**EE P 538 Advanced Analog IC Design**
University of Washington Electrical & Computer Engineering
Summer Quarter 2021

**Course Syllabus**

**Lectures:** TBD

**Instructor:** Jason Silver
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Office hours: TBD

**Teaching Assistant:** TBD
Email: TBD
Office Hours: TBD

**Required Textbook:** B. Razavi, *Design of Analog CMOS Integrated Circuits*, 2nd Ed, McGraw-Hill, 2016.

**Recommended textbook:** Gray, Hurst, Lewis, Meyer, *Analysis and Design of Analog Integrated Circuits*, 5th Ed, Wiley, 2009.

**Additional references:** R. Jacob Baker, *CMOS: Mixed-Signal Circuit Design*, 2nd Ed, Wiley, 2008.

Carusone, Johns, Martin, *Analog Integrated Circuit Design,* 2nd Ed, Wiley, 2011.

**Course Description:**
In this course we will explore advanced topics in analog and mixed-signal circuit integrated circuit design. Beginning with a review of MOS transistor physics and single-stage amplifiers, we will progress quickly to OTA and operational amplifier design with common-mode feedback and frequency compensation. We will conduct an in-depth treatment on noise (thermal and flicker) and mismatch in amplifiers and learn how to design circuits to achieve specific performance targets under realistic design constraints (e.g. power dissipation, circuit area).

Weekly assignments, typically comprising a single problem, will be given in which students conduct "hand" analysis of a given circuit architecture. Alongside the weekly assignments, students will use CAD tools to design and simulate analog integrated circuit blocks to meet noise, bandwidth, linearity, and power specifications, and verify their designs in Cadence. Supplemental references (typically engineering publications) will be provided as needed.

Students should be very comfortable with conducting basic linear circuit analysis (Kirchoff's and Ohm's laws, Thevenin/Norton equivalent circuits). Students should be familiar with transistor operation (FET and/or BJT) and should be comfortable with large- and small-signal analysis of transistor circuits. Familiarity with mathematical concepts related to engineering (Fourier/Laplace transforms, complex numbers) is required.

After completing the course, students will have developed the insight and experience essential to the design and evaluation of analog circuits for mixed-signal data acquisition systems.

**Tentative Schedule:**

| **Week** | **Topic** | **Reading** |
|---|---|---|
| 1 | MOS Physics and Operation | Razavi 2 |
| 2 | Single-Stage MOS Amplifiers | Razavi 3, 6 |
| 3 | Current Mirrors and Bias Circuits | Razavi 5 |
| 4 | Opamps and OTAs | Razavi 9 |
| 5 | Noise | Razavi 7 |
| 6 | Switched-Capacitor Circuits | Razavi 13 |
| 7 | Nonlinearity and Mismatch | Razavi 14 |
| 8 | TBD | |
| 9 | TBD | |

**Design Project:**

Several design projects will be assigned throughout the quarter. Projects will involve design and simulation (using Cadence design software) of analog integrated circuits toward written specifications. *Tentatively*, students will conduct brief (approximately 5 minutes) design review presentations to allow them to share their design with and receive feedback from the instructor and other students.

**Grading:**

- Weekly Assignments: 40%
- Midterm Exam 20%
- Design Projects: 40%

Please submit your work by the assigned due dates. Scores for late submissions will decrease by 1dB per day following the deadline unless arrangements are made prior to the due date. No exceptions.