Faculty:	FACULTY OF ELECTRICAL ENGINEERING		
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FACULTY OF ELECTRICAL ENGINEERING
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SEEE 3732
BASIC POWER LABORATORY

THREE-PHASE FOUR-WIRE FEEDER SYSTEM

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EXPERIMENT: THREE-PHASE FOUR-WIRE FEEDER SYSTEM

LEARNING OBJECTIVES:

After completing this lab, you will be able to:

1. Analyze the impact of a connected neutral conductor for a Three-Phase Four Wire System when supplying balanced and unbalanced three-phase loads.
2. Analyze the impact of an open-circuited neutral conductor for a Three-Phase Three Wire System when supplying balanced and unbalanced three-phase loads.
3. Identify the role of neutral wire in Three-Phase System supplying unbalanced three-phase load for loss of one-phase conductor.

INTRODUCTION:

A three-phase system is produced by a generator consisting of three sources, having the same amplitude and frequency but out of phase with each other by 120° (mechanically and electrically). Ideally, the three-phase load should be balanced (eg: when connected to a 3 phase equipment), but in practice, most of the loads are unbalanced as each phase caters different loads. It is very important to understand the concept of unbalanced three-phase systems to help ensuring the power system stability and reliability.

Recommended references:

(i) ***Alexander & Sadiku***, 'Fundamental of Electric Circuit 7th edition', *McGraw Hill, 2021.*

(ii) ***Hughes,*** Electrical and Electronic Technology, the 12th Edition, *Pearson, 2016*.

EQUIPMENT:

Model No.	Item
DL 2108TAL	3-Phase Power Supply
DL 1017R	Resistive Load
DL 1017L	Inductive Load
FLUKE 117	Multimeter

Precaution:

1. ***Always ask assistant engineer or supervisor to check the experiment connection before SWITCHING ON the power supply.***
2. ***NEVER use the ground connection for this experiment setup.***
3. ***The multi-meter function MUST be 'set' before SWITCHING ON the power supply.***
4. ***NEVER change the multi-meter function while the circuit is energized.***

PROCEDURE:

Note that all loads are in STAR connection.

Always **TURN OFF** main switch **SW1** before changing the load.

EXPERIMENT 1

1. Assemble the circuit according to the **preliminary exercise** 6)(i) so that the 3-phase power supply is connected to resistive and inductive (R in series with L) loads.
2. Conduct the experiment for balanced and unbalanced loads with a neutral conductor.
3. Measure and record all currents and voltages at the load terminal with 3 positions of loads (including the case considered in preliminary exercise 7).

EXPERIMENT 2

1. Assemble the circuit according to the **preliminary exercise** 6)(ii) so that the 3-phase power supply is connected to resistive and inductive (R in series with L) loads.
2. Conduct the experiment for balanced and unbalanced loads without a neutral conductor.
3. Measure and record all currents and voltages at the load terminal with 3 positions of loads (including the case considered in preliminary exercise 7). Use the same positions of loads as applied in experiment 1.

EXPERIMENT 3

1. Assemble the circuit according to the **preliminary exercise** 6)(iii) so that the 3-phase power supply is connected to resistive and inductive (R in series with L) loads.
2. Conduct the experiment for unbalanced load with loss of one phase conductor for Three Phase System with and without a neutral conductor.
4. Measure and record all currents and voltages at the load terminal with 3 positions of loads (including the case considered in preliminary exercise 7). Use the same positions of loads as applied in experiment 1.

RESULT, DATA ANALYSIS/OBSERVATION AND CONCLUSIONS

1. Complete results must be neatly presented in appropriate tables or/and figures.
2. Analyze and discuss the results of Experiments 1, 2 and 3. In your analysis and discussion:
   i. Compare and analyze the voltages and currents at the receiving end for both balanced and unbalanced systems between the experiments.
   ii. Examine and analyze the neutral current reading for the balanced and unbalanced systems in all experiments.
   iii. Discuss the impact of neutral conductor for a Three-Phase Four Wire System when supplying both balanced and unbalanced three-phase loads.
   iv. Discuss the consequences of the absence of a neutral conductor in a Three-Phase Three-Wire System when delivering power to both balanced and unbalanced three-phase loads.
   v. Verify the results from experimental work using theoretical approaches (phasor diagram and three-phase formula). Assume a positive sequence with V_{RN} as a reference. Indicate percentage of error for every result.
3. Answer and conclude the objective of the experiment.

ADDITONAL INSTRUCTION

SHORT REPORT

1. Include all results and the data analysis of all experiments.
2. Follow the general report format and structure that consists of a title, introduction, objectives, procedure, results, discussion & analysis and conclusion.
3. Use passive sentences in the report.
4. Please make sure to refer to the provided rubric on the website while preparing the short report.

LONG REPORT

1. Follow the general report format and structure that consists of cover page, title, theory & background, objectives, procedure, results, discussion & analysis, conclusion, and references.
2. Use passive sentences in the report.
3. Include the experimental results and analysis from the short report with proper descriptions.
4. Perform the analysis using **appropriate software** to validate your experimental results of all experiments.
5. Extend your report discussions by answering the following questions/item:
   i. Explain the difference between single-phase and three-phase systems in your own words.
   ii. What is the necessity for employing Y-Δ, Δ-Y, Y-Y, or Δ-Δ configurations in electrical power systems?
   iii. Project this experiment into a practical situation on the effect to the system due to disconnection of neutral conductor (while the three-phase line was delivering balanced and unbalanced loads). Propose possible solutions for this issue in your discussion.
6. Please make sure to refer to the provided rubric on the website while preparing the long report.