Analog Circuit Sequence
Why is Analog Important?

- Naturally occurring signals are analog
- Analog circuits are required to amplify and condition the signal for further processing
- Performance of analog circuits often determine whether the chip works or not
- Examples
  - Sensors and actuators (imagers, MEMS)
  - RF transceivers
  - Microprocessor circuits (PLL, high-speed I/O, thermal sensor)

[Silva]
Integrated Circuits

- 4-core Microprocessor (45nm CMOS)
  - Mostly Digital
  - Noteable analog blocks
    - PLL, I/O circuits, thermal sensor

- Cellular Transceiver (0.13μm CMOS)
  - Considerable analog & digital

- Instrumentation Amplifier (0.5μm CMOS)
  - Mostly Analog
  - Some Digital Control Logic
The Power of CMOS Scaling

- Scaling transistor dimensions allows for improved performance, reduced power, and reduced cost/transistor
- Assuming you can afford to build the fab
  - 32nm CMOS fab ~3-4 BILLION dollars
Course Topics

• Linear circuit analysis
  • Laplace transform basics
  • Bode Plots

• OpAmp Circuits
  • Opamp Properties
  • Amplifiers and basic filters

• Non-linear circuits
  • Large signal model
  • Small signal model
  • Diodes, BJTs, MOSFETs
Course Goals

• Learn how to analyze and simulate linear and non-linear circuits
  • Linear analysis → Laplace transforms, Bode plots
  • Nonlinear analysis → Linearize about a DC operating point to find AC small-signal response
  • Circuit simulation basics (PSPICE)

• Understand fundamental analog device properties
  • OpAmps, Diodes, BJTs, MOSFETs

• Learn amplifier properties and how to analyze/build multi-stage amplifier circuits
  • “Build” component is emphasized in lab and project
Administrative

• Instructor:
  • Sam Palermo
  • 315E WERC Bldg., 845-4114, spalermo@ece.tamu.edu
  • Office hours: MW 1:00pm-2:30pm

• Lectures: TR 8:00am-9:15pm, ETB 1037

• Recitation: W 3:00pm-4:00pm, ETB 1034
  • Recitation begins first week

• Class web page
  • http://www.ece.tamu.edu/~spalermo/ecn325.html

• Prerequisite
  • ECEN 314 (co-registration)
Class Material


- References
  - *Class Notes*, J. Silva-Martinez. **(Main Reader)**
  - *Class Notes*, A. Karsilayan. **(Excellent Condensed Notes)**
  - Material is posted on website

- Lab
  - Lab kit is required (MSC Bookstore)
  - Lab start date is TBD
    - Go ahead and look at Prelab 1 & 2, as these labs will probably be combined
  - Recommend buying personal breadboard and one lab kit per person

- Lectures
  - ~25% slides, with previous semester’s notes posted on website
  - ~75% delivered on whiteboard
Grading

• Exams (60%)
  • Three midterm exams (20% each)

• Homework/Quizzes (10%)
  • Collaboration is allowed, but independent simulations and write-ups
  • Need to install PSPICE on your laptop/computer
  • Due in my mailbox near WERC 315E by 5PM of due date
  • No late homework will be graded
  • Quizzes will be given in recitation and weighted equally with homework

• Laboratory (20%)

• Final Project (10% + 2%)
  • Report with measured results required
# Preliminary Schedule

<table>
<thead>
<tr>
<th>Topic</th>
<th>Week</th>
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<tbody>
<tr>
<td>I. Introduction to electronics</td>
<td>Week 1-4</td>
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<tr>
<td>II. Circuit analysis and bode plots</td>
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<tr>
<td>III. Operational amplifiers and circuit analysis</td>
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<tr>
<td>Review session (30 min.)</td>
<td>Feb. 17</td>
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<tr>
<td>1st MIDTERM</td>
<td>Feb. 19</td>
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<tr>
<td>IV. Diode and bipolar device models</td>
<td>Week 5-8</td>
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<td>V. Concepts on input and output impedances and transmission gain</td>
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<td>VI. Basic and multi-stage amplifiers</td>
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<tr>
<td>Review session (30 min.)</td>
<td>Apr. 2</td>
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<tr>
<td>2nd MIDTERM</td>
<td>Apr. 7</td>
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<tr>
<td>VII. Field-effect (MOS) transistors</td>
<td>Week 9-12</td>
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<tr>
<td>VIII. Basic and multi-stage amplifiers</td>
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<tr>
<td>IX. Differential amplifiers</td>
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<tr>
<td>Review session (30 min.)</td>
<td>Apr. 30</td>
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<tr>
<td>Project Report Due</td>
<td>May 5</td>
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<tr>
<td>3rd MIDTERM</td>
<td>May 8 (1:00PM-3:00PM)</td>
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*Exam dates are approximate and subject to change with reasonable notice.

- Dates may change with reasonable notice.
Reading & Homework

• Fundamentals of Circuit Analysis (Dr. Silva)
• 1.1, 1.2, App. D, E, F (Sedra/Smith)

• Homework 1 is posted on website and due 2/3/2015