About Computer Engineering in ECE

- A joint program between ECE and CS
- CE degrees
  - M. S., M. E., Ph.D.
- Group leader:
  - Dr. Pierce Cantrell
- Administrative assistant:
  - Vickie Winston, 333E WEB
- http://cesg.tamu.edu
- http://engineering.tamu.edu/electrical/
Faculty

- Pierce Cantrell (group leader)
- Nick Duffield
- Gwan Choi
- Paul Gratz
- I-Hong Hou
- Jiang Hu
- Sunil Khatri
- P. R. Kumar
- Peng Li
- Mi Lu
- Stavros Kalafatis
- JV Rajendran
- Weiping Shi
- Srinivas Shakkottai
- Alex Sprintson
- Xi Zhang
Areas of Research

- VLSI Circuits and Systems
  - Electronic Design Automation (EDA)
  - Logic Synthesis
  - System-on-Silicon (SoC)
  - Hardware Acceleration
  - Biomedical Applications
  - Low Power/Energy VLSI Design
  - Radiation Hardened VLSI Design
  - Solid State Radiation Detectors
  - VLSI Realization of Machine Learning Algorithms
Areas of Research

- Computer Systems and Architecture
  - Multi-core Processor Design
  - Processor Microarchitecture
  - Memory Systems Hierarchies
  - System Designs for Emerging Non-volatile Memories
  - Storage Systems
  - Network Processors
Areas of Research

- Communication Networks
  - Wireless Networks
  - Content Distribution
  - P2P Networks
  - Software-Defined Networks
  - Network Security
  - Real-time Communication
  - Network Coding
Areas of Research

- Cyber-Physical Systems
- Network and Data Science
  - Measurement and Analysis of Internet Data
  - Big Data Analytics
Prof. Stavros Kalafatis
- Datacenter system optimization
- Software-Defined systems
- Robotics
- Sensor systems

Prof. A. L. N. Reddy
- Computer networks
- Multimedia
- Computer architecture
• Prof. Pierce Cantrell - Group leader
  o Computer Networking

• Prof. Nick Duffield
  o Computer Networking
  o Measurement & Inference
  o Big Data & Algorithms
• Prof. I-Hong Hou
  o Wireless networks
  o Sensor networks
  o Multimedia networking
  o Queueing theory

• Prof. P. R. Kumar
• Research
  o Wireless networks
  o Cyber-physical systems
  o Energy systems
  o Automated transportation
  o Control theory
  o Information theory
  o Etc.
• Prof. Srinivas Shakkottai
• Research
  o Computer networks
  o Game theory
  o Content distribution
  o Wireless networks

• Prof. Alexander Sprintson
• Research
  o Communication networks
  o Network algorithms
  o Network coding
  o Network survivability
• Prof. Xi Zhang
  o Mobile wireless networks
  o Wireless sensor networks
  o QoS for wireless networks
  o Random signal Processing for wireless communication systems

• Prof. JV Rajendran
  o Hardware security
  o Nanoelectronic computing Architectures
  o VLSI design
• **Prof. Paul Gratz**
  - High performance multicore computer architectures
  - Memory systems
  - Reliability and energy efficiency in computer systems

• **Prof. Gwan Choi**
  - High-performance and low-power VLSI design
  - Wireless network circuits
  - High-performance and low-power VLSI design
  - Wireless network circuits
  - System-on-chip solutions for smartphones and tablets
• **Prof. Jiang Hu**
  - Physical design automation
  - Low power VLSI design
  - Hardware security

• **Prof. Weiping Shi**
  - VLSI logic synthesis
  - VLSI circuit design
  - Low power, resilient circuits
  - VLSI testing
• Prof. Sunil Khatri
  o VLSI logic synthesis and circuit design
  o Low power, resilient, rad-hard circuit
  o Genomics
  o FPGA and GPU based algorithm acceleration

• Prof. Peng Li
  o VLSI interconnect modeling, timing
  o Signal/power integrity
  o Analog/Mixed-signal/RF CAD
  o Circuit simulation
• Prof. Mi Lu
  o Parallel computing
  o Distributed processing
  o Computer architectures
  o Computer networks
• Vickie Winston
  Program Specialist II
  333E WEB
  Phone: 985-6487
  Email: vwinston@tamu.edu
MASTER OF SCIENCE IN COMPUTER ENGINEERING (Thesis Option)

- Total number of hours (32)
- A minimum of 24 classroom hours (Excludes 681, 684, 685, & 691)
- A minimum of 21 classroom hours from the College of Engineering and College of Science
- Transfer hours allowed from a peer institution (6)
- Max undergraduate hours (6 hours/400 only)
- Special problems, seminar, and research (681, 685, & 691)
  - 8 hours maximum of these courses
  - 4 hours minimum of 691
  - 1 hour of seminar (ECEN/CSCE 681) is required
    - No more than 3 hours (in combination) of ECEN 681, 684, and 685
- Final defense of thesis is required for all MS students.
Master of Engineering (Non-thesis option) 30 credit hours

- A minimum of 27 classroom hours (Excludes 681, 684, & 685) from
  - College of Engineering
  - College of Science
  - College of Business (at most one course, and only from the INFO Dept.)

- A minimum of 24 classroom hours from
  - The Departments of Computer Science and Engineering (CSE) or Electrical and Computer Engineering (ECEN)
  - At least 13 of these 24 hours must be in Electrical & Computer Engineering Department.

- Transfer hours allowed from another institution (6)
  - Transfer hours must be from a peer institution
  - Transfer hours are subject to approval of the Graduate Studies Committee

- Max undergraduate hours (6 hours/400 only)
- One hour of seminar is allowed (ECEN/CSCE 681) but is NOT required
- No more than 3 hours (in combination) of ECEN 681, 684, and 685
- A report is required in at least one of the ECE or CSE courses
- Students may petition for exemption from the final oral with the approval of the student's Committee Chair
- The Graduate Coordinator will be the chair of all MEN committees. No other committee members are needed.
Computer Engineering Degrees

Ph.D. IN COMPUTER ENGINEERING Total number of hours (64 or 96)

- For students who already hold a Master’s Degree, 64 total hours are required.
- For “direct PhD” students, 96 hours are required.
  - A minimum of 18 (or 42) classroom hours (excludes 681,684,685,691)
  - 18 hours required for students with a previous Master’s Degree and 42 for direct PhD students
    - Classroom hours must be taken from courses within the College of Engineering and College of Science

- Max undergraduate hours (8 hours / 2 courses 400 only)
- Three hours of seminar (ECEN/CSCE 681) are required
  - At most 3 hours of ECEN 684
  - No more than 2 credit hours of Directed Studies (685) are allowed
  - Students working on a research project should enroll in Research (691) hours
  - A maximum of 6 transfer hours allowed from another institution. Transfer hours must be from a “peer institution”. Transfer hours are subject to the approval of the Graduate Studies Committee. Total number of hours (64 beyond the MS or 96 beyond the BS)
Incoming PHD students are required to take the exam within one year of starting the program.

Students entering the program with a previous degree outside of Electrical or Computer Engineering are allowed, with the approval of their advisor, an extra year and will be required to take the exam by the end of the second year.

Those students that fail the examination are given a second opportunity to retake the exam which must be taken at the next opportunity in which the exam is offered.

Those that fail the examination twice will be removed from the PHD program.
Ph.D. requirements (cont.)

- Preliminary examination
- Final examination
Recommended first-year courses

- ECEN (undergraduate courses)
  - 468

- CSCE (undergraduate courses)
  - 410

- ECEN (graduate courses)
  - 602, 621, 651, 653, 654, 687, 714, 754, 749

- CSCE (graduate courses)
  - 614, 629, 662
Foundational Courses
(no graduate credit)

ECEN 214 Electrical Circuit Theory
ECEN 248 Introduction to Digital Systems Design
ECEN 314 Signals & Systems
ECEN 325 Electronics
ECEN 350 Computer Architecture and Design
ECEN 423 Computer and Wireless Communications Networks
CSCE 221 Data Structures and Algorithms
CSCE 311 Analysis of Algorithms
Tentative List of Courses for Graduate CEEN Students

Hardware/VLSI:
ECEN 454/714 Digital Integrated Circuit Design
ECEN 468 Advanced Digital System Design
ECEN 749 Microprocessor System Design
ECEN 624 IC Design Tools
ECEN 654 VLSI System Design
ECEN 680 Test and Diagnosis of Digital Systems
ECEN 687 Introduction to VLSI Design Automation
ECEN 699 Advances in VLSI Logic Synthesis
ECEN 751 Advanced Computational Methods for Integrated System Design
ECEN 752 Advances in VLSI Circuit Design
CSCE 661 Integrated Systems Design Automation
Tentative List of Courses for Graduate CEEN Students

Networks:
ECEN 602 Computer Comm. and Networking
ECEN 619 Internet Protocols and Modeling
ECEN 621 Mobile Wireless Networks
ECEN 627 Multimedia Systems and Networks
CSCE 663 Real-Time Systems
CSCE 665 Advanced Networking and Security
CSCE 664 Wireless and Mobile Systems
ECEN 689 Special Topics Courses
Tentative List of Courses for Graduate CEEN Students

Computer Architecture:
ECEN 651 Microprogrammed Control of Digital Systems (not CSCE 614)
ECEN 653 Computer Arithmetic Unit Design
ECEN 659 Parallel/Distributed Numerical Algorithms and Applications
ECEN 676 Advanced Computer Architecture
CSCE 605 Compiler Design
Systems and Software:
CSCE 410 Operating Systems
CSCE 606 Software Engineering
CSCE 629 Analysis of Algorithms
CSCE 662 Distributed Processing Systems
CSCE 670 Information Retrieval and Storage
Mathematics and Statistics:
MATH 415 Modern Algebra I*
MATH 416 Modern Algebra II
MATH 446 Principles of Analysis I*
MATH 447 Topics in Analysis II
STAT 601 Statistical Analysis
MATH 606 Theory of Probability I
MATH 607 Real Variables I*
MATH 608 Real Variables II
MATH 619 - Applied Probability*
MATH 625 - Applied SDEs
MATH 630 – Combinatorics
MATH 651 Optimization I*
MATH 652 Optimization II
Tentative List of Courses for Graduate CEEN Students

- English:
  - ENGL 301 Technical Writing (no grad credit)*

- Computer Engineering Seminar
  - ECEN 681 - Seminar
Networking and System Theory:
ECEN 434/754 Optimization for Electrical & Computer Engineering Applications
ECEN 663 Data Compression with Applications to Speech and Video
ECEN 750 Design and Analysis of Communication Networks
ECEN 753 Theory and Applications of Networking Coding
ECEN 755 Stochastic Systems
ECEN 689 Special Topics Courses
Offered in **Fall 2017**

- **Objectives:**
  Computer communication and computer networks; use of the International Standards Organization (ISO) seven-layer Open Systems Interconnection model as basis for systematic approach; operational networks to be included in the study of each layer; homework assignments to make use of a campus computer network.

- **Prerequisite:**
  Statistical probability background

- **Instructor:**
  Prof. Pierce Cantrell
Offered in Fall 2017

Objectives:
Fundamental architectures, principle, modeling techniques, and applications for mobile and wireless networks. Provides solid foundation in a wide spectrum of wireless communications techniques and protocols from PHY-layer to higher Network-Layer, as well as the rigorous analytical capabilities to evaluate performance of wireless networks. It addresses practical designing issues for hybrid wireless and wireline networks.

Prerequisite:
Graduate standing

Instructor:
Prof. Xi Zhang
ECEN 651: Microprogrammed Control of Digital Systems

Offered in Fall 2017

• Objectives:
  Hardware and software concepts involved in the design and construction of microprocessor-based digital systems; microprocessor architecture; bussing; interfacing; data input/output; memories; and software development for operation and testing; design projects with microprocessors and related components

• Prerequisite:
  ELEN 350 and 449 or approval of instructor.

• Instructor:
  Prof. Lu
ECEN 689: Special Topics in Data Mining Analysis

Offered in Fall 2017

Objectives:

• Statistical and computational methods for acquiring and analysing massive datasets, and their applications
• Sampling, sketching, frequent itemset mining, representative based clustering, probabilistic classification, cluster validation.

Prerequisite:
Instructor approval

Instructor:
Prof. Nick Duffield

k-sparse recovery

p=1/U
p=1
ECEN 699: Advances in VLSI Logic Synthesis

Offered in Spring 2018

Objectives:
The class covers several methods for logic representation, manipulation and optimization, for combinational as well as sequential logic. The course covers two-level as well as multi-level logic synthesis, and multi-valued synthesis as well. The focus is a sound understanding of the theory and practical implementation of logic techniques, which can be applied to a wide variety of fields.

Prerequisite:
Graduate standing, or instructor consent

Instructor:
Prof. Khatri
Offered in Fall 2017

- Objectives:
  In this class we take an analytical approach to understanding resource allocation on the Internet. We first study the system in a global sense, and use a deterministic approach to study congestion control protocols. We then study individual queues and routers, and use a stochastic approach to understanding system performance.

Prerequisite:
  Some probability background

Instructor:
  Prof. Srinivas Shakkottai
Offered in **Spring 2018**

Objectives:
Design of digit computer arithmetic unit, control and memory. Focusing on microprocessor arithmetic logic unit (ALU) design; high-speed addition, subtraction, multiplication and division algorithms and implementations; design and simulation with integrated circuit components and VLSI circuits.

**Prerequisite:**
ECEN 651

**Instructor:**
Prof. Mi Lu
Offered in Spring 2018

Solutions for mobile System-on-Chips (SoCs)

- **Topics Discussed:**
  - Introduction to Design Automation Methods
  - Low-Power VLSI Design
  - Low-Power Multimedia Processing
  - Timing Design for Low-Power Applications
  - Baseband Processing
  - HW/SW Co-design Verification
  - Memory Subsystem Design

- **What are SoCs?**
  A6, Hummingbird, Tegra, OMAP, Snapdragon, etc. Chips that go on to cell phones, tablets, and eventually everything else

- **What will the future SoCs have in common?**
  - Multi/many-core processors
  - Multimedia units
  - Baseband processing
  - Sensors
  - Memory
  - Special ASIC modules

We will discuss emerging design methods.

**Instructor:**
Prof. Gwan Choi
ECEN 755: Stochastic Systems

Offered in Spring 2018

Objectives:
Important applications in electrical and computer engineering require knowledge of stochastic systems. This course deals with several models of stochastic systems and their analysis. It studies topics including performance evaluation, estimation, control, scheduling, identification and adaptation. It has applications in several fields such as computer engineering, communication networks and control.

Prerequisite:
Math 411; and Graduate standing

Instructor:
Prof. P. R. Kumar
Seminars

- 681-603 seminar (Sprintson)
- Fishbowl seminar
- 681-600 Department seminar
Courses to be offered in Spring 2018

- ECEN 619 - Internet Protocols and Modeling (Dr. Zhang)
- ECEN 653 - Computer Arithmetic Unit Design (Dr. Lu)
- ECEN 654 - VLSI Systems Design
- ECEN 681 – CESG seminar
- ECEN 699 - Advances in VLSI Logic Synthesis (Dr. Khatri)
- ECEN 714 – Digital Integrated Circuit Design (stacked with 454)
- ECEN 749 – Microprocessor System Design (stacked with 449)
- ECEN 751 - Advanced Computational Methods for Integrated System Design (Dr. Li)
- ECEN 755 – Stochastic Systems (Dr. Kumar)
Funding opportunities

- **RA positions**
  - Funding provided by individual faculty members
  - Provide tuition waiver (in-state tuition)

- **TA positions**
  - Must pass ELPE
  - Provide tuition waiver
  - Assigned by the department
    - Course instructors can make recommendations

- **Grader positions**
  - Assigned by course instructors
  - Do provide tuition support/waiver
ECE Graduate Merit Scholarship
The scholarship awardees will receive a one-time stipend of $1,000 and be eligible for the in-state tuition.

Eligibility:
Newly admitted and current CESG Ph. D. and M. S. students who are currently not supported by a research, teaching assistantship or a fellowship. Note that scholarship recipients are required to complete a thesis and shall not transfer to the non-thesis M.E. program at a later time.

How to Apply:
Submit your application online at:
http://engineering.tamu.edu/electrical/academics/advising/graduate/funding
You should specify your “Area” as “Computer Engineering”. You should not apply to multiple areas at the same time.

Talk to faculty members you would like to work with
ECEN Orientation

HECC, Room 106, 1pm
Questions?
Offered in **Spring 2016**

**Objectives:**
This course explores design of high-performance computer architectures and their quantitative analysis. Microarchitectural details of modern superscalar processors. Emphasis on fine-grain and coarse-grain parallelism; interconnection networks; shared memory architectures; multi-threaded architectures. Achieving performance under strict power constraints.

**Prerequisite:**
ECEN 651 or CPSC 614 or approval of instructor

**Instructor:**
Prof. Paul Gratz
ECEN 754: Optimization for Electrical and Computer Engineering Applications

Offered in Fall 2015

Objectives:

• Important applications in electrical and computer engineering require knowledge of linear/nonlinear/convex programming.
• This course covers applications of importance to Electrical and Computer Engineering, including estimation of signals, routing and congestion control in communication networks, elastic flows in real-time wireless networks, wafer fabrication plants, and economic dispatch in electrical power systems.
• Students will write their own code for several methods.

Prerequisite:
Math 304 or 309 or 311; and Math 251; and Graduate standing

Instructor:
Prof. P. R. Kumar
**ECEN 753: Theory and Applications of Network Coding**

**Offered in Fall 2015**

**Objectives:**
- Wireless network coding
- Coding for reliability and security
- Distributed storage/regenerating codes

**Prerequisite:**
Graduate standing

**Instructor:**
Prof. Alex Sprintson