Instructor: Dr. Hongjiang Song hongjiang.song@asu.edu

Credits: 4 hours

Prerequisites:
- Basic VLSI analog circuits
- Basic VLSI digital circuits

Grading:
- Homework 15%
- Midterm Exams 40%
- Final Exam 25%
- Project 20%

Course Description:
This course was originally known as the VLSI High-Speed I/O Circuits. It covers various VLSI circuit design topics of VLSI high-speed I/O (or broadband) circuits including the theoretical basis, design, modeling, and validation techniques. This course is intended for first or second year graduate students and the objective is to build a practical knowledge of the VLSI high-speed I/O circuits and the applications to various industry high-speed I/O circuit standards, such as LVDS, USB2.0, 1394, S-ATA, PCI-Express, Mipi, etc. There will be weekly (bi-weekly) HW and design projects. CAD tools such as CADENCE, MATLAB will be used during the class.

Text book:

Reference:
- Selected journal/conference papers on VLSI High-Speed I/O Circuits that support covered topics

Lecture Topics:
- High-Speed I/O Circuit Fundamental
  1. High-speed I/O standards, trends and fundamental design challenges
  2. Basic I/O prototype and SFG models, Basic I/O circuit timing equation
  3. I/O circuit architectures, Common Clock, Forward Clock, and Embedded Clock Signaling
- High-Speed Serial I/O Modeling
  1. Jitter analysis, modeling and link jitter budgeting
  2. Bit Error Rate (BER) analysis and modeling
  3. DRC tracking loop modeling
  4. PLL/DLL/PI modeling
  5. Signal Integrity and Power Delivery
- VLSI High-Speed Serial I/O Circuit designs/implementations
  1. Transmitter circuits
  2. Receiver circuits
  3. Channel, T-line, Automatic Termination and Equalization Circuits
  4. PLL/DLL/PI circuits
  5. Data recovery circuit
  6. Voltage and current references circuits
- Validation Techniques of High-Speed I/O Circuits
  1. TDR & VNA
  2. Jitter & BERT measurement