CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
CHITTAGONG-4349, BANGLADESH.

Course No. EEE-182

Course Title: Basic Electrical Engineering Sessional

Experiment No. 8

FAMILIARIZATION WITH ALTERNATING CURRENT (AC) WAVES

PRELAB WORK:

- **Read this laboratory manual carefully before coming to the laboratory class, so that you know what is required.**
- Try to **follow** the lecture notes of **EEE 111.**
- **DONOT** copy others blindly!!!
- **Submit your lab report before the roll call.**

OBJECTIVE:

To study ac (sinusoidal) wave forms and correlate them with practically measurable effective values. An understanding on a simple ac circuit is also expected to be developed in the experiment.

THEORY:

Any periodic variation of current or voltage where the current (or voltage), when measured along any particular direction, goes positive as well as negative, is defined to be an AC quantity. Sinusoidal AC wave shapes are the ones where the variation (current or voltage) is a sine function of time.

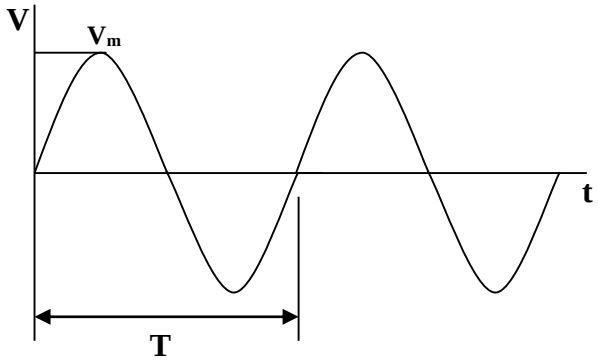

Figure 1: An AC (sinusoidal) voltage waveform.

For the wave form in Fig. 1,

Time period = T
Frequency f = 1/T
$v = V \sin 2\pi ft = V \sin(2\pi / T)t$

Effective Value:

Effective (r.m.s.) values of sinusoidal waveforms are given as:

$$V = \sqrt{\frac{1}{T}\int_0^T v^2 dt} = \frac{V_m}{\sqrt{2}} \qquad \text{(For sinusoidal wave)}$$

$$I = \sqrt{\frac{1}{T}\int_0^T i^2 dt} = \frac{I_m}{\sqrt{2}} \qquad \text{(For sinusoidal wave)}$$

These values are directly measured in ac voltmeter / ammeters and can be used in power calculation as:

$P = I^2 R = V^2 / R$

Phase Difference:

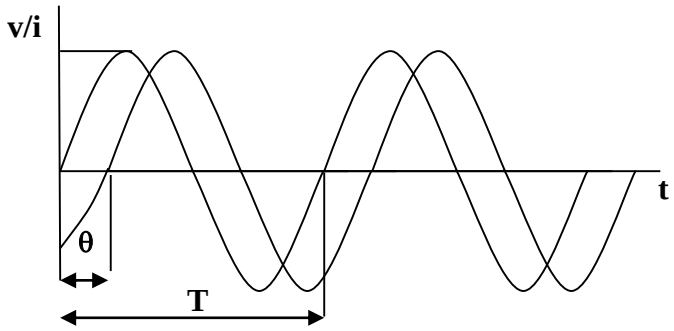

Figure 2: Two sinusoidal waves with phase difference.

Phase difference between two ac sinusoidal waveforms is the difference in electrical angle between two identical points of the two waves. In fig. 2, the voltage and current equations are given as:

$v = V_m Sin(2\pi / T)t$
$i = I_m Sin(2\pi / Tt - \theta)$

Impedance:

Relation between the voltage across and the current through any component of an ac circuit is given by impedance. For the voltage and current waveforms in Fig. 2, the corresponding impedance Z is given as:

$$Z = V_m / I_m \angle\theta) = V_{rms} / I_{rms} \angle\theta$$

APPARATUS:

1. Oscilloscope.

2. Function generation.
3. Decade resistor.
4. Capacitor bank.
5. AC voltmeter.
6. AC ammeter.
7. SPST.
8. Breadboard.

CIRCUIT DIAGRAM:

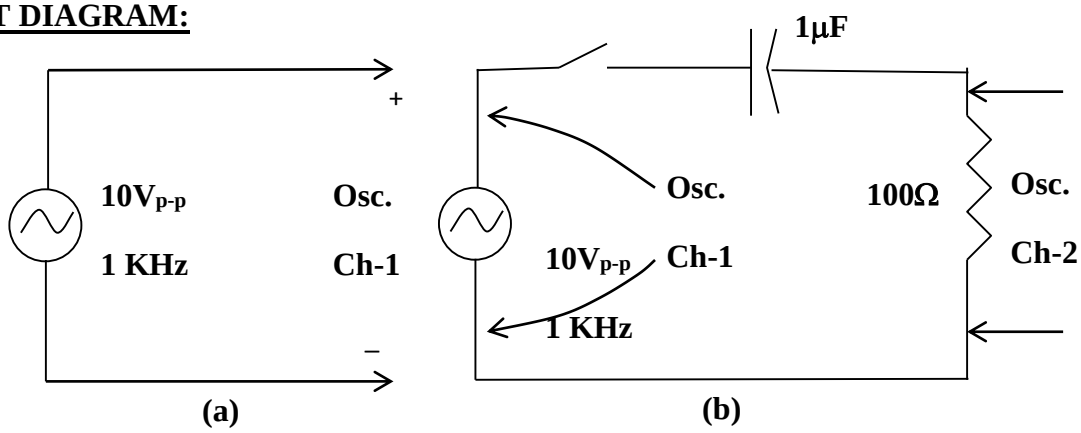

Figure 3: Circuit arrangement for Familiarization with AC wave.

PROCEDURE:

1. Connect the output of the function generator directly to channel 1 of the oscilloscope as shown in Fig. 3(a). Set the amplitude of the wave at 10V and the frequency at 1 kHz. Select sinusoidal wave shape.
2. Sketch the wave shape observed on the oscilloscope. Determine the time period of the wave and calculate the frequency.
3. Measure the voltage with an AC voltmeter.
4. Change the frequency to 500Hz and note what happens to the display of the wave. Repeat when the frequency is increased to 2 KHz.
5. Construct the circuit as shown in Fig. 3(b). Measure the input voltage with an AC voltmeter and the input current with an AC ammeter. The ration between the voltage and the current gives the magnitude of the impedance, ***Z***.
6. Observe the wave shapes of oscilloscope channels 1 and 2 simultaneously. Find the frequency of both the waves and amplitude from the display. Determine the phase difference between the two waves. The phase difference is given by 360ft, where ***'t'*** is the time delay between the two waves. Also observe which of the two waves lead. Note that the voltage in channel 2 is the voltage across a resistance and hence this is in phase with the current flowing in the circuit.

REPORT:

1. Compare the frequency of the wave determined from the oscilloscope with the mentioned value on the function generator in step 2 of the procedure.
2. Calculate the r.m.s. value of the voltage observed in step 2 of the procedure and compare with that measured in step 3.
3. How does the time period vary when the frequency of the wave is changed in step 4?
4. Calculate the magnitude of the impedance from the readings taken in step 5.
5. Find the magnitude and the phase angle of the impedance from the readings taken in step 5 and 6.