LAB NO: 6

CALCULATION OF ACTIVE POWER, REACTIVE POWER AND APPARENT POWER USING ETAP SOFTWARE

Objective:

The main objective of this lab is to calculate active, reactive power and apparent power in a single line diagram using ETAP software

Theory:

Active Power:

The power which is actually consumed or utilized in an AC Circuit is called True power or Active power or Real power. It is measured in kilowatt (kW) or MW. It is the actual outcomes of the electrical system which runs the electric circuits or load.

Reactive Power:

The power which flows back and forth that means it moves in both the directions in the circuit or reacts upon itself, is called Reactive Power. The reactive power is measured in kilo volt-ampere reactive (kVAR) or MVAR.

Apparent Power:

The product of root mean square (RMS) value of voltage and current is known as Apparent Power. This power is measured in kVA or MVA.

It has been seen that power is consumed only in resistance. A pure inductor and a pure capacitor do not consume any power since in a half cycle whatever power is received from the source by these components, the same power is returned to the source. This power which returns and flows in both the direction in the circuit, is called Reactive power. This reactive power does not perform any useful work in the circuit.

In a purely resistive circuit, the current is in phase with the applied voltage, whereas in a purely inductive and capacitive circuit the current is 90 degrees out of phase, i.e., if the inductive load is connected in the circuit the current lags voltage by 90 degrees and if the capacitive load is connected the current leads the voltage by 90 degrees.

Hence, from all the above discussion, it is concluded that the current in phase with the voltage produces true or active power, whereas, the current 90 degrees out of phase with the voltage contributes to reactive power in the circuit.

Therefore,

True power = voltage x current in phase with the voltage

Reactive power = voltage x current out of phase with the voltage

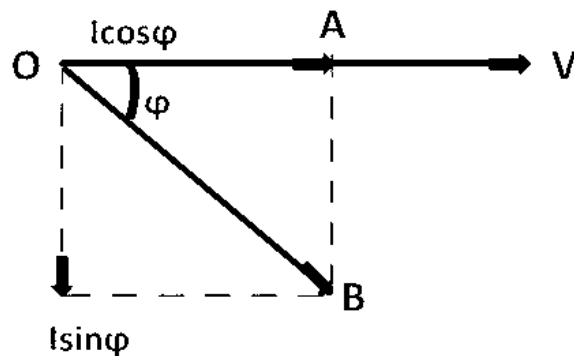The phasor diagram for an inductive circuit is shown below:

Figure 6.1: phasor diagram for an inductive circuit

Taking voltage V as reference, the current I lags behind the voltage V by an angle ϕ. The current I is divided into two components:

I Cos ϕ in phase with the voltage V

I Sin ϕ which is 90 degrees out of phase with the voltage V

Therefore, the following expression shown below gives the active, reactive and apparent power respectively.

Active power $P = V \times I \cos\phi = V I \cos\phi$

Reactive power $Q = V \times I \sin\phi = V I \sin\phi$

Apparent power $S = V \times I = VI$

Steps for Calculating Active, Reactive and Apparent Power in ETAP:

- Select Power Grid and bring it to Main Window.

- Open power grid properties and provide information of power grid.

- Then drop busbar into the main window.

- Then open busbar properties and enter its required data.

- Then connect the grid with the busbar.

- Then drag the two winding transformer into the main window and enter its values.

- Then connect primary side of the transformer to the busbar.

- Then drag a second busbar and connect secondary side of the transformer to it.

- Then drag a circuit to the main window and connect it to the second busbar.

- In the last, drag an induction motor to the main window and connect it to the busbar.

- To calculate active power, first click load flow icon in left corner and then click run load flow icon in right corner and then select KW below units icon.

- To calculate reactive power, change KW to kVAR below units icon.

- To calculate reactive power, change KW to kVAR below units icon.

- To calculate apparent power, change kVAR to KVA below units icon.

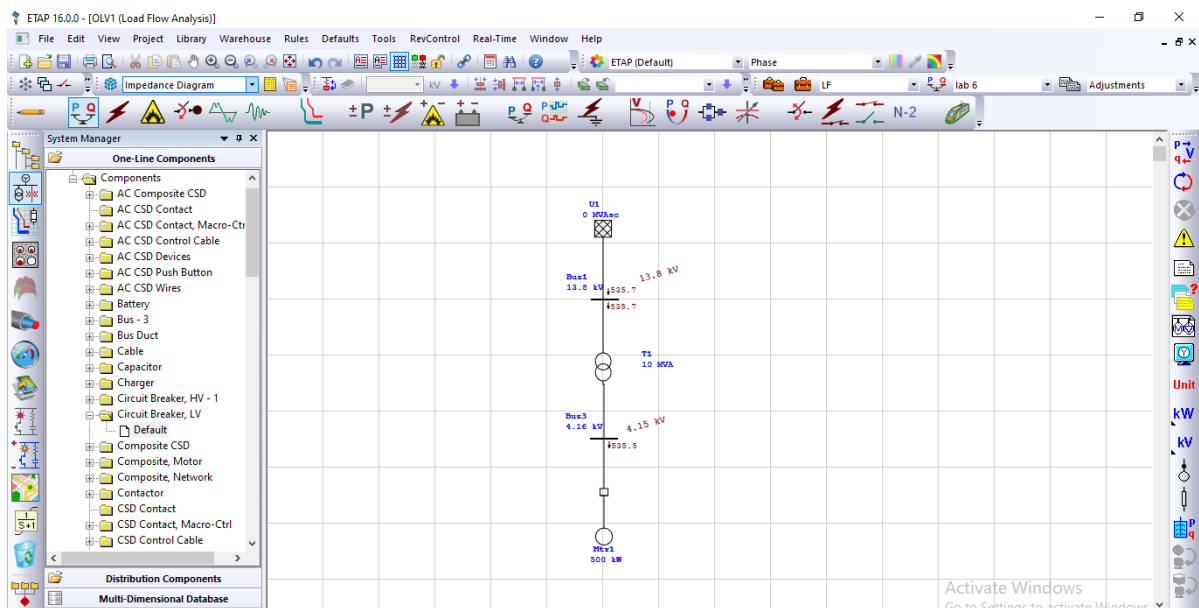The simulation results are shown in the figures below:

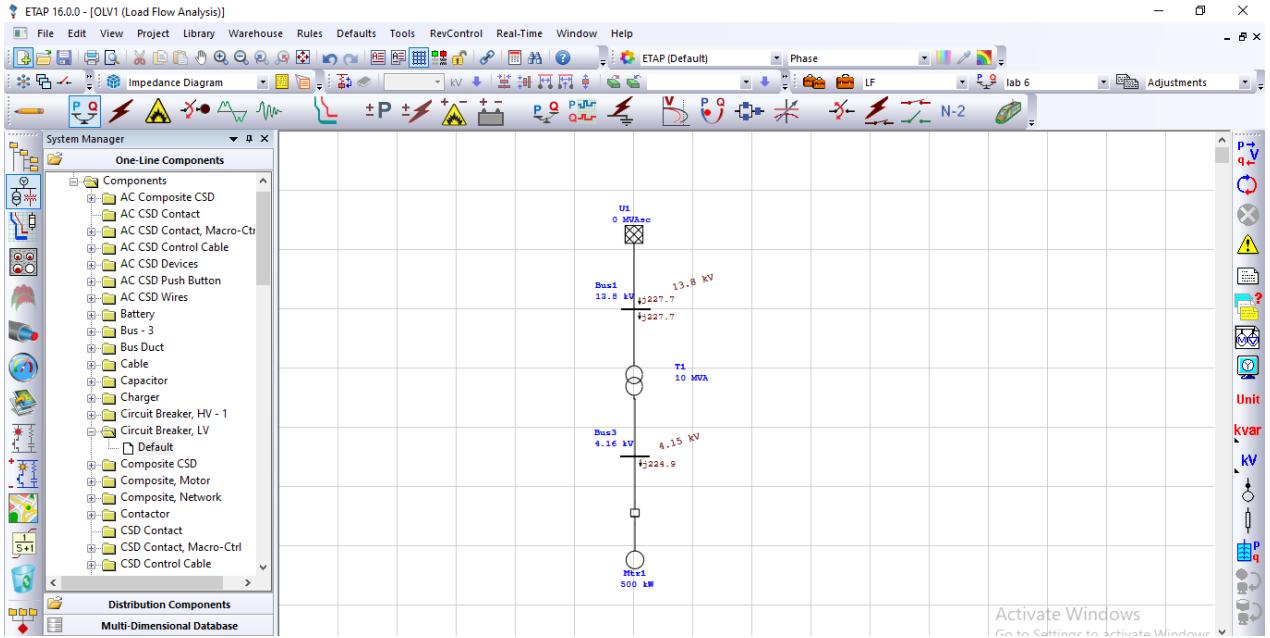**Figure 6.2: Simulation Results of Active Power**
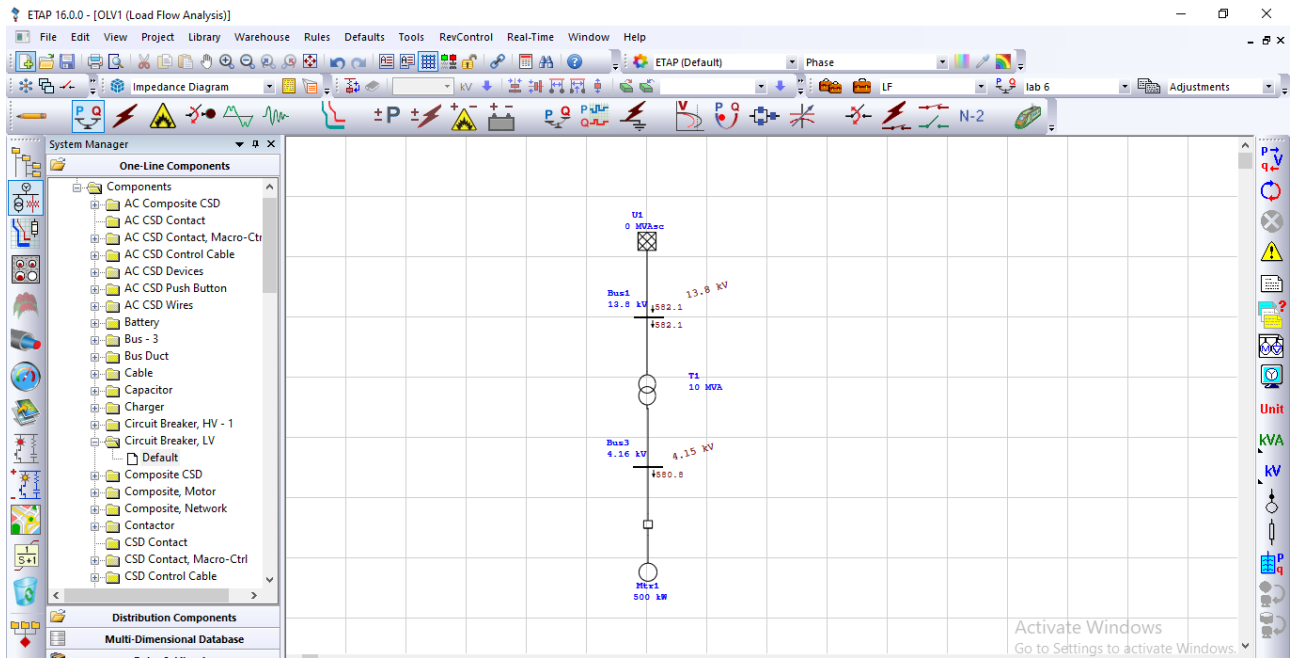
Figure 6.3: Simulation Results of Reactive Power

Figure 6.4: Simulation Results of Apparent Power

POST LAB QUESTIONS:

Q1: What is the main difference between active and reactive power?

Q2: what is the difference between power in AC and DC circuits?

Q3: Write down the importance of Reactive power in power system.

Teacher Remarks:

Obtained Marks: / 10