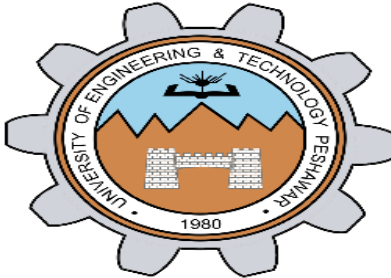# LAB REPORT NO 3

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CS-II lab

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Lab 3

Inductive Reactance

Objective

Inductive reactance will be examined in this exercise. In particular, its relationship to inductance and frequency will be investigated, including a plot of inductive reactance versus frequency.

Theory Overview

The current – voltage characteristic of an inductor is unlike that of typical resistors. While resistors show a constant resistance value over a wide range of frequencies, the equivalent ohmic value for an inductor, known as inductive reactance, is directly proportional to frequency. The inductive reactance may be computed via the formula: $X_L = 2\pi f L$

The magnitude of inductive reactance may be determined experimentally by feeding an inductor 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 inductive 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 DMM

Components

1. 1 mH   actual:_____
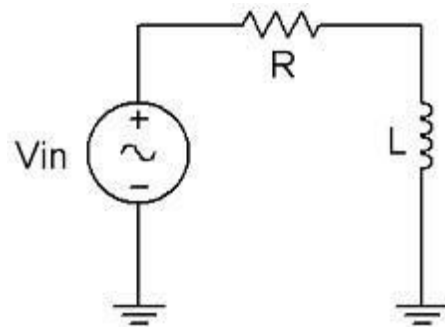
2. 10 mH actual:_____

3. 10 kΩ   actual:_____   **Figure 1**

Procedure

1. **Current Source**
    Using Figure 1 with Vin=10 Vp-p and R=10 kΩ, and assuming that the reactance of the inductor is much smaller than 10k and can be ignored, determine the circulating current using measured component values and record in Table 1.

2. **Measuring Reactance**
    Build the circuit of Figure 1 using R=10 kΩ, and L=10 mH. Place one probe across the generator and another across the inductor. Set the generator to a 1000 Hz sine wave and 10Vp-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 XL using the measured inductor value and record in Table2.

4. Record the peak-to-peak inductor voltage and record in Table 2.

5. Using the source current from Table 1 and the measured inductor 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 10 mH inductor with the 1mH unit and repeat steps two through six, recording results in Table 3.

8. Using the data of Tables 2 and 3, create plots of inductive reactance versus frequency.

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

For 1mH inductor:-

Frequency	X_l Theory	V_l(p-p) Exp	X_l Exp	%Dev
1k	6.3	6.3mV	6.28	0.317%
2k	12.6	12.6 mV	12.56	0.314%
3k	19.0	19.0 mV	18.84	0.84%
4k	25.4	25.4 mV	25.12	1.1%
5k	31.5	31.5 mV	31.4	0.3%
6K	37.7	37.7 mV	37.68	0.54%
8K	50.5	50.5 mV	50.24	0.51%
10k	63	63 mV	62.8	0.317%

Table 2

Frequency	X_L Theory	V_L(p-p) Exp	X_L Exp	%Dev
10k	63	63mV	62.8	0.317%
20k	125.8	125.8 mV	125.6	0.15%
30k	190	190 mV	188.4	0.84%
40k	252	252 mV	251.2	0.31%
50k	314.5	314.5 mV	314	0.15%
60K	378.5	378.5 mV	376.8	0.44%
80K	503.5	503.5 mV	502.4	0.21%
100k	630.1	630.1 mV	628	0.33%

For 10mH inductor:-

Frequency	X_I Theory	V_I(p-p) Exp	X_I Exp	%Dev
1k	63.3	63.3mV	62.8	0.78%
2k	125.9	125.9 mV	125.6	0.23%
3k	189.1	189.1 mV	188.4	0.37%
4k	253.5	253.5 mV	251.2	0.90%
5k	314.1	314.1 mV	314	0.03%
6K	377	377 mV	376.8	0.053%
8K	506.3	506.3 mV	502.4	0.7%
10k	631	631 mV	628	0.47%

Table 2

Frequency	X_L Theory	V_L(p-p) Exp	X_L Exp	%Dev
10k	631	631mV	628	0.47%
20k	1259.4	1259.4 mV	1256	0.26%
30k	1885	1885 mV	1884	0.05%
40k	2514.6	2514.6 mV	2512	0.10%
50k	3140.8	3140.8 mV	3140	0.025%
60K	3770.2	3770.2 mV	3768	0.05%
80K	5026.9	5026.9 mV	5024	0.057%
100k	6281.4	6281.4 mV	6280	0.022%

Questions

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

Answer:-

Inductive reactance is directly related with frequency, I we increase frequency inductive reactance increases and vice versa. As shown in the reading.

2. **What is the relationship between inductive reactance and inductance?**

Answer:-

inductive reactance is also directly related with inductance as verified in the reading of 1mH and 2mH inductance of inductor. The overall values inductive reactance (XL) with different frequencies for 1mH inductor is less than the values of XL for 2mH inductor.

3. **If the 10mH trial had been repeated with frequencies 10 times higher than those in Table 2, what effect would that have on the experiment?**

Answer:-

if 10mH is repeated with 10 times frequency higher than those in table 2 then the value of inductive reactance will be increases 10 times. Because both are directly related.

4. **Do the coil resistances have any effect on the plots?**

Answer:-

The coil resistance is called inductive reactance so it has direct relation with the amplitude of the plots. Voltage drop is increase with rise in amplitude of a plot if we increase the resistance of the coil.