Last Name:______________________________________

First Name:______________________________________

SCHULICH
School of Engineering
UNIVERSITY OF CALGARY

ENEL 487 Midterm Examination

March 11, 2019

10:00 - 10:50 am

Instructor: Pouyan (Yani) Jazayeri

- Exam consists of 3 problems.
- Write answers in the space provided below each question.
- Show your work neatly in the work area. Otherwise, marks for partially correct answers cannot be given.
- Total marks for the exam is 23.
- Closed book exam. You may not refer to books or notes during the test.
- No wireless devices or earphones allowed during exam.
- Only scientific calculators without formulae storage and text display are allowed.

Problem 1:

Your colleague has purchased a single phase, 48kVA, 480/120 V distribution transformer from a country with lax attitudes towards honesty and standards! Going through the transformer test report, you have found the following data for the short circuit test:
Applied voltage to the HV winding = 50V, measured current = 50A, real power measured = 1500 W

a) Which transformer model parameters are calculated in this test? Calculate their values. [3 marks]

b) The salesperson representing the manufacturer claims that the transformer windings are made of ideal, lossless conductors. Can you verify or dispute this claim based on the available information. Justify your answer [1 mark]

c) The rated values for a Δ-Y transformer are 96kVA, 2400/240 V . The HV side is Δ-connected and the LV side is Y-connected.
The rated current for the HV side is _______________A [1 mark]

The maximum current in each winding on the HV side is _______________A [1 mark]

Problem 2:

This is the same system as Problem 2 on Quiz 1:

A balanced Δ-connected load (Load 1) with impedance of 6+j12 Ω per phase is connected in parallel with a balanced Y-connected load (Load 2) with impedance of 2-j4 Ω per phase. A line with impedance of 1 Ω per phase connects these loads to a 208V source.

In the per-phase circuit, load voltage was calculated to be $100\angle{-30^0}$ and the current in the line was calculated to be $20\angle{-30^0}$

a) Draw a phasor diagram showing all 3 <u>phase</u> voltages for Load 1. Provide the name, magnitude, and phase angle for each phasor in your diagram [3 marks]

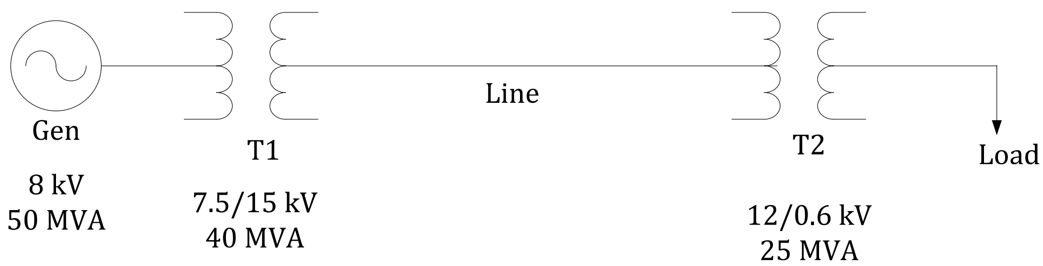
b) Calculate the total power losses in the line. Include the units in your answer [1 mark]

c) Calculate the power factor for the source in the per-phase circuit. [2 marks]

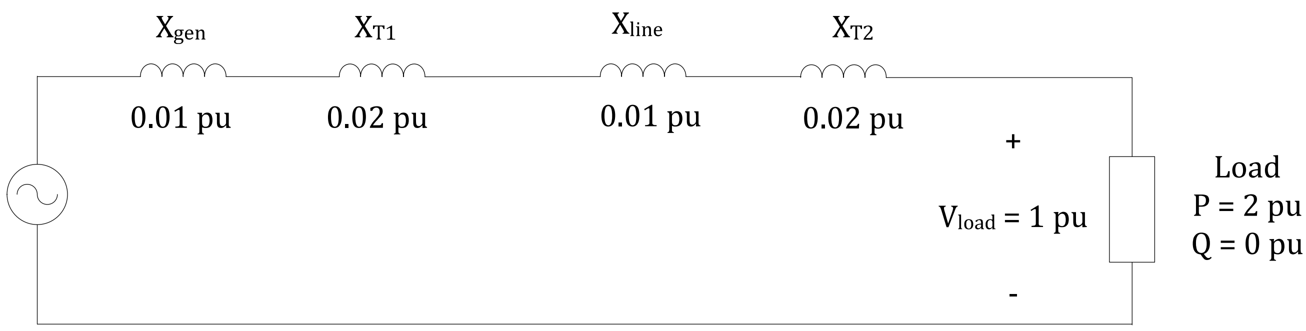
d) Is the source Y-connected or Δ-connected? Explain. [1 mark]

Problem 3:

Following is a single line diagram of a three phase system:



The corresponding per unit circuit (impedance diagram) is shown below:



The following base values were used: S_{base} = 100 MVA, V_{base}= 7.5kV in Gen zone

a) Calculate the total three phase power of the load. Include the units in your answer. [1 mark]

b) Calculate the magnitude of the line-to-line voltage at the load. [2 marks]

c) Calculate the reactance of the line in Ohms. [2 marks]

d) Calculate the reactance of T1 in Ohms referred to the HV side [2 marks]

e) Calculate the magnitude of the line-to-line voltage at the generator terminals. [3 marks]

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Question	**1**	**2**	**3**	**Total**
Mark	/6	/7	/10	/23

You can detach this page

General

Single Phase $\overline{\text{S}}$: $\overline{S} = \overline{V} \cdot \overline{I}^*$

Q for L and C: $Q_L = \frac{V^2}{X_L} \qquad Q_C = \frac{V^2}{X_C}$

Y Connection: $\overline{V_{ll}} = \sqrt{3}\angle 30^o \cdot \overline{V_\phi}$

Δ Connection: $\overline{I_l} = \sqrt{3}\angle -30^o \cdot \overline{I_\phi}$

3 Phase Power: $\overline{S_{3\phi}} = 3 \cdot \overline{V_\phi} \cdot \overline{I_\phi^*}$

$S = \sqrt{3} \cdot V_{ll} \cdot I_l$

$P = S \cdot pf \qquad S^2 = P^2 + Q^2$

Per Unit

Single Phase:

$$S_{\text{base},1\phi} = P_{\text{base},1\phi} = Q_{\text{base},1\phi}$$

$$I_{\text{base}} = \frac{S_{\text{base},1\phi}}{V_{\text{base,L-N}}}$$

$$Z_{\text{base}} = R_{\text{base}} = X_{\text{base}}$$

$$Z_{\text{base}} = \frac{V_{\text{base,L-N}}}{I_{\text{base}}} = \frac{V^2_{\text{base,L-N}}}{S_{\text{base},1\phi}}$$

Three Phase:

$$S_{\text{base},3\phi} = 3 \cdot S_{\text{base},1\phi}$$

$$V_{\text{base,L-L}} = \sqrt{3} V_{\text{base,L-N}}$$

$$I_{\text{base}} = \frac{S_{\text{base},3\phi}}{\sqrt{3} V_{\text{base,L-L}}}$$

$$Z_{\text{base}} = \frac{V^2_{\text{base,L-L}}}{S_{\text{base},3\phi}}$$

Change of Base:

$$Z_{\text{pu,new}} = Z_{\text{pu,old}} \left(\frac{V_{\text{base,old}}}{V_{\text{base,new}}} \right)^2 \frac{S_{\text{base,new}}}{S_{\text{base,old}}}$$