**Experiment**

**4**

Capacitors

**Introduction:** The purpose of this experiment is to verify some of the relationships involving capacitance and, in the process, learn more about capacitors. Since they are our first major circuit element, you will also be developing your ability to work with circuits. Specifically, you will:

 1) Use an LCR meter to measure Cm for this capacitor as a function of d and compare the result to the theoretically predicted result.

 2) To measure the dielectric constant of a material and observe the affect of dielectrics on capacitance.

 3) To verify the relationships for equivalent capacitance for both series and parallel capacitors using the LCR meter.

**Theory:** Using your text, show complete derivations and/or explanations for each of the following important relationships.

 1) For a parallel plate capacitor:

 a) C= εoA/d

 b) C = kCo = kεοΑ/d

 **Theory:** continue

 2) For parallel capacitance: C = C1 + C2 + C3 + …

 Be sure to include a circuit diagram of this arrangement.

 3) For series capacitance: 1/C = 1/C1 + 1/C2 + 1/C3 + …

 Include a circuit diagram.

**Procedure:**

 Part 1: Connect the LCR meter to the sliding capacitor and measure d and C for up to 5 cm of separation. Collect at least ten data points. Also measure the area of the plates.

 Part 2: Measure Co for the demountable capacitor (be sure to have spacers in place).

 Insert the mica dielectric and measure Ck.

 Part 3: Measure C for the two demountable capacitors separately. Connect them in series and parallel and measure Ceq for each arrangement. Again, be sure spacers are in place for each measurement.

**Data:**

 **Part 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Trial | d(cm) | C(pF) | Trial | d(cm) | C(pF) |
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 Diameter of Cylindrical Plate: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Part 2

 Co\_\_\_\_\_\_\_\_\_\_\_\_\_ C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Data:** continued

# Part 3: Measured Capacitances

 C1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ C2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Cp \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Cs \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Analysis:**

 **Part 1**: Graph C vs. 1/d ( Why?) and evaluate the slope. Calculate εo from your slope

 and compare to the accepted value with a % error. Watch the units.

 **Part 2**: Calculate the dielectric constant for the mica used.

 **Part 3:** Calculate Ceq for both the parallel and series capacitance and compare with the

 measured values with % errors.

 **Attach your graph and calculations to this report and show your results below**.

 **Results**:

 Part 1: εο\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ % Error \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Part 2: κ\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part 3: Calculated Capacitances**

 Parallel Series

 Ceq: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Ceq: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 % Error: \_\_\_\_\_\_\_\_\_\_\_\_ % Error: \_\_\_\_\_\_\_\_\_\_\_\_