

Name \_\_\_\_\_ ECE 3600 Homework 4 3 phase Due: Wed, 1/22/25 c

Note: All voltages and currents are always assumed to be RMS unless said to be otherwise.

1. The following are questions from p 78 of the textbook. These could be good closed-book exam questions.

a) 2.1. What types of connections are possible for three-phase generators and loads?

b) 2.2. What is meant by the term "balanced" in a balanced three-phase system?

c) 2.3. What is the relationship between phase and line voltages and currents for a wye (Y) connection?

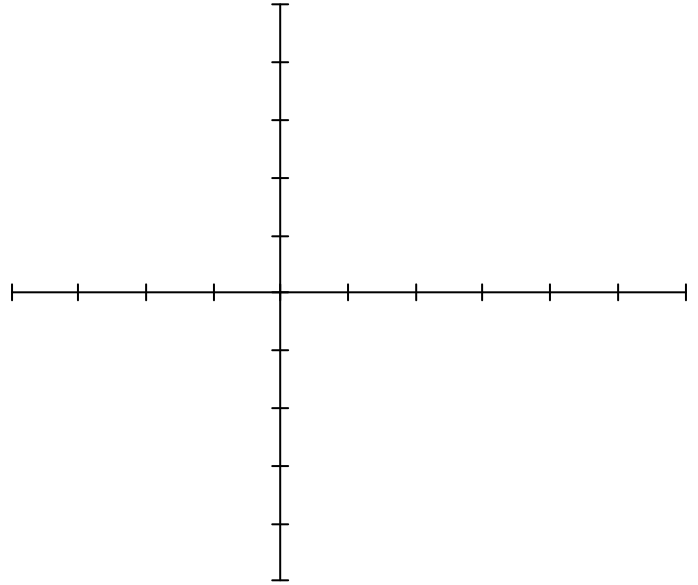
d) 2.4. What is the relationship between phase and line voltages and currents for a delta ( $\Delta$ ) connection?

e) 2.5. What are the two phase sequences?

f) 2.7. What is a Y- $\Delta$  transform?

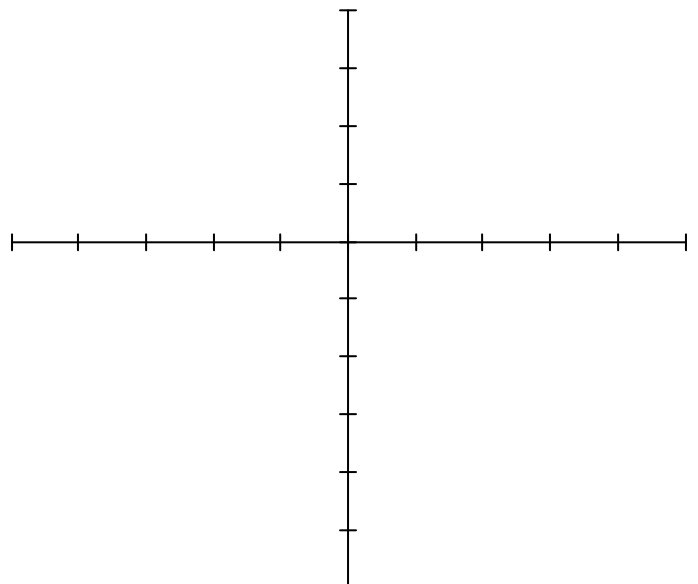
2. Textbook 2-1. Three impedances of  $4 + j3 \Omega$  are  $\Delta$ -connected and tied to a three-phase 208-V power line. Find  $I_\phi$ ,  $I_L$ , P, Q, S (|S|), and the power factor of this load.

3. a) A balanced three-phase 480-V source (three line-to-neutral voltages of 277 V) supplies a balanced three-phase inductive load. The load draws a total of 9 kW at a power factor of 0.9. Calculate the phase currents and the magnitude of the per-phase load impedances, assuming a Y-connected load. Draw a phasor diagram showing all three voltages and currents, assume  $V_a$  is  $0^\circ$ .



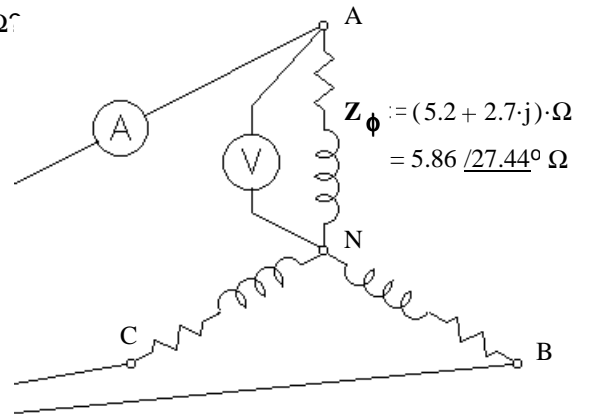
- b) In order to correct the power factor, three capacitors are connected in parallel with the load impedances.  $\omega := 377 \frac{\text{rad}}{\text{sec}}$   
Find the value of the capacitors.

4. Repeat problem 3, assuming a delta-connected load. a)  
Make sure you are clear about the phase angle of  $I_{ab}$ .



- b)

5. The voltmeter shown measures 120 V. Let this voltage be the phase reference ( $0^\circ$ ). The phase impedance is  $Z_\phi = 5.2 + j2.7 = 5.86 \angle 27.44^\circ \Omega$
- a) What is  $V_{AB}$  as a phasor?



- b) What would the ammeter measure?

- c) What is the apparent power?

- d) What is the real power?

- e) Correct the power factor with capacitors connected in a delta configuration, that is, find the value of the capacitors.

$$\omega := 377 \frac{\text{rad}}{\text{sec}}$$

6. Three 230-V generators are connected in a wye configuration to generate three-phase power. The load consists of three balanced delta-connected impedances of  $Z_L = 3.8 + j1.5 \Omega$ .
- An ammeter is placed in one line, what would it measure?
  - Find the total apparent power.
  - Find the total real power consumed by the load.
  - What is the phase angle between  $I_A$  and  $V_{AB}$ , assuming ABC rotation?

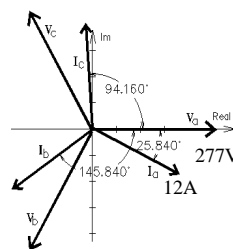
**Answers**

1. a) 2.1. Y &  $\Delta$       b) 2.2. The 3 voltages are equal, the 3 currents are equal and the 3 loads are equal.

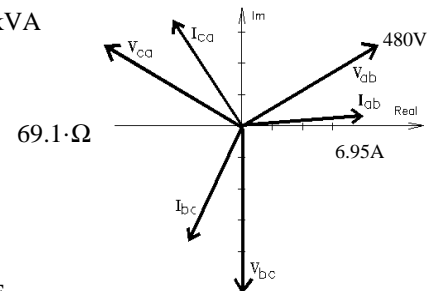
c) 2.3.  $V_\phi = \frac{V_{LL}}{\sqrt{3}} = \frac{V_L}{\sqrt{3}}$        $I_\phi = I_L$       d) 2.4.  $V_\phi = V_{LL} = V_L$        $I_\phi = \frac{I_L}{\sqrt{3}}$

e) 2.5. abc or acb      f) 2.7.  $Z_Y = \frac{Z_\Delta}{3}$       2. 41.6A·A      72.1·A      20.8·kW  
 15.6·kVAR      26.0·kVA

3. 12·A lagging by 25.8°      23· $\Omega$   
 b) 50.2· $\mu$ F



4. 6.95A / 4.16°  
 b) 16.7· $\mu$ F



5. a) 208·V·e<sup>j·30·deg</sup>      b) 20.5·A      c) 7.37·kVA      d) 6.54·kW      e) 69.5· $\mu$ F

6. 168·A      117·kVA      108·kW      -51.541°