PH LAB ASSIGNMENT 4

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Aim:-

1. Determine the relationship between charge and voltage for a capacitor.

2. Determine the energy stored in a capacitor or a set of capacitors in a circuit.

3. Explore the effect of space and dielectric materials inserted between the conductors of the capacitor in a circuit.

4. Determine the equivalent capacitance of a set of capacitors in series and in parallel in a circuit.

Theory: -

Capacitor: - Ability to store energy in the form of electrical charge.

$Q = CV$,

where Q = charge, C = capacitance and V

= Potential difference across the plates

Capacitance: - Ratio of the amount of electric charge stored on a conductor to a difference in electric potential.
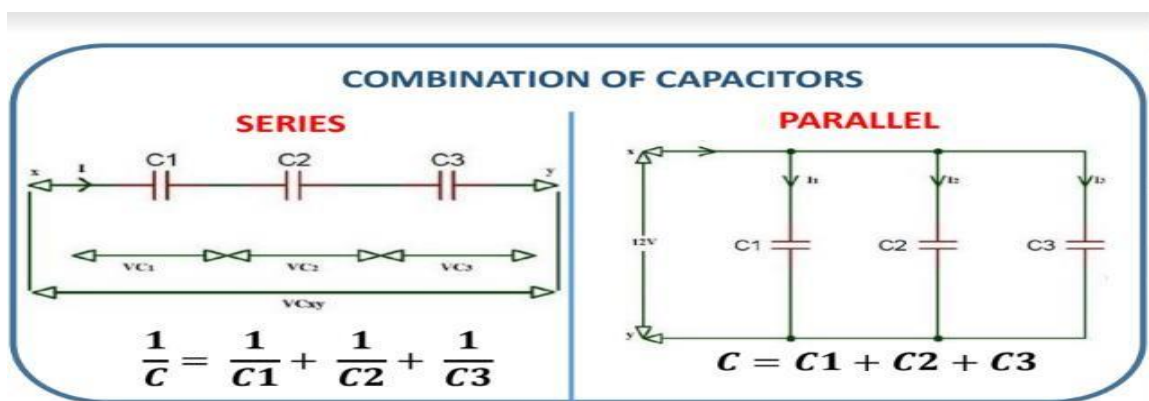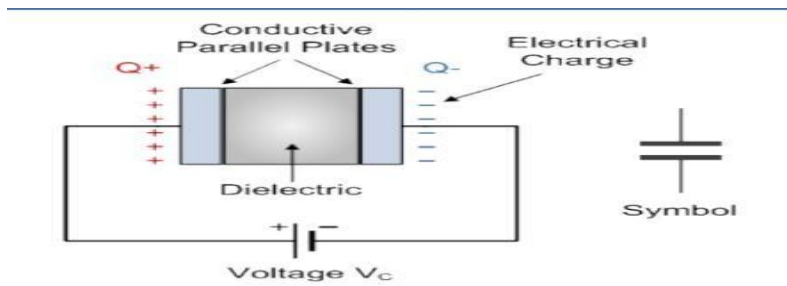
$C = \varepsilon_0 A / d$

where, ε_0 = permittivity of free space, A = area of plate, d = distance between plates.

Dielectric inside a capacitor: -

$C = k \varepsilon_0 A / d$, where k is Dielectric Constant

Energy stored in a capacitor : - $E = CV^2 / 2$

COMBINATION OF CAPACITORS

SERIES

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

PARALLEL

$$C = C1 + C2 + C3$$

Observation & Tables: -

Table for Aim 1: -

Sr. No.	Voltage	Charge
1	0.172	$0.15 * 10^{-13}$
2	0.53	$0.47 * 10^{-13}$
3	0.57	$0.5 * 10^{-13}$
4	0.65	$0.58 * 10^{-13}$
5	0.69	$0.61 * 10^{-13}$
6	0.769	$0.68 * 10^{-13}$
7	0.849	$0.75 * 10^{-13}$
8	0.928	$0.82 * 10^{-13}$
9	1.008	$0.89 * 10^{-13}$
10	1.088	$0.98 * 10^{-13}$

Graph: -
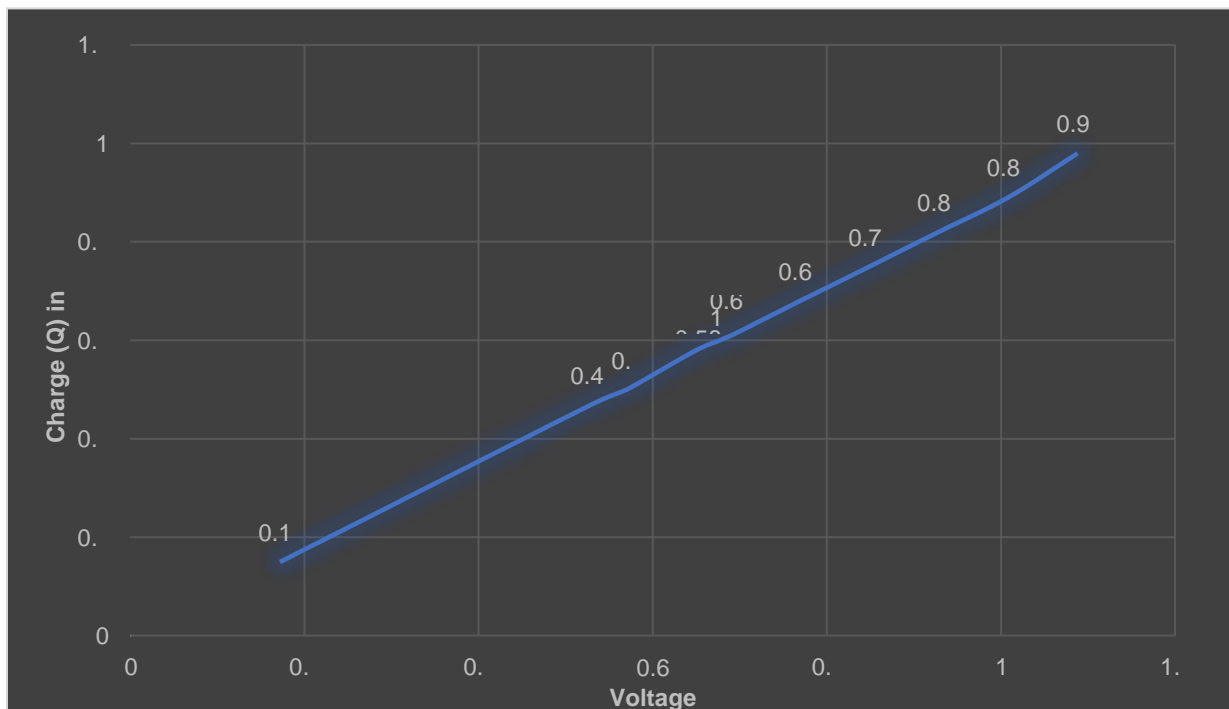
Table for Aim 2: -

Sr. No.	Voltage(V)	Charge (Q)	Stored Energy (J)
1	0.756	$0.49 * 10^{-13}$	$0.18 * 10^{-13}$
2	1.194	$0.77 * 10^{-13}$	$0.46 * 10^{-13}$
3	1.5	$0.97 * 10^{-13}$	$0.73 * 10^{-13}$
4	0.465	$0.3 * 10^{-13}$	$0.07 * 10^{-13}$
5	0.664	$0.49 * 10^{-13}$	$0.14 * 10^{-13}$
6	1.102	$0.71 * 10^{-13}$	$0.39 * 10^{-13}$
7	0.505	$0.33 * 10^{-13}$	$0.08 * 10^{-13}$
8	0.345	$0.22 * 10^{-13}$	$0.04 * 10^{-13}$
9	0.903	$0.58 * 10^{-13}$	$0.26 * 10^{-13}$
10	0.823	$0.53 * 10^{-13}$	$0.22 * 10^{-13}$
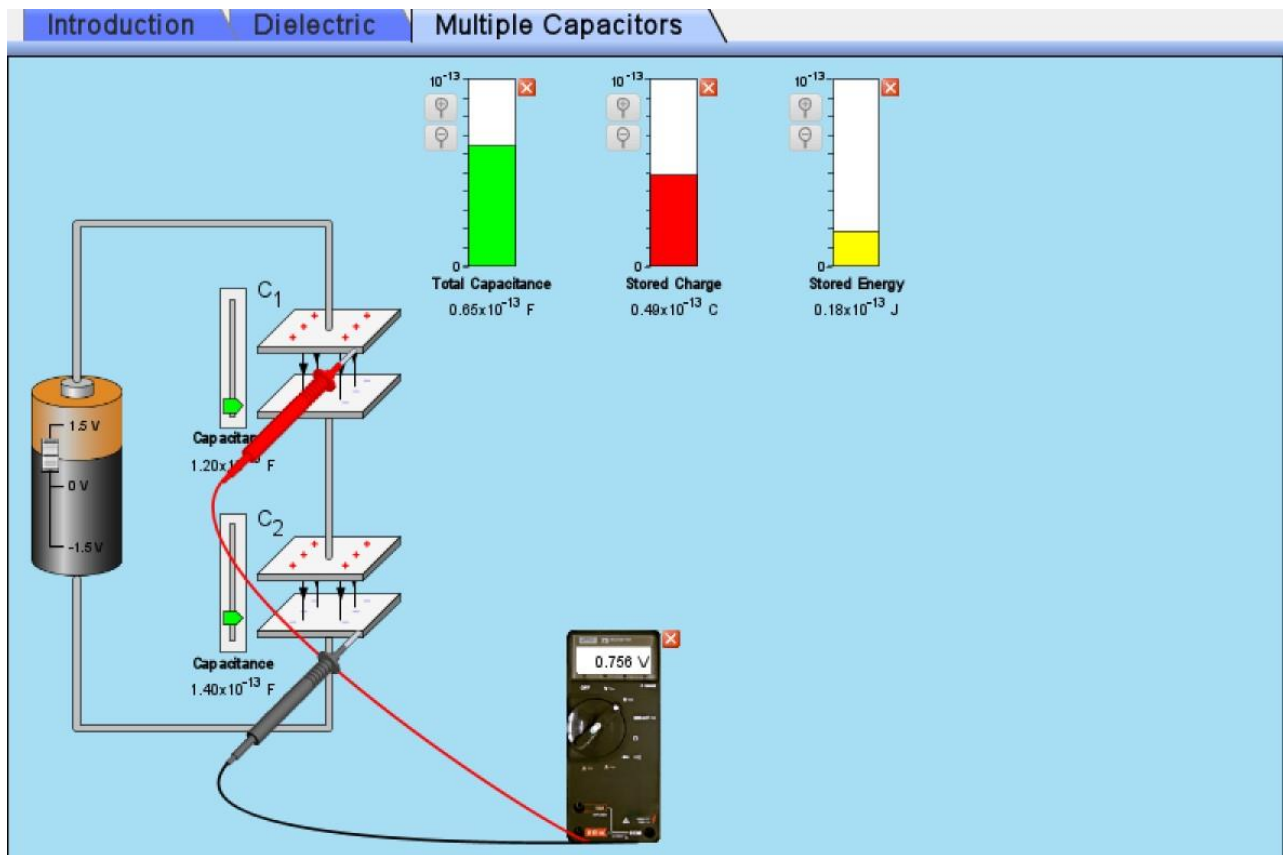
Table for Aim 3: -

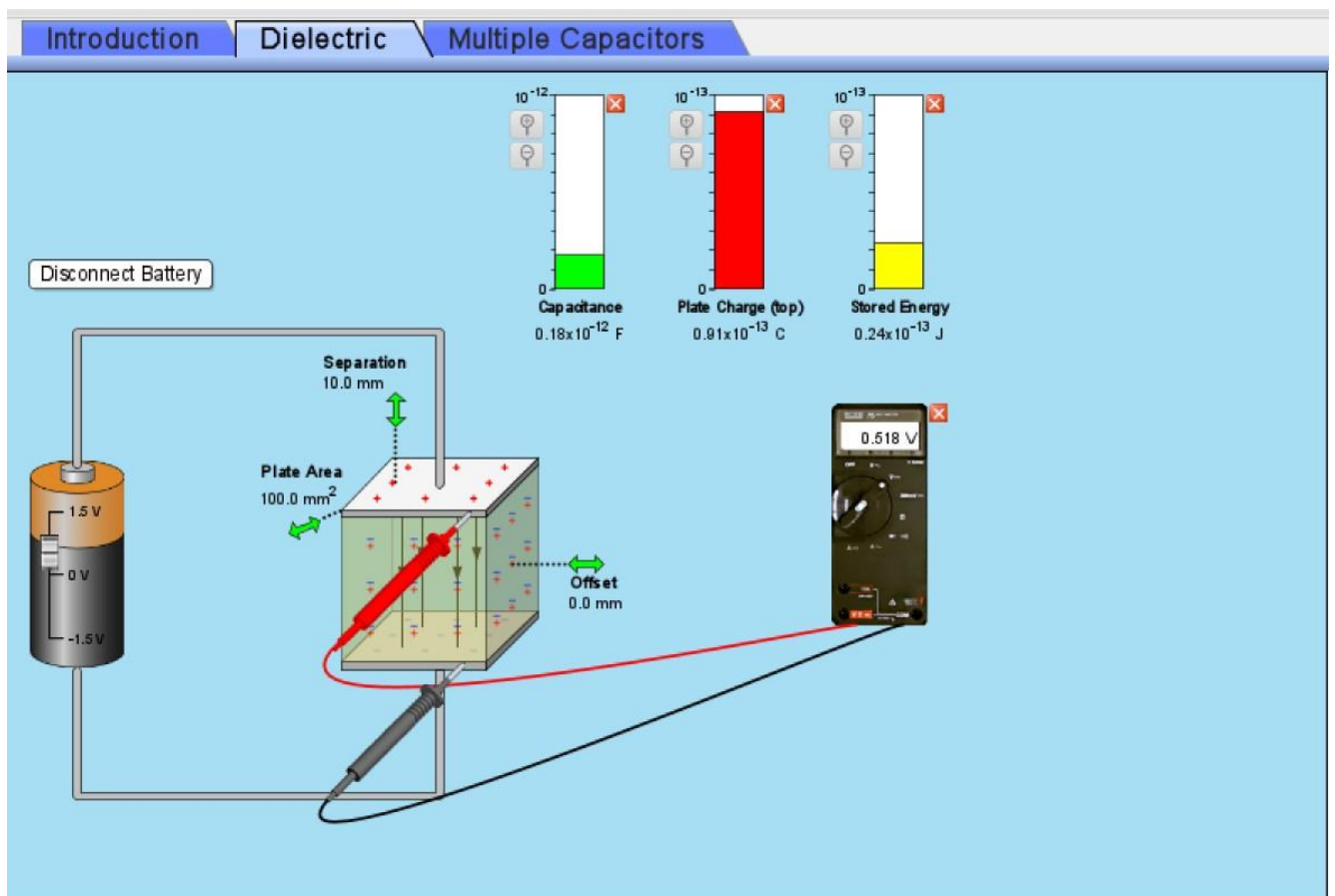| Sr. No.	Voltage	Charge	Capacitance	Stored Energy (J)	Dielectric constant
1	0.358	$0.67 * 10^{-13}$	$0.19 * 10^{-12}$	$0.12 * 10^{-13}$	2.1 (Teflon)
2	0.198	$0.82 * 10^{-13}$	$0.31 * 10^{-12}$	$0.06 * 10^{-13}$	3.5 (Paper)
3	0.119	$0.5 * 10^{-13}$	$0.42 * 10^{-12}$	$0.03 * 10^{-13}$	4.7 (Glass)
4	0.279	$0.74 * 10^{-13}$	$0.27 * 10^{-12}$	$0.1 * 10^{-13}$	3 (Custom)
5	0.518	$0.91 * 10^{-13}$	$0.18 * 10^{-12}$	$0.24 * 10^{-13}$	2 (Custom)

Table for Aim 4: -

Sr. No.	Capacitor 1 (C_1) in F	Capacitor 2 (C_2) in F	Capacitor 3 (C_3) in F	Combination Type	Total Capacitance ($C_{eq.}$)
1	$1.5 * 10^{-13}$	$1.5 * 10^{-13}$	0	2 In Series	$0.07 * 10^{-12}$
2	$1.2 * 10^{-13}$	$1.7 *$	$2.10 *$	3 In Series	$0.05 * 10^{-12}$
3	$2 * 10^{-13}$	$1.6 * 10^{-13}$	0	2 In Parallel	$0.36 * 10^{-12}$
4	$2.4 * 10^{-13}$	$1.4 * 10^{-13}$	$2.2 * 10^{-13}$	3 In Parallel	$0.6 * 10^{-12}$
5	$2 * 10^{-13}$	$1.6 * 10^{-13}$	$1.9 * 10^{-13}$	2 In Series + 1 In Parallel	$0.28 * 10^{-12}$
6	$2 * 10^{-13}$	$1.7 * 10^{-13}$	$2.5 * 10^{-13}$	2 In Parallel + 1 In Series	$0.14 * 10^{-12}$
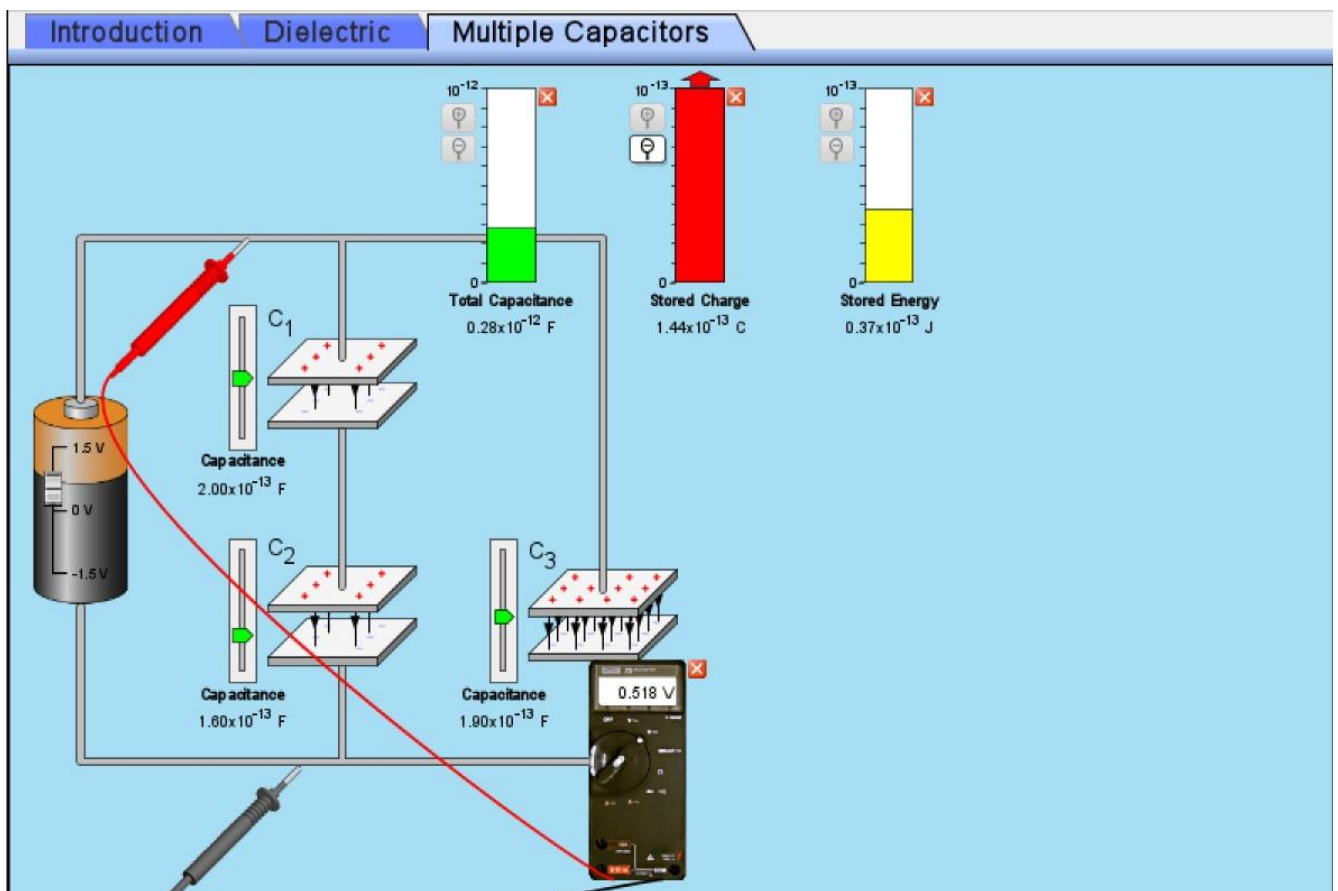
Result: -

In this Experiment we learnt the effect of space and dielectric materials inserted between the conductors of capacitors in a circuit, the relation between charge and voltage for capacitor, the energy stored in a capacitor in a circuit, the equivalent capacitance of a set of capacitors in a series and in parallel in a circuit.

Thank you