# ECE 4/517 MIXED SIGNAL IC DESIGN

## LECTURE 1 SLIDES

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College of Engineering

# COURSE OUTLINE

**Instructor** : Vishal Saxena
**Email** : vsaxena AT uidaho DOT edu
**Time** : Tue and Thu, 9:30-10:45 AM
**Course dates** : Jan 12, 2017 – May 4, 2017
**Location** : JEB 26 (*Please note the change of place*)
**Office Hours** : Tue & Thu 11:15 AM-12:15 PM (or by appointment), BEL 318
**Holidays** : Spring Break
**Final Exam time**: Friday, May 12, 7:30-9:30 AM
**Course Site** : http://lumerink.com/courses/ece517/s17/ECE517.htm
**Piazza Site** : https://piazza.com/uidaho/spring2017/ece517/home

# COURSE TOPICS

- Data Conversion and spectral estimation fundamentals
- Review of Switched Capacitor Circuits, Sample-and-hold, Comparators
- Nyquist rate ADCs: Flash, SAR, Pipelined, Time-interleaved ADCs.
- High-speed Link design issues: Driver Circuits, Equalizers, PAM signaling, ADCs for high-speed links.
- *Note: This is an advanced elective course. It is important that the students have a good understanding of Analog and Digital Circuit fundamentals.*

# PREREQUISITES

Analog IC Design Basics (ECE 410: Advanced Electronics)

- MOS amplifier design, including operation amplifiers, biasing, and stability analysis; advanced use of HSPICE
- Knowledge of material in ECE 4/515 is recommended

Undergrad-level Signals and Systems

- Fourier, DTFT, Laplace, z-transforms, poles and zeros. Matlab scripting.

Transistor-level circuit details are covered in ECE 4/515 Analog IC Course

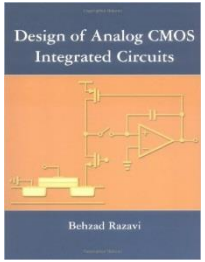
Can review material online on the course sites:

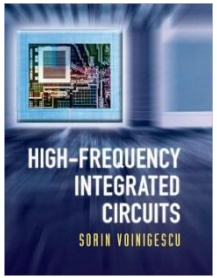
- CMOS Analog IC Design: http://lumerink.com/courses/ece5411/s11/Lectures.htm
- Advanced Analog IC Design: http://lumerink.com/courses/ECE614/f12/Lectures.htm

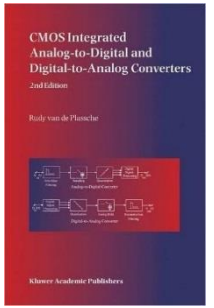
# TEXTBOOK AND REFERENCES

Lecture notes and handouts will be used. Following references are useful to supplement the course material:

- Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill.
- High-Frequency Integrated Circuits by Sorin Voinigescu, 1st ed., Cambridge.
- CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters by Rudy J. van de Plassche, Springer.



# COURSE PEDAGOGY AND GRADING

Combination of lecture notes, slides and simulation

- Lecture notes will be posted online (may have 1 or 2 days delay)
- Additional slides, Matlab code, Homeworks, etc. will also be posted.

Workload (Grading)

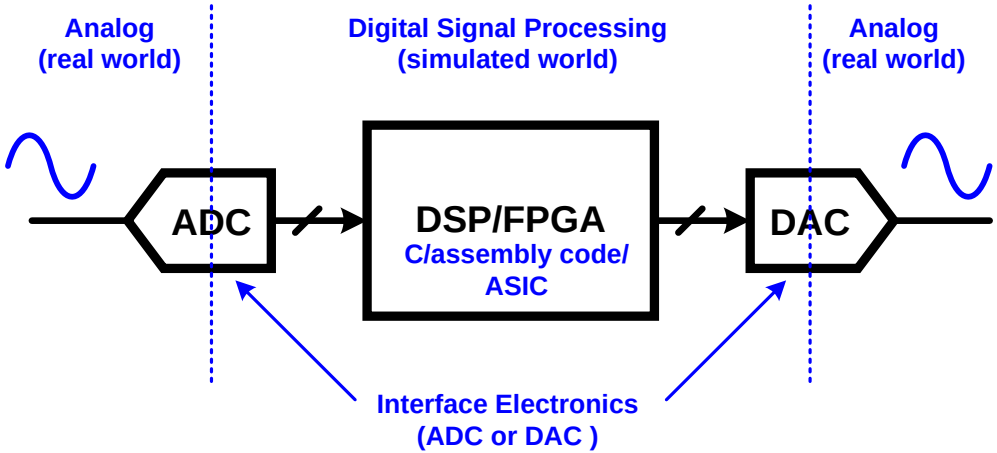
- 25% Homeworks
- 25% Midterm Exam
- 25% Project 1
- 25% Project 2 or Final Exam

# COURSE POLICIES

## Policies

- No late work (rare exceptions allowed). Penalty details on course site.
  - Submission will not be accepted if the solutions are distributed by any means.
- No net surfing in class. Avoid distracting other students.
- Neither the final exam nor final project will be returned at the end of the semester.
- Academic Honesty
  - No plagiarism is allowes
  - Do you own work: can discuss but not replicate work of others
  - See Article II of the University if Idaho's Student Code of Conduct http://www.webs.uidaho.edu/fsh/2300.html

# DATA CONVERTERS




Real world: Continuous-time, continuous-amplitude signals.

Digital world: Discrete-time, discrete-amplitude signal representation.

Interface circuits: ADC and DACs.

- Varying speed and precision requirements.

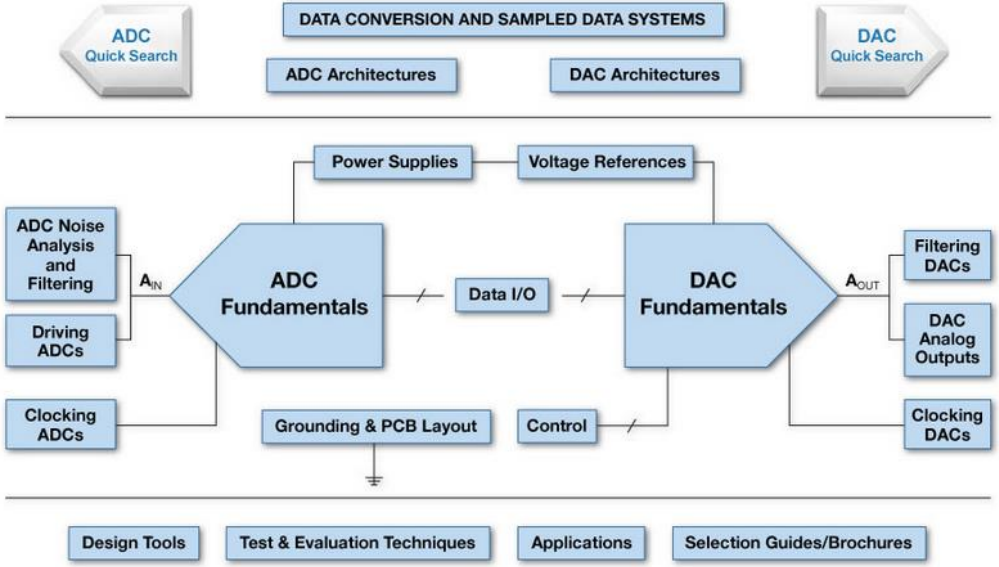
# DATA CONVERSION SCENARIOS

Any application using a sensor and/or an actuator

- Wireless: RF Rx and Tx chain
- Twisted pair: ADSL modem
- Coaxial: Cable modem
- Serial/Optical links: 10G+ ADC for modulation and equalization
- Audio Recording: 24-bit stereo ADCs
- Audio players: stored data to speaker (audio DAC)
- HDD read channel: Magnetic disk to microprocessor
- Biomedical applications (e.g. sensing blood glucose level and actuating the insulin pump),.....

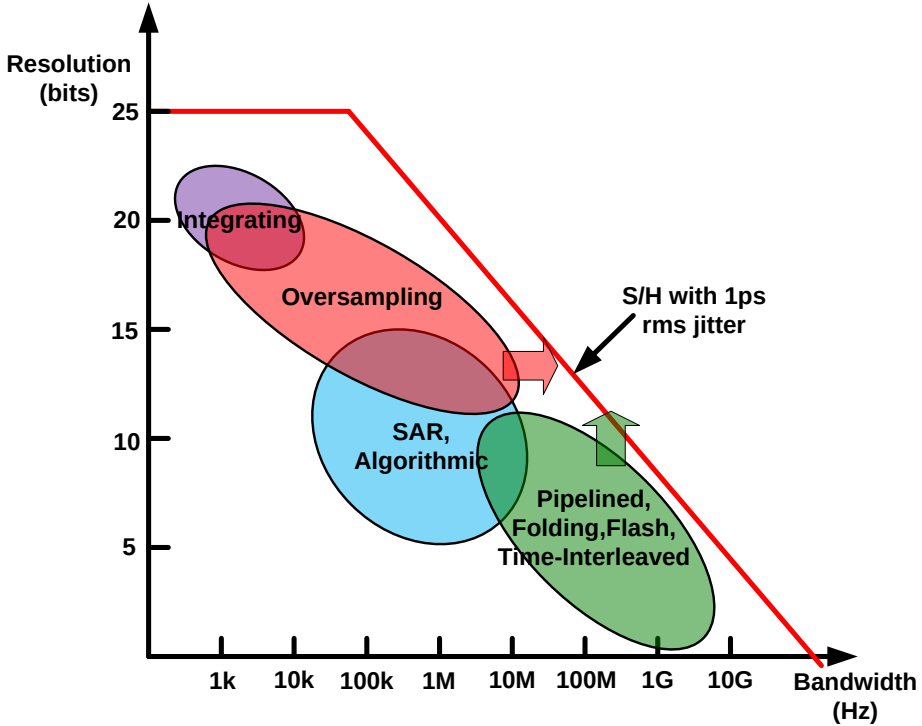
Speed and resolution requirements vary with the application.

# DATA CONVERTERS

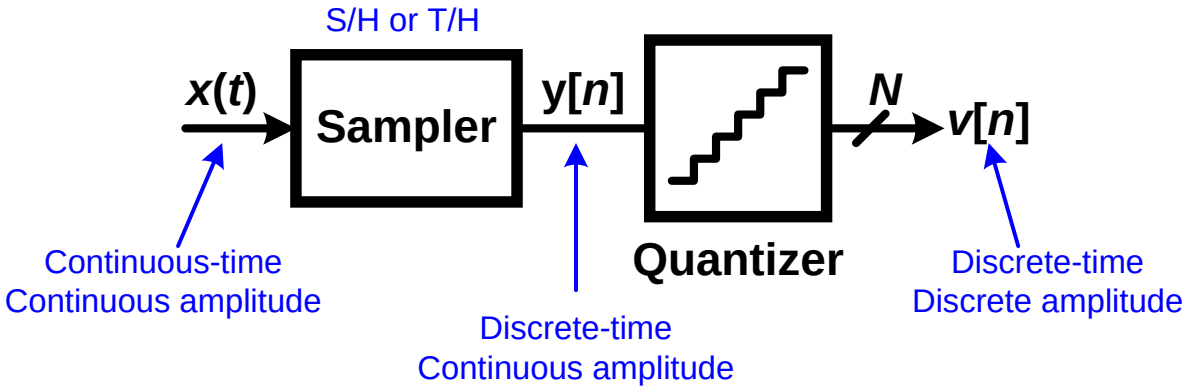



http://www.analog.com/en/data-conversion-knowledge-resource/conversions/index.html

# ANALOG TO DIGITAL CONVERTER ARCHITECTURES



# ANALOG-TO-DIGITAL CONVERTER (ADC)

# SAMPLING PROCESS

- Refer to lecture notes.