SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 23EET103 / Electric Circuits and Electron Devices

I YEAR / II SEMESTER

Unit II – AC CIRCUITS

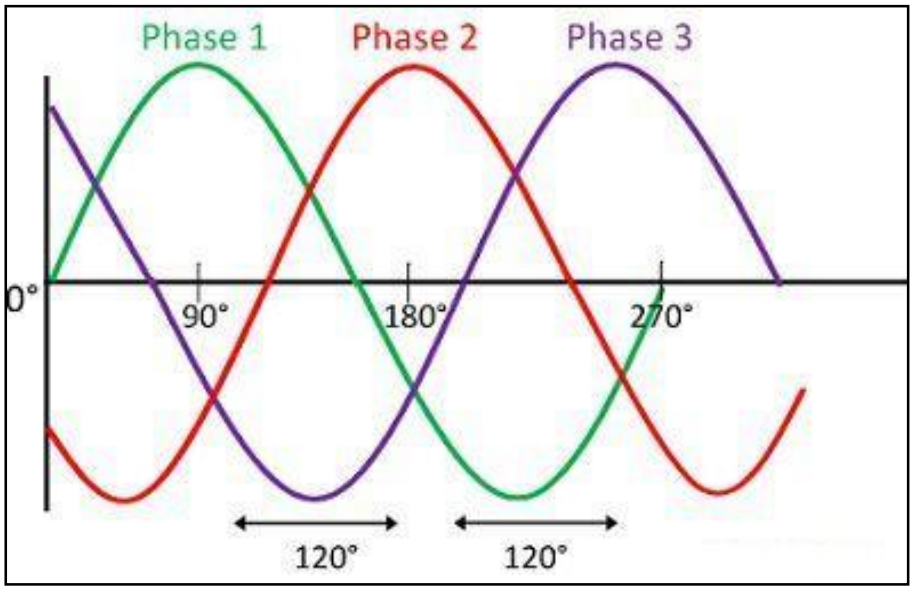
Topic : Three Phase Power

THREE PHASE SYSTEM

- The system which has three phases, i.e., the current will pass through the three wires, and there will be one neutral wire for passing the fault current to the earth is known as the three phase system.
- The system which uses three wires for generation, transmission and distribution is known as the three phase system.
- The sum of the line currents in the 3-phase system is equal to zero, and their phases are differentiated at an angle of 120^{o}
- The three-phase system has four wire, i.e., the three current carrying conductors and the one neutral.
- Advantages – It gives the continuous supply to the load. Also it has higher efficiency and minimum losses.
- It provides an uninterruptible power, i.e., if one phase of the system is disturbed, then the remaining two phases of the system continue supplies the power.

THREE PHASE SYSTEM

- The three phase system induces in the generator which gives the three phase voltage of equal magnitude and frequency.
- The magnitude of the current in one phase is equal to the sum of the current in the other two phases of the system.

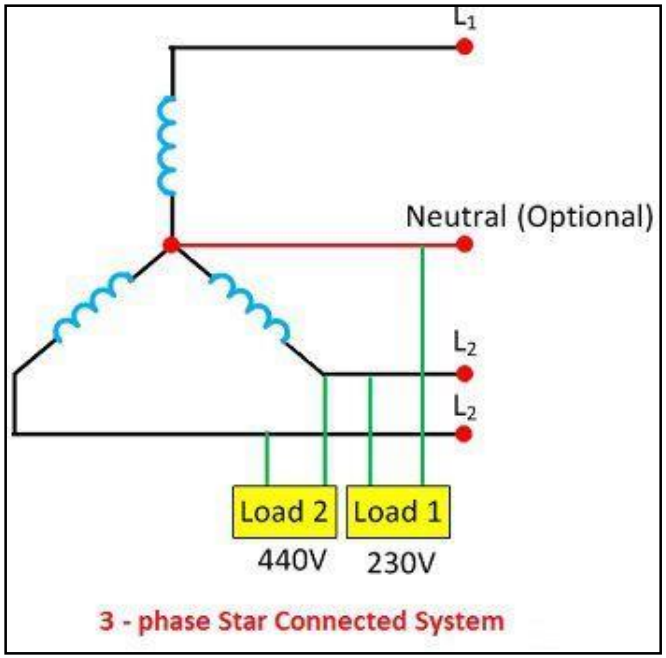


- The 120º phase difference of the three phases is must for the proper working of the system. Otherwise, the system becomes damaged

THREE PHASE SYSTEM - CONNECTIONS

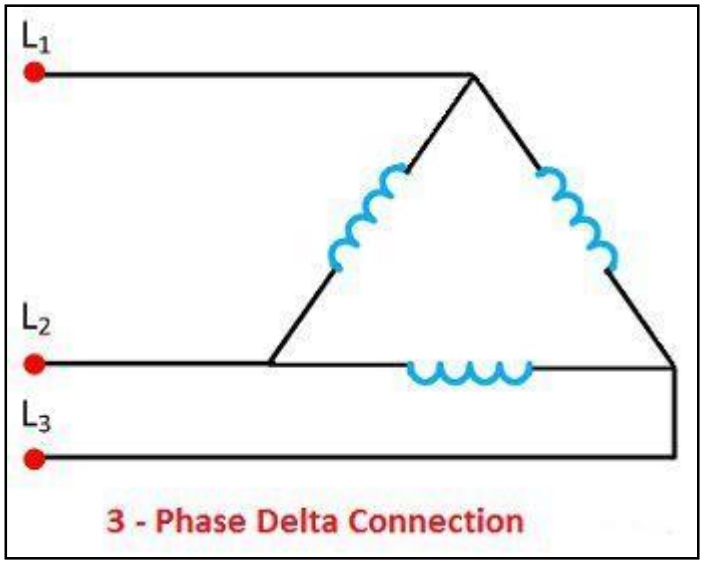
STAR CONNECTION

- It requires four wires in which there are three phase conductors and one neutral conductor.
- The neutral point passes the unbalanced current to the earth and hence make the system balance.



DELTA CONNECTION

- The delta connection has three wires, and there is a no neutral point.



THREE PHASE POWER - FORMULAS

- In 3 phase circuits (balanced load), the power is defined as the sum of various powers in a three-phase system.

$$P = 3V_{ph} I_{ph} Cos\varphi$$

- Power in star connections in a 3 phase circuits is given as

$$P = 3 \frac{V_L}{\sqrt{3}} I_L Cos\varphi$$

- Power in delta connections in a 3 phase circuits is given as

$$P = 3 V_L \frac{I_L}{\sqrt{3}} Cos\varphi$$

- The total power in a 3 phase balanced load system, irrespective of their connections, the power is given by the relation

$$P = \sqrt{3} V_L I_L Cos\varphi$$

- Its units are kilowatt (kW) or Watt (W).

GENERATION OF THREE PHASE POWER

- In a 3 phase system, there are three equal voltages or EMFs of the same frequency having a phase difference of 120 degrees.
- These voltages can be produced by a three-phase AC generator having three identical windings displaced apart from each other by 120 degrees electrical.

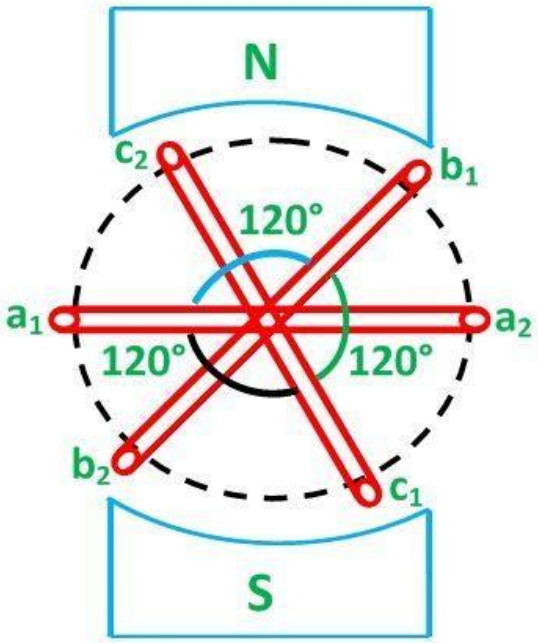


Figure A

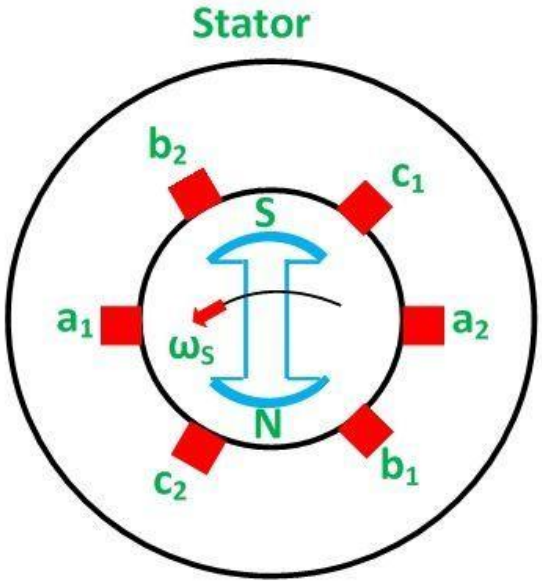


Figure B

GENERATION OF THREE PHASE POWER

- When the windings are kept stationary, and the magnetic field is rotated an emf is induced in each winding.
- The magnitude and frequency of these EMFs are the same but are displaced apart from one another by an angle of 120 degrees.
- Three identical coils a1a2, b1b2 and c1c2 as shown in the above figure.
  - a1, b1 and c1 are the starting terminals
  - a2, b2 and c2 are the finish terminals
- The phase difference of 120 degrees has to be maintained between the start terminals a1, b1 and c1.
- Now, let the three coils mounted on the same axis, and are rotated by either keeping coil stationary and moving the magnetic field or vice versa in an anticlockwise direction at (ω) radians per seconds. Three EMFs are induced in the three coils respectively.

GENERATION OF THREE PHASE POWER

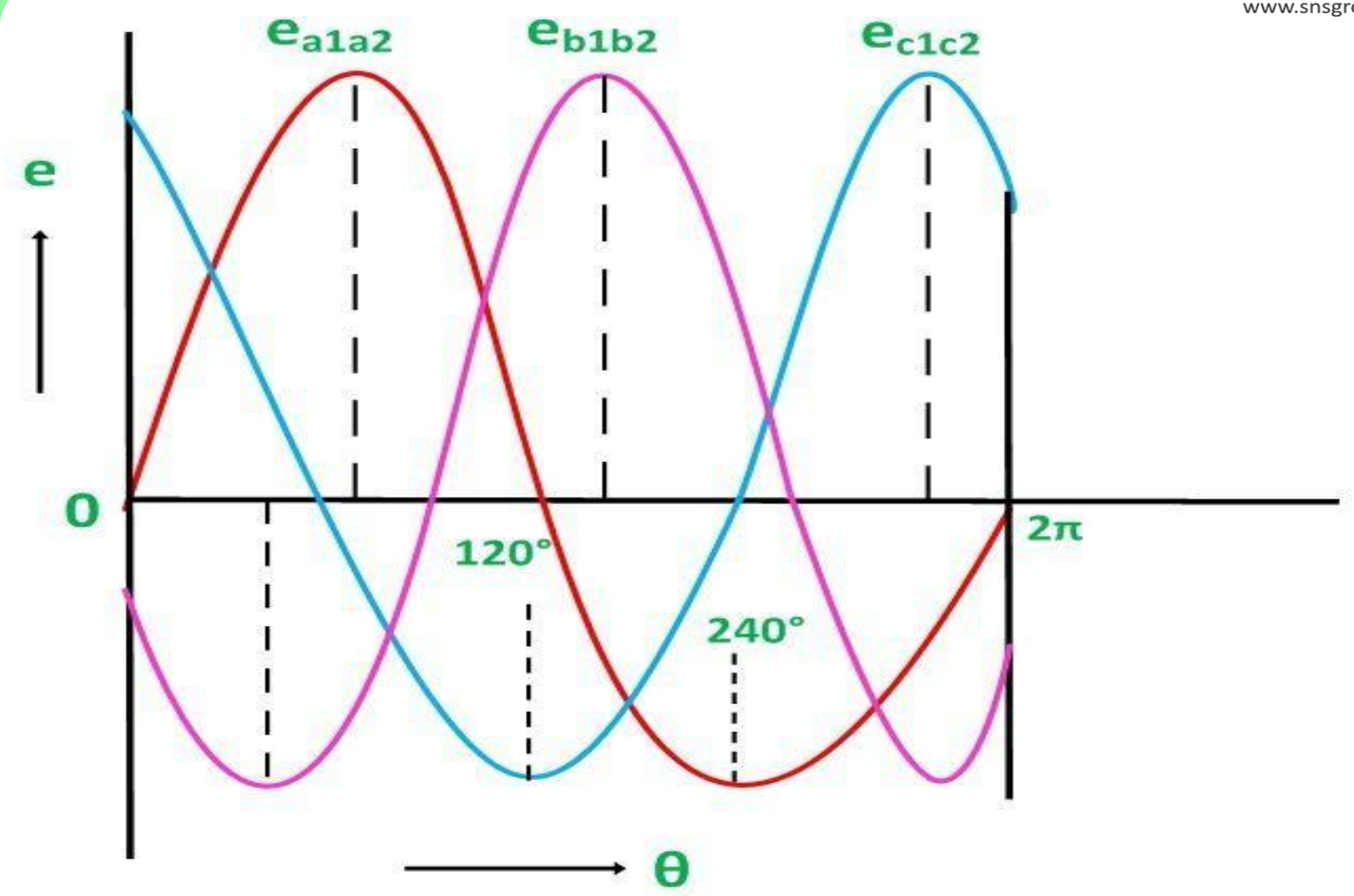


Figure C

GENERATION OF THREE PHASE POWER

- The emf induced in the coil a1a2 is zero and is increasing in the positive direction as shown by the waveform ea1a2.

- The coil b1b2 is 120 degrees electrically behind the coil a1a2. The emf induced in this coil is negative and is becoming maximum negative as shown by the wave eb1b2.

- Similarly, the coil c1c2 is 120 degrees electrically behind the coil b1b2, or we can also say that the coil c1c2 is 240 degrees behind the coil a1a2. The emf induced in the coil is positive and is decreasing as shown in figure C represented by the waveform ec1c2.

THREE PHASE POWER – PHASOR DIAGRAM & EQUATION

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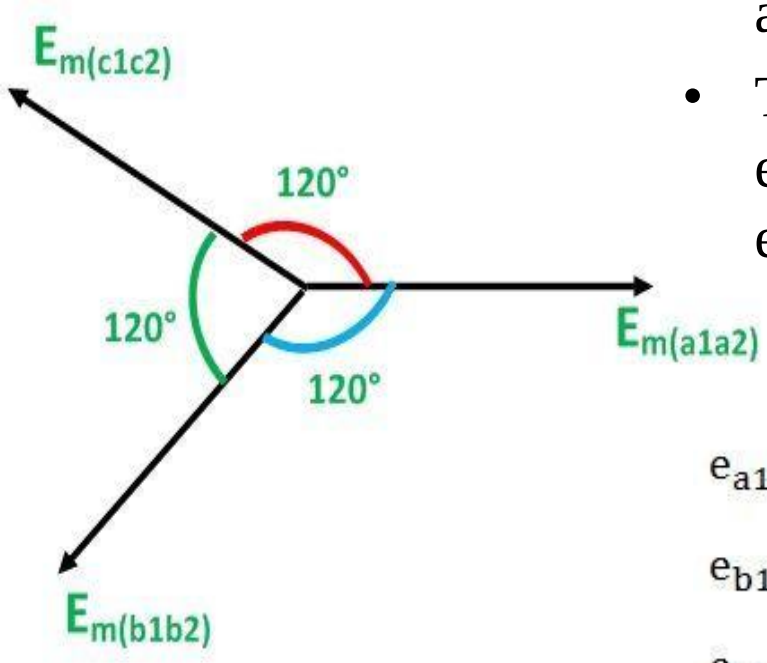
PHASOR DIAGRAM



- The EMFs induced in the three coils in 3 phase circuits are of the same magnitude and frequency and are displaced by an angle of 120 degrees from each other.
- These EMFs of 3 phase circuits can be expressed in the form of the various equations

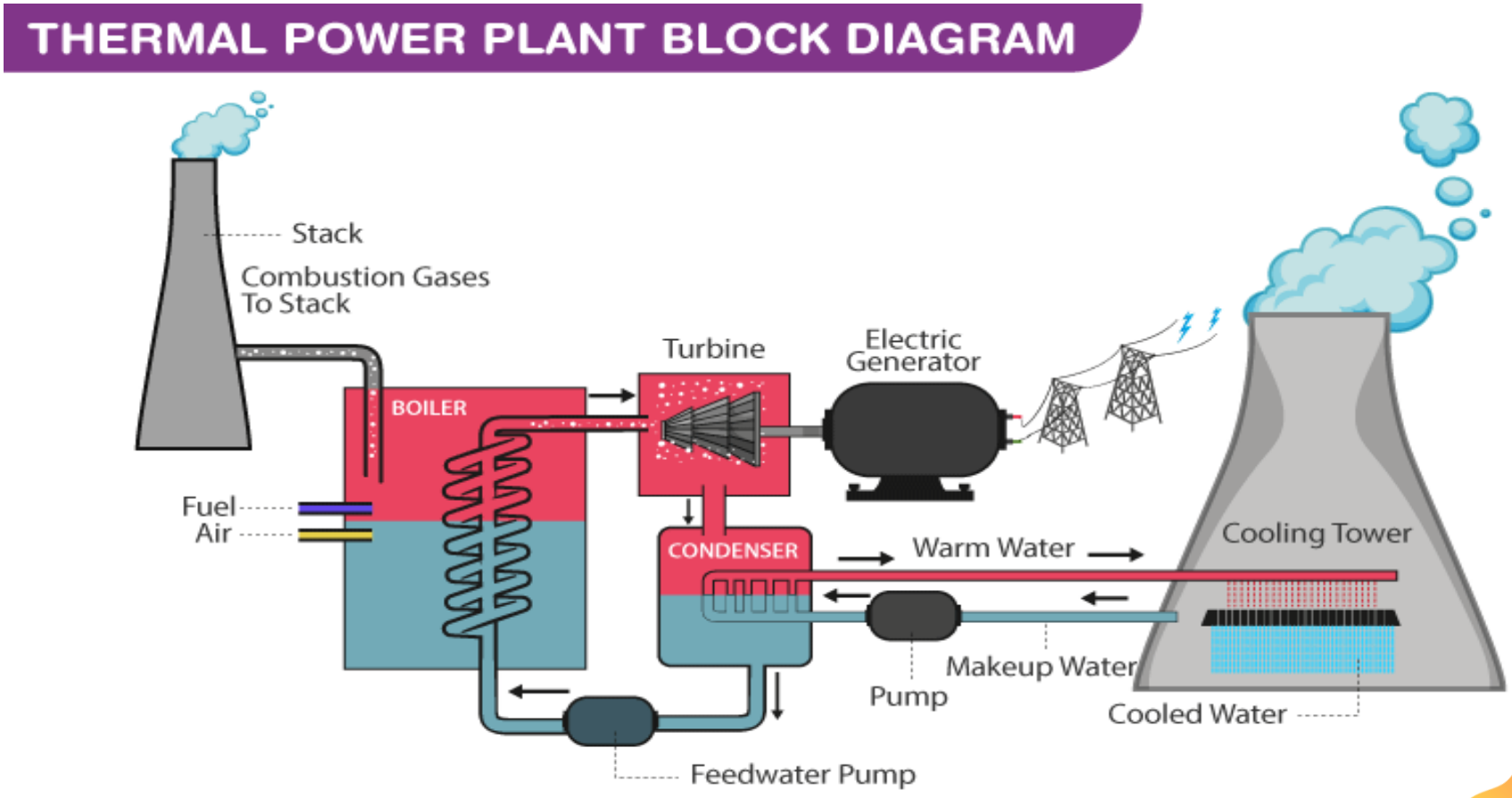
$$e_{a1a2} = E_m \sin \omega t$$

$$e_{b1b2} = E_m \sin(\omega t - 2\pi/3) = E_m \sin(\omega t - 120°)$$

$$e_{c1c2} = E_m \sin(\omega t - 4\pi/3) = E_m \sin(\omega t - 240°)$$

GENAERATION OF THREE PHASE POWER IN THERMAL POWER PLANT

The thermal Power plant is a power generation station which burns fossil fuels as coal, petroleum etc., to produce electricity. It does by utilizing the chemical energy stored in the fuel, burning it and then converting it into mechanical energy. This mechanical energy is utilized to operate an electrical generator to generate electricity.



KEEP
LEARNING.

Thank u

SEE YOU IN NEXT CLASS