Unit Title:	**Electrical Principles 1**
Unit Number:	**DCL-1-102**
Unit Value:	**1.0**
Course(s):	**H.N.D. Building Services Engineering** **B.Eng. Building Services Engineering** **H.N.D. Computer Aided Engineering**

Time allocation: 150 hours; 24 hours lectures,
12 hours Tutorial, 24 hours work shop, 90 hours private study.

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1. CONTENTS OF THIS GUIDE

2. AIMS

This unit provides the first level basic concepts of Electrical Engineering. It leads to the understanding of the basic principles desired for all Electrical and Electronic Engineers and provides the students with the knowledge of Electrical Engineering systems and building blocks, and the practical and analytical concepts involved in their design and operation.

3. LEARNING OUTCOMES

The learning outcome of the unit is that the student will understand the use of symbolic notations for calculation of single-phase and three-phase circuit problems. The basic knowledge of how power systems are arranged and controlled, the fundamental principles of operation of single-phase transformers and dc machines, the production of rotating fields due to two and three phase systems and their utilisation in electrical machines, and to carry out simple calculations involving all aspects mentioned.

4. READING LIST

The recommended books for the unit are:

1).

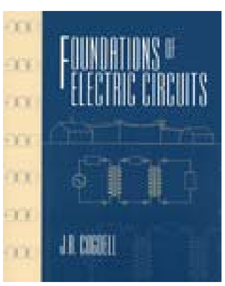
Electrical Engineering: Principles and Applications, 2/e

Allan R. Hambley, Michigan Technological University

Copyright 2002, 864 pp.
Cloth format
ISBN 0-13-061070-4

2).

Foundations of Electric Circuits, 1/e



J.R. Cogdell, University of Texas, Austin

Copyright 1999, 300 pp.
Paper format
ISBN 0-13-907742-1

3). Higher Electrical Engineering, J. Shephard, A.H. Morton and L.F. Spence. Published by Longman, 1999.

4). Basic Circuit Analysis, John O'Malley.

Additional recommended books:

3). Basic Electrical Engineering, J. Shephard, A.H. Morton and L.F. Spence. Published by John Wiley and son.

4). Theory and Problems of Electric Circuit, J. Edminster.

5). Materials Science, 3rd edn., J.C. Anderson, K.D. Leaver, R.D. Rawlings and J.M. Alexander. Published by Van Nostrand Reinhold, 1985.

6). Fundamentals of Electric Circuits, 4th edn., D.A. Bell. Published by Prentice-Hall, 1988.

7). An Introduction to Semiconductor Microtechnology, D.V. Morgan and K. Board. Published by Open University, 1985.

5. CALENDAR

Topic	Study weeks
1a. basic units	1
1b. Introduction to Phasors	1
2a. Derived units	2
2b. Complex numbers I	2
3a. Introduction to Average Values	3
3b. Complex numbers II	3
4a. Formal method of applying Kirchoff’s Laws	4
4b. Simple a.c circuits I	4
5a. Introduction to Energy Source Elements I	5
5b. Simple a.c circuits II	5
6a. Introduction to Energy Source Elements	6
6b. Admittance of parallel circuits	6
Phase Test	**7**

(a) and (b) refer to the two streams covered in the course.

6. INTRODUCTION TO LECTURES

SECTION A:

Introduction to common units (Week 1)

This involves introducing students to the quantities commonly used in electrical engineering. These include Energy, Charge, Time Voltage, Current and Power. What the quantities represent, their associated units and their relationship with each other is also addressed.

Resistance and Resistors (Week 2)

Students are introduced to the concept of resistance and its benefits and problems for electrical engineering. Equivalent values for series and parallel combinations of resistors are covered. The application of equivalent values to simplifying large networks of resistors is also dealt with.

Introduction to Kirchoff's Laws (Week 3)

Students are introduced to Kirchoff's Voltage and Current Laws and their importance to electrical engineering. Use of these laws in analysing simple circuits is also addressed.

Formal method of applying Kirchoff's Laws (Week 4)

Students are introduced to a more rigorous formal method of applying Kirchoff's two laws to analysing large complicated circuits.

Introduction to Energy Source Elements (Week 5-6)

Students are introduced to the concept of Energy Source Elements. Dependent and independent Sources are covered as well as the major differences between Ideal and Practical source elements. The effect on analysing circuits that contain Energy Sources Elements with Kirchoff's Laws are also addressed.

Week 7 - Phase Test.

Introduction to Energy Storage Elements (Week 8-12)

Students are introduced to the concept of Energy Storage Elements, principally Capacitors and Inductors. Equivalent values for Storage Elements connected in Series and Parallel are dealt with. The Current/Voltage characteristics for Storage devices are considered in detail including an introduction to differential equations. Analysis of selected circuits containing Storage Elements is also undertaken.

SECTION B:

Introduction to Phasors (week 1)

This involves the understanding the representation of sinusoidally varying quantities by phasors and the resolution of the phasors into two components at right angles with each other. The significance of the j-operator and the effect of applying the operator to the vectors.

Complex numbers (weeks 2 & 3)

Addition, subtraction, multiplication and division of the phasors. For phasors $A_1 = a_1 + jb_1$ and $A_2 = a_2 + jb_2$ and their addition to $A_1 + A_2 = (a_1 + a_2) + j(b_1 + b_2)$, and their subtraction $A_1 - A_2 = (a_1 - a_2) + j(b_1 - b_2)$, as well as multiplication and division.

Simple a.c circuits (weeks 4 & 5)

This section is related to expressing impedance as a complex number, in the form Z = R ± jX, and representation of alternating current and voltage as complex phasor operators.

Admittance of parallel circuits (week 6)

Expression of an admittance as Y = 1/Z = 1/(R ± jX) = G ± jB and the comparison of the impedance and admittance expressions for simple series and parallel circuits.

Week 7 - Phase Test.

Introduction to electromagnetics (week 8)

This is an introductory lecture on basic laws of electromagnetic induction, which describes briefly, the basic concepts of Faraday's law. It outlines the important electromagnetic relationships defining the magnetic flux Φ, magnetic flux density $\boldsymbol{B}$, permeability of magnetic materials μ, and the analogy of a magnetic circuit in comparison to an electric one.

Single Phase Transformer (weeks 9, 10, 11)

This section of the unit will embark on explaining the fundamental principles of operation of single-phase transformers and carries out simple calculations involving their use.

It explains the reason for the use of transformers in power engineering.
Ideal transformer. Losses associated with a real transformer such as iron loss associated with the magnetic core, leakage losses and copper losses associated with the primary and secondary windings, as well as the limitation of the magnetic characteristics of the core material.
Familiarisation with $N_1/N_2 = E_1/E_2 = I_2/I_1$ expressions for an ideal transformer.
The phasor diagram for the primary and secondary sides of the single-phase transformer on load.

Basic concepts of Power Systems (week 12)

This lecture gives an overall view of the basic concepts of generation and transmission of electrical energy from generating plants through distribution networks to the end user.

7. WORKSHOP SESSIONS

Laboratory sessions are of two-hour duration, and will be attended weekly. You will usually work in groups of two. The instruction books will be available on your first laboratory session. You will also be able to obtain a note on the maintaining your logbook, to which you should pay a good deal of attention.

8. TUTORIAL SESSIONS

Each student will attend a one-hour tutorial session every week. The tutorial sessions will be in conjunction with the lecture streams outlined in the calendar. Tutorials will be conducted in smaller groups than those of the lectures.

9. ASSESSMENT METHOD

The unit will be assessed based on a one hour written examination held in mid semester (usually carried out on week 7), a two hour end of unit test, and the assessed laboratory log book, with the marks split as follows:

a. One 60-minute mid-semester Phase-test	25%
b. One 2-hour end-of-unit examination	50%
c. Laboratory logbook	25%

<u>9a. Mid-semester Phase-test (25%)</u>
The Phase- test has two sections A and B, which cover the two streams of the unit. These sections carry 50% of the total assessment for this test, and all questions must be attempted. Number of questions and layout for questions may vary for each section.

<u>9b. End-of-unit examination (50%)</u>
The end-of unit examination also has two sections A and B, which cover the two streams of the unit. These sections carry 50% of the total assessment for this examination. All questions must be attempted. Number of questions and layout for questions may vary for each section.

<u>9c. Laboratory logbook (25%)</u>
Laboratory logbooks are assessed for write-ups on individual workshop experiments. These are scrutinised for presentation of results, discussions and conclusive remarks made for each experiment. A logbook is a real-time log report on the workshop session and must be dated at the beginning of each session. For each write-up, students must

give a description of Aims and/or Objectives of the experiment, present results obtained, and answer questions raised in the instruction manual.

GH Shirkoohi Sept. 2005