Title: **Capacitors, ICE** Lab: 29

Course: Electrical Applications Unit: Electrical Lab CLO: 2, 3, 4

Name ANSWER KEY Grade 28pts. Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Objectives**

1. Student shall identify the relationship between voltage and current in a resistive-capacitive (RC) circuit.
2. Student shall construct an AC RC circuit, take voltage readings and analyze the results.

**Assessment**

Students shall demonstrate a comprehension of the objectives listed above by scoring a minimum of 75% on this Lab. Grading shall be based on instructor evaluation.

**Materials**

|  |  |
| --- | --- |
| Student Provided Materials | Department Provided |
| Proto-Board | Oscilloscope |
| Multimeter | Waveform Generator |
| Resistor Kit |  |
| Component Kit |  |
| Calculator |  |

**Theory**

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A capacitor is an electrical component made two plates, one positive and one negative, separated by a dielectric. Capacitance is represented by the letter *C* in equations and is measured in *Farads (F)*. In a RC circuit, current will lead voltage. We use a three-letter acronym to denote this relationship.

I C E

Where;

I = Current

C = Capacitance and verb “Comes before”

E = Voltage

The acronym *ICE* is read, “Current Comes before Voltage…”. The *C* in the middle has a double meaning indicating “… for a Capacitive circuit” and “ … Come before…”.

**Graphic**

|  |  |
| --- | --- |
|  |  |

**Circuit**



Where;

**Instructions**

Set the scope to trigger off Channel 2.

1. Is there a phase shift between voltage and current in a resistor?
   1. Yes
   2. No
2. The signal displayed on Channel 1 represents which phase in the circuit?
   1. Volts
   2. Amps
3. The signal displayed on Channel 2 represents which phase in the circuit?
   1. Volts
   2. Amps

|  |  |  |
| --- | --- | --- |
| 1. Calculate the phase shift using the formulas to the right. 40.921˚ 2. Measure the phase shift \_\_\_\_\_\_\_ 3. Do the calculated and measured phase shifts?    1. Agree    2. Disagree |  | |
|  |  |
|  |  |
|  |  |  |

1. If the answer to the previous question was “disagree”, explain the possible reasons this could be so.

Calculate the *capacitive reactance* (XC) and phase angles (θ) for each of the following frequencies. Adjust the signal generator to each frequency and measure the phase angles. Calculate the power factor (PF) based on the active power divided by the apparent power. The formula for power factor is as follows;

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency | Xc | Calculated  Phase Shift | Measured  Phase Shift | Power Factor |
| 1.8kHz | 884.194Ω | 52.437˚ |  | 0.610 |
| 2.3kHz | 691.978Ω | 45.5˚ |  | 0.701 |
| 3.2kHz | 497.359Ω | 36.182˚ |  | 0.807 |
| 3.7kHz | 430.148Ω | 32.316˚ |  | 0.845 |

Evaluations

1. If the frequency increases, the capacitive reactance (XC)?
   1. Goes Up
   2. Goes Down
   3. Stays the same
2. If resistance is increased in a resistive-capacitive (RC) series circuit, the phase angle will?
   1. Increase
   2. Decrease
   3. Stay the same
3. If the supply voltage is decreased, the power factor (PF) for an RC circuit will?
   1. Increase
   2. Decrease
   3. Stay the same
4. In a purely capacitive circuit (no resistance or inductance) the relationship between voltage and current will be?
   1. Voltage before current by 45˚
   2. Current before voltage by 90˚
   3. Voltage and current in phase
   4. Voltage before current by 90˚
5. If two sinewaves are said to be “in phase”, theta will equal 90˚.
   1. True
   2. False

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