

Department of ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

23EET103-Electric Circuits and Electron Devices
I B.Tech. CSE-IOT/ II SEMESTER



UNIT II : AC CIRCUITS

Topic : Three Phase Circuits ,Advantages and Generation

Before Learning Three-Phase, Let Us Recall:

- AC voltage varies sinusoidally with time
- One complete cycle has positive and negative half cycles
- Frequency in India = 50 Hz
- RMS value = Effective value of AC
- Single-phase system produces only one alternating voltage
- Power output is pulsating
- Not ideal for heavy industrial loads

PROBLEM WITH SINGLE-PHASE (EMPATHISE)

- Heavy motors require smooth power
- Single-phase supply produces pulsating power

Causes:

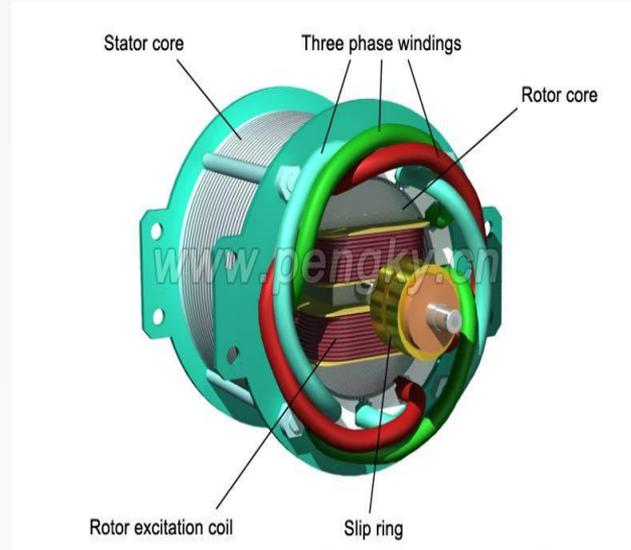
- Vibrations and noise
- Reduced efficiency
- Motor overheating
- Higher transmission losses
- Larger conductor requirement

PROPOSED IDEA (IDEATE)

- Solution: Multi-Phase System
 - ✓ Generate three equal voltages
 - ✓ Maintain 120° phase difference
 - ✓ Achieve constant power
 - ✓ Improve motor performance
-
- → This leads to the Three-Phase System

WHAT IS A THREE-PHASE SYSTEM?

- A three-phase system consists of:
 - Three alternating voltages
 - Equal magnitude
 - Same frequency
 - 120° phase difference
 - Phases labeled as R, Y, B
 - Key Feature:
 - Provides balanced and continuous power

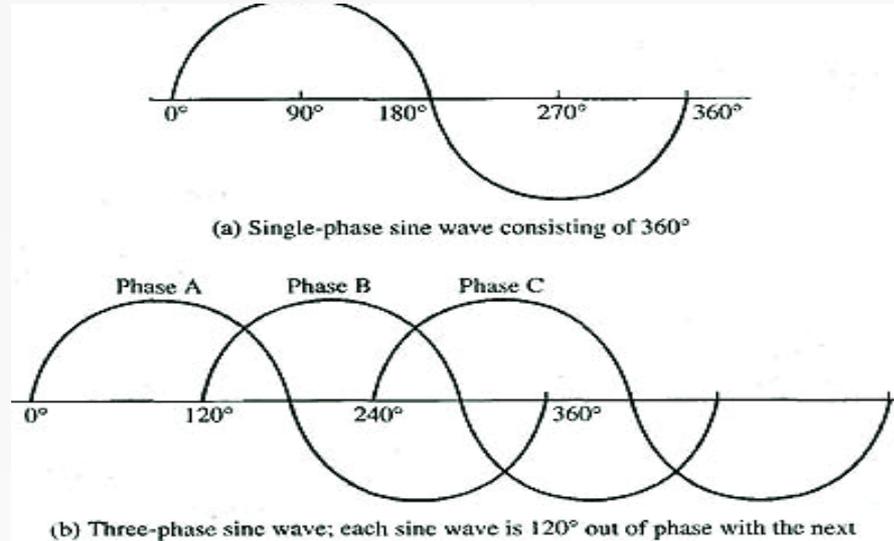


THREE-PHASE WAVEFORM

- Three sinusoidal waves spaced 120° apart
- At any instant, one phase is maximum
- Other two phases support the power
- Ensures nearly constant power output

• Result:

- ✓ Smooth energy transfer
- ✓ Minimal ripple



GENERATION OF THREE-PHASE POWER

- Construction of Alternator:
- Three identical stator coils
- Coils placed 120° apart
- Rotating magnetic field (Rotor)
- EMF induced in each coil
- Output:
- Three balanced sinusoidal voltages

MATHEMATICAL REPRESENTATION

- ✓ Phasor sum of all three voltages = Zero
- ✓ Balanced system → No neutral current

$$V_R = V_m \sin(\omega t)$$

$$V_Y = V_m \sin(\omega t - 120^\circ)$$

$$V_B = V_m \sin(\omega t - 240^\circ)$$

CONNECTION TYPES

1 Star (Y) Connection

Neutral point available

Line Voltage:

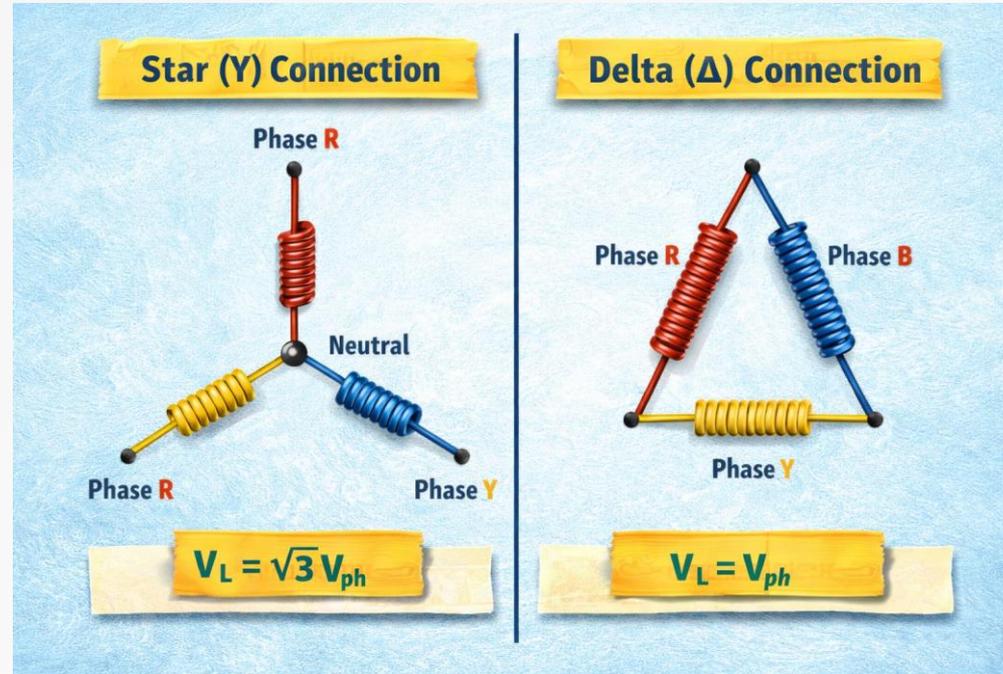
Used in distribution systems

2 Delta (Δ) Connection

No neutral point

Line Voltage = Phase Voltage

Used for heavy loads and motors



TESTING AND VERIFICATION

Testing Using CRO / DSO:

- Measure all three phase voltages
- Observe waveform shape
- Verify 120° phase shift
- Check equal magnitudes
- **Expected Result:**
 - ✓ Balanced sinusoidal waves
 - ✓ Smooth continuous power

ADVANTAGES OF THREE-PHASE SYSTEM

Constant power transfer

Requires less conductor material

Higher efficiency

Self-starting motors

Reduced maintenance

Lower transmission losses

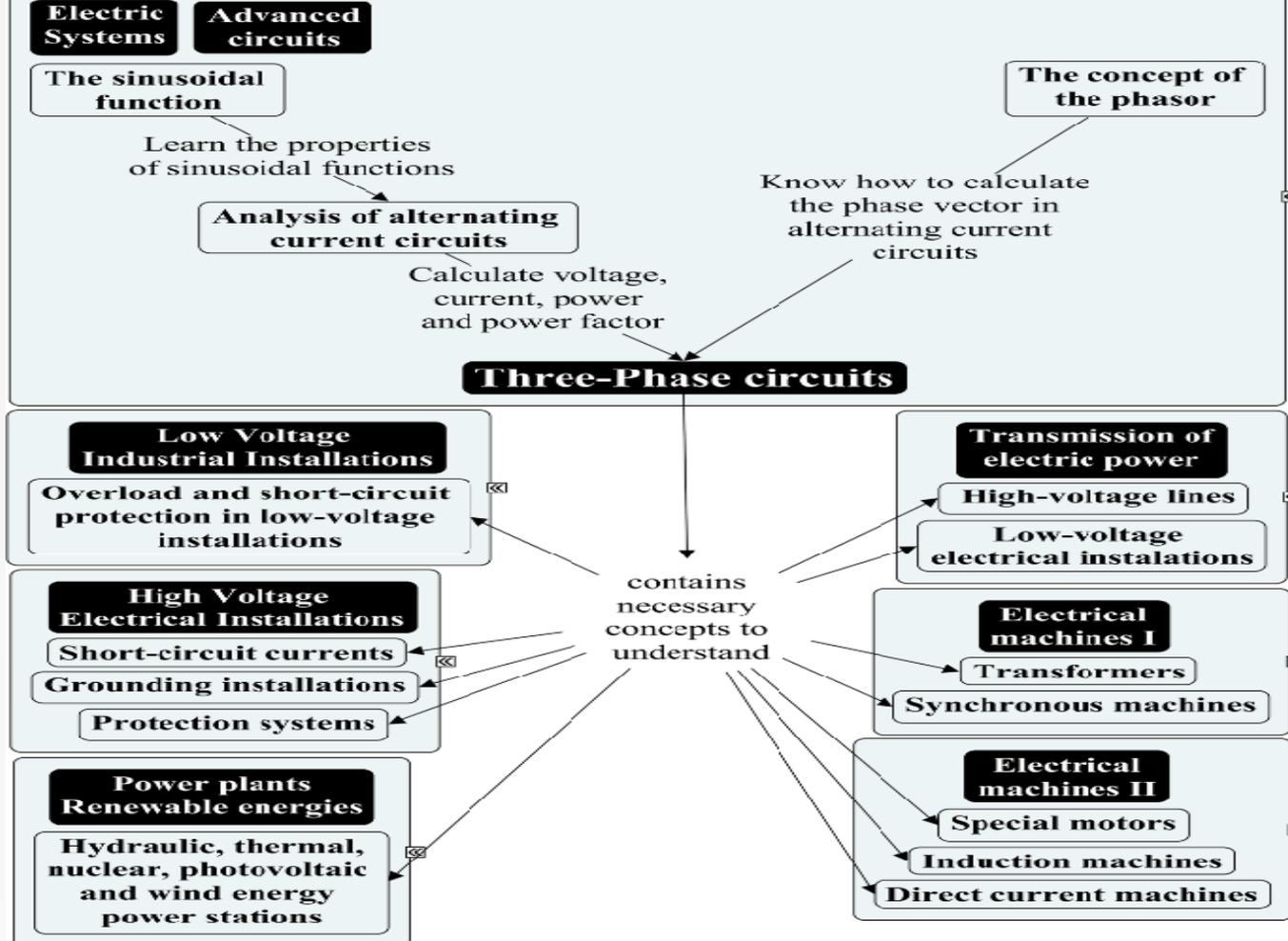
Better voltage regulation

Real-World Applications

- Power generation
- Transmission systems
- Elevators
- HVAC systems
- Industrial machines

Conclusion

- Produces balanced power
- Provides constant torque
- Improves efficiency
- Reduces cost
- Essential for engineering applications



1. SPOT THE MISTAKE!



Which Statement is WRONG?

A Three-phase voltages are 120° apart

B Three-phase produces pulsating power

C Phasor sum equals zero

D Three-phase motors are self-starting

2. WHAT IF? THINKING QUESTION



What if **ONE PHASE** is lost?

- ◆ **Motor Stops?**
- ◆ **Motor Overheats?**
- ◆ **Efficiency Drops?**



Thank
you!