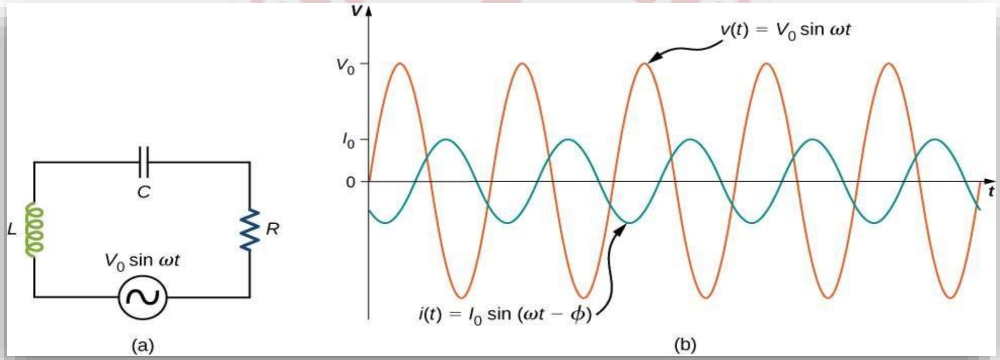
Presentation on

AC FUNDAMENTALS



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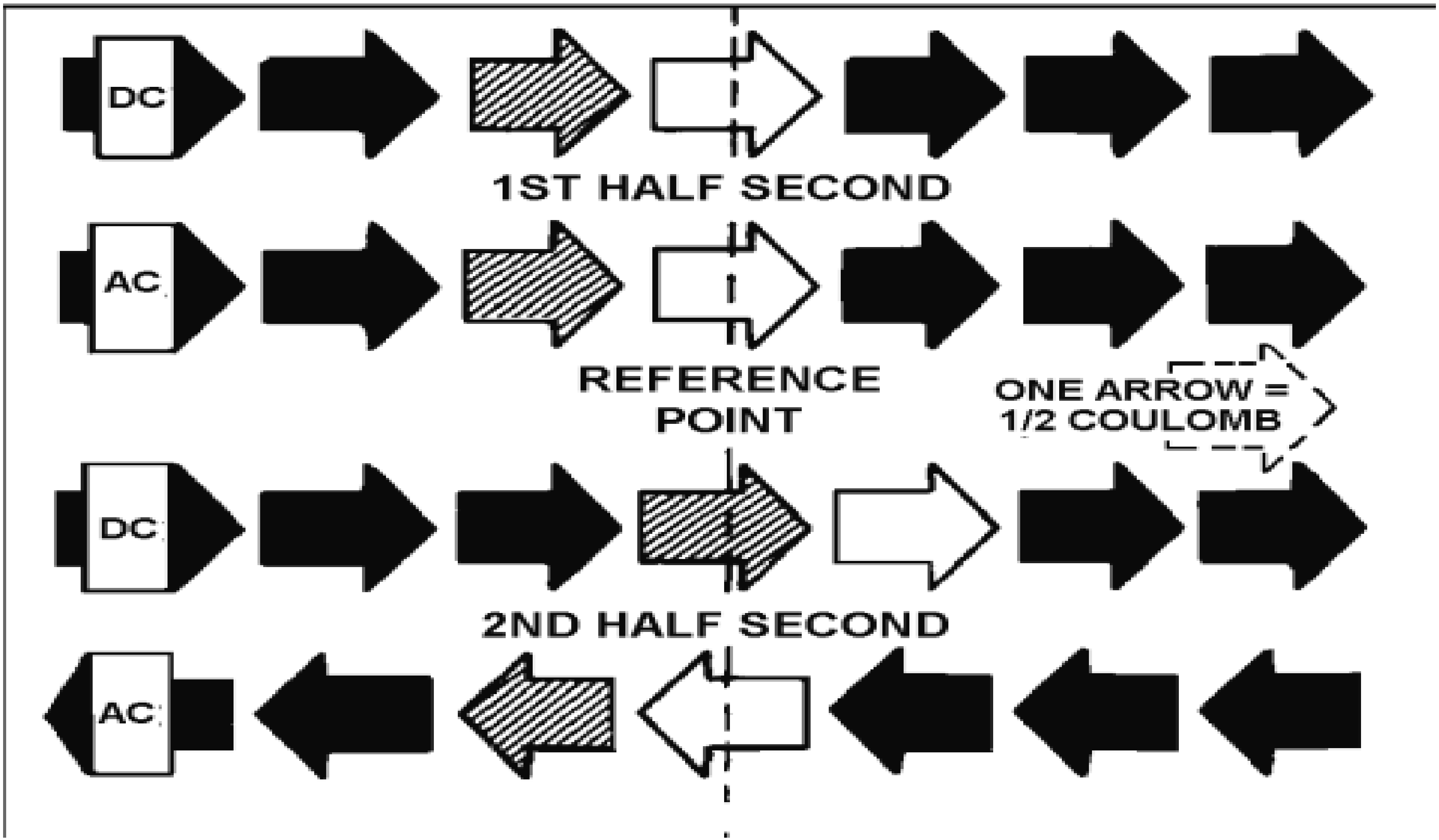
Comparing D.C & A.C Current Flow In A Wire



AC Vs DC

ALTERNATING CURRENT	DIRECT CURRENT
AC is safe to transfer longer distance even between two cities, and maintain the electric power	DC cannot travel for a very long distance. It loses electric power
The rotating magnets cause the change in direction of electric flow.	The steady magnetism makes DC flow in a single direction.
The frequency of AC is dependent upon the country. But, generally, the frequency is 50 Hz or 60 Hz.	DC has no frequency of zero frequency.
In AC the flow of current changes its direction backwards periodically.	It flows in a single direction steadily
Electrons in AC keep changing its directions – backward and forward	Electrons only move in one direction – that is forward

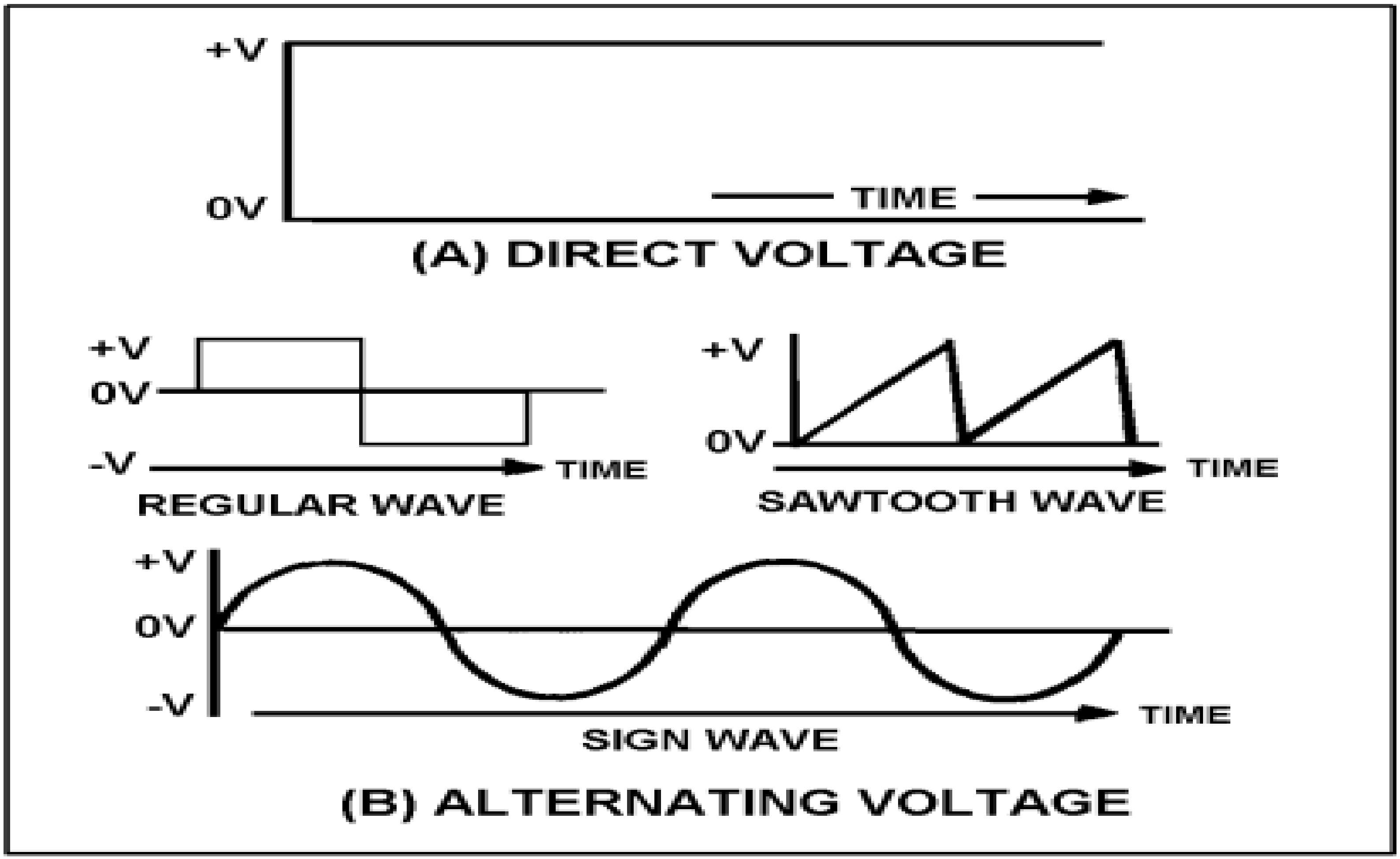
Alternating Current

- Alternating Current (AC) flows one way, then the other way, continually reversing direction.
- An AC voltage is continually changing between positive (+) and negative (-).
- The rate of changing direction is called the frequency of the AC and it is measured in hertz (Hz) which is the number of forwards-backwards cycles per second.

Direct Current

- Direct Current (DC) always flows in the same direction, but it may increase and decrease.
- A DC voltage is always positive (or always negative), but it may increase and decrease
- Electronic circuits normally require a steady DC supply which is constant at one value or a smooth DC supply which has a small variation called ripple.
- DC voltage is shown to have a constant amplitude.

Representation of A.C & D.C



Root Mean Square value of AC

- "RMS value of an alternating current is that steady state current (dc) which when flowing through the given resistor for a given amount of time produces the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time"
- Root Mean Square value of voltage is given by

$$V=\frac{V_m}{\sqrt{2}}$$

- Root Mean Square value of current is given by

$$I=\frac{I_m}{\sqrt{2}}$$

Phase angle.

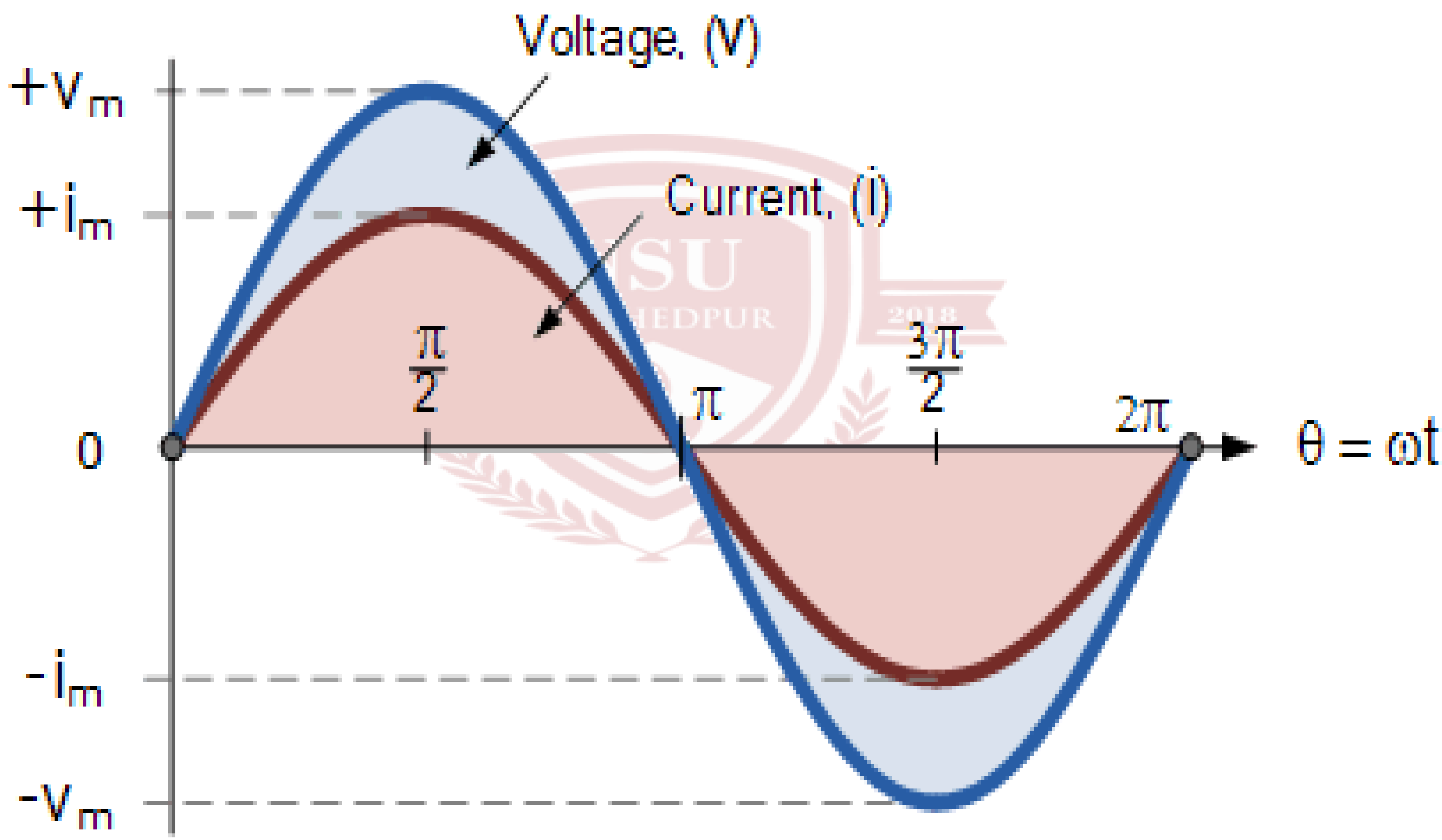
- Phase Difference is used to describe the difference in degrees or radians when two or more alternating quantities reach their maximum or zero values.
- The phase difference or phase shift as it is also called of a Sinusoidal Waveform is the angle Φ (Greek letter Phi), in degrees or radians that the waveform has shifted from a certain reference point along the horizontal zero axis.

Phase Difference Equation: $A_{(t)} = A_{max} \times \sin(\omega t \pm \Phi)$

where,

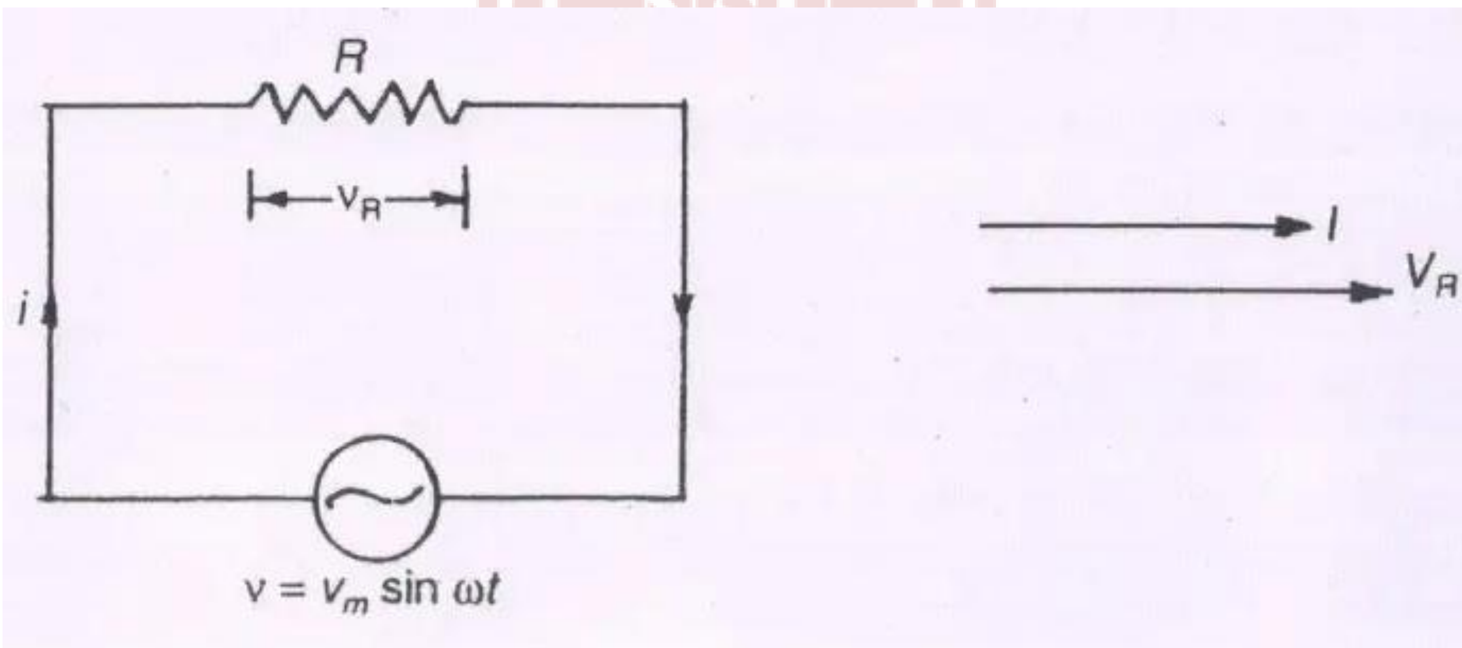
- A_m – is the amplitude of the waveform.
- ωt – is the angular frequency of the waveform in radian/sec
- Φ (phi) – is the phase angle in degrees or radians that the waveform has shifted either left or right from the reference point.

Phase difference and Phase Shift

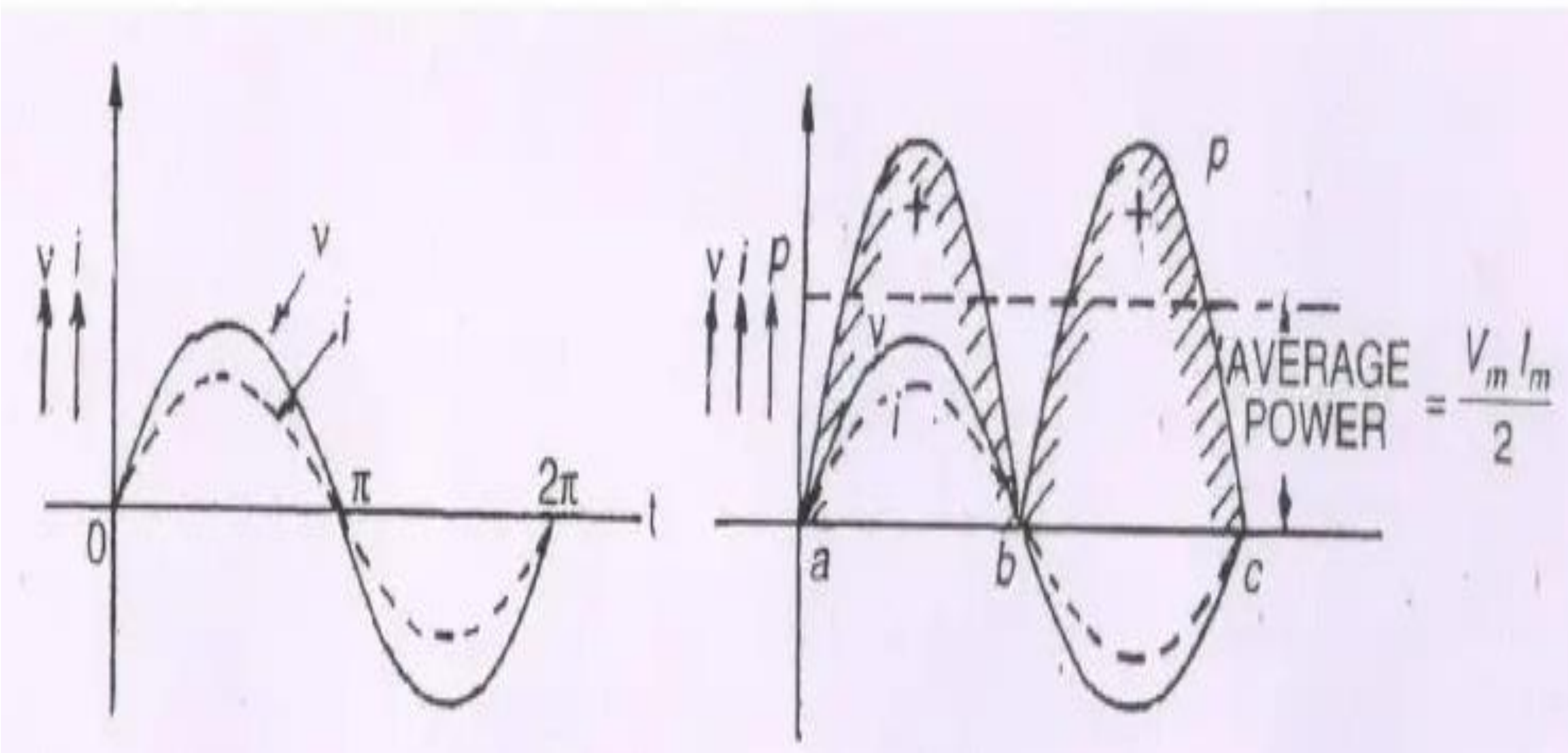


AC circuit components

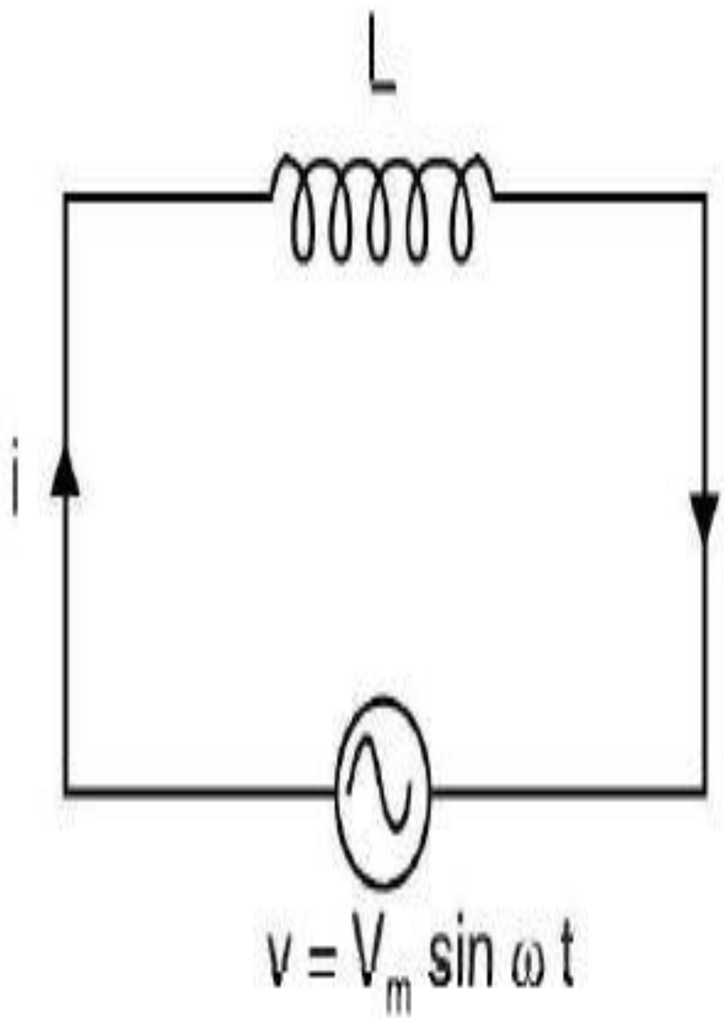
A.C. through Resistance only

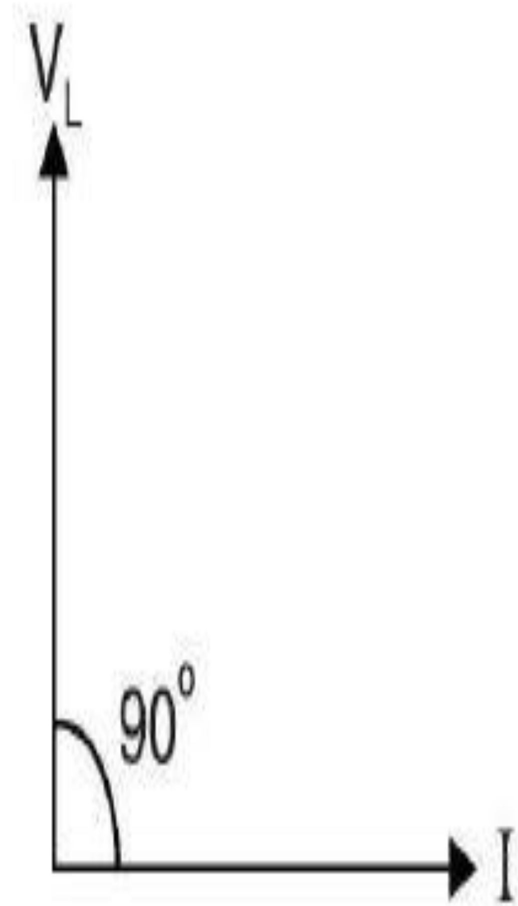


Phasor diagram of pure Resistive circuit

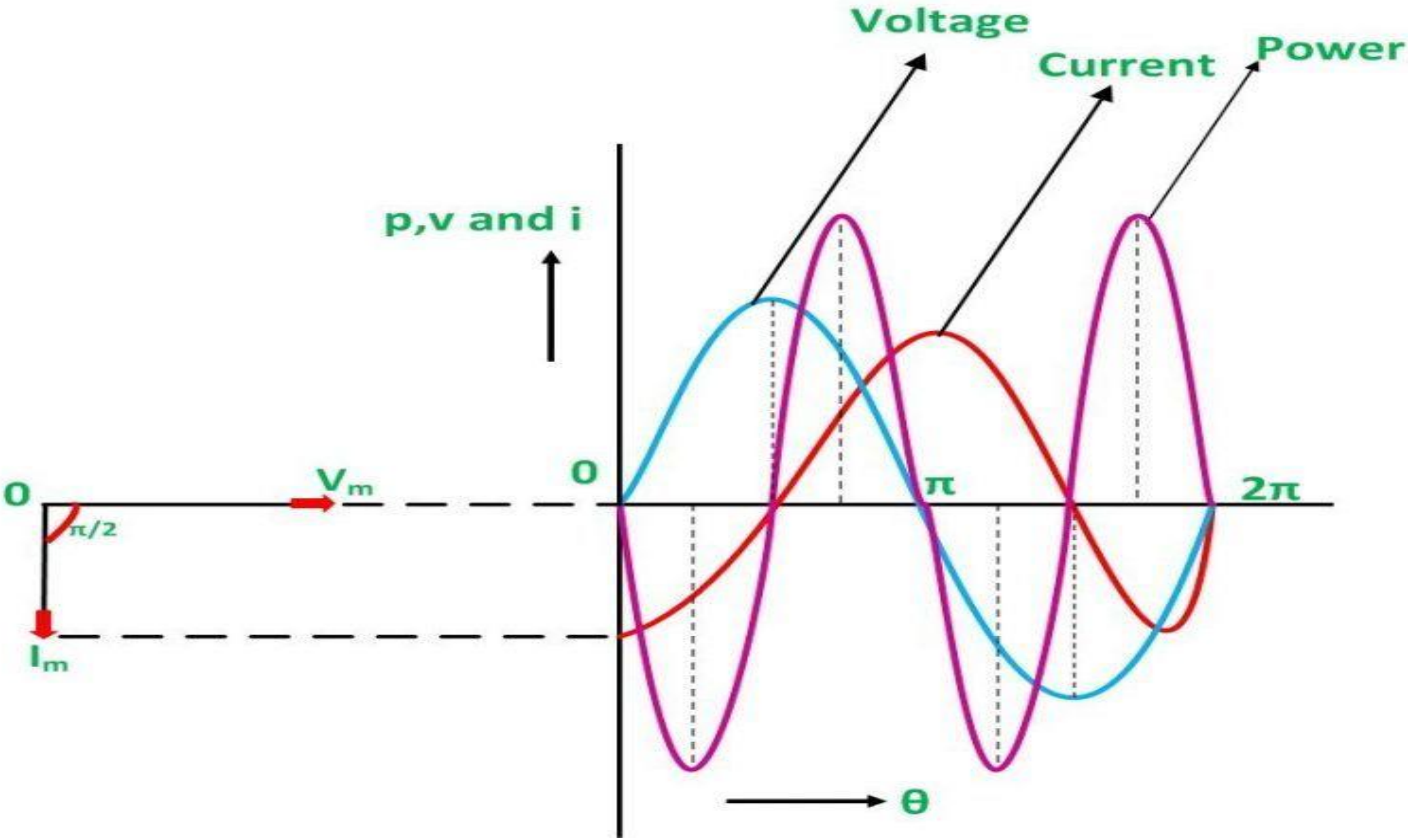


A.C. through Inductance only

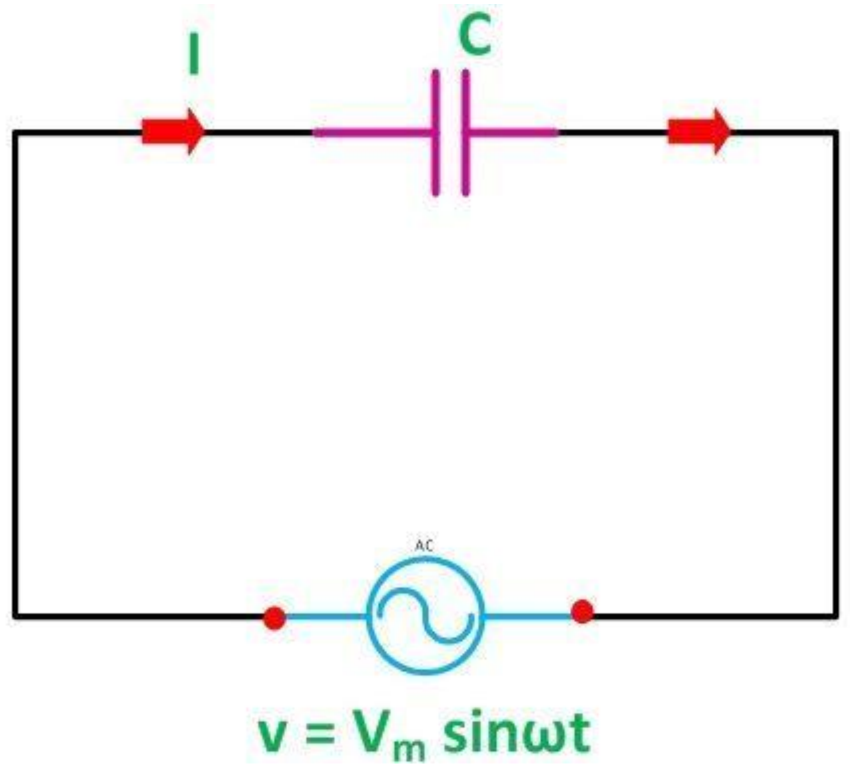


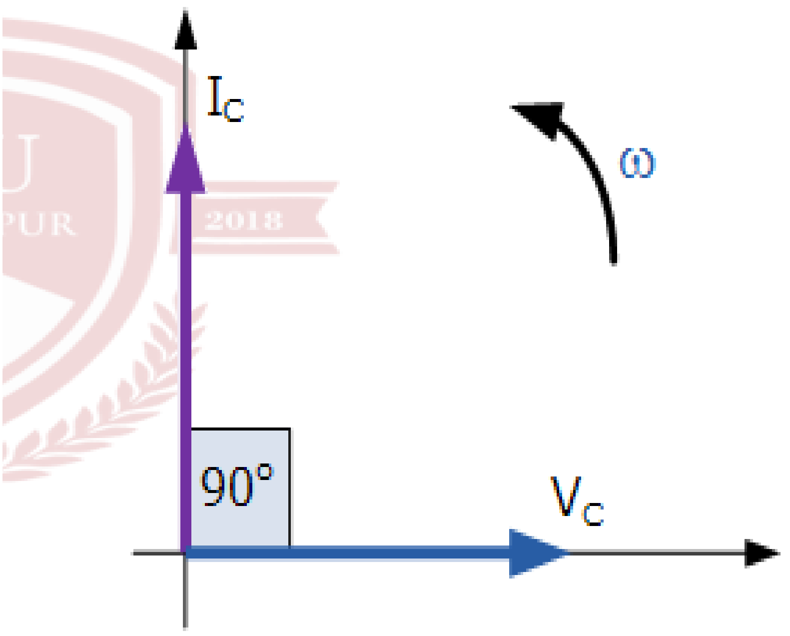


Phasor diagram of pure inductive circuit

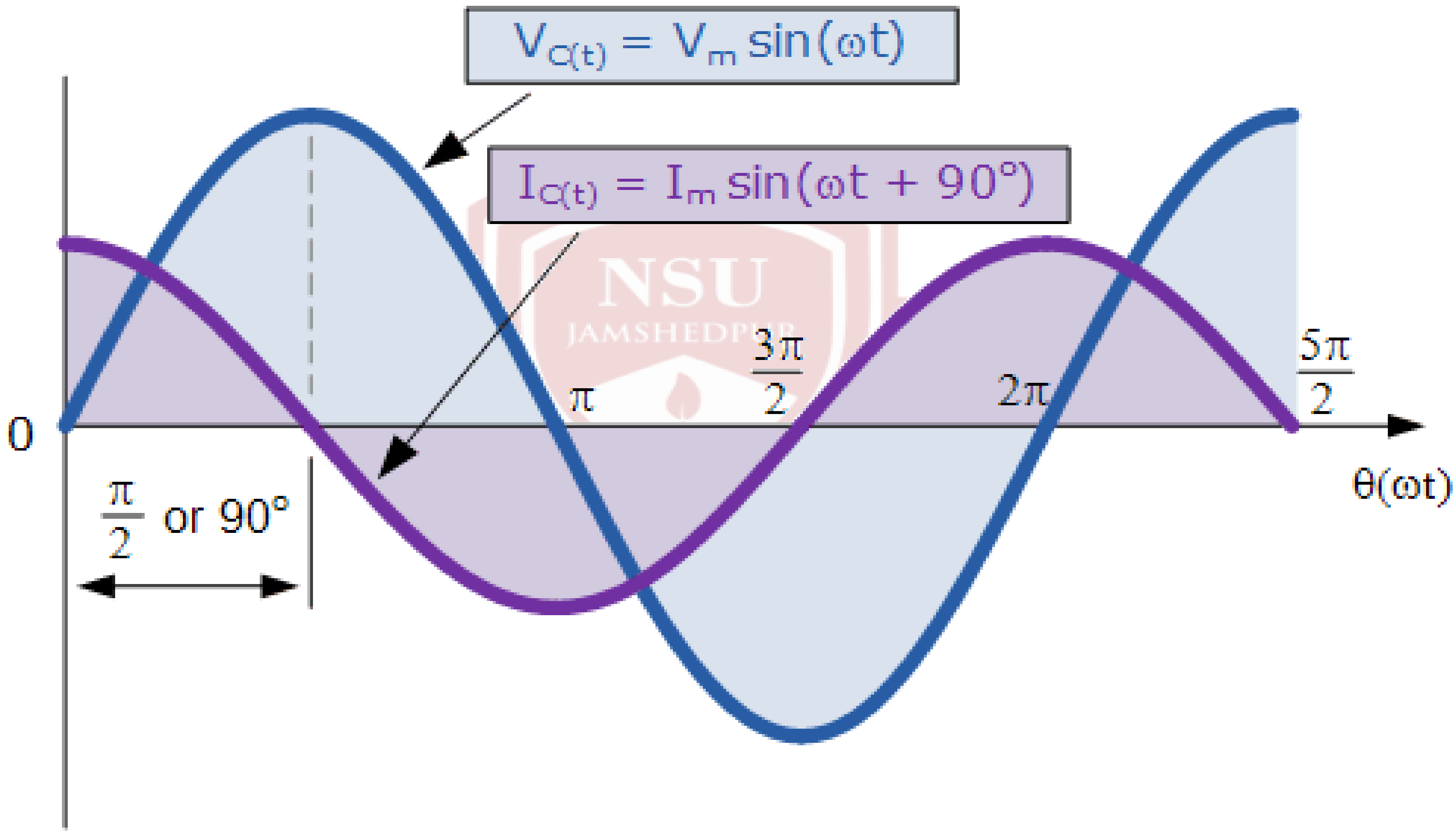


A.C. through Capacitance only





Phasor diagram of Pure capacitive Circuit



Reactance & Impedance in AC Circuit

- Inductive Reactance is given by

X_L=2πfL=ωL

- Capacitive Reactance is given by

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

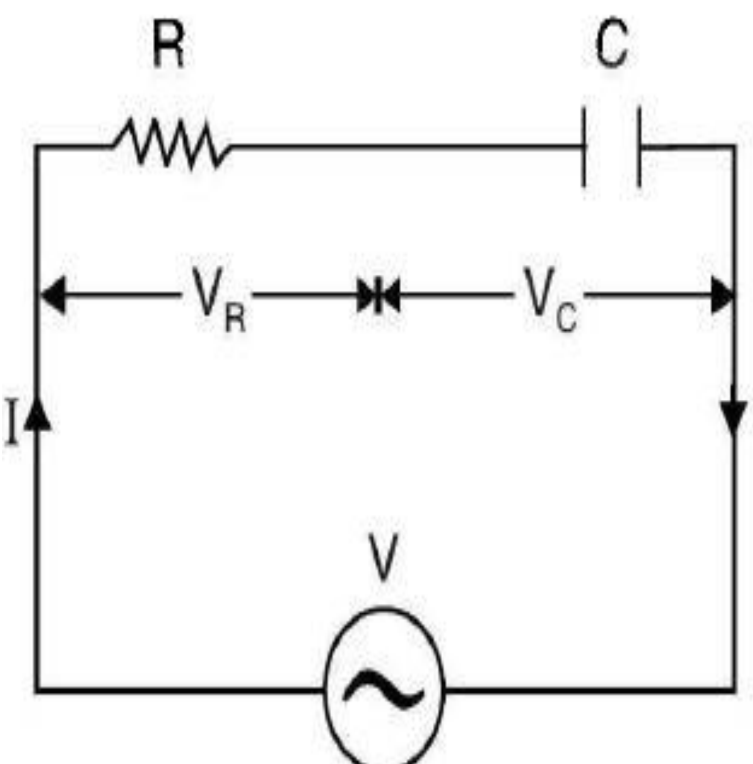
When $X_L > X_C$,then the circuit is Inductive.

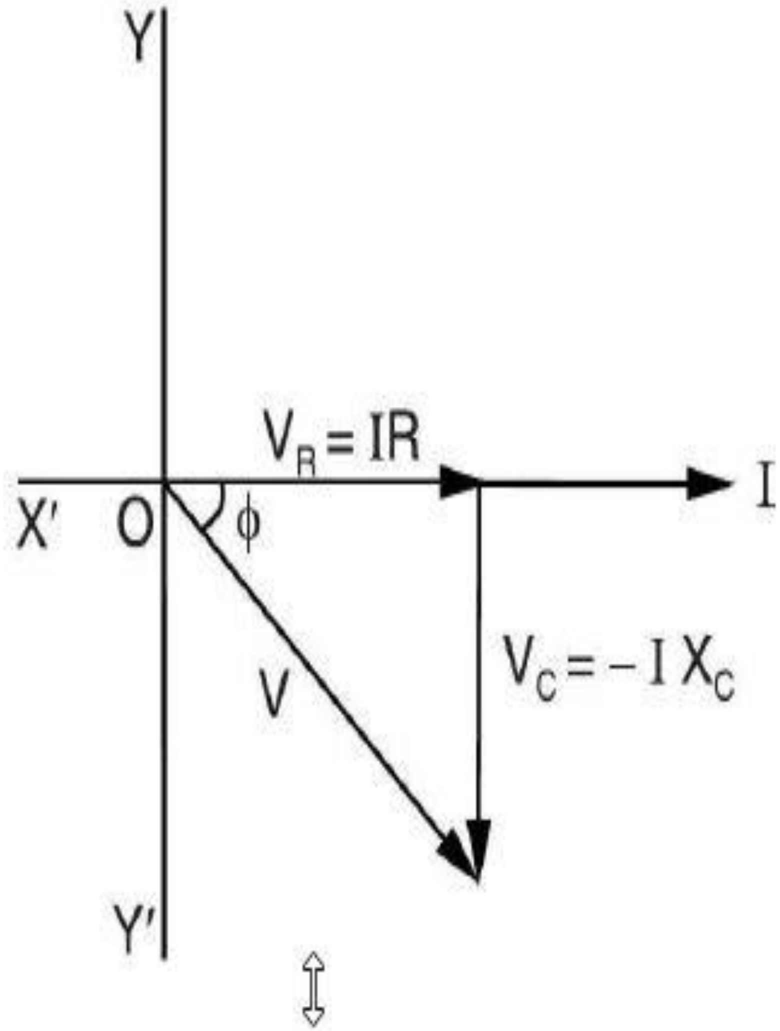
$X_C > X_L$,then the circuit is Capacitive.

Total circuit Reactance $X_T = X_L - X_C$ or $X_C - X_L$

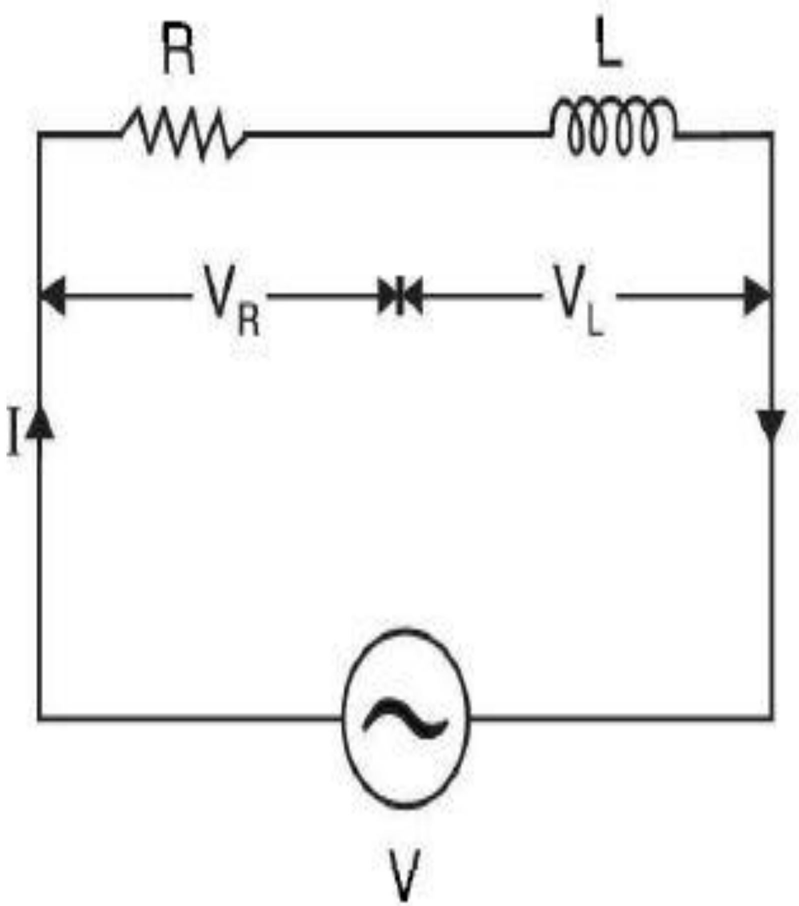
Total circuit Impedance Z=$\sqrt{R^2 + {X_T}^2}$

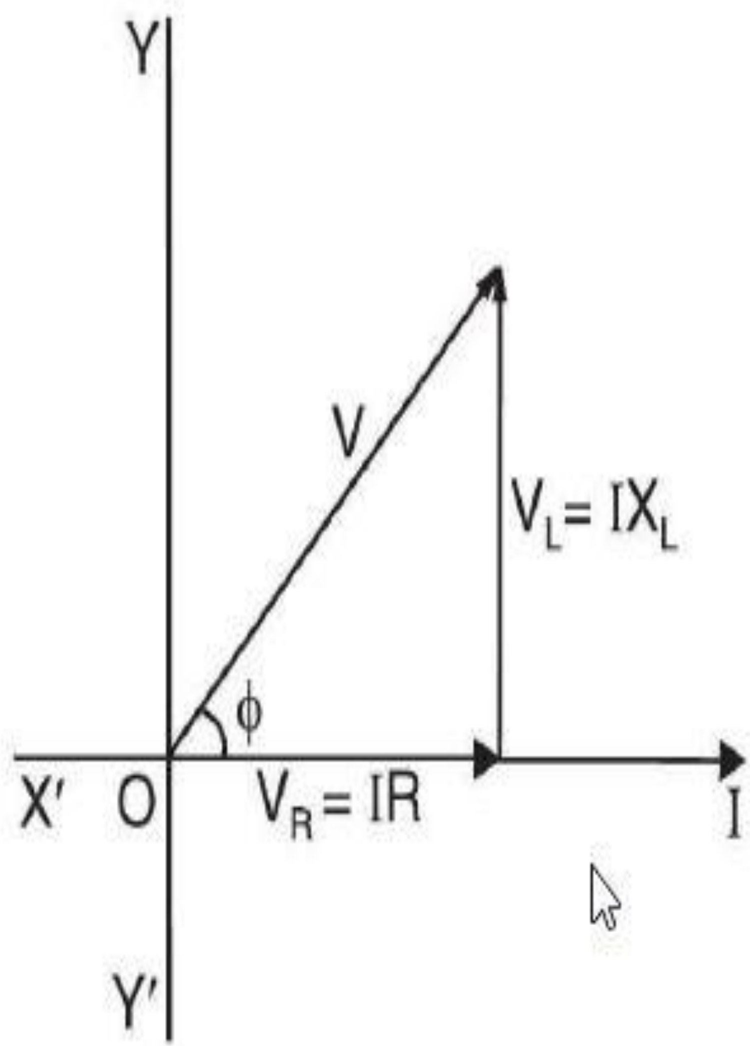
RC Series Circuit



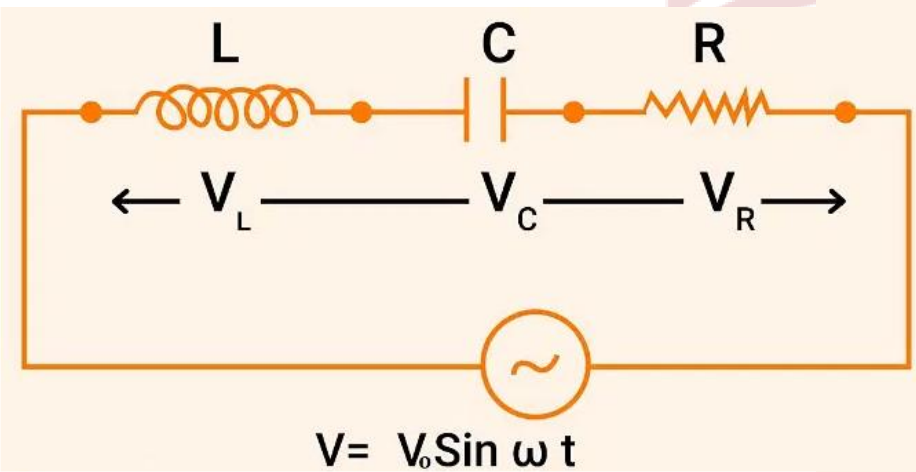


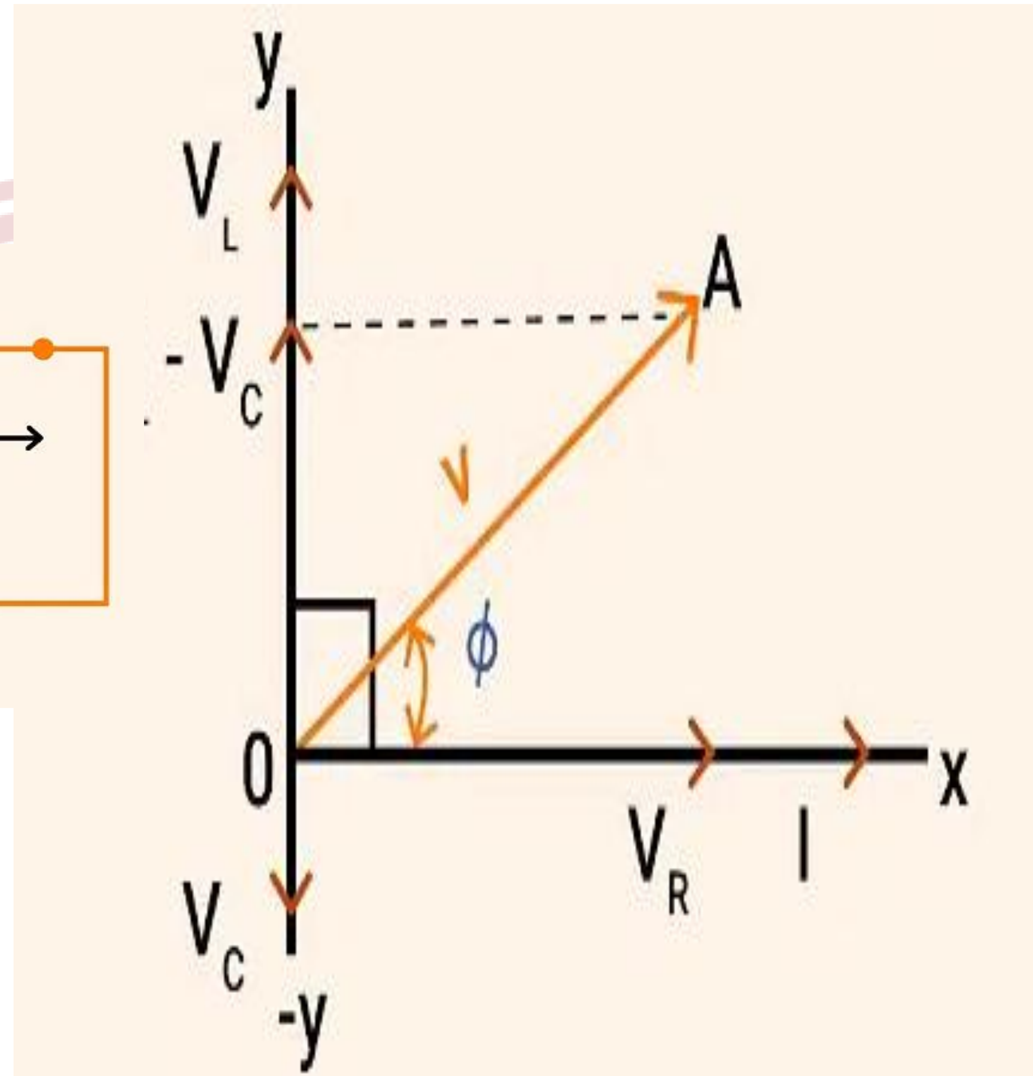
RL Series Circuit



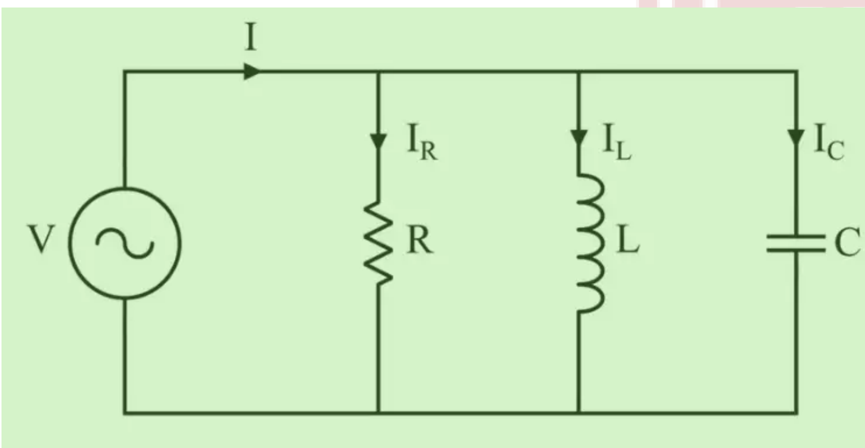


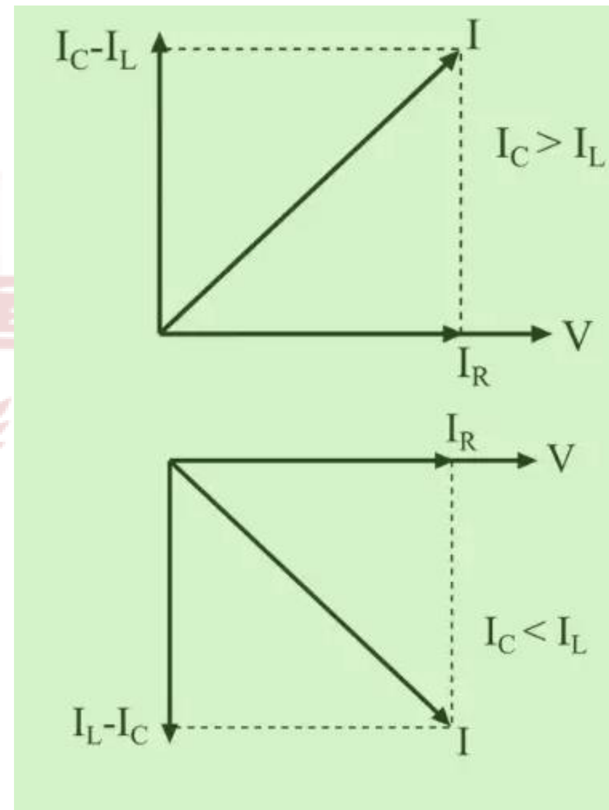
Resistance Inductance and Capacitance in series





Resistance, Inductance & Capacitance in parallel

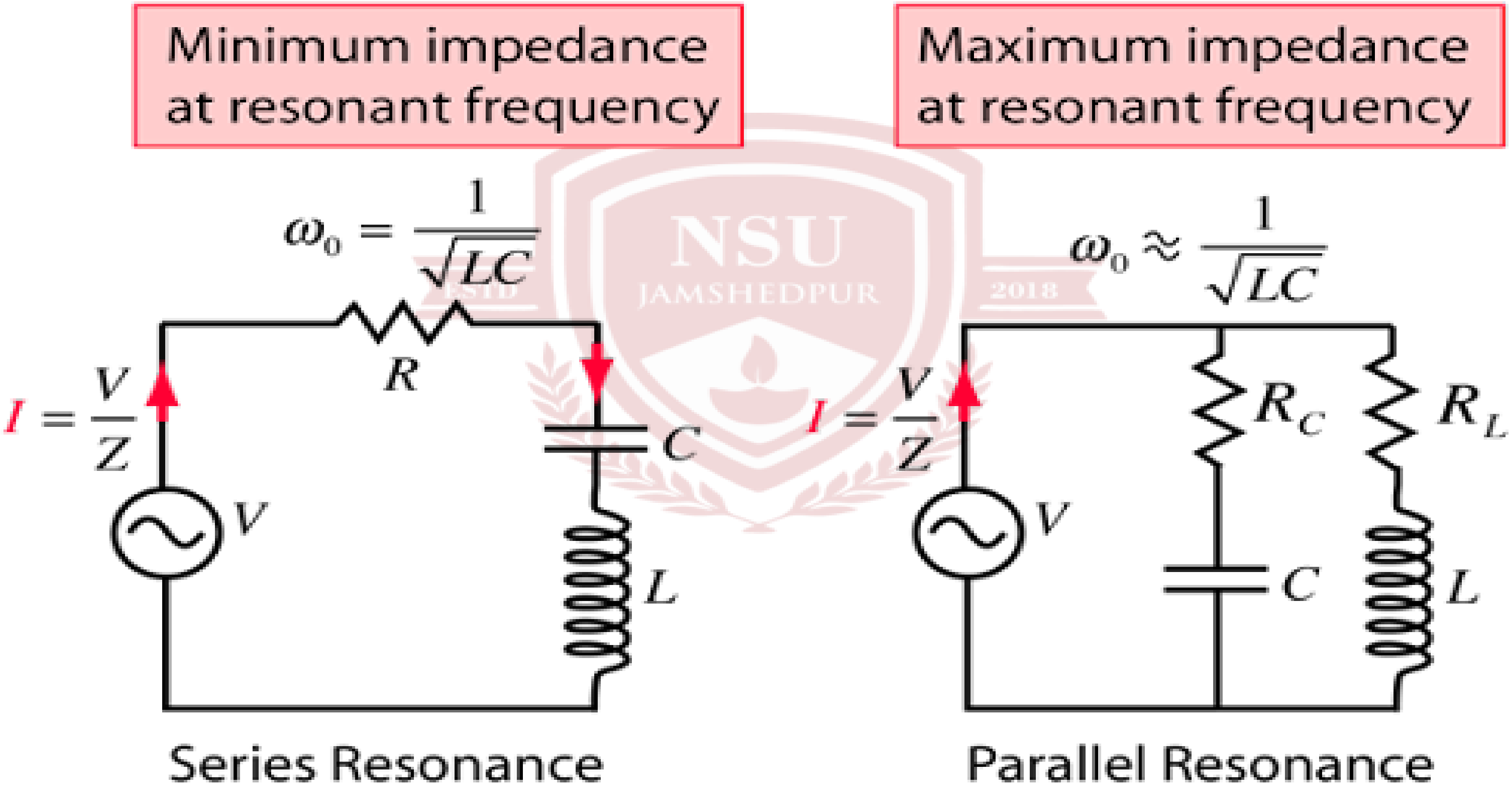




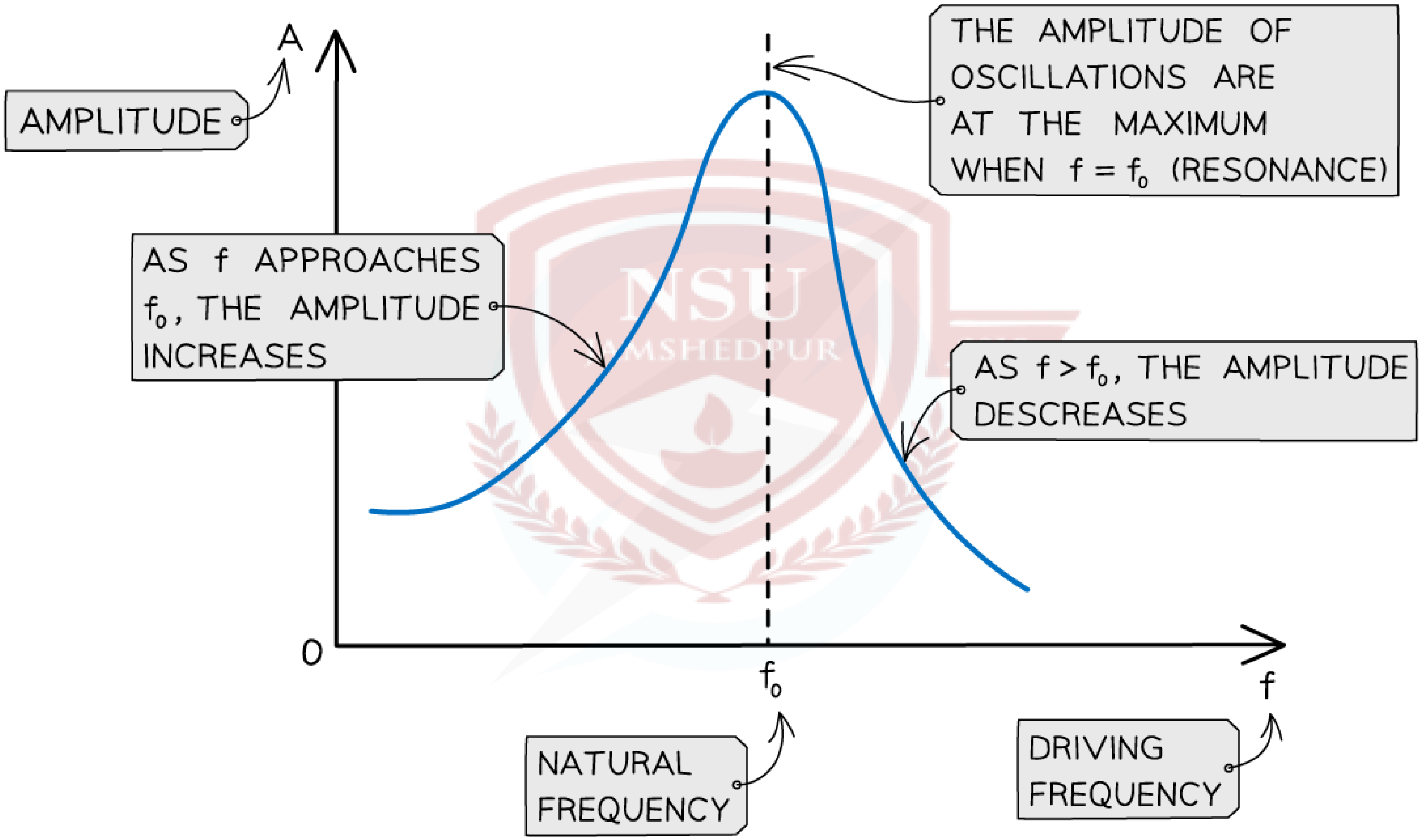
Resonance condition

- A series RLC circuit contains a resistor(R),an Inductor(L) and a capacitor (C) connected in series
- Resonance in a series RLC circuit occurs when the reactive effects of the inductor and capacitor cancel each other out, resulting in a purely resistive circuit.
- At resonance, the circuit exhibits some interesting properties, such as a maximum current and a minimum Impedance.
- Understanding the phenomenon of resonance in a series RLC circuit is essential in designing and analysing many electronic devices and systems.
- Power dissipated is maximum
- Net Reactance is Zero i.e $(X_L - X_C) = 0 \; or X_T = 0$

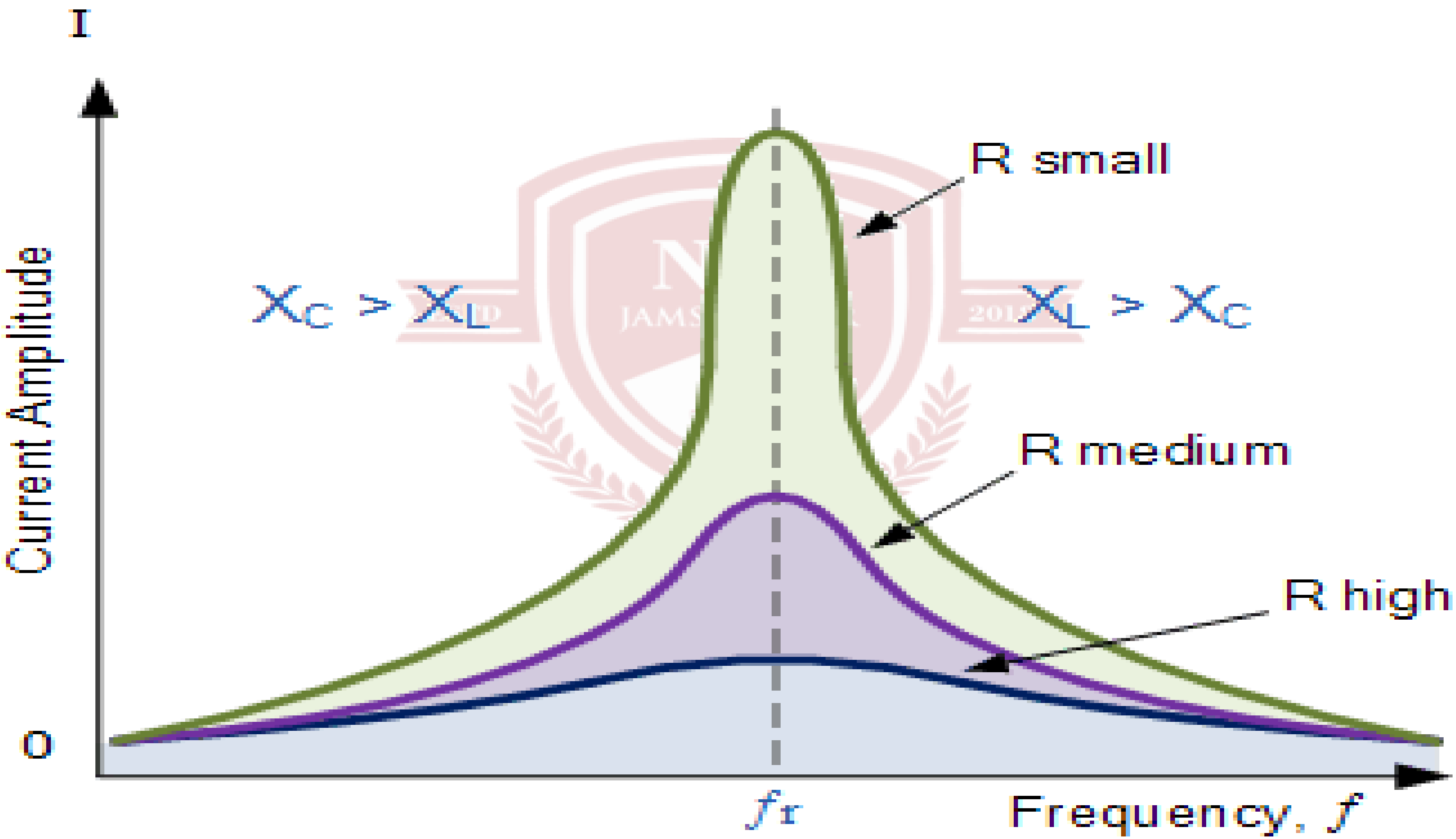
Series & Parallel Resonance



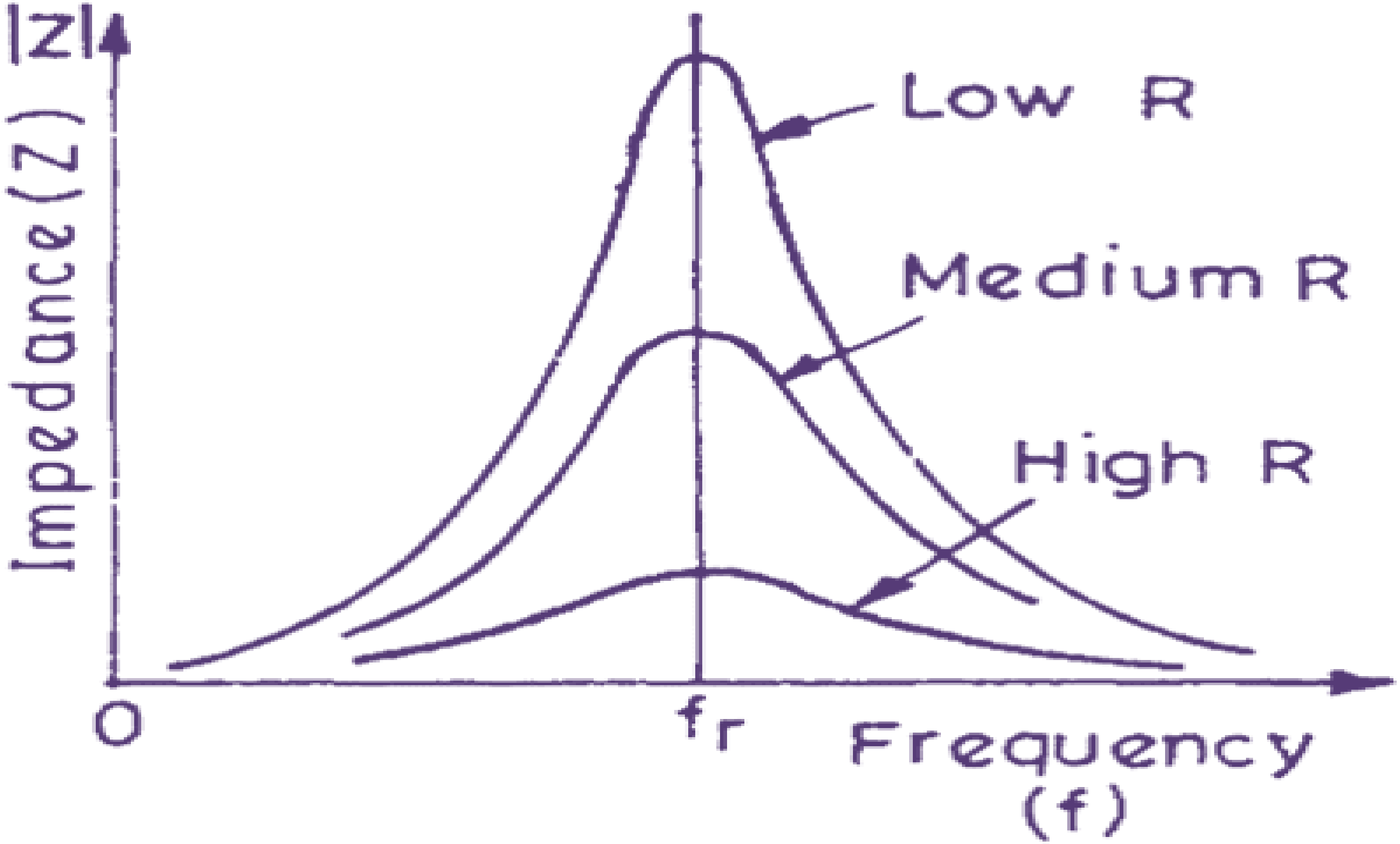
Graphical Representation of Resonance



Series Resonance



Parallel Resonance



Resonance Frequency

- The frequency at which Resonance occurs is easily calculated by

Net Reactance is Zero i.e $(X_L - X_C) = 0$ $or X_T = 0$

X_L=2πfL (1)

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

$X_L = X_C$ at Resonance

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Where f_r is resonant frequency.

Application Of A.C Fundamentals

Power Generation and Distribution:

- **Power Plants:** AC is the standard for power generation in most power plants. Generators produce AC, which is then transformed to higher voltage levels for efficient long-distance transmission.
- **Transmission Lines:** AC is preferred for long-distance power transmission due to its ability to be easily transformed to different voltage levels, reducing energy losses

Electric Motors:

- **Industrial Applications:** AC motors power a wide range of industrial machinery, including pumps, fans, compressors, and conveyor systems.
- **Home Appliances:** AC motors are commonly used in household appliances like refrigerators, washing machines, and air conditioners

Cont.

Residential and Commercial Electrical Systems:

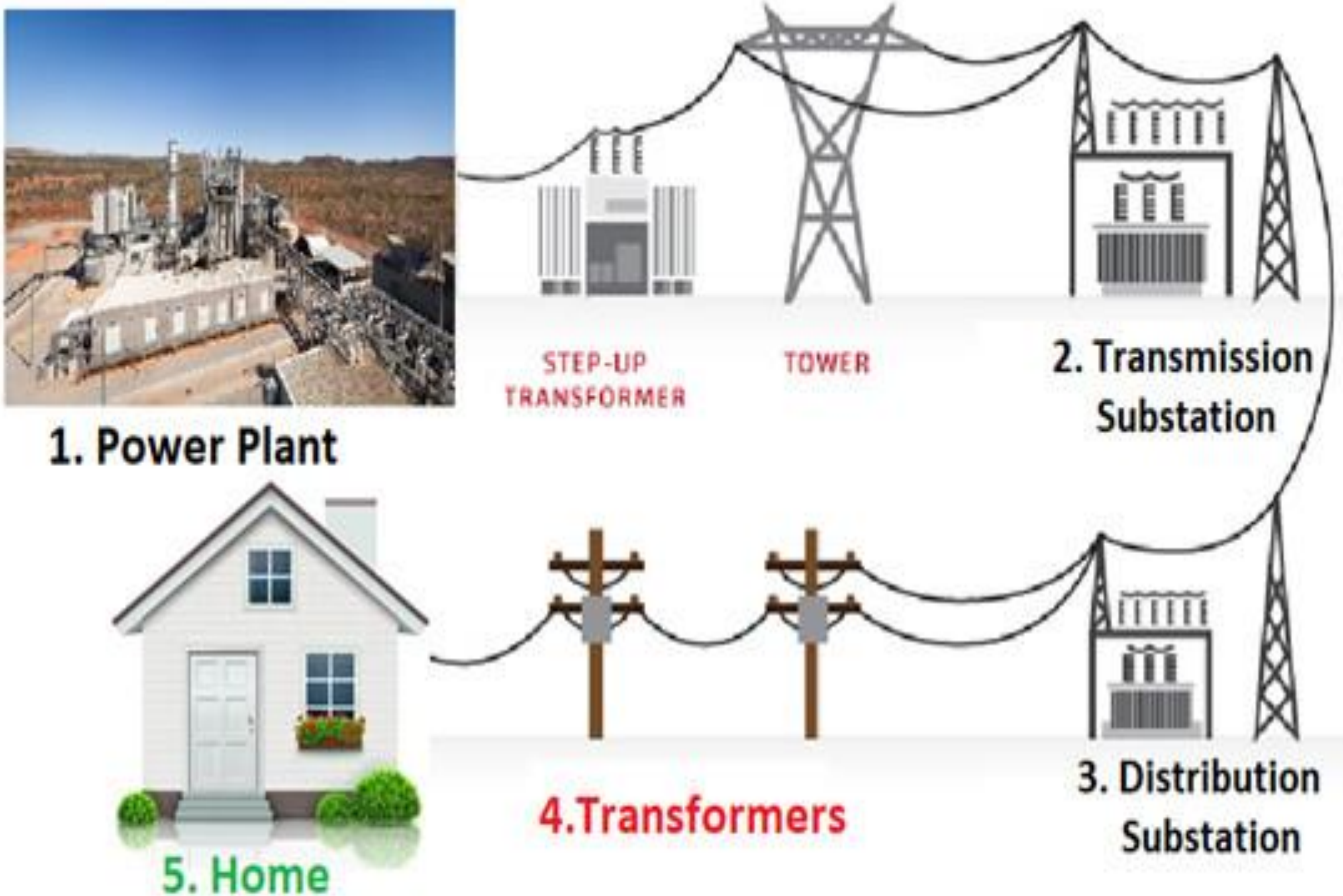
- **Lighting Systems:** AC is used for powering lighting systems in homes, offices, and public spaces.
- **HVAC Systems:** Heating, ventilation, and air conditioning systems commonly use AC power for both the compressor and fan motors

Electronics and Information Technology:

- **Power Supplies:** AC power is converted to DC power for electronic devices using power supplies.
- **Computers and Servers:** AC power is used to operate computers and servers, with power supplies converting it to the required DC voltages.

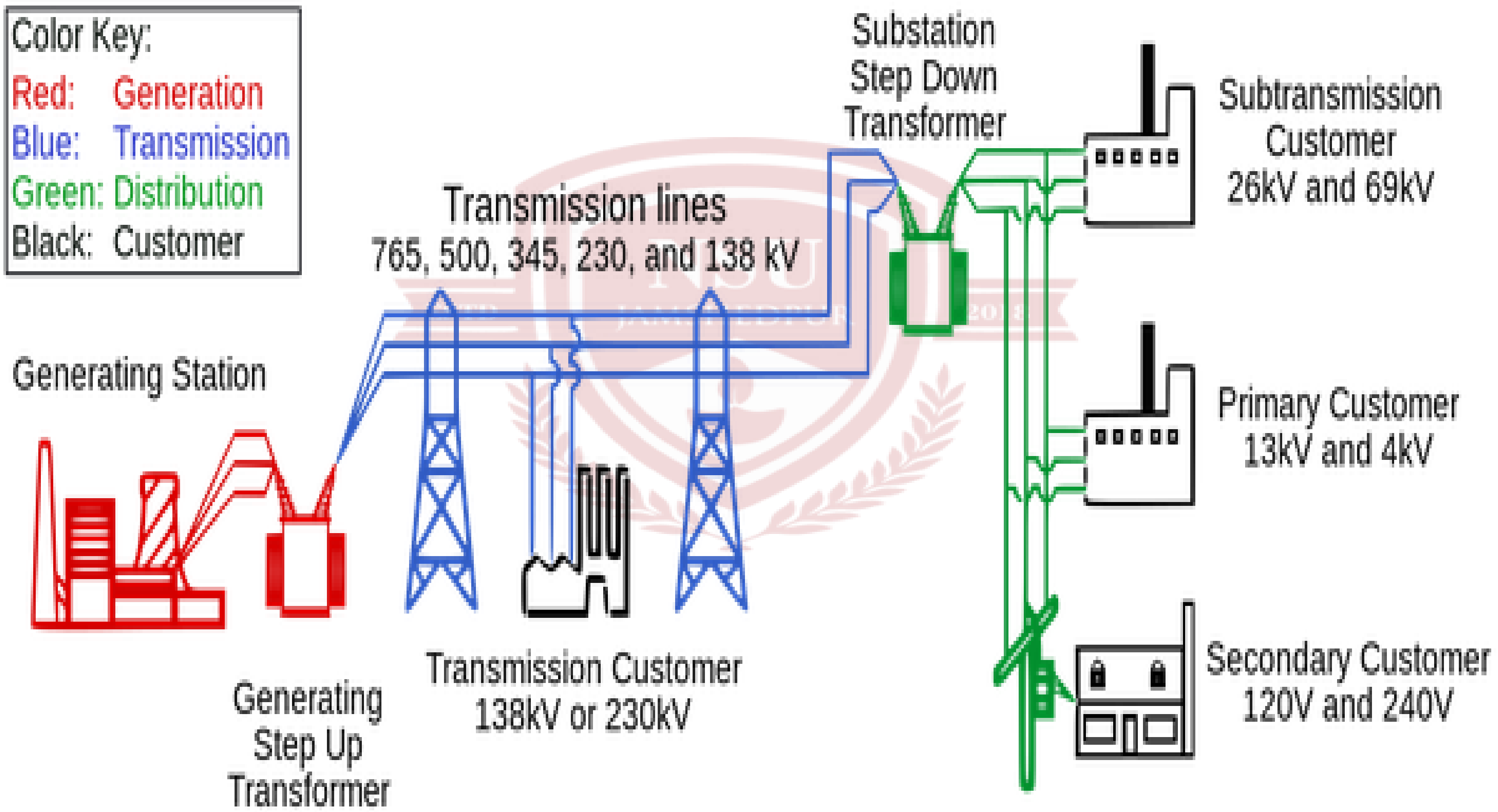
Medical Equipment:

- **Imaging Systems:** Equipment such as X-ray machines and MRI scanners use AC power for various components.
- **Life Support Systems:** Many medical devices that provide life support, such as ventilators, use AC power



1. Power Plant
STEP-UP
TRANSFORMER
TOWER
2. Transmission
Substation
3. Distribution
Substation
4.Transformers
5. Home

Why A.C?



Color Key:
Red: Generation
Blue: Transmission
Green: Distribution
Black: Customer
Transmission lines
765, 500, 345, 230, and 138 kV
Substation
Step Down
Transformer
Subtransmission
Customer
26kV and 69kV
Generating Station
Primary Customer
13kV and 4kV
Secondary Customer
120V and 240V
Transmission Customer
138kV or 230kV
Generating
Step Up
Transformer

THANK YOU