

# Circuits II

EE221

Unit 12

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Three Phase Circuits, Balanced Y-Y, Y- $\Delta$ , and  
 $\Delta$ - $\Delta$  Three-Phase Circuits

# Polyphase Circuits

Polyphase circuits contain multiple sources at the same frequency but different phases. Power is distributed over the power grid in the form of three-phase sinusoids.

Advantages of Three-Phase power distribution include:

- (Constant Power) Instantaneous power can be constant in a three phase system.
- (More Economical) For equivalent power, the 3-Phase systems are more economical than single-phase (can be driven with lower currents and voltages, and fewer wires required because of a common neutral connection between the phases).
- (Flexible) Single phase service can be extracted from the 3-phase systems or phases manipulated to create additional phases.

# Balanced 3-Phase Voltages

Balanced phase voltages are equal in magnitude and separate by 120 degrees in phase.

Voltages generated from a 3-phase generator can have 2 phase sequence possibilities depending on direction of the rotor:

Positive sequence (Counter Clockwise Rotation):

$$\hat{V}_{an} = V_p \angle 0^\circ$$

$$\hat{V}_{bn} = V_p \angle -120^\circ$$

$$\hat{V}_{cn} = V_p \angle -240^\circ = V_p \angle 120^\circ$$

Negative sequence (Clockwise Rotation):

$$\hat{V}_{an} = V_p \angle 0^\circ$$

$$\hat{V}_{bn} = V_p \angle -240^\circ = V_p \angle 120^\circ$$

$$\hat{V}_{cn} = V_p \angle -120^\circ$$

Show that the sum of all phase voltages in a balanced system is zero.