

## 1 Instructor

**Dr. Stefano Gregori.** THRN 222, 519-824-4120 ext. 56191, sgregori@uoguelph.ca. Office hours posted on the course web page, other times by appointment.

## 2 Laboratory coordinator

**Mr. Ben Beacock.** THRN 2308, 519-824-4120 ext. 53729, bbeacock@uoguelph.ca.

## 3 Meetings

**Lectures.** Tuesdays and Thursdays, 08:30 to 09:50, ROZH 108.

**Laboratories.** Tuesdays and Thursdays, 16:00 to 17:20, THRN 2336.

## 4 Materials

**Textbook.** B. Razavi, *Design of analog CMOS integrated circuits*, McGraw-Hill, 2001.

**References.** The books below are available on course reserve in the library. Additional references are indexed by library call numbers TK7800 to TK8360.

- B. Razavi, *Fundamentals of microelectronics*, Wiley, 2007.
- F. Maloberti, *Analog design for CMOS VLSI systems*, Kluwer, 2001.
- A. S. Sedra, K. C. Smith, *Microelectronic circuits*, Oxford, 5th ed., 2004.
- R. C. Jaeger, T. N. Blalock, *Microelectronic circuit design*, McGraw-Hill, 3rd ed., 2006.
- A. R. Hambley, *Electronics*, Prentice Hall, 2000.

## 5 Prerequisites

**Topics.** Success in this course requires a good understanding of the mathematical tools for describing engineering systems, of the techniques for electric circuit analysis, and of the fundamentals of electronics. If you do not have this background, you will have to bring yourself up to speed. Please contact me, I will be happy to talk to you about your prospects.

**Courses.** As stated in the Undergraduate Calendar.

## 6 Description

This course explores the basic ideas and techniques in analysis and design of analog integrated circuits (IC's) in CMOS technology. The main emphasis is on device models, circuit operation, and design techniques. The course begins with a short introduction of device physics, CMOS technology, MOS transistor, noise, and analog circuit modeling. The properties of integrated resistors, capacitors, and analog switches are presented next. The course includes the design of basic building blocks, such as current mirrors, gain stages, differential pairs, differential to single ended convertors, and output stages, leading to the design of operational amplifiers and comparators. Discussion will cover aspects such as dc biasing, compensation techniques, low-noise design, slew rate, settling, low-power design, and layout techniques.

## 7 Learning objectives

After successfully completing the course you will be able to describe operating principles and performance characteristics of analog IC's and to apply the studied concepts to the analysis of engineering systems including analog IC's. To this purpose you will learn to:

- Identify terms, quantities, and models used by engineers for describing IC's.
- Make use of techniques and skills for analyzing and designing analog IC's.
- Comprehend the importance of circuit structures, physical and technological parameters, layout construction, and device modeling.
- Conduct analysis and simulations, interpret results, and improve design of analog IC's.
- Communicate effectively about specifications, design, simulation, testing, and applications of analog IC's.

## 8 Approach

Lectures focus the attention on important points and significant relationships, clarify concepts, and present examples. You are encouraged to study the textbook, explore the reference material, and come to class prepared to engage with examples.

Homework will be assigned but not graded. Homework are for your instruction and enjoyment and they are a useful practice in preparation for the tests. Working through the assignments and then comparing your results with the solutions is strongly recommended.

There will be two written tests, meant to probe the understanding of the material at hand with pen-and-paper numerical problems and conceptual questions. The course has also a laboratory component based on industry-grade software tools, divided into two laboratory sessions. You will practice with software tools and simulations and you will be required to complete the corresponding two laboratory reports.

Any student not taking a test receives a grade of zero. Any student not taking part to a laboratory session or not handing in a laboratory report receives a grade of zero. There are no makeup tests and late submissions are not accepted for marking. In case you have a legitimate reason for missing a test or a laboratory, or for handing in a report late, I may consider an accommodation upon presentation of a written request and suitable documentation before the date of the test or the laboratory.

## **9 Evaluation**

The breakdown for grading the whole course is as follows.

Test 1	30%
Test 2	30%
Laboratory 1	20%
Laboratory 2	20%

## **10 Obtaining help**

You can obtain help from me during my office hours and after lectures. Please come and talk to me if you need help or you have fallen behind in your work. I am willing to put in as much effort to help you as you are willing to put in to help yourself. I am happy to work with you on difficult concepts and hear your suggestions for ways to make the course better. If you are not free during our office hours, then email me with some days and times you are available, and I will schedule an appointment that works for both you and me.

You will benefit greatly from getting together regularly with your classmates to study and work together on problems. I encourage such collaboration. Talking about the material with other students is a great way to understand it and to develop confidence about your understanding.

Help is available, please be informed about the following services. If you are ill, call the Student Health Services or a medical doctor. If you have emotional, family, or living environment problems that affect your ability to study, visit the Counselling Services or your academic advisor. For disabilities or temporary disabilities contact the Centre for Students with Disabilities. I have made every effort to avoid conflicts with religious obligations. If there is a discrepancy, please contact me as soon as possible.

## **11 Scholastic integrity**

The value of an academic degree depends on the integrity of the work done by you to earn that degree. It is imperative that you keep a high level of honor in your work. The policies on scholastic dishonesty reported in the Undergraduate Calendar will be enforced.

I invite you to familiarize yourself with your responsibilities outlined in the Undergraduate Calendar and with the School of Engineering Code of Ethics. I recommend that you review the tutorial available on <http://www.webshops.uoguelph.ca/AcademicIntegrity/> and that you discuss with me any question that you may have.

## **12 Communications and accuracy of records**

Communication is through announcements in class. It is your responsibility to keep yourself informed about the course. Some information will be posted on the course web page or sent through email messages to your student email address. It is your responsibility to check these sources.

## **13 Disclaimer**

I reserve the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph academic regulations.