Q1 Q2 Q3
6 6 7.5
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W

STUDENT NAME: [redacted] **NUMBER:** [redacted]

PA NUMBER L12

ELEC 3605, ELECTRICAL ENGINEERING

TEST #2, NOVEMBER 2014

TIME: ONE HOUR

TEST #2 CONTAINS THREE QUESTIONS

AUTHORIZED MEMORANDA: (1) Foundations of Electric Circuits, Cogdell

(2) ELEC 3605 Course Pack Fall, 2014

(3) Calculator

1. <6 Marks>

Given that the loads are **single-phase**, complete the following table.

Load	Real Power P in watts	Reactive Power Q in vars	Apparent Power in VA	Voltage In Volts	Current In Amps	Power Factor
#1	200	100	223.6	150	1.49	0.894 lag
#2	320	-240.2	400	40	10	0.80 lead

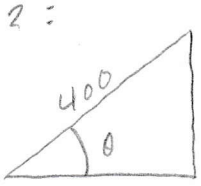
6/6

load #1 : $S = \sqrt{P^2 + Q^2} = \sqrt{200^2 + 100^2} = 223.6\ VA$

$PF = \frac{P}{S} = \frac{200}{223.6} = 0.894 \quad \theta = \cos^{-1} 0.894 = 26.62°$

$S = VI \quad I = \frac{S}{V} = \frac{223.6}{150} = 1.49\ A$

load #2 :



$\theta = \cos^{-1} 0.8 = 36.9°$

$P = S\cos\theta = 400(0.8) = 320\ W$

$Q = S\sin\theta = 400 \sin 36.9 = 240.2\ VARS$

$S = VI \rightarrow V = \frac{S}{I} = \frac{400}{10} = 40\ V$

6/6

W

2. <6 Marks>

Given that the loads are balanced **three-phase**, complete the following table.

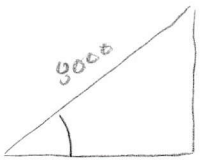
Load	Real Power P in watts	Reactive Power Q in vars	Apparent Power in VA	Line-to-Line Voltage In Volts	Line Current In Amps	Power Factor
#1	8000	2000	8246.2	476.1	10	0.97 lag
#2	7200	− 3481.8	8000	923.8	5	0.90 lead

load #1 : $S = \sqrt{P^2 + Q^2} = \sqrt{8000^2 + 2000^2} = 8246.2$ VA

$S = \sqrt{3} V_{LL} I_L \rightarrow 8246.2 = \sqrt{3} V_{LL} (10)$ $V_{LL} = \frac{8246.2}{\sqrt{3}(10)} = 476.1$ V

$PF = \frac{P}{S} = \frac{8000}{8246.2} = 0.97$

load #2 :



$\cos\theta = 0.9$

$P = S\cos\theta = 8000(0.9) = 7200$ W

$Q = S\sin\theta = 8000\sin(\cos^{-1}0.9) = 3481.8$ VARs

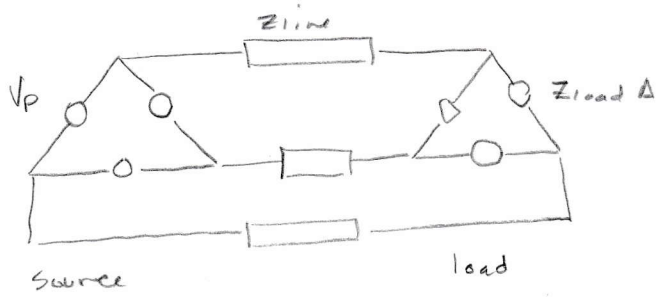
$S = \sqrt{3} V_{LL} i_L \rightarrow 8000 = \sqrt{3} V_{LL} (5)$ $V_{LL} = \frac{8000}{5 \times \sqrt{3}}$

$= 923.8$ V

3. <8 Marks>

A three-phase source is connected to a balanced delta load through a three-phase feeder with an impedance of (0.388 + j1.499) Ω per phase. Each side of the delta has an impedance of (18.187 + j10.5) Ω, and the line-to-line voltage at the load is 8000 volts. Calculate:

a) The line current
b) The magnitude of the phase current
c) The power factor of the load
d) The real power, the reactive power, and the apparent power of the load
e) The line-to-neutral and the line-to-line voltage at the source.

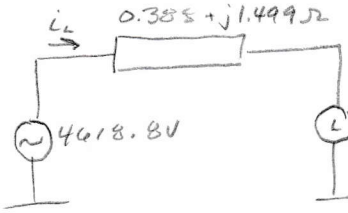


$Z_{line} = 0.388 + j1.499\ \Omega$

$Z_{load\ \Delta} = 18.187 + j10.5\ \Omega$

$V_{LL} = 8000\ V$

a)



$Z_{load\ Y} = \frac{Z_{load\ \Delta}}{3} = \frac{18.187 + j10.5}{3} = 7\angle 29.9°\ \Omega$

$V_p = \frac{V_{LL}}{\sqrt{3}} = \frac{8000}{\sqrt{3}} = 4618.8\ V$

$i_{line} = \frac{V_p}{Z_T} = \frac{4618.8}{7\angle 29.9} = \boxed{659.8\angle -29.9\ A}$

b) $i_p = \frac{i_{line}}{\sqrt{3}} = \frac{659.8\angle -29.9}{\sqrt{3}} = \boxed{380.9\angle -29.9\ A}$

c) $PF = \cos\theta = \cos 29.9 = \boxed{0.866\ lag}$ (-ve θ)

d) $S = \sqrt{3}\, V_{LL} I_L$

$= \sqrt{3}(8000)(659\angle -29.9)$

$\boxed{= 9131.4\angle -29.9\ kVA}$

$P = S\cos\theta$

$= 9131.4\angle -29.9\,(0.866)$

$\boxed{= 7907.8\angle -29.9\ kW}$

R +ve

C

$Q = S\sin\theta \qquad \theta = \cos^{-1} 0.866 \cong 30°$

$= 9131.4\angle -29.9 \sin 30$

$\boxed{= 4565.7\angle -29.9\ kVARS}$

7.5/8

e) on nxt page →

e) $V_{LN} = (659.8\angle -29.9°\,A)(0.308 + j1.499\,\Omega) + 4618.8\,V$

$= 5383.4\angle 7.8°\,V$

$V_{LL}_{source} = \sqrt{3}V_{LN} = \sqrt{3}(5383.4\angle 7.8) = 9324.4\angle 7.8°\,V$