Analog Design
(1MEI104)

January-June 2002
18-20 hrs Mondays and Wednesdays
Classroom E13

Instructor Information

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General Description

This course will enable students to analyze and design analog electronic circuits. Semiconductor device behavior is reviewed for deriving suitable models based on equivalent circuits. Emphasis is made on the fundamental building blocks for developing analog integrated circuits as well as on VLSI techniques for analog circuits. The use of simulation software and practical implementations in the laboratory will be emphasized through out the course. An introductory research project will be realized through out the course.

Prerequisites

No previous graduate course is required.

Objectives

By the end of the course the student will be able to:

A. Derive the main electrical features of p-n junctions based on semiconductor and electromagnetic theory (ANALYSIS)

B. Identify the fundamental principles of semiconductor theory for device modeling (COMPREHENSION)

C. Explain the origin of circuit equivalent models of electronic devices and use them in practical applications (APPLICATION)

D. Design single and multistage amplifiers implemented with bipolar transistors as well as with field

effect transistors (SYNTHESIS)

E. Calculate the frequency response of single and multistage amplifiers (ANALYSIS)

F. Efficiently analyze feedback amplifiers (ANALYSIS)

G. Optimize the performance of feedback amplifiers (SYNTHESIS)

H. Analyze the stability of amplifiers and apply frequency compensation techniques (ANALYSIS)

I. Emulate the behavior of artificial neural networks using discrete analog implementations (SYNTHESIS)

J. Calculate the performance of the typical building blocks used in analog integerated circuits: current mirrors, current sources and sinks, active resistors and loads, voltage and current references (ANALYSIS)

K. Analyze power amplifiers and output stages typically used in integrated circuits (ANALYSIS)

L. Verify the behavior of electronic circuits using simulation software (APPLICATION)

M. Use measurement instruments to characterize simple electronic systems (APPLICATION)

N. Implement in the lab some electronic circuits previously analyzed, and contrast measurements with theoretical predictions (ANALYSIS)

O. Review a topic on analog VLSI techniques, write a report and make a technical presentation (EVALUATION)

P. Research on a practical application of analog electronic circuits and write a technical report (EVALUATION)

General Contents

1. Basic semiconductor theory
2. Device modeling
3. Fundamental amplifier configurations
4. Frequency response
5. Feedback
6. Electronic Neural Networks
7. Current mirrors
8. Current sources and sinks
9. Active resistors and loads
10. Voltage and current references
11. Output stages

12. Multistage amplifiers

Relationship between Contents and Objectives

	1	2	3	4	5	6	7	8	9	10	11	12
A	√	√										√
B	√											
C		√	√									
D			√									
E				√								
F					√							
G					√							
H					√							
I						√						
J							√	√	√	√		
K											√	
L		√	√	√	√	√	√	√	√	√	√	√
M						√	√	√	√	√	√	
N						√	√	√	√	√	√	
O							√	√	√	√	√	√
P						√						

Course Skeleton

For the proposed course skeleton it is assumed: a group of 5 to 15 students; 2 sessions per week, 2 hours long each, during 16 weeks; laboratory available 8 hours a day, from Monday to Friday; simulation software available at ITESO and/or at home (WinSpice, Electronic Workbench, OrCad, or any other similar circuit simulator).

It is also expected that the student will be able to dedicate an average of 10 hours of work per week to this course, including attending classes.

Week	Activity	Week	Activity
1		9	
2		10	
3	Exam 1 (Contents 1 and 2)	11	Exam 3 (Contents 5)
4		12	Contents 6
5		13	Presentations on contents 7 and 8
6		14	Presentations on contents 9 and 10
7	Exam 2 (Contents 3 and 4)	15	Presentations on contents 11 and 12
8		16	Research project

Assessment

The overall grade in this course will be built from the following elements:

3 Exams	50%
1 Technical presentation	30%
1 Research project	20%

The exams will be applied during class, and will have a duration of 1 hour and 50 minutes each.

Each student will make a technical presentation on a topic on analog VLSI techniques, and write a report. Depending on the selected topic and the class size, the presentation can be realized individually or in teams of 2-3 students. The report must be hand in on the day of the presentation, with copies for the rest of the students. The presentation and the report will be evaluated not only by the instructor but also by the classmates. The presentations are scheduled as indicated in the course skeleton. Further instructions about the technical presentations will be explained later.

Missed exams and presentations can not be made up.

Each student will develop a research project during the course. A relevant topic will be proposed by the instructor, but the students can suggest alternative topics. The research report must be supported by computer simulations and lab measurements. More information about the research project will be presented later in the course.

Assignments will be suggested for the student to test their comprehension of concepts and their ability to analyze and design electronic circuits. These assignments will not be graded. It is strongly suggested to the students to solve these problems, since they are fundamental in the learning process.

Teaching Methods

This course will use a variety of teaching methods including: lecturing, self-conducted research work, computer simulations, project report writing, assignments, readings and seminars.

Important information related to the course will be posted in the instructor's web site through out the semester. Open and frequent communication with the instructor is encouraged. Collaboration between the students is also encouraged.

The course will be conducted mainly in Spanish, but some of the lectures and discussions will be held in English. Most of the written material for the course will be available in English. The lab reports can be submitted in either English or Spanish.

References and Other Resources

Analysis and Design of Analog Integrated Circuits, 4th Edition
Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer
Wiley, 2001

VLSI Design Techniques for Analog and Digital Circuits
Randall L. Geiger, Phillip E. Allen and Noel R. Strader
McGraw Hill, 1990

Analog VLSI signal and information processing
Mohamed Ismail, Terri Fiez
McGraw-Hill, 1994

Analog MOS Integrated Circuits
P.R. Gray, D.A. Hodges, R.W. Brodersen.
IEEE, 1980

Analog Integrated Circuit Design
D.A. Johns and K. Martin
Wiley, 1997

Integrated Electronics
J. Millman and C.C. Halkias
McGraw Hill

Microelectronic Circuits
Adel S. Sedra and Kenneth C. Smith
Oxford University Press

Microelectronic Circuit Design
Jaeger, Richard C.
McGraw-Hill

Instructor's web site
http://iteso.mx/~erayas

Sedra/Smith web site
http://www.oup-usa.org/sc/0195116631/sedrasmith.org

Multisim circuit simulator from Electronics Workbench's
http://www.electronicsworkbench.com

Microelectronics Laboratory Using Electronics Workbench (EWB)
IEEE Self-Study Course
Muhammad Rashid, University of West Florida
2000, ISBN 0-7803-4804-4
IEEE Online Catalog: customer-service@ieee.org

Micro-Cap spice circuit simulator
http://www.spectrum-soft.com/

WinSpice circuit simulator
http://www.winspice.com/

On line internet seminars on electronics
http://www.netseminar.com/
http://www.techonline.com/

NOTA: En caso de alguna dificultad o confusión respecto de este programa de estudios (por estar en idioma inglés), favor de consultar directamente con el profesor.