ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

COURSE OUTLINE

ELEN 142 CIRCUIT ANALYSIS

This course introduces students to concepts of circuit analysis for AC and DC circuits. Topics include: fundamental electrical quantities, series and parallel circuits, network analysis and theorems, resistance, capacitance and inductance. Instruments, instrumentation and troubleshooting concepts are introduced. Use is made of complex numbers and phasor diagrams to explain the operation of AC circuits.

OFFERED	1st Semester:	
CREDIT:	4	
IN-CLASS WORKLOAD:	4 lecture, 1 tutorial, 2 lab	
OUT-OF-CLASS WORKLOAD:	6	
PREREQUISITES:	Reserved for Students Registered in the DND Program	
INSTRUCTOR INFORMATION:	Jasmin Casauay, EIT	Office: TEC 206
	250-370-4422	casauaymj@camosun.ca

OBJECTIVE

Upon completion of this course the student will have a complete understanding of DC and AC circuit operation, including the analysis of circuits containing capacitors and inductors.

OUTLINE

Estimated Time

1. Introduction (review) (1 hour)

   1.1 SI Units
   1.2 Scientific Notation and Engineering Notation

2 Nature of Electricity (review) (1 hour)

   2.1 Theory of Electrical Charge
   2.2 Structure of the Atom
      2.2.1 Bohr's Model and Structure of atoms and ions
      2.2.2 States of Matter and Bonding
   2.3 Conductors, Insulators and Semi-Conductors
   2.4 Conventional versus Electron Current Flow
   2.5 Definition of the Coulomb, Ampere, Volt and Ohm

3. Resistance (3 hours)

- 3.1 Types of Resistors including Linear Resistors and Non-Linear Resistors
- 3.2 Resistor Color Code
- 3.3 Ohm's and Watt's Law
- 3.4 Work, Energy, Power in Resistive Circuits

4. Resistive Networks and Simple Circuit Analysis (7 hours)

- 4.1 Series Circuits
- 4.2 Kirchhoff 's Voltage Law (KVL)
- 4.3 Voltage Divider Rule
- 4.4 Parallel Circuits
- 4.5 Kirchhoff's Current Law (KCL)
- 4.6 Current Divider Rule
- 4.7 Series - Parallel Circuits
- 4.8 The Voltage Divider – two resistors, a potentiometer
- 4.9 Voltmeter, Ammeter, Ohmmeter and other DC Measuring Instruments
- 4.10 Wheatstone Bridge Circuit
- 4.11 Delta - Wye Conversions

5. Circuit Analysis using Basic Network Theorems (9 hours)

- 5.1 Equivalent Circuits
- 5.2 Constant Voltage Sources
- 5.3 Practical Voltage Sources
- 5.4 Internal Resistance
- 5.5 Constant Current Sources
- 5.6 Current Sources in Parallel and Series
- 5.7 Maximum Power Transfer Theorem
- 5.8 Thevenin's Theorem
- 5.9 Norton's Theorem* (optional)
- 5.10 Superposition Theorem
- 5.11 Mesh Current Analysis

6. Capacitance (2 hours)

- 6.1 Electric Fields
- 6.2 Electrostatic Induction
- 6.3 Dielectrics
- 6.4 Capacitance
- 6.5 Capacitors in Series
- 6.6 Capacitors in Parallel

7. Capacitance in DC Circuits (7 hours)

- 7.1 Charging/Discharging
- 7.2 Time Constant
- 7.3 Stored Energy
- 7.4 Capacitor Response to step and rectangular inputs
- 7.5 Capacitor as an Integrator and Differentiator

8. Inductance (2 hours)

- 8.1 Electromagnetic Inductance
- 8.2 Faraday's Law
- 8.3 Lenz's Law
- 8.4 Self-Inductance
- 8.5 Inductors in Series
- 8.6 Inductors in Parallel

9. Inductance in DC CIRCUITS (4 hours)

- 9.1 Rise/Fall of Current in an RL Circuit
- 9.2 Time Constant
- 9.3 Stored Energy
- 9.4 RL Circuit Response to a Step input

10. Introduction to Alternating Current (4 hours)

- 10.1 Sine Wave Generation and Phase Relationships
- 10.2 Period, Frequency and Phasor Representations of Sine Waves
- 10.3 Purely Resistive AC Circuits
- 10.4 Peak, Average, and Effective (RMS) Value of A Sine Wave
- 10.5 Other Types of Periodic Waveforms

11. Capacitance in AC Circuits (5 hours)

- 11.1 Capacitive Reactance
- 11.2 Analysis of Series RC Circuits
- 11.3 Analysis of Parallel RC Circuits
- 11.4 Power in a Capacitive Circuit

12. Inductance in AC Circuits (5 hours)

- 12.1 Inductive Reactance
- 12.2 Analysis of Series RL Circuits
- 12.3 Analysis of Parallel RL Circuits
- 12.4 Power in an Inductive Circuit

13. Non Resonant AC Circuits (4 hours)

- 13.1 Analysis of Series RLC Circuits
- 13.2 Analysis of Parallel RLC Circuits
- 13.3 Power in an RLC Circuit

14. Resonant AC Circuits (6 hours)

- 14.1 Series Resonance
- 14.2 Quality Factor & Selectivity in A Series Resonant Circuit
- 14.3 Parallel Resonance
- 14.4 Quality Factor & Selectivity in A Parallel Resonant Circuit

15. Transformers (4 hours)

- 15.1 Theory of Operation - Mutual Inductance
- 15.2 Iron, Air, and Ferrite Core Transformers
- 15.3 Voltage and Current Ratios
- 15.4 Reflected Impedance
- 15.5 Transformer Losses

16. Filters (6 hours)

- 16.1 Low Pass Filters
- 16.2 High Pass Filters
- 16.3 Gain, Attenuation, Decibel, Decade, and Octave
- 16.4 Normalized Frequency Response Curves vs. Bode-plots
- 16.5 Band Pass Filters
- 16.6 Band Reject Filters (or Notch Filters)

Total In-Class Theory Hours *(including quizzes, term exams)* **70 hours**

LABORATORY EXERCISES

There will be a total of 13 lab exercises to be completed, one per week of the semester. Each exercise will be of 2 hours duration and all must be completed satisfactorily in order to gain a credit for ELEN 142. All labs will be handed out during class in the week prior to the exercise and preparation must be completed by the student before the start of the lab.

1. Introduction to Multisim
2. Lab Introduction
3. Simple Series Circuit and Voltage Divider
4. Parallel and Series-Parallel Circuits
5. DC Network Theorems
6. DC Capacitive Circuits
7. DC Inductive Circuits
8. Introduction to AC Measurements
9. AC Measurements in a Series RC Circuit
10. Amplitude, Phase Angle and Power in a Series AC Circuit
11. Resonant and Non-Resonant RLC Circuits
12. Transformer Characteristics
13. Filters

HOLIDAYS

- Monday - **May 20th** - Victoria Day - College closed (Week 4)
- Monday - **July 1st** - Canada Day - College Closed (Week 9)
- Monday -**August 5th** - British Columbia Day - College closed (Week 14)

EVALUATION

Assignments	10%
Labs	20%
Term Test 1 (Date: TBA)	15%
Term Test 2 (Date: TBA)	15%
Final Exam	40%
Total Course Mark	100%

GRADING (in accordance with the College policy):

A+	90 – 100%	**B-**	70 - 72%
A	85 – 89%	**C+**	65 - 69%
A-	80 – 84%	**C**	60 - 64%
B+	77 – 79%	**D**	50 - 59%
B	73 – 76%	**F**	< 50%

A minimum of 60% overall mark must be achieved in both the theory and lab portions to pass the course. Less than 60% overall mark in either portion will result in a failure of the entire course. In addition, to pass the course, the final examination mark must be not less than 50%.

The final grading is based on 85% of theory work, and 15% of lab evaluation. Lab evaluation will be based on completing all assigned exercises and lab reports. Labs are to be completed within the assigned lab period and evaluated as satisfactory or unsatisfactory. Any unsatisfactory lab reports must be redone until a satisfactory level is achieved.

Attendance and completion of all lab material is mandatory to complete the course. Attendance at all tutorials is also compulsory.

Quizzes may be given at any time without prior notice and will be based on the current class notes, example problems and any textbook reading assigned.

COURSE TEXT

- **Introduction to Circuit Analysis**
  Walls Johnstone ISBN 0-314-93386-7

(or)

- **Circuit Analysis with Devices** 2nd Edition (or newer)
  Robbins and Miller ISBN 140187984-5

- **Laboratory Exercises, Handouts and Course Outline**