RYERSON UNIVERSITY

Department of Electrical and Computer Engineering

ELE404 - Microelectronic Circuits - Winter 2008

Course Information

www.ee.ryerson.ca/~courses/ele404/

Professors:

Name	Office	Ext.	E-mail	Counseling Hours
Dr. D. Androutsos	ENG 467	6104	dimitri@ee.ryerson.ca	Tuesdays 1pm-2pm
Dr. A. Kabbani	ENG 433	6089	adnan@ee.ryerson.ca	T.B.D

Course Coordinator: Prof. Dimitri Androutsos

Teaching Assistants:

Name	E-mail
Ali **Hesson**	ali.hesson@ryerson.ca
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Course Organization- Lecture/Lab Hours:

Lecture – **4 hrs/week**

Lab – **15 hrs total**

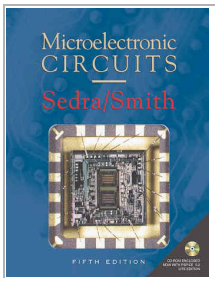
Tests – **4 Quizzes, 1 Midterm, 1 Lab Test**

Course Description:

This course provides an introduction to electronics and devices; and analysis and design of transistor amplifiers. The topics include: signal types and amplifier concepts; ideal operational amplifiers (op-amps); diodes, linear and non-linear circuit applications involving op-amps and diodes. Bipolar and field-effect transistors – physical structures and modes of operation; DC analysis of transistor circuits; transistor as an amplifier and as a switch; BJT & FET Amplifiers – small signal models, biasing and single-stage amplifiers circuits; biasing in BJT integrated circuits; differential and multistage amplifier.

Pre-requisites: All required first year courses.

Required Text:

Required Textbook	**Microelectronic Circuits, 5th Edition,** A. Sedra & K.C. Smith, **Oxford University Press, ISBN: 0-19-514251-9**	

Reference Texts:

1) ***Microelectronic Circuit Design***, RC Jaeger & T.N. Blalock, McGraw Hill, 2004
2) ***Introduction to Electronic Circuit Design*****,** R. Spencer & M. Ghausi**,** Prentice Hall, 2001

Lecture Content Outline:

Topic Descriptions	Hours	Text Sections
Introduction to Electronics - signal types & spectrum - amplifier concepts - circuit model for amplifiers	4	1.1, 1.2, 1.3, 1.4, 1.5
Linear Application of Op-Amps - the ideal op-amp - the inverting configuration amplifier - applications of the inverting amplifier - the non-inverting amplifier - instrumentation amplifiers	6	2.1, 2.2, 2.3, 2.4, 2.8.1, 2.8.2
Diodes & Basic Circuit Applications - the ideal diode & physical properties - rectifier, limiting & clipping circuits - peak detector & voltage multiplier - diode function generating & logic circuits - silicon junction diodes and diode ratings - diode models - analysis of real diode circuits	8	3.1, 3.2, 3.3, 3.4, 3.5, 3.6
Non-linear Circuit Applications (op-amps & diodes) - precision rectifier circuits - square- & triangular- wave generation	4	13.9, 13.4, 13.5
MID-TERM Exam	2	**February 12, 2008, 3-5pm**
Bipolar Junction Transistors (BJTs) - physical structure & modes of operation - the BJT as an amplifier & switch - DC biasing - small-signal models of BJTs - single & multistage BJT amplifier configurations	12	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7.
MOS Field-Effect Transistors (MOSFETs) - structure & modes of operation of e-type MOSFETS - the FET as an amplifier - DC Biasing - small-signal models of FETs - FET Current Sources (see below) - single-FET amplifier configurations with active load	8	4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7,
IC Design Philosophy & IC Biasing - MOSFET Current Sources, Current Mirrors, & *Steering Circuits* - BJT basic, enhanced & Widlar Current Sources	4	6.1, 6.3
Differential Amplifiers - The BJT Differential Pair & Amplifier - The MOS Differential Pair & Amplifier	4	7.1, 7.2, 7.3, 7.5

Course Evaluation:

THEORY*		**75%**
4 Quizzes (4 X 3% each)	12%	
Mid-Term Exam	23%	
Final Exam	40%	
LABORATORY*		**25%**
5 Labs	20%	
Lab Test	5%	
	TOTAL	**100%**

***To achieve a passing grade in the course, the student must pass both the Theory and Laboratory components of the course.**

Curriculum Content Analysis: Basic Science:**5%**; Eng. Science: **65%** & Eng. Design: **30%**

Laboratory/Quiz Schedule:

WEEK	DATE RANGE		
1	Jan 7 - 11	No scheduled Lab or Tutorial	
2	Jan 14 - 18	**LAB # 1**: *Op-Amp Linear Circuit Applications*	
3	Jan 21 - 25	**QUIZ #1**	*(Lab #1 Due)*
4	Jan 28 - Feb 1	**LAB # 2**: *Diode Circuits*	
5	Feb 4 - 8	**QUIZ #2**	*(Lab #2 Due)*
6	Feb 11 - 15	***MIDTERM***	*(No Lab or Quiz)*
7	Feb 25 – 29	**LAB # 3**: *Precision Rectifier Circuits*	
8	Mar 3 - 7	**QUIZ #3**	*(Lab #3 Due)*
9	Mar 10 - 14	**LAB # 4**: *Basic Circuit Applications of BJTs*	
10	Mar 17 - 21	**QUIZ #4**	*(Lab #4 Due)*
11	Mar 24 - 28		*No LAB or QUIZ*
12	Mar 31 – April 4	**LAB # 5**: *Basic Circuit Applications of FETs*	
13	Apr 7 - 11	**LAB TEST**	*(Lab #5 Due)*

Quizzes:

There will be **FOUR (4) quizzes** in this course that will essentially be questions taken out of the ***assigned homework problems*** (with some values changed). If you do the homework problems then you should do well in all the quizzes. We will be providing answers to all the assigned problems.

Lab Materials:

Simulation Tool (required)	Electronic Work-Bench Circuit Simulator tool and PSPice are available for students' use in **ENG 406** and **ENG 408**. For home use, a student-version of pSPICE is included with the textbook.
Lab Handouts (required)	The lab material & instructions for each lab exercise will be posted in the LABS section of the BlackBoard web page during the week prior to the scheduled lab work. It is the students' responsibility to access, and print, the lab material from the website on a timely basis.
Lab Kit (required)	**Will be sold on:** DATE: Thursday January 11, 2008 **TIME**: 10:30 AM- 4:30 PM PLACE: Room ENG310 ELE 404 kit is **$60.00 including Tax**. See BlackBoard page for details.

	Lab 1	Quiz 1	Lab 2	Quiz 2	Lab 3	Quiz 3	Lab 4	Quiz 4	Lab 5	Lab Test	*Lab Supervisor*
S 1	Jan 16	Jan 23	Jan 30	Feb 6	Feb 27	Mar 5	Mar 12	Mar 19	Apr 2	Apr 9	A. Kabbani
S 2	Jan 18	Jan 25	Feb 1	Feb 8	Feb 29	Mar 7	Mar 14	Mar 21	Apr 4	Apr 11	R. Rzeszutek
S 3	Jan 16	Jan 23	Jan 30	Feb 6	Feb 27	Mar 5	Mar 12	Mar 19	Apr 2	Apr 9	B. Okeke
S 4	Jan 17	Jan 24	Jan 31	Feb 7	Feb 28	Mar 6	Mar 13	Mar 20	Apr 3	Apr 10	A. Hesson
S 5	Jan 14	Jan 21	Jan 28	Feb 4	Feb 25	Mar 3	Mar 10	Mar 17	Mar 31	Apr 7	R. Rzeszutek
S 6	Jan 17	Jan 24	Jan 31	Feb 7	Feb 28	Mar 6	Mar 13	Mar 20	Apr 3	Apr 10	B. Okeke
S 7	Jan 14	Jan 21	Jan 28	Feb 4	Feb 25	Mar 3	Mar 10	Mar 17	Mar 31	Apr 7	A. Hesson

★Special Instructions READ CAREFULLY:

- Each Lab experiment consists of pre-lab assignment & lab measurements. An important part of the pre-lab requirement is that each student must simulate the lab circuits using the EWB Simulation Tool or pSPICE prior to the lab work. Complete pre-lab for each student will be graded at the **beginning** of each Lab period. **A student that has not attempted the pre-lab will not be allowed to perform the actual lab experiment and will be required to leave the laboratory and consequently receive a mark of ZERO for that lab**. Lab work and results for each Lab Group will be assessed by the end of the Lab period. **A short-form report per group is due during students' scheduled lab period the week following each lab experiment**. Refer to the instructions provided with the lab experiment.
- **Lab Reports that are handed in late will receive a penalty of 25% per day (including weekends). The lab is due ONE week after your lab is performed, during the scheduled tutorial time. Any lab handed to TAs after that time slot is considered late. Any labs that have been slid under any professor's or TA's door, or given to the front office, or any other method in which you or your partner do not hand the lab write-up to the TA directly, will get an automatic ZERO.**
- **All the required course specific written reports will be assessed not only on their technical or academic merit, but also on the communication skills of the author(s) as exhibited through these reports.**
- If there is any change on the laboratory schedule or lecture topics, announcement will be made in the lecture and/or through the ELE404 Course Web page.

IMPORTANT NOTES:

- **It is the student's responsibility to inform the professors, within the first TWO weeks of class, of any religious observances that conflict with important course dates. No accommodation will be made if these conflicts are not brought to our attention within the first TWO weeks.**
- **It is the students' responsibility to regularly check the course web page for updates and announcements**
- **If you miss any significant dates for valid medical reasons, then you must fill out a medical form at the front office of the Department of Electrical & Computer Engineering ENG 478.**

NOTE: Ryerson University Policy

- "All of the required course specific written reports will be assessed not only on their technical or academic merit, but also on the communication skills of the author as exhibited through these reports."
- "All students are required to activate and maintain a Ryerson University central Matrix e-mail account which shall be an official means by which they will receive University communications." It is also recommended that, where possible, students utilize these account for communicating with their instructors.