Computer Engineering:
Incoming MS Student Orientation
Requirements & Course Overview

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MS Requirements: Overview *(see bulletin for details)*

- **Total:** _at least 30 points_ (at or above 4000-level, no P/F)
- **“Core” requirement:** _at least 15 points_ from listed core
- **6000-level requirement:** _at least 12 points_ (CS or EE or joint)
- **Research credits (optional):** _at most 9 points_ (towards requirements)
- **Non-tech electives (optional):** _at most 3 points_ (towards requirements)
- **Min GPA:** _at least 2.7_ / **Time period:** _at most 5 years_
Core Comp Eng Course List – 18+1

- **CSEE W4119** Computer networks
- **CSEE W4140** Networking laboratory
- **EECS E4321** Digital VLSI circuits
- **EECS E4750** Hybrid Comp. for Sig. & Data Proc.
- **EECS E4764** IoT – Intelligent & Connected Sys.
- **CSEE W4823** Advanced logic design
- **CSEE W4824** Computer architecture
- **CSEE W4840** Embedded systems
- **CSEE W4868** System-on-chip Platforms

- **EECS E4951** Wireless Networks & Systems
- **CSEE E6180** Modeling and Perf. Evaluation
- **EECS E6321** Adv. Digital Elec. Circuits
- **EECS E6322** VLSI Arch. For SP & ML
- **EECS E6765** IoT – Sys. & Phys. Data Analytics
- **CSEE E6824** Parallel computer architecture
- **CSEE E6861** CAD of Digital Systems
- **CSEE E6863** Formal Verif. HW/SW
- **CSEE E6868** Embedded Scalable Platforms

- **COMS E6424** Hardware Security
Overview of MS Comp Eng Courses

- Selective survey of key computer engineering courses
- Focus: Core courses
  - EECS: covered in EE presentations
- ... incomplete list!: MS degree allows other courses too
Digital/VLSI Design

CSEE W4823 Advanced Logic Design [Spring 18?]

Instructor: Prof. Mingoo Seok

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 & CRC codes
• design projects: custom floating point units, Huffman conversion
Digital/VLSI Design

EECS E4321 Digital VLSI Circuits [Fall]

Instructor: Prof. Ken Shepard

Description:
• Design and analysis of high speed VLSI logic, arithmetic and memory circuits.

EECS 6321 Adv. Digital Electronic Circuits [Spring?]

Instructor: Prof. Mingoo Seok

Description:
• Advanced techniques: VLSI logic, arithmetic and memory circuits.

[see EE course presentations]
Digital/VLSI Design

EECS 6322 VLSI Arch. for SP & ML [Fall]

Instructor: Prof. Mingoo Seok

Description:

• Pipelining, Parallel architectures, Systolic Arrays.

[see EE course presentation]
Computer Architecture/Parallel Systems

CSEE W4824 Computer Architecture [Spring]

Instructor: Prof. Simha Sethumadhavan

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
  • parallel processors and thread-level parallelism
  • memory hierarchy design
  • synchronization and cache coherence protocols
  • interconnection networks
Computer Architecture/Parallel Systems

CSEE W6824 Parallel Computer Architecture

Description:
- Organization, interconnection networks, synchronization, performance analysis.

EECS E4750 Heterogeneous Computing for SP [Fall]

Instructor: Prof. Zoran Kostic

Description:
- General-purpose GPU programming for signal processing.

[see EE course presentation]
Embedded Systems

CSEE W4840 Embedded Systems [Spring]

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
CSEE E4868 System-on-Chip Platforms [Fall]

Instructor: Prof. Luca Carloni

Description:
- Design & programming of system-on-chip platforms.
- **Topics include:**
  - overview of technology & trends
  - methodologies & CAD tools
  - software simulation
  - system-C language
  - hardware-software partitioning
  - communication, power, applications
SOC

CSEE E6868 Embedded Scalable Platforms [Spring]

Instructor: Prof. Luca Carloni

Description:

• Design & programming of embedded scalable platforms.

• **Topics include:**
  • SOC design
  • Embedded software programming
  • Electronic design automation
  • Research papers
  • Significant project
IoT

EECS E4764 IoT: Intelligent & Connected Systems [Fall]
Instructor: Prof. Fred Jiang

Description:
• Cyber-physical system projects.

EECS E6765 IoT: Sys & Phys Data Analytics [Spring]
Instructor: Prof. Zoran Kostic

Description:
• IoT from the point of view of data.

[see EE course presentation]
Networking and Communications

CSEE W4119 Computer Networks [Fall, Spring]

Instructor: Gil 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

CSEE W4140 Networking Laboratory [Fall, Spring]

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

CSEE W4951 Wireless Networks & Systems

Instructor: Gil Zussman

Description:
- Topics in wireless & mobile networking.
  
  [see EE course presentation]

CSEE E6180 Modeling and Performance Analysis

(sometimes)

Description:
- Introduction to queuing analysis and simulation techniques.
CSEE E6861 CAD of Digital Systems

Instructor: Prof. Steve Nowick

Description:
- High-level tools for digital system design.
- **Topics include:**
  - Synthesis
  - RTL
  - Static timing analysis
  - Optimal scheduling
  - Optimal library mapping
  - Testability
CSEE E6863 Formal Verification of Hardware/Software Systems [Fall]

Instructor: Drs. Michael Theobald & Franjo Ivancic

Description:
• Theory & practice of designing correct hardware/software systems.
• **Topics include:**
  • Temporal logics
  • Model checking
  • Deadlock & liveness
  • SAT checkers
  • Binary Decision Diagrams
  • Case studies
COMS E6424 Hardware Security [Fall]

Instructor: Prof. Simha Sethumadhavan

Description:
- Theory & practice of designing secure hardware systems.

Topics include:
- Hardware Supply Chain
- Side Channel Attacks & Defenses
- Compartmentalization
- Fault Attacks & Defenses
- Hardware Support for Strong Software
- Anomaly Detection
MS Project Opportunities

- Worked out individually with faculty
  - for credit: signing up for EE or CS project courses
  - for stipend: often over summers

- Typically requires student to:
  - demonstrate sufficient background and strengths
  - first take relevant 4000-/6000-level course(s)

(... and do well)