Course Description: Design techniques for analog integrated circuits. The primary focus of this course is CMOS. Emphasis will be placed on the design of the fundamental circuits required for analog signal processing. Students will be expected to design and test several design problems. All students are expected to work on a sizeable project that comprises a significant percentage of the final grade. The objective of this course is to provide the basic design concepts and tradeoffs involved in analog integrated circuit design.

Course outline:

<table>
<thead>
<tr>
<th>Lecture Time (weeks)</th>
<th>Book Chapters</th>
<th>Course</th>
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<tbody>
<tr>
<td>I. Introduction to analog design</td>
<td>(chap 1)</td>
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<td>II. Basic MOS device physics</td>
<td>(chap 2)</td>
<td>II.</td>
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<td>III. Single-stage amplifiers</td>
<td>(chap 3)</td>
<td>III.</td>
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<td>IV. Differential amplifiers</td>
<td>(chap 4)</td>
<td>IV.</td>
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<td>V. Current mirrors and biasing techniques</td>
<td>(chap 5)</td>
<td>V.</td>
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<td>VI. Frequency response of amplifiers</td>
<td>(chap 6)</td>
<td>VI.</td>
<td>1.5</td>
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<td>VII. Noise</td>
<td>(chap 7)</td>
<td>VII.</td>
<td>1.5</td>
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<td>VIII. Feedback</td>
<td>(chap 8)</td>
<td>VIII.</td>
<td>1.5</td>
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<td>IX. Operational amplifiers</td>
<td>(chap 9)</td>
<td>IX.</td>
<td>1.0</td>
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<td>X. Stability and frequency compensation</td>
<td>(chap 10)</td>
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<td>1.0</td>
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<td>XI. Nanometer design studies</td>
<td>(chap 11)</td>
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Text: Design of Analog CMOS Integrated Circuits, 2nd Edition
Behzad Razavi
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Tony Chan Carusone, David Johns & Ken Martin
John Wiley & Sons, Inc. 2011

Used books: http://www.abebooks.com/, www.amazon.com and our books store often has used books.
Homework Assignments:
LATE HOMEWORK WILL NOT BE ACCEPTED! Some of the homework assignments will require circuit simulation on
the computer. Students will be expected to design and test one or more design projects. Students are expected to
use Cadence for circuit design and layout (Cadence support will be provided only by the TA if there is one). Some of
the hand calculations can get quite complex and so it is recommended that you get hold of some symbolic analysis
program on a computer. Examples of such symbolic analysis programs include: Mathematica, MathCAD, MAPLE,
MathType, etc. I personally use MathCAD the most. The purpose of the homework is to build upon your
understanding of course concepts and to develop analog circuit design skills. The Institute of Technology makes
Mathematica available to its students. Please, check http://it.umn.edu for more information.

Projects:
All along the quarter students are expected to work on a project of significant size. You are expected to work on a
single project. As these projects make up a significant proportion of your final grade, students are advised to start
thinking of topics for their final project immediately. All students have to design an opamp as their first project. You
will have to complete circuit design, i.e., everything that is necessary to get your design fabricated at an IC foundry.
More details about the project will be provided in a separate handout.

Computer use:
Students are expected to use LTSpice/PSpice/Cadence for design problems. Directions for accessing LTSpice, Cadence
tools & HSPICE are provided on the course website. Example designs are also provided for your convenience.
Students are expected to either already know SPICE or are expected to learn SPICE on their own. It will not be
explicitly taught in class. So if you do not already know SPICE, start learning it at the earliest. Take a look at the
course website for information regarding introductions to SPICE.

Grading policy:
- Homework assignments 15%
- Midterm I examination 25%
- Midterm II examination 25%
- Project proposal 5%
- Interim project report 10%
- Final project report 20%

Exam timings:
- Midterm I examination Tuesday, Oct 16th (in class)
- Midterm II TBD

Project related dates:
- Project proposal due Tuesday, September 25th
- Interim project report due Thursday, November 8th
- Final project report due TBD