University of Technology, Sydney
Faculty of Engineering

Subject: **48572 Power Circuit Theory**

Assessment Number: **4**

Assessment Title: **Lab 4 – Fault Prediction and Verification**

Tutorial Group:

Students Name(s) and Number(s)

Student Number	Family Name	First Name

Declaration of Originality:

The work contained in this assignment, other than that specifically attributed to another source, is that of the author(s). It is recognised that, should this declaration be found to be false, disciplinary action could be taken and the assignments of all students involved will be given zero marks. In the statement below, I have indicated the extent to which I have collaborated with other students, whom I have named.

Statement of Collaboration:

Signature(s)

Marks

Pre-Work	/2
Lab Work	/1
Post-Work	/2
TOTAL	/5

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Assessment Submission Receipt

Assignment Title:	**Lab 4 – Fault Prediction and Verification**	**Mark**
Student's Name:		
Date Submitted:		
Tutor Signature:		Office use only ☺

Lab 4 – Fault Prediction and Verification

Asymmetrical loading of three-phase transformers with faults (and loads).

Introduction

Faults on a 3-phase power system represent extreme cases of unbalanced loads. Different transformer connections affect the resultant unbalanced currents and voltages. Specifically, whether the windings are connected in delta or star, and whether the neutral is earthed or not, can have a dramatic effect on the current and voltage magnitudes and waveforms.

Objectives

1. To measure and observe on a DSO the currents and voltages for various three-phase transformer connections and faults (or loads), and to compare measured values (magnitude only) with calculated values.

L4.2

Equipment

- 1 single-phase 240 V, 8A autotransformer – Warburton Franki Variac
- 1 three-phase 240 V, 8A autotransformer – Warburton Franki Variac
- 1 three-phase 415 V, 6A / 120 V, 12 A / 120 V, 12A transformer – Trenco
- 1 three-phase resistive load, 110 Ω per phase
- 1 AC voltmeter / ammeter – YEW
- 1 digital multimeter
- 1 power quality clamp meter – Fluke 345
- 1 rheostat (12.4 Ω or 24 Ω)

Safety

Cat. B lab

This is a Category B laboratory experiment. Please adhere to the Category B safety guidelines (issued separately).

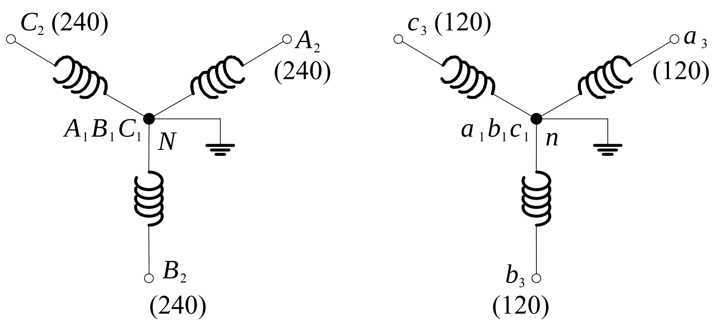
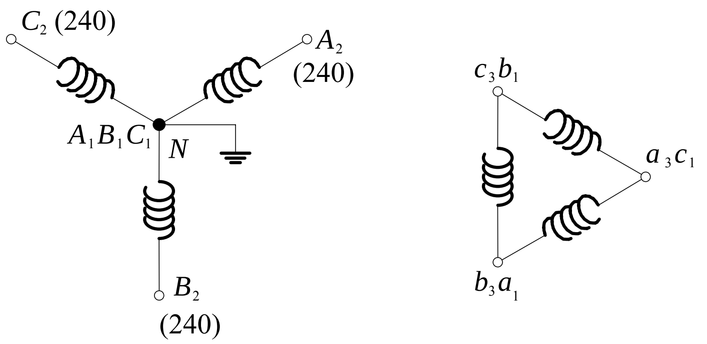
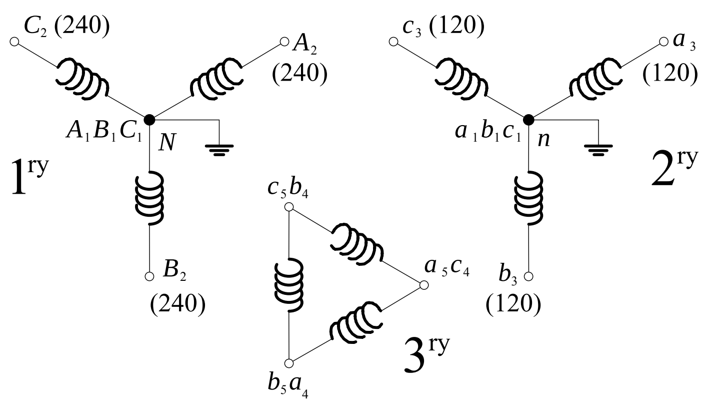
Warning!

Remember:

1. **Choose suitable METER SCALES and <u>WIND DOWN</u> and <u>SWITCH OFF</u> the supply Variac when making circuit connections.**
2. **<u>Ensure equipment is earthed.</u>**

Lab Work

The following table shows various transformer connections and faults.

Transformer Connection	Fault	Fault Resistance
1. 	(a) 2^{ry} L_a-E (b) 2^{ry} L_b- L_c (c) Simultaneous (a) + (b)	In all cases R_f = $\frac{110}{9}\ \Omega$ (load bank) <u>OR</u> 12.4 Ω or 24 Ω (rheostat)
2. As above but with 1^{ry} neutral disconnected.	As above	As above
3. 	As above	As above
4. As above but with 1^{ry} neutral disconnected.	As above	As above
5. 	(a) 2^{ry} L_a-E (b) 3^{ry} L_4- L_5 (c) Simultaneous (a) + (b)	<u>2^{ry} (a_3-n)</u> $R_f = \frac{110}{6}\ \Omega$ <u>OR</u> 12.4 Ω or 24 Ω <u>3^{ry} (a_5- a_4)</u> $R_f = \frac{110}{9}\ \Omega$ <u>OR</u> 12.4 Ω or 24 Ω
6. As above but with 1^{ry} neutral disconnected.	As above	As above

L4.4

Lab Work [1 mark]

1. **<u>Do not connect the supply or turn on the power until circuit connections are checked by a lab tutor.</u>**

2. Note the rated current of the equipment in the table below:

Equipment	Current Rating (A)	Voltage Rating (V)
3-phase Variac (per phase)		
3-phase transformer (per phase)		
resistors (load bank = $\frac{110}{9}\Omega$)		
resistors (load bank = $\frac{110}{6}\Omega$)		
Rheostat		

3. **<u>At all times the equipment rating must not be exceeded.</u>**

4. Repeat the following steps 5-10 for each of the circuits 1-6 in the table.

5. Wire up the circuit as given in the table, noting the following:

   - Use the 3-phase Variac as a "constant balanced voltage supply".
   - Use the YEW voltmeter to measure the supply voltage (V_a-N).
   - The Variac output must not exceed the rated voltage of the transformer – 240 V RMS, phase-neutral. (Remember that the Variac can also INCREASE the incoming voltage).

6. After the circuit has been checked, turn on the Variac and bring up the voltage until the fault current is at a large value close to the equipment rating.

7. Use the Fluke 345 clamp meter to measure all 1^{ry} , 2^{ry} (and 3^{ry}) voltages and currents.

8. If you feel it is necessary, measure the fault resistance and the transformer parameters.

9. Use a DSO and current probes to observe waveforms. Remember that the DSO leads are earthed, so they **MUST NOT** be connected to the primary of the transformer when the neutral is connected.

10. **Wind down and switch off the Variac.**

L4.6

Report

Only submit ***ONE*** report per lab group.

Complete the assignment cover sheet and attach your pre-work.

Ensure you have completed:

1. ***Pre-Work*** – Formulate the theory. Define base values. Calculate the predicted fault currents for each of the circuits.

2. ***Lab Work*** – Draw circuit diagrams & describe the experimental setup. Measure and record all relevant quantities for each of the circuits.

3. ***Post-Work*** – Tabulate experimental and calculated values. Explain differences. Comment on waveforms (distortion, harmonic content).

The lab report is due in exactly two (2) weeks.