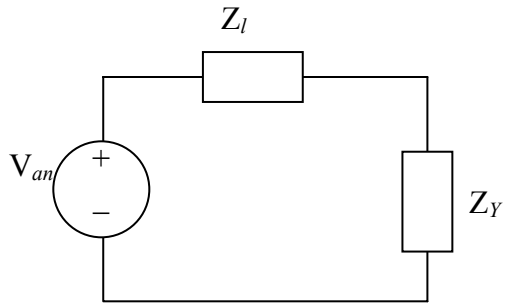
EE228 **Spring 2007**

PROBLEM SET #30

Chapter 12, Solution 29.

We can replace the delta load with a wye load, $Z_Y = Z_\Delta/3 = 17+j15\Omega$.
The per-phase equivalent circuit is shown below.



$$I_a = \frac{V_{an}}{Z_Y + Z_\ell} = \frac{120}{17 + j15 + 0.4 + j1.2} = 5.0475\angle -42.96°$$

$$S = 3S_p = 3\,|I_a|^2\, Z_Y = 3(5.0475)^2(17 + j15) = \underline{1.3 + j1.1465 \text{ kVA}}$$

Chapter 12, Solution 40.

Transform the delta-connected load to its wye equivalent.

$$\mathbf{Z}_Y = \frac{\mathbf{Z}_\Delta}{3} = 7 + j8$$

Using the per-phase equivalent circuit above,

$$\mathbf{I}_a = \frac{100\angle 0°}{(1 + j0.5) + (7 + j8)} = 8.567\angle -46.75°$$

For a wye-connected load,

$$I_p = I_a = |\mathbf{I}_a| = 8.567$$

$$\mathbf{S} = 3|\mathbf{I}_p|^2 \mathbf{Z}_p = (3)(8.567)^2(7 + j8)$$

$$P = \text{Re}(\mathbf{S}) = (3)(8.567)^2(7) = \underline{\mathbf{1.541\ kW}}$$

Chapter 12, Solution 47.

$$\text{pf} = 0.8 \quad \text{(lagging)} \quad \longrightarrow \quad \theta = \cos^{-1}(0.8) = 36.87°$$
$$\mathbf{S}_1 = 250\angle 36.87° = 200 + j150 \text{ kVA}$$

$$\text{pf} = 0.95 \quad \text{(leading)} \quad \longrightarrow \quad \theta = \cos^{-1}(0.95) = -18.19°$$
$$\mathbf{S}_2 = 300\angle -18.19° = 285 - j93.65 \text{ kVA}$$

$$\text{pf} = 1.0 \quad \longrightarrow \quad \theta = \cos^{-1}(1) = 0°$$
$$\mathbf{S}_3 = 450 \text{ kVA}$$

$$\mathbf{S}_T = \mathbf{S}_1 + \mathbf{S}_2 + \mathbf{S}_3 = 935 + j56.35 = 936.7\angle 3.45° \text{ kVA}$$

$$\left|\mathbf{S}_T\right| = \sqrt{3}\, V_L I_L$$

$$I_L = \frac{936.7 \times 10^3}{\sqrt{3}\,(13.8 \times 10^3)} = \underline{\textbf{39.19 A rms}}$$

$$\text{pf} = \cos\theta = \cos(3.45°) = \underline{\textbf{0.9982 (lagging)}}$$