

Module Objective

❖ To understand the

- ✓ Concept of three phase system – definition, requirement, advantages
- ✓ Types of three phase system
- ✓ Basic terminologies related to three phase system

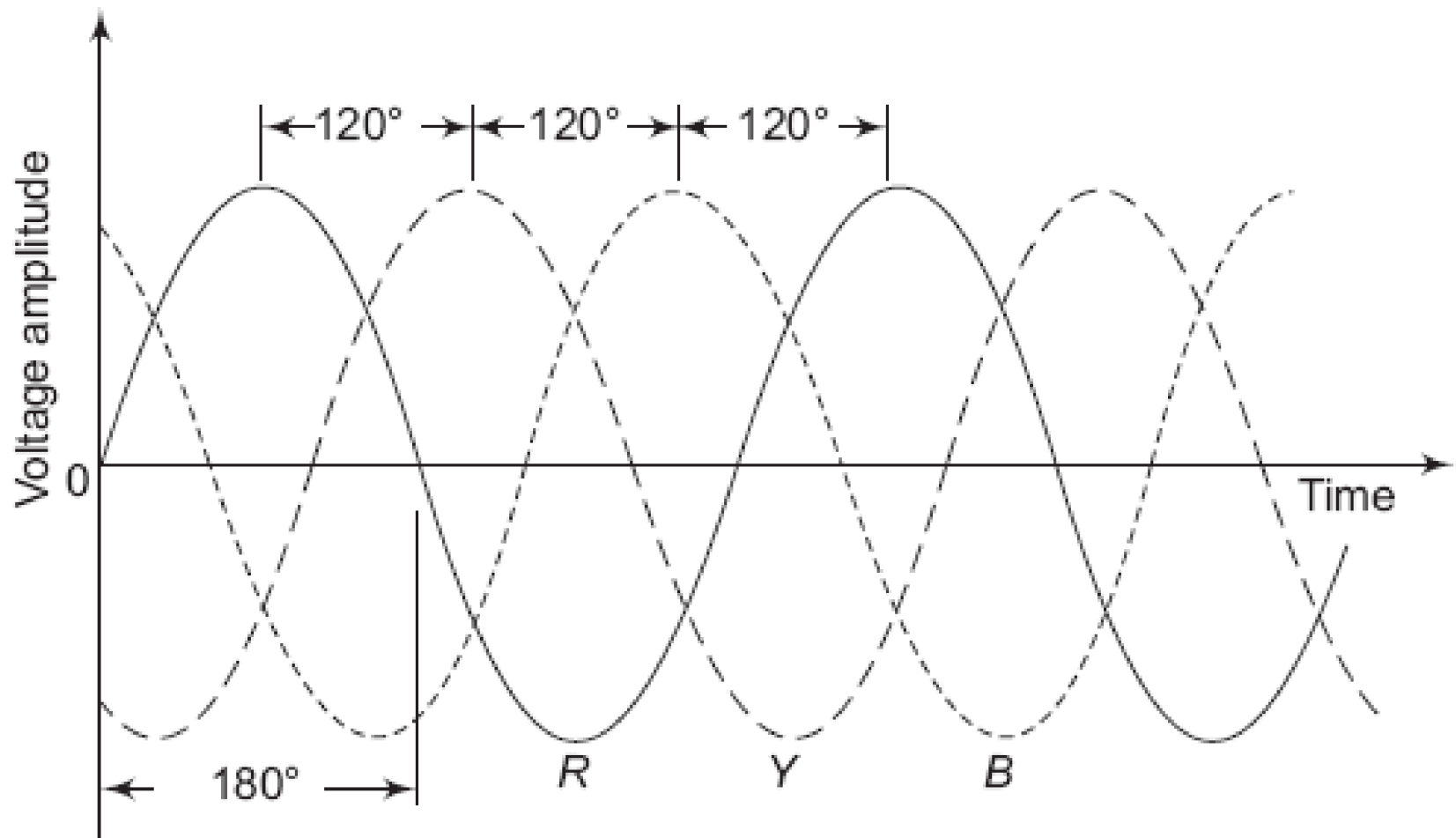
Three phase system

- ❖ Two types of systems:
 - ✓ single-phase and
 - ✓ poly-phase systems.
- ❖ A single-phase system consists of two wires, where the current flows through one wire and returns through another wire, when it is energized by two terminals.
- ❖ But in general, a three-phase system, which is a type of poly-phase system, is used to generate, transmit and distribute electrical energy.

Three phase system (Contd..)

- ❖ Considered as three separate single phase systems.
- ❖ Each phase is displaced from each other by 120°
- ❖ Peaks of the respective voltages do not occur simultaneously.
- ❖ Three phase is represented as R phase, Y phase and B phase or simply RYB

Three phase system (Contd..)



Advantages

- ❖ Size of energy source required is less
- ❖ Requirement of conductor material is less
- ❖ Has better power factor and efficiency
- ❖ Higher output power can be obtained
- ❖ Efficient, reliable, economical and has better regulation
- ❖ When a fault occurs in a single line, the other two lines can be used to transmit the power to the load

Basics of three phase system

- ❖ The color codes of the wires are : red (R), yellow (Y) and blue (B) wire.
- ❖ The two different configurations are:
 - ✓ star (Y) connection and
 - ✓ delta (D) connection.
- ❖ The different types of three-phase power systems are:
 - ✓ three-phase, three-wire system
 - ✓ three-phase, four-wire system.
- ❖ The fourth wire in a three-phase four-wire system is the neutral wire, represented in black color.

Terms

- ❖ **Phase** - A branch of the circuit in a three-phase system
- ❖ **Line** - The wire that connects the source and load
- ❖ **Neutral** - The fourth wire in the three-phase system, where all the phases in a star connection are connected together
- ❖ **Phase voltage** - The voltage measured between a line and neutral or the voltage across a particular phase.

Denoted as \bar{V}_{RN} , \bar{V}_{YN} & \bar{V}_{BN} or simply \bar{V}_R , \bar{V}_Y & \bar{V}_B

Terms (Contd..)

- ❖ **Line voltage or line-to-line voltage** : The voltage which is measured between any two lines in a three-phase power system.

Denoted as \bar{V}_{RY} , \bar{V}_{YB} & \bar{V}_{BR} . Given by

$$\bar{V}_{RY} = \bar{V}_R - \bar{V}_Y, \bar{V}_{YB} = \bar{V}_Y - \bar{V}_B \text{ \& } \bar{V}_{BR} = \bar{V}_B - \bar{V}_R$$

- ❖ **Line currents**: The currents flowing through a particular line.

Denoted as \bar{I}_R , \bar{I}_Y & \bar{I}_B

- ❖ **Phase currents**: The current flowing through a single-phase or branch of the system. Denoted as \bar{I}_{RY} , \bar{I}_{YB} & \bar{I}_{BR}

Terms (Contd..)

- ❖ **Load impedance:** For a star-connected load, the impedance between the line and neutral is called load or line impedance and for a delta-connected load, the impedance between two lines is called load or phase impedance.
- ❖ **Phase sequence:** The time order or the sequence in which the electrical quantity in the three-phase system reach their respective maximum values

Terms (Contd..)

- ❖ **Balanced condition:** The condition for having a balanced source or a balanced load is given below.
 - ✓ Balanced source: A three-phase system is said to be a balanced source, if the phase voltage of each phase has the same magnitude and frequency and the phase difference between the lines is 120° .
 - ✓ Balanced load: A three-phase system is said to be a balanced load if the impedance is same for all the phases, either in star or delta connection.
- ❖ **Unbalanced condition:** If the load impedance differs in one or more phases, then the three-phase system is said to be an unbalanced load. This unbalanced condition leads to changes in line and phase currents.

Terms (Contd..)

- ❖ **Three-phase source:** If the three-phase system is used to generate a three-phase power supply then it is said to be a three-phase source.
- ❖ **Three-phase load:** If the three-phase system uses the three-phase supply to perform certain functions, then it is said to be a three-phase load.

Terms (Contd..)

- ❖ **Power factor:** The cosine of the angle between phase voltage and the phase current. It can be lagging, leading or unity, depending upon the type of load connected to the system.
- ❖ **Phasor diagram:** The diagram that represents the line voltage, phase voltage, line current and phase current of a three-phase source or a three-phase load is known as a phasor diagram. In a star-connected three-phase system, phase voltage is taken as the reference; while, in a delta-connected three-phase system, line voltage is taken as the reference.

Module Outcome

- ❖ Using this module, students can able to understand the
 - ✓ Basics of three phase system
 - ✓ Requirement of three phase supply
 - ✓ Different terminologies related to the three phase system.