

What is Electrical Energy?

Like all other forms of energy, **electrical energy** is the capacity to do work. Like other forms of energy, electrical energy can be converted into other forms such as light energy, heat energy etc. Energy can only be transferred when a difference in energy level exists.

Energy and Power

Power is the rate at which energy is converted into another form. The power is measured in terms of **Watts**. If the amount of power is high, large amount of energy will be converted in a given time. **Joule** is the unit of energy. 1 watt is equal to 1 joule per second. Thus power can be calculated as

$P = J / t$ W. Thus 1 joule is 1 Watt x 1 second

Hence joule is measured in watt seconds. If the power is measured in **kilo watts** and **time in hours**, then the unit of electrical energy is **kilo-watt hour or kWh**. Electricity tariff is based on kWh.

Energy consumption of appliances can be easily calculated. For example, if a computer rated 200 Watts is running 60 minutes, then the energy consumption will be

$J = Pt$

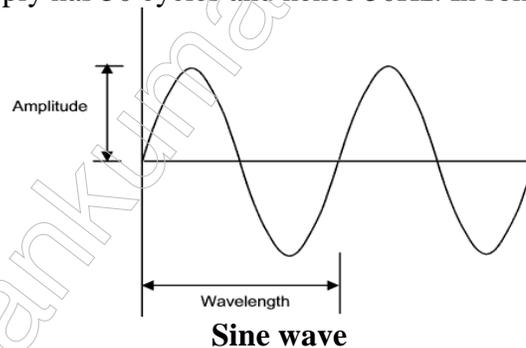
P is the power rating of computer – 200 W

t is the time in seconds. That is 60 minutes x 60 = 3600 seconds

Thus energy consumption J is **$200 \times 3600 = 720000$ J** or **720 kilo Joule**

Electric energy form

AC power is graphically represented as **Sine wave** or Sinusoidal wave. It has two alternating cycles and one cycle is one complete repetition of the sine wave pattern. The domestic electric supply has 50 cycles and hence 50Hz. In some countries it is 60Hz.



The important features of AC power are Amplitude, Cycles, Frequency, Peak-to-Peak, and RMS.

1. Amplitude

Amplitude is the maximum value of current or voltage. It is represented by either of the two "peaks" of the sine wave. This maximum voltage level is also called as t "**Peak Voltage**". It can be either positive or negative. Positive and negative refers to the direction of current flow. A negative number does not mean that the voltage is Zero but it represents the current flows in the opposite direction.

2. Cycles

In the Sine wave, one cycle is the one complete repetition of the sine wave pattern. The sine wave begins from zero, goes to positive through the Positive Peak, then to negative through zero, reaches the Negative Peak and to the zero.

3. Frequency

Frequency is the number of times the Sine Wave Pattern Cycle occurs in a second. The unit of measurement for Frequency is Hertz. The name is given in honor of the scientist Heinrich Rudolf Hertz.

4. Peak-to- Peak voltage

Peak-to-peak voltage is the voltage measured between the maximum Positive and Negative Amplitudes on the sine wave. Its value is twice that of Amplitude. Peak to peak voltage is the maximum voltage available. But this voltage not all useable in practical applications.

5. Root mean square – r.m.s

RMS value is the effective or usable value of a varying voltage or current. RMS is the standard way of measuring and reporting effective Alternating Current and voltage. It is not the peak voltage but the average voltage available. The RMS value can be determined by

The RMS is found by multiplying the Peak Amplitude by the Square Root of 2. That is approximately 0.707. RMS voltage (V_{RMS}) is 0.707 or about 71% of the peak voltage (V_{PEAK}). The domestic electricity is rated at 230 volt r.m.s. Hence the peak voltage is

$$\text{Peak} = 230 \times 1.414 = 325 \text{ volts}$$

The peak voltage is the maximum value present in a varying alternating voltage. That is from 0V to maximum positive voltage.