PHYF214 PHYSICS LAB REPORT SEM1 2018-2019
Lab 12 Group 7: Dielectric Constant [DC]

Ashwin Kumar K - 2017A8PS1034G

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1 Experimental Tasks

1. To determine the relation between voltage V and the charge stored Q and plot a graph between these two quantities.
2. To determine the the dielectric constant of air from the data collected above.
3. To plot charge on capacitor against the inverse of the distance between the capacitor plates.
4. To find the dielectric constant of different media by the same method as in (1.) and (2.).

2 Apparatus

Plate capacitor, Plastic plate, Glass plates f. current conductors, High-value resistor (10 MOhm) High voltage supply unit, Capacitor, Voltmeter, Connecting cord, Screened cable.

3 Theory

The experiment aims at demonstrating the concept of Electrostatic potential and that of the electric field inside a dielectric media. It can be shown that $C = \frac{Q}{V}$ and $\epsilon_0 = \frac{Cd}{A}$. So the slope of Q v/s V graph will give the capacitance of the given parallel plate capacitor, and the capacitance of the capacitor will give us the dielectric constant of the medium.

4 Observations

The least count of the Source Voltage is 0.1kV i.e 100V
and the capacitance of the known capacitor is 220 nF
The diameter of the circular capacitor plates is 26cm.

The graph of the charge in capacitor v/s Voltage across capacitor is given bellow,

Voltage across known capoacitor (in V)	Q (in c)	V (in kV)
0.2	4.40E-008	0.2
0.38	8.36E-008	0.4
0.6	1.32E-007	0.6
0.8	1.76E-007	0.8
0.99	2.18E-007	1
1.2	2.64E-007	1.2
1.44	3.17E-007	1.4
1.62	3.56E-007	1.6
1.8	3.96E-007	1.8
Slope		2.2366667E-007

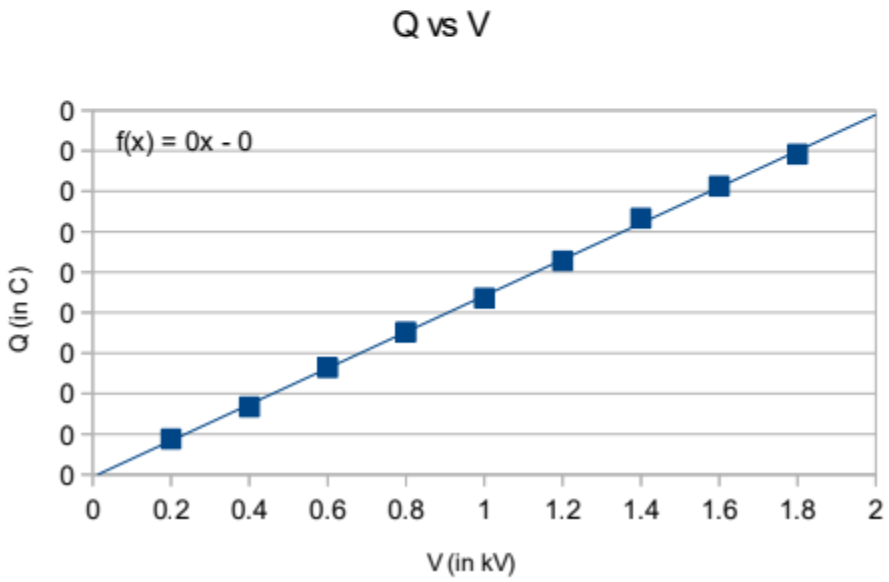

Figure 1: Table and graph of the charge in capacitor v/s Voltage

Now, the graph of the charge stored in the capacitor v/s the inverse of distance between the plates (keeping the voltage constant) is

Voltage across known capoacitor (in V)	Q (in c)	distnace(in mm)	1/d(in m^-1)
2.04	4.488E-007	2	500
1.5	3.30E-07	3	333.33333333
1.02	2.24E-07	4	250
0.82	1.80E-07	5	200
0.72	1.58E-07	6	166.66666667
0.58	1.28E-07	7	142.85714286
0.5	1.10E-07	8	125

Figure 2: Table of Q v/s $\frac{1}{d}$

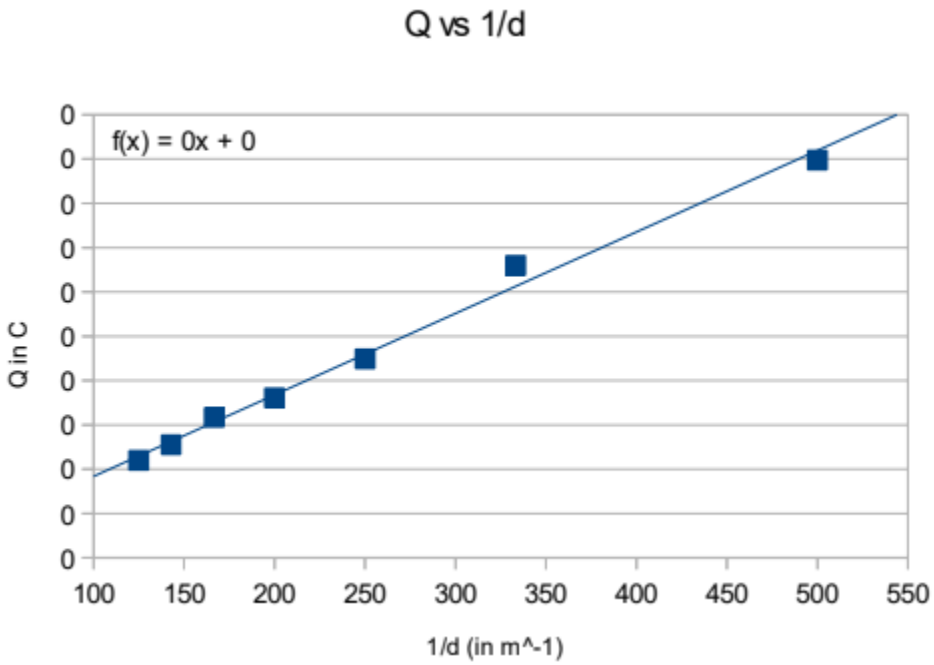

Figure 3: Graph of Q v/s $\frac{1}{d}$

In order to measure the permittivity and the dielectric constant of the plastic slab, let us plot the graph of charge on capacitor v/s the voltage, after inserting plastic slab between the plates.

Dilectric of a plastic	thickness of slab=1cm	
Voltage across known capoacitor (in V)	Q (in c)	V (in kV)
0.4	8.80E-08	0.2
0.78	1.72E-07	0.4
1.2	2.64E-07	0.6
1.56	3.43E-07	0.8
2	4.40E-07	1
	Slope =	4.37E-007

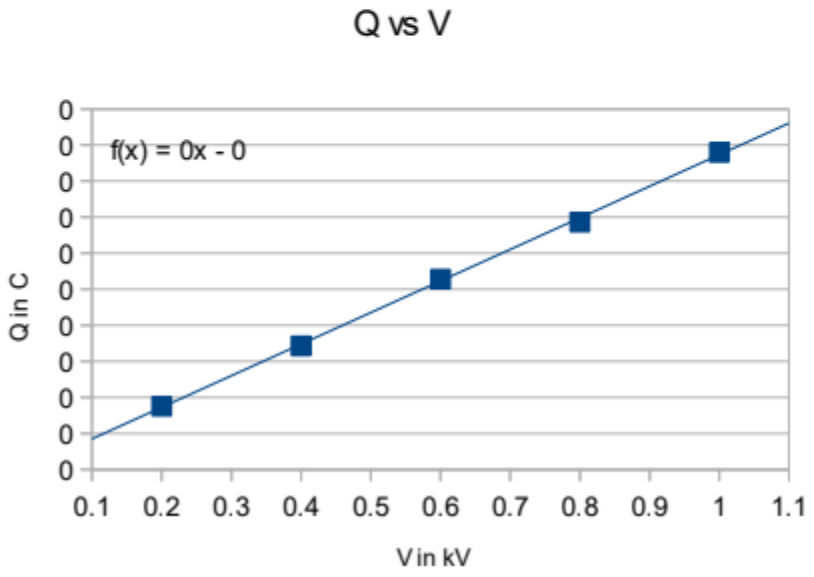

Figure 4: Table and graph of Q v/s V with plastic slab

5 *Analysis:*

The Capacitance of the capacitor is given by $C = \frac{Q}{V}$, that is the slope of the graph1, so,

$C = 2.23667x10^{-7}$

Now, we know that, $C = \frac{A\epsilon_0}{d}$

So, ϵ_0 which is the permittivity of the air (actually free space) is given by $\epsilon_0 = \frac{Cd}{A}$

So, permittivity comes out to be, $\epsilon_0 = 8.4271x10^{-12}$ which is very close to the actual value, similary, the permitivity of plastic comes out to be, $\epsilon = 8.2324x10^{-11}$ So, the dielectric constant of plastic is, nearly k = 9.769

6 Result

The capacitance of the parallel plate capacitor when the distance between the plates is 2mm, is found to be $2.23667x10^{-7}$ F, and the capacitance of the parallel plate capacitor is found to be inversely proportional to the distance between the plates. Further, the permittivity of the air is found to be $8.4271x10^{-12}$ and the permittivity of plastic is $8.2324x10^{-11}$, so the dielectric constant of the plastic slab is 9.769, and the graphs and the data shows that we can increase the capacitance of the capacitor by inserting a dielectric slab between its plates.