ECE 415/515 –ANALOG INTEGRATED CIRCUIT DESIGN

COURSE INTRODUCTION

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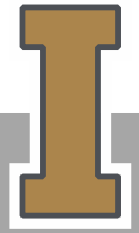
College of Engineering

COURSE OUTLINE

Course Site : http://lumerink.com/courses/ece515/f18/ECE515.htm



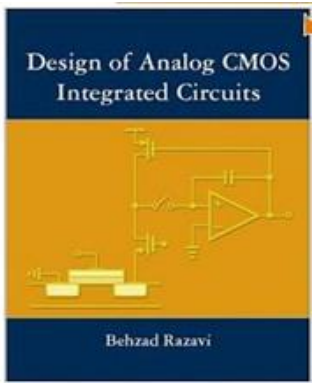
COURSE TOPICS

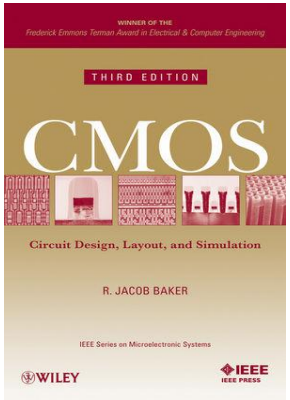
- CMOS transistor models
- Advanced current mirrors and biasing, review of amplifiers.
- Opamps: frequency compensation, negative feedback and stability, half circuit analysis.
- Voltage references (bandgap reference) and regulators.
- Fully-differential Opamp design and simulation.
- Noise, mismatch, and distortion in analog circuits.
- Analog layout considerations (if time permits)

Prerequisites – ECE 410 or permission.

REFERENCES

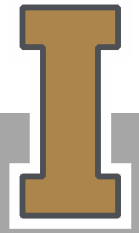
- Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill, 2002
- Additional Reference:
- CMOS Circuit Design, Layout and Simulation – R. J. Baker, 3nd Edition, Wiley-IEEE, 2010 For detailed references and handouts see this course site.





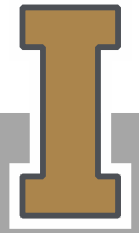
COURSE PEDAGOGY AND GRADING

- Combination of lecture notes and slides
  - Lecture notes to be posted online
  - Additional slides, Matlab code etc. will also be posted on the site
- Workload (Grading)
  - Homeworks (20%)
  - Midterm Exam 1 (20%)
  - Midterm Exam 2 (20%)
  - Design Project (20%)
  - Final (20%)
- Cadence is used for design-based HWs and Projects



COURSE POLICIES

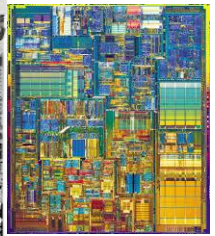
- No late work
- Neither the final exam nor final project will be returned at the end of the semester
- No internet surfing in class on any device
- Plagiarism and outsourcing (!) of work is not acceptable (See UoI Policy).
- See detailed policies on the course site



WHY ANALOG? – THE MYTHS

Analog

Digital



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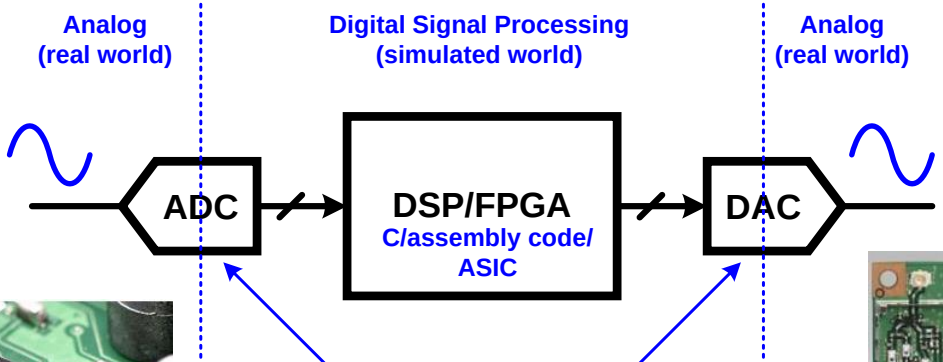
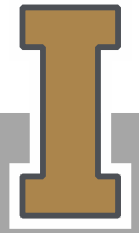
WHY ANALOG CIRCUITS?



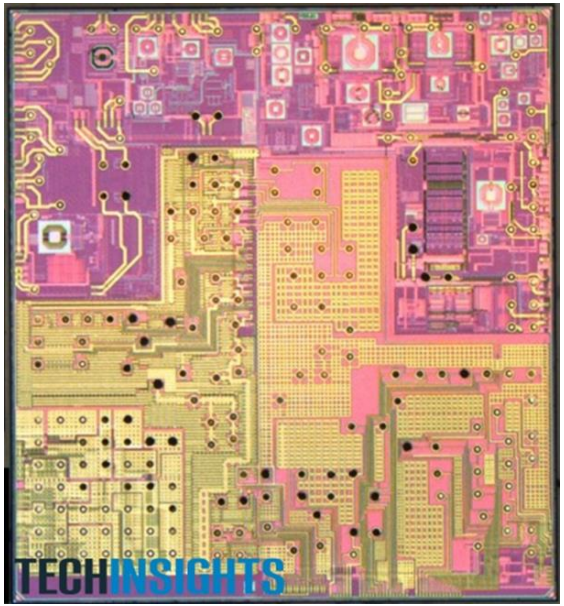
- Real world is analog.
- Digital world: Discrete-time, discrete-amplitude signal representation.
  - Interface circuits: ADC and DACs.
- High speed signal processing circuits are analog (Serial IOs, 60 GHz RF)

ANALOG CIRCUITS IN MODERN VLSI SYSTEMS

- Analog to digital conversion (ADCs)
- Digital to analog conversion (DACs)
- Amplification and filtering
- Signal processing circuits at high frequencies
  - RFICs, Serial I/O, optical transceivers, etc.
- Power management-voltage references, voltage regulators
- Clock generation circuits (PLLs/CDRs)
  - The last two are found even on many “digital” ICs

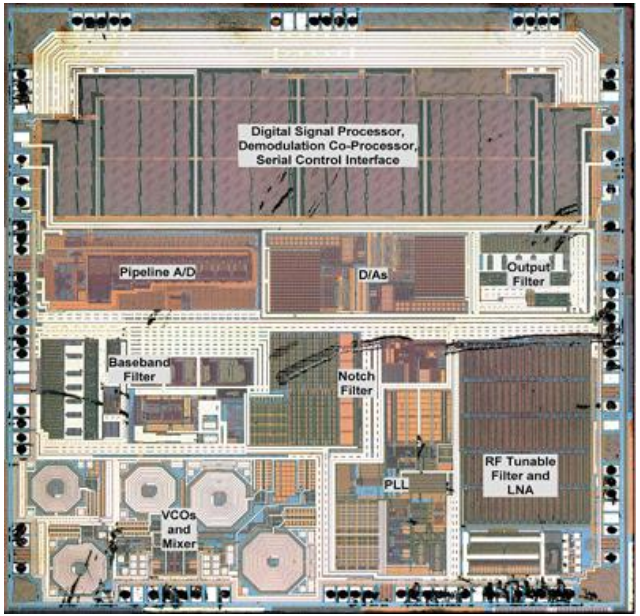


ANALOG CIRCUITS IN ACTION



BCM 4330 – Mobile Wireless

Single-band 2.4 GHz 802.11 b/g/n or dual-band 2.4 GHz and 5Ghz 802.11 a/b/g/n Integrated ARM® Cortex™-M3 processor and on-chip memory.



XC3028 TV Tuner Chip

Single-chip analog and digital TV tuner showing the fully integrated RF-to-baseband functional blocks.

ANALOG COURSES AT UI

ECE 410
- Microelectronics II

ECE 515
–Analog IC Design

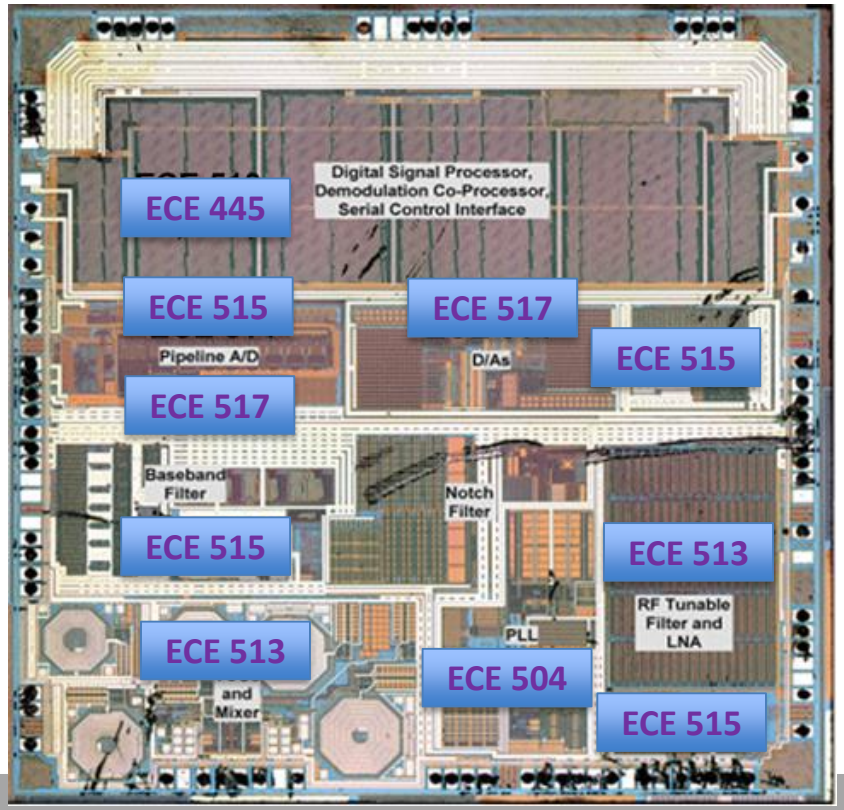
ECE 517
– Mixed-Signal IC Design

ECE 519
– CMOS Imager Design

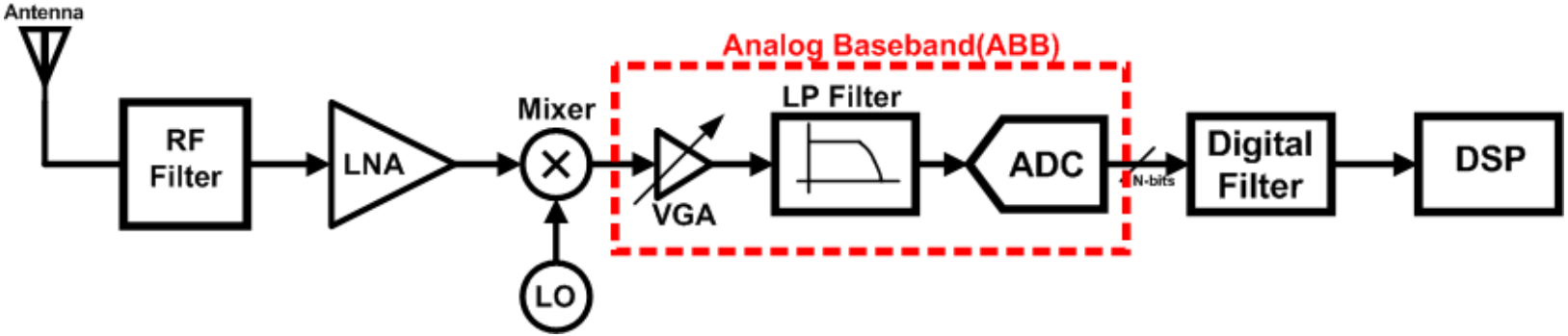
ECE 513
– RF IC Design

ECE 504
–PLL and High-speed Link Design

ECE 504-X
– Other Advanced Topics in IC Design

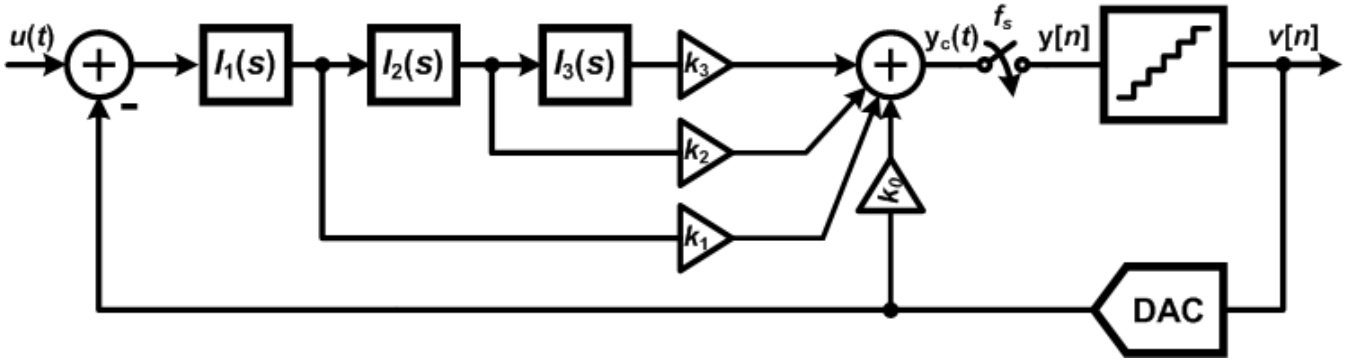


SYSTEM LEVEL VIEW – A RADIO RECEIVER



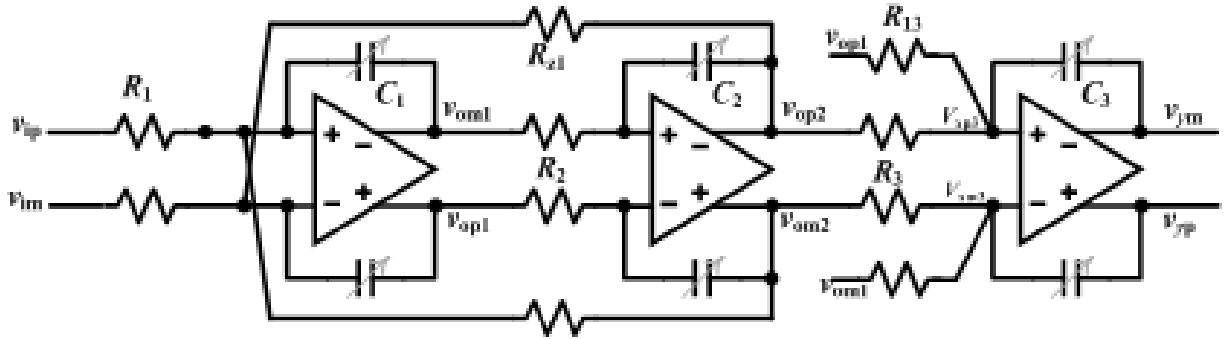
- Top-down approach is used in system design.
- Scope:
  - MS or PhD Thesis
  - System-on-a-chip Product

BLOCK LEVEL VIEW – A DELTA-SIGMA ADC



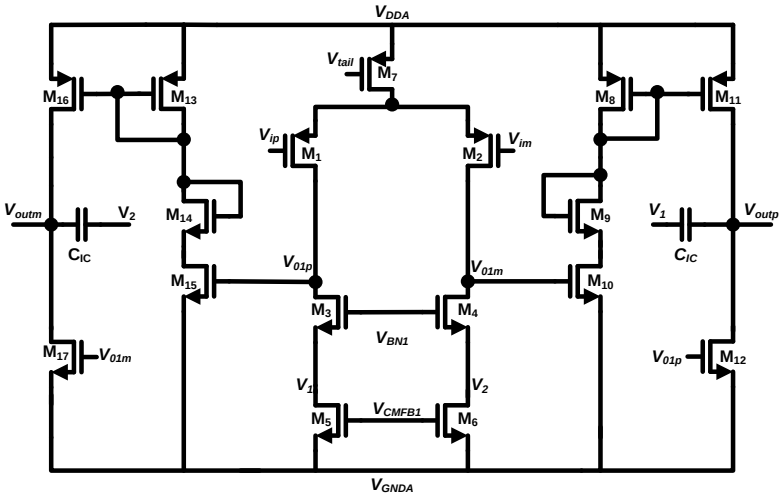
- Scope:
  - Mixed-Signal IC Design (ECE 5/417)

CIRCUIT LEVEL VIEW – A LOOP-FILTER



- Scope:
  - Analog IC Design (ECE 5/415)
  - Mixed-Signal IC Design (ECE 5/417)

TRANSISTOR LEVEL VIEW – AN OPAMP



- Scope:
  - ECE 410 and ECE 4/515
  - In this course, we will learn the basics of transistor-level analog design.

CHIP AND PCB VIEW