SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE NAME: Electronic Circuit Analysis and Design

CODE NO.: ELN 320

PROGRAM: Electronic Technology

SEMESTER: Five

DATE: 1993 Sept. 2

PREVIOUS OUTLINE DATED: 1993 Jan. 4

AUTHOR: Peter Szilagyi

NEW:_____ **REV.:** X

APPROVED: W. Filipowich — COORDINATOR — Sep 2/93 — DATE

_____ — DEAN — _____ — DATE

Electronic Circuit Analysis and Design	ELN 320
Course name	**Code No.**
Total credit hours:	**92**
Prerequisites:	**ELN 245 and MTH577**

PHILOSOPHY/GOALS:

This project oriented course is intended to develop the students ability to apply design and analysis techniques and reporting skills to project oriented tasks.

STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course, the student will be able to:

1. Create, print and plot electronic schematic diagrams with a computer aided design tool. (HIWIRE)

2. Design printed circuit board layout and produce PCB art master with a computer aided design tool.(SMARTWORK).

3. Import schematic diagrams and PCB layouts into Word Perfect.

4. Analyze and design electronic circuits; such as linear and pulse amplifiers, linear and switched mode power converters and pulse generators.

5. Complete all phases of an electronic circuit project, including design, manufacturing and documentation.

Electronic Circuit Analysis and Design — ELN 320

Course name — Code No.

TOPICS TO BE COVERED:

1. Schematic capture and printed circuit board design.
2. Heat-sink design.
3. Two port parameters applied to BJTs.
4. Power MOSFET transistors.
5. Linear voltage and current regulators.
6. Switched mode power supplies. (SMPS).
7. Pulse and clock generator design.

LEARNING ACTIVITIES	**REQUIRED RESOURCES**
Block 1: Schematic capture and printed circuit board design.	
- Starting and quitting Hiwire. - Basic drawing techniques. - Layers and groups. - Drawing a schematic. - Printing a schematic.	Hiwire and Smartwork software. Dongle. Mouse. IBM compatible PC. Dot matrix printer. HP 7475a plotter.
- Starting and quitting Smartwork. - Entering commands. - Placing pads and adding traces. - Manipulating text. - Block operations. - Printing and plotting a PCB.	

Block 2: Heat-sink design.

- Dissipated power in a semiconductor junction.
- The definition of the thermal resistance.
- The electrical equivalent to heat flow equations.
- Temperature rise versus dissipated power characteristics.
- Effect of waveform shape on RMS value.
- The normalized transient thermal impedance.
- Design examples.

Textbook.

Handouts.

Laboratory equipment, as outlined in handout.

Block 3: Two port parameters applied to BJTs.

- Black box theory.
- The hybrid defining equations.
- Two port, hybrid equivalent network.
- Short circuit output and open circuit input hybrid parameters.
- Two port device connected to source and load.
- CE, CB and CC hybrid equivalent circuits.
- The meaning of h_{11} , h_{12} , h_{21} , h_{22} .
- Input and output impedance, voltage gain and current gain of an amplifier.
- How to read h parameters from curves presented in data books.

Class notes.

Handouts.

Mathcad software.

Computers available in B102.

Block 4: Power MOSFET transistors.

- MOSFET structure, operation and physics.
- Advantages of power MOSFETs.
- Basic characteristics of power MOSFETs.
- Safe Operating Areas.
- Gate drive requirements.
- Gate drivers for power MOSFETs.

Motorola: Power MOSFET transistor data. (Available in college library.)

Electronic Circuit Analysis and Design — **ELN 320**

Course name — **Code No.**

LEARNING ACTIVITIES	**REQUIRED RESOURCES**
Block 5: Linear Voltage and Current regulators.	Textbook.
- Line and load regulation. - Classes of voltage regulators. - Linear shunt and series regulators. - Overvoltage and short circuit protection. - Monolithic integrated circuit regulators. - Programmable voltage regulators. - Current source and current sink regulators. - Design examples.	Class notes and handouts.
Block 6: Switched Mode Power Supplies.	
- Classes of switched power supplies. - Buck, Boost, and cascaded converters. - Continuous Current Mode (CCM) and Discontinuous Current Mode (DCM) of operation. - Voltage Mode and Current Mode topologies. - Pulse Width Modulators (PWM). - Closed loop control of SMPS. - Isolated SMPS. - The DC to DC transformer concept. - The Forward Converter. - The Flyback Converter.	Textbook. Class notes and handouts. Components for the hardware project (available in B102).
Block 7: Pulse and Clock Generator design.	
- The exponential equation of a charging capacitor. - Generators based on TTL and CMOS gates. - Generators based on Schmitt triggers. - Generators with integrated monostables. - Monolithic integrated circuit pulse generators. - Crystal clock oscillators. - Logic controlled Run-Stop oscillators. - Pulse triggered Pulse-Burst generators. - Programmable Pulse Generators. - Design examples.	Class notes and handouts.

Course name

METHOD OF EVALUATION

Four written tests will be conducted. Quizzes may be given without prior notice. Design assignments, laboratory experiments and hardware projects will carry the same weight as theory:

Tests and quizzes	160 Marks
Experiments and Projects	160 Marks
Total	320 Marks (100%)

GRADING

A+	91% - 100%
A	81% - 90%
B	71% - 80%
C	55% - 70%
R	< 55%

REQUIRED STUDENT RESOURCES

Text book: MOTOROLA; LINEAR/SWITCHMODE VOLTAGE REGULATOR HANDBOOK.

Hardware kit: Available in B102.

REFERENCE BOOKS

1. Rudolf P. Severns and Gordon Bloom, Modern DC-to-DC Switchmode Power Converter Circuits.
2. Eugene R. Hnatek, Design of Solid State Power Supplies.
3. Keith H. Billings, Switchmode Power Supply Handbook.
4. Abraham I. Pressman, Switching Power Supplies: Theory and design.
5. George C. Chryssis, High-Frequency Switching Power Supplies.
6. Motorola, Power MOSFET transistor data.

All reference books are available in the college library.