SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: Circuit Design/Research

CODE NO. : ELN-3220 **SEMESTER:** 6

PROGRAM: Electrical/Electronic Engineering Technologist

AUTHOR: PETER SZILAGYI

DATE: Jan. 2003 **PREVIOUS OUTLINE DATED:**

APPROVED:

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DEAN **DATE**

TOTAL CREDITS: 7

PREREQUISITE(S): MTH-551

HOURS/WEEK 6

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

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Understand the principles and characteristics of solid state semiconductor switches.

   Potential Elements of the Performance:
   - Sketch the current, voltage and power waveforms of a generic switch
   - Classify semiconductor switches as minority, majority and mixed carrier devices
   - Draw the output characteristics of MOSFETs, IGBTs, power BJTs and Schottky diodes
   - Design, operate and test generic solid state switches with inductive load

2. Use Hybrid parameters for BJTs

   Potential Elements of the Performance:
   - Write the hybrid defining equations
   - Convert common emitter hybrid parameters to CC and CB parameters
   - Calculate input and output impedance and gain based on hybrid parameters
   - Use MathCad, a computer method for gain and impedance calculations

3. Specify heat sinks for semiconductors

   Potential Elements of the Performance:
   - Measure the thermal resistance of a heat sink in the laboratory
   - Calculate the dissipated power for a given semiconductor
   - Calculate the required thermal resistance for a given amount of dissipated power
   - Determine the static and transient temperature rise for a semiconductor switch

4. Design Linear Voltage Regulators

Potential Elements of the Performance:

- Be familiar with Shunt and Series voltage regulators
- Use simple and fold back short circuit protection circuits
- Design digitally controlled voltage regulators
- Design voltage regulators using Linear Integrated Circuits.

5. Understand and design DC to DC converters

Potential Elements of the Performance:

- Sketch the schematics of Buck, Boost , Flyback and Cuk converters
- Draw the typical waveforms for Buck, Boost , Flyback and Cuk converters
- Analyze the circuit diagrams of each of the above converters

6. Design isolated switched mode power supplies (SMPS)

Potential Elements of the Performance:

- Sketch the schematics of Flyback and Forward
- Test an existing flyback converter, using a digital storage oscilloscope and current probes
- Identify schematic diagrams of Push-Pull, Half-Bridge and Full-Bridge power supplies.

7. Research a topic in SMPS and build a prototype SMPS

Potential Elements of the Performance:

- Complete a Library search and an Internet search to collect technical information.
- Write a Technical Report on the state of the art of SMPS
- Use a computer method to design a flyback converter.
- Apply prototyping methods to construct and test a working flyback converter.

III. TOPICS:

1. Review and classification of power electronic components
2. Characteristics and construction of solid state switches
3. Hybrid parameters
4. Heat sink design
5. Printed circuit board design and prototype manufacturing
6. Linear voltage regulators
7. Switched mode voltage regulators

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

1. Circuit Design Study Material notes and Parts Kits are sold in the Bookstore.
2. Laboratory handouts will be provided by the teacher.
2. Hiwire, Smartwork, MathCad , PSPICE, Eagle and IsoPro software is available in the computer room (B1035) and also in B1020 and B1070.
3. It is recommended, that the student downloads a free version of the above
4. Motorola Linear and Interface data book. This book is available in B1020. Component specifications can be downloaded from the Motorola web site.

V. EVALUATION PROCESS/GRADING SYSTEM:

There will be three written Tests, six Laboratory Experiments and a Research project. Each component has the following weight:

50% Theory + 25% Laboratory + 25% Research = 100%

In order to pass the course, each of the three components must be individually passed. A Laboratory Report book will be presented for marking, no later than the end of week #8 of the semester. The Research Report and Project is completed and demonstrated no later than week #14 of the semester. Late reports are only marked pass/fail.

The following semester grades will be assigned to students in postsecondary courses:

Grade	Definition	Grade Point Equivalent
A+	90 - 100%	4.00
A	80 - 90%	3.75
B	70 - 80%	3.00
C	60 - 70%	2.00
R (Repeat)	59% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field placement or non-graded subject areas.	
X	A temporary grade. This is used in limited situations with extenuating circumstances giving a student additional time to complete the requirements for a course (see *Policies & Procedures Manual – Deferred Grades and Make-up*).	
NR	Grade not reported to Registrar's office. This is used to facilitate transcript preparation when, for extenuating circumstances, it has been impossible for the faculty member to report grades.	

Upgrading:

- If a test is missed for reasons whatsoever, the grade for that test is 0, unless a credible reason is given for the absence.
- No upgrading tests will take place during the semester. All rewrites will be scheduled during the last week of the semester.
- In the case of final marks less than 60% but greater than 55%, provided an 80% or better attendance record, consideration will be given to a supplemental examination covering the whole course.
- Attendance for laboratory classes is compulsory. Attendance for all theory classes is highly recommended and recorded, but not mandatory.

VI. SPECIAL NOTES:

Special Needs:
If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your instructor and/or the Special Needs office. Visit Room E1204 or call Extension 493, 717, or 491 so that support services can be arranged for you.

Retention of course outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism
Students should refer to the definition of "academic dishonesty" in *Student Rights and Responsibilities*. Students who engage in "academic dishonesty" will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course, as may be decided by the professor. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the instructor. Credit for prior learning will be given upon successful completion of the following:

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students will be required to provide a transcript and course outline related to the course in question.