in an ionic bond or between atoms in a covalent bond.

The dipole moment is a measure of the polarity of the molecule.

When two electric charges, of opposite sign and equal magnitude, are separated by a distance, an electric dipole is established.

The size of a dipole is measured by its dipole moment (μ).

Polarizability → It is a measure of how easily an electron cloud is distracted by an electric field. If the electron cloud is easy to distort, we say that the species it belong to is polarizable.

$$\alpha = P/E$$

Dielectric Constant →

It is defined as ratio of permitivity of a given material to the permitivity of free space.

$$K = \frac{C}{C_0}$$

FORMULA USED →

$$K = \frac{C}{C_0}$$

where, K = Dielectric Constant
C = Capacitance with material
C_0 = Capacitance with Vacuum.

Observation Table →

(A) Material = Teflon

(1) Distance between plates = 6.0 mm

S.No	Area of plate	Capacitance with material	Capacitance with free space	Dielectric Constant
1	400	0.12×10^{-11} f	0.06×10^{-11}	2
2	304.1	0.09×10^{-11} f	0.04×10^{-11}	2.25
3	202.8	0.06×10^{-11} f	0.03×10^{-11}	2

② Area of plate = 299.7 mm^2

S.No	Distance b/w plates	Capacitance with material	Capacitance with free space	Dielectric Constant
1	5 mm	0.11×10^{-11}	0.05×10^{-11}	2.2
2	8.1mm	0.07×10^{-11}	0.03×10^{-11}	2.33
3	10.0 mm	0.06×10^{-11}	0.03×10^{-11}	2.00

(B) Material = paper

① Distance between plates = 6.0 mm

S.No	Area of plate	capacitance with material	Capacitance with free space	Dielectric Constant
1	400.0	0.21×10^{-11} f	0.06×10^{-11}	3.5
2	258.9	0.13×10^{-11} f	0.04×10^{-11}	3.25
3	154.9	0.08×10^{-11} f	0.02×10^{-11}	4.00

② Area of plate = 286.6 mm^2

S.No	Distance b/w Plates	Capacitance with material	Capacitance with free space	Dielectric Constant
1	6.0 mm	0.15×10^{-11}	0.04×10^{-11}	3.75
2	8.1mm	0.11×10^{-11}	0.03×10^{-11}	3.67
3	10.0 mm	0.09×10^{-11}	0.03×10^{-11}	3.00

(c) Material = glass.

(1) Distance between plates = 6.0 mm

S.No	Area of plate	Capacitance with material	Capacitance with free Space	Dielectric Constant
1	400.0	0.28×10^{-11}	0.06×10^{-11}	4.67
2	269.5	0.19×10^{-11}	0.04×10^{-11}	4.75
3	192.0	0.13×10^{-11}	0.03×10^{-11}	4.34

(2) Area between plates = 400.0 mm^2

S.NO	Distance between plates	Capacitance with material	Capacitance with free Space	Dielectric Constant
1	10.0 mm	0.17×10^{-11} F	0.04×10^{-11}	4.25
2	6.5 mm	0.25×10^{-11}	0.05×10^{-11}	5.00
3	5.0 mm	0.33×10^{-11}	0.07×10^{-11}	4.714

CALCULATION →

(A) Teflon.

Average of dielectric Constant = 2.13

percentage error = $\frac{2.13 - 2.1}{2.1} \times 100$

= 1.42 %.

(B) Paper.

Average of dielectric Constant = 3.52

percentage error = $\frac{3.52 - 3.5}{3.5} \times 100$

= 0.57 %

(C) Gloss

Average of dielectric Constant = 4.62

percentage error => $\frac{4.7 - 4.62}{4.7} \times 100$

= 1.7 %

Learning outcomes. →

(1) To understaut the concept of dipole moment, capacitance and permittivity.

(2) To find dielectric constaut of any unknown substance.

(3) To understaud factors affecting capacitance of the material.