LAB REPORT NO 2

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CS-II lab

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Lab 2

Capacitive Reactance

Objective

Capacitive reactance will be examined in this exercise. In particular, its relationship to capacitance and frequency will be investigated, including a plot of capacitive reactance versus frequency.

Theory Overview

The current – voltage characteristic of a capacitor is unlike that of typical resistors. While resistors show a constant resistance value over a wide range of frequencies, the equivalent ohmic value for a capacitor, known as capacitive reactance, is inversely proportional to frequency. The capacitive reactance may be computed via the formula:

$$X_C = \frac{1}{2\pi f C}$$

The magnitude of capacitive reactance may be determined experimentally by feeding a capacitor a known current, measuring the resulting voltage, and dividing the two, following Ohm's Law. This process may be repeated across a range of frequencies in order to obtain a plot of capacitive reactance versus frequency. An AC current source may be approximated by placing a large resistance in series with an AC voltage, the resistance being considerably larger than the maximum reactance expected.

Equipment

1. AC Function Generator
2. Oscilloscope

Components

1. 1 µF actual:__________________
2. 2 µF actual:__________________
3. 10 kΩ actual:__________________

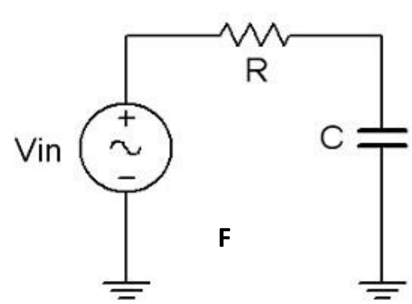

Figure 1

Procedure

Current Source

1. Using Figure 1 with V_{in}=10V_{p-p} and R=10kΩ, and assuming that the reactance of the capacitor is much smaller than 10k and can be ignored, determine the circulating current using measured component values and record in Table 1.

Measuring Reactance

2. Build the circuit of Figure 1 using R=10kΩ, and C=1 μF. Place one probe across the generator and another across the capacitor. Set the generator to a 200 Hz sine wave and 10V_{p-p}. Make sure that the Bandwidth Limit of the oscilloscope is engaged for both channels. This will reduce the signal noise and make for more accurate readings.
3. Calculate the theoretical value of X_c using the measured capacitor value and record in Table 2.
4. Record the peak-to-peak capacitor voltage and record in Table 2.
5. Using the source current from Table 1 and the measured capacitor voltage, determine the experimental reactance and record it in Table 2. Also compute and record the deviation.
6. Repeat steps three through five for the remaining frequencies of Table 2.
7. Replace the 1 μF capacitor with the 2.2 μF unit and repeat steps two through six, recording results in Table 3.
8. Using the data of Tables 2 and 3, create plots of capacitive reactance versus frequency.

$i_{source(p-p)}$	0.001A

For capacitor, C=1μF:-

Frequency	X_c Theory	V_c(p-p) Exp	X_c Exp	%Dev
200	**800**	**0.8v**	**796.17**	**0.47**
400	**400**	**0.4v**	**398**	**0.5**
600	**270**	**0.26v**	**269.3**	**0.37**
800	**200**	**0.2**	**199.4**	**0.3**
1K	**160**	**0.16**	**159.33**	**0.43**
1.2K	**130**	**0.13**	**129.6**	**0.25**
1.6K	**100**	**0.1**	**99.5**	**0.50**
2k	**80**	**0.08**	**79.6**	**0.50**

Table 2

For capacitor, C=2μF :-

Frequency	X_c Theory	V_c(p-p) Exp	X_c Exp	**%Dev**
200	**361.2**	**0.36v**	**360.1**	**0.30**
400	**179.6**	**0.17v**	**179.22**	**0.211**
600	**120**	**0.12v**	**119.01**	**0.825**
800	**91.01**	**0.092**	**90.11**	**0.98**
1K	**70.2**	**0.073**	**70**	**0.284**
1.2K	**59**	**0.059**	**58.97**	**0.0508**
1.6K	**51.2**	**0.051**	**50.8**	**0.781**
2k	**46.1**	**0.046**	**44.1**	**4.338**

Questions

1. **What is the relationship between capacitive reactance and frequency**?

   Answer:- Capacitive reactant has inverse relation with frequency, as the frequency of the Ac is increases the reactant of capacitance decreases means capacitor has no potential to block or resist AC.

$$X_c=1/2\pi fc$$

$$X_c \propto 1/f$$

2. **What is the relationship between capacitive reactance and capacitance?**

   Answer:- Capacitive reactance is inversely related with capacitance because capacitance is the ability of capacitor to store energy if capacitor has large reactance.

$$X_c \propto 1/C$$

3. **If the experiment had been repeated with frequencies 10 times higher than those in Table 2, what would the resulting plots look like?**

   Answer:- If we increase the frequency 10 times the value of capacitive reactant(X_c) decrease 10 times. Both the experimental and theoretical will decrease 10 times if the experiment repeated with frequency set 10 times higher than the frequency in table 2.

$$X_c \propto 1/f$$

4. **If the experiment had been repeated with frequencies 10 times lower than that in Table 2, what effect would that have on the experiment?**

Answer:- If we decrease the frequency 10 times the value of capacitive reactant(X_c) increase 10 times. Both the experimental and theoretical will increase 10 times if the experiment repeated with frequency set 10 times higher than the frequency in table 2.