

# EE303 — Energy Systems and Power Electronics

## Lecture 7. Three-phase circuit analysis

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# Today's objectives

- **CONVERT** a  $\Delta$ -connected source and load to Y-connected (and vice versa)
- **ANALYZE** symmetric three-phase circuits using the **per-phase method**

## Problem 2, p. 22, class notes

### Problem

A 3- $\phi$  load has a per-phase impedance, connected in Y, of  $100 + j30 \Omega$ . The line-to-line voltage magnitude at the load is 1500 V. The three-phase distribution line supplying this load has an impedance of  $10 + j5 \Omega/\phi$ .

- 1 Calculate the line-to-line voltage magnitude at the sending end of the distribution line.
- 2 Calculate real and reactive power supplied at sending end.
- 3 Calculate the power factor at the sending end.
- 4 Calculate the power factor at the receiving end.
- 5 Calculate the losses on the transmission line.
- 6 Perform a sanity check (compute power consumed by load).

## Example B3.2, p. 19, class notes

### Problem

Three balanced three-phase loads are connected in parallel. Load 1 is Y-connected with an impedance of  $150 + j50 \Omega/\phi$ ; load 2 is  $\Delta$ -connected with an impedance of  $900 + j600 \Omega/\phi^a$ ; and load 3 is 95.04 kVA at 0.6 pf leading. The loads are fed from a distribution line with an impedance of  $3 + j24 \Omega/\phi$ . The magnitude of the line-to-neutral voltage at the load end of the line is 4.8 kV.

- ① Calculate the total complex power at the sending end of the line.
- ② What percent of the average power at the sending end of the line is delivered to the load?

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<sup>a</sup>This notation is slightly unfortunate. In this case, let's assume that it stands for: "per leg of the  $\Delta$ ."

## Example B3.3, p. 21, class notes

### Problem

*A balanced 230-Volt (rms) three-phase source is furnishing 6 kVA at 0.83 pf lagging to two  $\Delta$ -connected parallel loads. One load is a purely resistive load drawing 2 kW. Determine the phase impedance of the second load.*

# Reading material

The material we covered today corresponds to:

- Module B3, pp. 7–21 of class notes
- Chapter 8, pp. 179–200 of textbook