COURSE NUMBER: ET1100

COURSE TITLE: Electrotechnology

COURSE DESCRIPTION:

This is an introductory course in electrical theory covering the basic concepts of electricity, circuit analysis and magnetism. The laboratory work is designed to develop skills in the construction of electrical circuits and use of electrical measuring instruments as well as reinforcing theoretical concepts.

PREREQUISITES: None

CO-REQUISITES: None

CREDIT VALUE: Four (4)

COURSE HOURS PER WEEK: Three (3)

LAB HOURS PER WEEK: Two (2)

SUGGESTED TEXT:

Boylstad, L. R. (2010). *Introductory circuit analysis* (12th ed.). Prentice-Hall. ISBN-10: 0131746663 or ISBN-13: 9780131714666

Or

Robbins, A.H., and Miller, W.C. (2012). *Circuit analysis theory and practice* (5th ed.). Delmar Publishing Inc.. ISBN-10: 1133281001;r ISBN-13: 978-1133281009

Or

Jackson, H.W., Temple, D., and Kelly, B.E. (2012). *Introduction to electric circuits* (9th ed.). Oxford University Press. ISBN-13: 978-0-19-543813-0

And accompanying lab book

Jackson, H.W., Temple, D., and Kelly, B. (2012). *Introduction to electric circuits: Lab manual* (9th ed.). Oxford University Press. ISBN-13: 978-0-19-542310-5

LEARNING RESOURCES:

Zbar, P.B., and Rockmaker, G. (2000). *Basic electricity: A text-lab manual* (7th ed.). McGraw-Hill. ISBN-13: 9780078212758

MAJOR TOPICS:

1.0 Introduction to Electricity
2.0 Ohm's Law and Electric Circuits
3.0 Magnetism and Electromagnetism
4.0 Electrical Measurement
5.0 Inductance

LEARNING OBJECTIVES:

1.0 Introduction to Electricity

- 1.1 Nature of Electricity
  - 1.1.1 Simple Atomic Theory
    - 1.1.1.1 Draw the Bohr model of the atom
  - 1.1.2 Conductors and Insulators
    - 1.1.2.1 Define electrical conduction
    - 1.1.2.2 Explain why copper is a good conductor referring to its atomic structure
    - 1.1.2.3 Define insulator
- 1.2 Electrical Quantities
  - 1.2.1 Charge
    - 1.2.1.1 Define electrical charge
    - 1.2.1.2 Describe the symbol and units of charge
  - 1.2.2 Electromotive Force
    - 1.2.2.1 Define EMF
    - 1.2.2.2 Describe the symbol and units of EMF
    - 1.2.2.3 List six sources of EMF
  - 1.2.3 Current
    - 1.2.3.1 Define current
    - 1.2.3.2 Define the symbol and units of current
    - 1.2.3.3 Describe the relationship between current and charge
  - 1.2.4 Resistance
    - 1.2.4.1 Define resistance
    - 1.2.4.2 Define the symbol and units of resistance
    - 1.2.4.3 Sketch the schematic symbol for resistance

1.2.4.4 Determine resistance values from the color code
1.2.4.5 Describe a potentiometer and rheostat

1.2.5 Metric Prefixes
1.2.5.1 List common metric prefixes used with electrical units

1.3 Use of Electrical Meters
1.3.1 Ohmmeter
1.3.1.1 Use an ohmmeter to measure resistance

1.3.2 Voltmeter
1.3.2.1 Properly connect a voltmeter in a circuit
1.3.2.2 Use correct scales for voltage measurement

1.3.3 Ammeter
1.3.3.1 Properly connect an ammeter in a circuit
1.3.3.2 Use correct scales for current measurement

1.4 Electrical Potential
1.4.1 Potential Difference
1.4.1.1 Define potential difference
1.4.1.2 Determine potential difference between two charge bodies

1.4.2 Emf. And Voltage Drop
1.4.2.1 Distinguish between EMF. And voltage drop

2.0 Ohm's Law and Electric Circuits

2.1 Ohm's Law
2.1.1 Simple Electric Circuit
2.1.1.1 Draw a schematic diagram of a simple electric circuit
2.1.1.2 Distinguish between conventional current and electron flow

2.1.2 Ohm's Law Equation
2.1.2.1 State the relationship between current, voltage and resistance
2.1.2.2 Write the formula for Ohm's Law
2.1.2.3 Calculate values of E. I and R using Ohm's Law

2.2 Series Circuits
2.2.1 Series Circuit Description
2.2.1.1 Define a series circuit by its current property
2.2.1.2 Write the equation for total resistance of a series circuit
2.2.1.3 Apply Ohm's Law to calculate the current in a series circuit

2.2.2 Kirchhoff's Voltage Law

2.2.2.1 Calculate voltage drops in a series circuit
2.2.2.2 State Kirchhoff's voltage law

2.2.3 Voltage Division
2.2.3.1 Derive the formula for voltage division in a series circuit
2.2.3.2 Calculate resistor voltages using voltage division

2.3 Parallel Circuits
2.3.1 Parallel Circuit Description
2.3.1.1 Define a parallel circuit
2.3.1.2 Describe the voltage property of a parallel circuit
2.3.1.3 Write reciprocal formula for total resistance

2.3.2 Kirchhoff's Current Law
2.3.2.1 Calculate branch currents using Ohm's Law
2.3.2.2 State Kirchhoff's current law

2.3.3 Special Parallel Circuits
2.3.3.1 Derive formula for two resistors in parallel
2.3.3.2 Derive formula for equal resistors in parallel

2.3.4 Current Division
2.3.4.1 Derive the formula for current division
2.3.4.2 Calculate branch currents using current division

2.3.5 Conductance
2.3.5.1 Define conductance
2.3.5.2 Specify the symbol and unit of conductance
2.3.5.3 Express Ohm's law using conductance
2.3.5.4 Solve the parallel circuit using conductance

2.4 Series - Parallel Circuits
2.4.1 Circuit Reduction Techniques
2.4.1.1 Simplify large circuits using series and parallel techniques
2.4.1.2 Calculate equivalent resistance of series-parallel circuits

2.4.2 Calculation of Branch Currents and Voltages
2.4.2.1 Calculate voltage and current in different parts of a series-parallel circuit

2.5 Electrical Power and Energy
2.5.1 Power Developed by Current Flow
2.5.1.1 Explain how power is developed by a current flow
2.5.1.2 Derive the basic electrical power formula
2.5.1.3 Specify the symbol and unit for power

2.5.2 Power Formulas
2.5.2.1 Combine the power formula with Ohm's Law
2.5.2.2 Calculate power using the different formulas

2.5.3 Power Rating of Resistors
2.5.3.1 Relate size of resistor to power rating
2.5.3.2 Calculate resistor power rating

2.5.4 Horsepower
2.5.4.1 Define horsepower in electrical terms

2.5.5 Electrical Energy
2.5.5.1 Define electrical energy
2.5.5.2 Specify symbol and units

2.5.6 Heating Effect of an Electrical Current
2.5.6.1 Describe the heating effect
2.5.6.2 Define calorie
2.5.6.3 Calculate heat produced by an electrical current

2.6 Voltage Dividers
2.6.1 Series Voltage Divider
2.6.1.1 Draw the circuit for simple voltage divider
2.6.1.2 Calculate circuit components

2.6.2 Use of Bleeder Resistor
2.6.2.1 Draw voltage divider circuit with bleeder resistor
2.6.2.2 Explain how this circuit has better voltage regulation
2.6.2.3 Design circuit with bleeder resistor

2.6.3 Potentiometer
2.6.3.1 Describe the potentiometer as a variable voltage divider

2.6.4 Multiple Voltage Divider
2.6.4.1 Draw the circuit for a multiple voltage divider
2.6.4.2 Calculate resistor values
2.6.4.3 Calculate power ratings

2.7 Resistance of Conductors
2.7.1 Laws of Resistance of Conductors
2.7.1.1 State the laws of resistance for conductors

2.7.2 Resistivity Formula
2.7.2.1 Define resistivity

2.7.2.2 Write the formula for conductor resistance
2.7.2.3 Calculate conductor resistance using square area

2.7.3 Circular Mill Method
2.7.3.1 Define circular mills
2.7.3.2 Express resistivity in circular mills
2.7.3.3 Calculate resistance of conductor using circular mills

2.7.4 American Wire Gage
2.7.4.1 Describe the American Wire Gage
2.7.4.2 Calculate resistance of conductors using the American Wire Gage

2.7.5 Effect of Temperature on Resistance
2.7.5.1 Describe the effect of temperature on the resistance of different materials
2.7.5.2 Define temperature coefficient
2.7.5.3 Derive equation for calculating resistance at different temperatures

2.7.6 Voltage Drop in Supply Feeders
2.7.6.1 Calculate load voltage
2.7.6.2 Calculate wire size for specified load conditions
2.7.6.3 Calculate power loss in feeder

2.8 Cells and Batteries
2.8.1 Simple Primary Cell
2.8.1.1 Define primary cell
2.8.1.2 Draw diagram of simple primary cell
2.8.1.3 Describe chemical activity to develop a potential difference
2.8.1.4 Describe polarization and local action

2.8.2 Equivalent Circuit
2.8.2.1 Define internal resistance
2.8.2.2 List causes of internal resistance
2.8.2.3 Draw equivalent circuit
2.8.2.4 Calculate load voltage

2.8.3 Grouping of Cells
2.8.3.1 Define battery
2.8.3.2 Calculate quantities in series connected cells
2.8.3.3 Calculate quantities in parallel connected cells
2.8.3.4 Calculate quantities in series-parallel connected cells

2.8.4 Secondary Cell

2.8.4.1 Define secondary cell
2.8.4.2 List examples of secondary cells
2.8.4.3 Define battery capacity in terms of ampere-hour rating

3.0 Magnetism and Electromagnetism

3.1 Nature of Magnetic Field
3.1.1 Electron Theory of Magnetism
3.1.1.1 Describe the electron theory of magnetism

3.1.2 Magnetic Lines of Flux
3.1.2.1 Describe magnetic field
3.1.2.2 Sketch magnetic field around a bar magnet
3.1.2.3 List properties of magnetic lines of flux

3.1.3 Magnetic Field between Two Magnets
3.1.3.1 Sketch magnetic field between adjacent like poles
3.1.3.2 Sketch magnetic field between adjacent unlike poles

3.1.4 Magnetic Field around a Current Carrying Conductor
3.1.4.1 Sketch magnetic field around a current carrying conductor
3.1.4.2 Determine direction of magnetic field using right-hand rule
3.1.4.3 Describe ways of increasing strength of magnetic field

3.1.5 Electromagnet
3.1.5.1 Sketch magnetic field around an electromagnet
3.1.5.2 List factors controlling strength of electromagnetic field

3.2 Magnetic Terms and Units
3.2.1 Magnetomotive Force
3.2.1.1 Define magnetomotive force
3.2.1.2 Specify symbol and units

3.2.2 Magnetic Flux
3.2.2.1 Define magnetic flux
3.2.2.2 Specify symbol and units

3.2.3 Reluctance
3.2.3.1 Define reluctance
3.2.3.2 Specify symbol and units

3.2.4 Magnetic Circuit "Ohm's Law"
3.2.4.1 State the relationship between MMF, flux and reluctance
3.2.4.2 Calculate magnetic quantities using magnetic circuit Ohm's law

4.0 Electrical Measurement

4.1 Principles of Measurement

4.1.1 Moving Coil Meter Movement

4.1.1.1 Sketch the moving coil meter movement

4.1.1.2 Describe the operation of the moving coil meter movement

4.1.1.3 Define current sensitivity

4.1.2 Current Measurement - the Ammeter

4.1.2.1 Draw circuit for a single range ammeter

4.1.2.2 Calculate shunt resistor

4.1.2.3 Draw circuit and calculate shunts for multirange ammeter

4.1.3 Voltage Measurement - the Voltmeter

4.1.3.1 Draw the circuit for a single range voltmeter

4.1.3.2 Calculate multiplier resistor

4.1.3.3 Define voltmeter sensitivity

4.1.3.4 Draw the circuit and calculate multipliers for a multirange voltmeter

4.1.4 Resistance Measurement - the Series Ohmmeter

4.1.4.1 Draw the series ohmmeter circuit

4.1.4.2 Calibrate the ohmmeter scale

5.0 Inductance

5.1 Electromagnetic Induction

5.1.1 Faraday's Law

5.1.1.1 State Faraday's law of electromagnetic induction

5.1.2 Dynamic and Static Induction

5.1.2.1 Describe methods of changing flux

5.1.2.2 Define dynamic and static induction

5.1.3 Flemming's Right-Hang Rule

5.1.3.1 Determine direction of inducted voltage using Flemming's rule

5.1.4 Induced Voltage Formula

5.1.4.1 List factors controlling induced voltage

5.1.4.2 Write formula for induced voltage

5.1.5 Self-Induction

5.1.5.1 Define self induction

5.1.5.2 Calculate induced voltage in a coil

5.1.6 Lenz's Law
5.1.6.1 State Lenz's law
5.1.6.2 Use Lenz's law to determining the direction of self induced voltage

5.2 Inductance
5.2.1 Definition of Inductance
5.2.1.1 Relate induced voltage to rate of change of current
5.2.1.2 Define inductance

5.2.2 Formula for Inductance
5.2.2.1 Derive equation for inductance
5.2.2.2 Define inductance
5.2.2.3 Specify symbol and unit

5.2.3 Factors Governing Inductance
5.2.3.1 List factors controlling inductance

5.2.4 Inductances in Series
5.2.4.1 Derive formula for total inductance of series inductors

5.2.5 Inductances in Parallel
5.2.5.1 Derive formula for total inductance of parallel inductors

5.2.6 Inductance in a D.C. Circuit
5.2.6.1 Sketch current response of a D.C. circuit containing an inductor

Laboratories:

1.0 Resistor color code and use of the ohmmeter
2.0 Direct current measurement and control of current
3.0 Ohm's law
4.0 The series circuit
5.0 Current in a parallel circuit
6.0 Total resistance of a parallel circuit
7.0 Total resistance of series-parallel circuits
8.0 Voltage-Divider circuits (unloaded)
9.0 Voltage-Divider circuits (loaded)
10.0 Characteristics of D.C. meter movement + Current meter shunts
11.0 Voltmeter Multipliers

EVALUATION:

Assignments: 5%
Laboratories: 15%

Quizzes:	30%
Final Exam:	50%
Total:	100%

If a student misses a laboratory session *without a valid documented reason***, a mark of 0 for that lab will be assigned. In order to be eligible to write the final examination (including a supplementary final examination) and pass the course, students must pass (minimum of 50%) the essential laboratory component of the course. A student who misses more than 3 labs without valid documentation will be required to drop the course. Please note that dropping the course without academic prejudice must be done within established College processes and time frames.
** What would be considered as a "valid documented reason" will be at the discretion of the Campus Administrator in consultation with the faculty responsible for this course.

DATE DEVELOPED: **DATE REVIEWED:**

REVISION NUMBER: 4 **DATE REVISED:** March 2013

Note to instructor: Check PIRS to ensure this outline is the most current version.