

The Fu Foundation School of Engineering and Applied Science



# Computer Engineering: Incoming MS Student Orientation Course Overview

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*Chair, Computer Engineering Program*

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## Overview of 4000-/6000-Level Comp Eng Courses

- Selective survey of some key computer engineering courses
- Focus: COMS (i.e. CS), CSEE, EECS courses
  - EE comp eng courses: covered in EE presentations
- ... incomplete list: MS degree allows other courses too

# Digital/VLSI Design

## **CSEE 4823 Advanced Logic Design [Fall 11]**

*Instructor: Prof. Steven Nowick*

### Description:

- 2nd-level course in digital system design
- **Topics include:**
  - designing/optimizing large complex subsystems =RTL design
  - VHDL (industrial hardware description language)
  - advanced arithmetic circuits (Kogge-Stone prefix adders, array multipliers)
  - low-power design: bus encoding, “precomputation”, gated clocking
  - controller design (Mealy/Moore)
  - fault-tolerance, error correction/detection, soft errors, Hamming codes
  - design projects: custom floating point units, Huffman conversion

# Digital/VLSI Design (cont.)

## EECS 4340 Computer Hardware Design [Fall 11]

*Instructor: Prof. Simha Sethumadhavan*

### Description:

- Practical hardware design through implementation, simulation and prototyping of an entire system
- **Topics include:**
  - assembly language, I/O, interrupts
  - datapath + control design
  - buses, memory architecture
  - programmable logic: hardware prototyping with FPGA's
  - fundamentals of Verilog
  - testing and validation of hardware
  - industrial CAD tools
  - major lab project

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# Digital/VLSI Design (cont.)

## **ELEN 4321 Digital VLSI Circuits [Fall 11]**

*Instructor: Prof. Ken Shepard*

Description:

- Design and analysis of high speed VLSI logic and memory circuits.

*[see EE course presentation]*

# Computer Architecture/Parallel Systems

## CSEE 4824 Computer Architecture [Fall 11]

*Instructor: Prof. Luca Carloni*

### Description:

- **Advanced topics in modern computer architecture**, illustrated by recent case studies.
- **Topics include:**
  - quantitative analysis
  - pipelining, out-of-order execution, speculation
  - superscalar, VLIW and vector processors
  - embedded processors
  - memory hierarchy design
  - multi-processors and thread-level parallelism
  - synchronization and cache coherence protocols
  - interconnection networks

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## Computer Architecture/Parallel Systems (cont.)

### **CSEE 6824 Parallel Computer Architecture** [Spring 12]

*Instructor: Prof. Simha Sethumadhavan*

Description:

- Fundamentals of parallel computer systems
- **Topics include:**
  - recent parallel architectures (industrial/research)
  - shared memory and distributed memory systems
  - synchronization and coherence models
  - recent case studies

## Computer Architecture/Parallel Systems (cont.)

### **COMS 4130 Parallel Programming [Fall 11]**

*Instructor: Prof. Kim/Dr. Saraswat*

Description:

- Programming parallel processors, concurrency foundations.
- **Topics include:**
  - basics of parallel programming
  - principles of concurrency: data parallelism, deadlock, determinacy
  - pgmg. assignments: incl. game playing, high-performance cptg., machine learning
  - modern parallel programming languages

# Embedded Systems

## **CSEE 4840 Embedded Systems** [Spring 12]

*Instructor: Prof. Stephen Edwards*

### Description:

- Embedded system design and implementation combining hardware and software.
- **Topics include:**
  - hardware/software interfacing
  - bus protocols and device drivers
  - custom peripherals
  - microprocessor-based system design
  - team project target: a substantial embedded system
    - hardware/software design employing FPGA's
    - e.g. digital tone control, speech synthesizer, internet radio, interfacing and peripherals

# Embedded Systems (+ SoC/NoC)

## **CSEE 6847 Distributed Embedded Systems** [Spring 12]

*Instructor: Prof. Luca Carloni*

### Description:

- Inter-disciplinary graduate course on design of distributed embedded systems.
- **Topics include:**
  - system robustness: variable communication delays + component behaviors
  - communication protocols
  - on-chip communication micro-networks
  - fault-tolerant architectures
  - robust deployment of embedded software
  - recent research challenges in: design complexity, scalability, security

# Computer-Aided Design (CAD)

## CSEE 6861 Computer-Aided Design of Systems [Spring 12]

*Instructor: Prof. Steven Nowick*

### Description:

- Introduction to modern CAD tools and algorithms for designing digital systems.
- **Topics include:**
  - high-level synthesis and optimization of custom function units
  - synthesis and optimization of finite state machines
  - two-level/multi-level logic optimization
  - technology mapping to cell libraries
  - static timing analysis, testability
  - introduction to asynchronous design
  - small project: design of a CAD package

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## Special Offerings:

### **CS 6998-3 Formal Verification of Hardware/Software Systems [Fall 11]**

*Instructor: Drs. Theobald/Ivancic*

### **EE 6920 Introduction to VLSI Testing [sometimes offered]**

*Instructor: Dr. Abramovici*

# Networking and Communications

## **CSEE 4119 Computer Networks [Fall 11, Spring 12]**

*Instructor: G. Zussman and others*

Description:

- Introduction to modern computer networks.
- **Topics include:**
  - Technical foundations of the Internet
  - Applications, protocols
  - Local area networks (LANs)
  - Algorithms for routing and congestion control
  - Security
  - Basics of performance evaluation

# Networking and Communications (cont.)

## **CSEE 4140 Networking Laboratory [Spring 12]**

### Description:

- Hands-on networking lab course.
- **Topics include:**
  - technologies and protocols of the Internet
  - CISCO routers
  - wide area networks
  - networking protocol foundations:
    - IP, ARP, ICMP, UDP, TCP, DNS, RIP, FTP, TELNET, SMTP
  - Substantial projects: putting “principles into practice”

# Networking and Communications (cont.)

## **COMS 4180 Network Security**

Description:

- Introduction to network security concepts and mechanisms.

## **CSEE 6180 Modeling and Performance Analysis**

Description:

- Introduction to queuing analysis and simulation techniques.

## **COMS 6181 Advanced Internet Services**

Description:

- In-depth survey of protocols and algorithms to transport multimedia info across the Internet.