Master of Science & Doctor of Philosophy in Computer Engineering Orientation

August 22, 2018

Paul Gratz
Department of Electrical and Computer Engineering
Outline

• General Overview of CESG
• Areas of Research
• Faculty & Staff
• Requirements for Degrees
• Foundation and First-Level Graduate Courses
• Tentative List of Courses for MS & PhD CEEN Students
  – Must take at least 6 courses from this list
• Tentative Course Offerings for Academic Year 2019 and 2020 in Computer Engineering & Systems Courses
• Other Orientations
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/
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
  – Hardware Security
Areas of Research

• Computer Aided Design and Synthesis
  – Optimization for energy-efficient VLSI circuits
  – Design for testability
  – On-chip communication fabrics
  – Dynamic power management
  – Adaptive circuit design
  – Interactions btwn physical & system-level design
  – Heuristics for large scale combinational optimization
Areas of Research

- Computer Systems and Architecture
  - Fault-tolerant systems
  - Storage and file systems
  - Distributed systems
  - System Designs for Emerging Non-volatile Memories
  - Network Processors
  - Computer architecture
    - Multiprocessor systems on chips (MPSoC)
    - Memory System Hierarchies
    - Cloud computing
    - Processor cyber security
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
  – Machine Learning and AI
Faculty

- Pierce Cantrell (group leader)
- Gwan Choi
- Nick Duffield
- Paul Gratz
- I-Hong Hou
- Jiang Hu
- Stavros Kalafatis
- Sunil Khatri
- P. R. Kumar
- Peng Li
- Mi Lu
- Kevin Nowka
- JV Rajendran
- Narasimha Reddy
- Weiping Shi
- Srinivas Shakkottai
- Alex Sprintson
- Karen Watson
- Xi Zhang
CESG Faculty

Pierce Cantrell
Senior Associate Professor
Group Leader
Computer Networking

Narasimha Reddy
Associate Dean for Research
Assoc. Agency Director for Strategic Initiatives & Centers
(Texas A&M Engineering Experiment Station)
Computer architecture
Computer networks
Multimedia
CESG Faculty

Gwan Choi
Associate Professor

High-performance & low-power VLSI design
System-on-chip solutions for smartphones and tablets
Wireless network circuits

Nick Duffield
Professor

Computer Networking
Big Data & Algorithms
Measurement & Inference
CESG Faculty

Paul Gratz
Associate Professor
Processor reliability and efficiency
Processor performance
Memory systems
Processor Security

Jiang Hu
Professor
Co-Director of Graduate Programs
Physical design automation
Low power VLSI design
Hardware security
CESG Faculty

I-Hong Hou
Assistant Professor

Cloud computing and edge computing
Multimedia networking
Wireless networks
Queueing theory

P. R. Kumar
College of Engineering Chair in Computer Engineering
Regents Professor
Distinguished Professor

Automated transportation
Cyber-physical systems
Wireless networks
Information theory
Energy systems
Control theory
...and more
CESG Faculty

**Peng Li**  
Professor  
Analog/Mixed-signal Design Verification  
Hardware Machine Learning Systems  
Brain-Inspired Computing  
IC Power Delivery

**Sunil Khatri**  
Professor  
VLSI logic synthesis and circuit design  
Hardware machine learning  
Hardware Security  
Algorithm acceleration on FPGA / GPU  
Low power, resilient, rad-hard circuits
CESG Faculty

Mi Lu
Professor

Computer architectures
Distributed processing
Computer networks
Parallel computing

Srinivas Shakkottai
Associate Professor

Caching & Content Distribution
Data Collection & Analytics
Learning & Game Theory
Wireless Networks
CESG Faculty

Stavros Kalafatis
Professor of the Practice

Datacenter System Optimization
Software-Defined Systems
Sensor Systems
Robotics

Kevin Nowak
Professor of the Practice

VLSI Circuits and Systems
Artificial Intelligence
Computer Systems
CESG Faculty

JV Rajendran
Assistant Professor
Nanoelectronic computing
Hardware security
Architectures
VLSI design

Alexander Sprintson
Professor
Communication networks
Network survivability
Network algorithms
Network coding
CESG Faculty

Weiping Shi
Professor

Low power, resilient circuits
VLSI logic synthesis
VLSI circuit design
VLSI testing

Xi Zhang
Professor

Random signal processing for wireless communication systems
QoS for wireless networks
Wireless sensor networks
Mobile wireless networks
CESG Faculty

Karen Watson
Regents Professor

Engineering education
Entrepreneurship
VLSI design
CESG Staff

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Requirements for Master of Engineering (Non-Thesis) in Computer Engineering

- Total number of hours (30)
- A minimum of 27 classroom hours (excludes 681(seminar), 684(internship), & 685(directed studies))
  - Classroom hours must be taken from courses within the College of Engineering and/or College of Science.
  - One course from the ISYS Dept. in the College of Business is allowed.
  - A minimum of 24 classroom hours from the Departments of CSCE and ECEN
  - At least 13 of these 24 hours must be in ECEN.
  - At least 6 courses from the CEEN Master of Engineering student course list – see slides 7-11.
- Transfer hours allowed from another institution (maximum of 6 hours)
  - Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
  - Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.
- Undergraduate hours allowed (maximum of 6 hours)
  - Only 400 level undergraduate courses can be included on your degree plan.
  - Courses must be from the College of Engineering and/or College of Science.
- Seminar (681), Internship (684), Directed Studies (685):
  - One hour of seminar is allowed (ECEN/CSCE 681) but is NOT required.
  - No more than 3 hours allowed (combined)
- Research (691) hours are not allowed on the ME degree plan.
- A Final Project Report is required to be submitted to the Graduate Office.
  - A graded project from any ECEN or CSCE graduate course can be used to fulfill this requirement.
  - The project requires a grade, the professor’s signature, and a completed cover page.
  - It must be submitted in the graduating semester;
    See the eCampus page for submission deadlines and other requirements.
- Composition of supervisory committee:
  - The Graduate Coordinator will be the chair of all ME committees. No other committee members are needed.
    See additional course requirements on slide 29 or in Graduate Handbook
Requirements for Master of Science (Thesis) in Computer Engineering

1. Total number of hours (32)
2. A minimum of 24 classroom hours (excludes 681(seminar), 684(internship), 685(directed studies) & 691(Research))
   • A minimum of 21 classroom hours from the College of Engineering and/or College of Science
   • Courses on degree plan must be approved by Research Advisor
3. Transfer hours allowed from another institution (6)
   • Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   • Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.
4. Undergraduate hours allowed (6)
   • Only 400 level undergraduate courses can be included on the degree plan
   • Courses must be approved by Research Advisor
5. Seminar, directed studies, and research (681, 685, & 691)
   • 8 hours maximum of these courses
   • 4 hours minimum of 691
   Note: If co-chair is outside of ECEN, research credits must be split 50/50 between chair and co-chair.
   • 1 hour of seminar (ECEN/CSCE 681) is required
   • No more than 3 hours (in combination) of ECEN 681, 684, and 685
6. Final defense of thesis is required for all MS students.
   - A thesis proposal must be approved by the supervisory committee and submitted to the Graduate Office at least 1 month before the defense.
   - Date and location of the thesis defense must be scheduled through the Graduate Office at least 1 month in advance so that official notification can be provided to OGAPS.
   - Thesis must be submitted to committee members at least two weeks before defense.
   - Please see ecampus page for details.

7. Composition of supervisory committee – at least 3 members total
   - At least two members within Computer Engineering Group from ECEN
   - At least one member from outside ECEN
   - Note: Committee Chair must be ECEN faculty (or CSCE joint faculty appointment). Co-chair may be from outside department.

See additional course requirements on slide 29 or in Graduate Handbook.
Requirements Doctor of Philosophy in Computer Engineering

1. 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.

2. A minimum of 18 (or 42) classroom hours (excludes 681, 684, 685, and 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
   – **Courses on degree plan must be approved by Research Advisor**

3. A maximum of (6) transfer hours allowed from another institution.
   – Transfer hours must be from a U.S. peer institution; they cannot have been used on a previous degree plan.
   – Students must send syllabi, transcript, and TAMU course equivalent to the Graduate Office. Transfer hours are subject to the approval of the GSC.

4. Undergraduate hours allowed (2 courses or 8 hours)
   – Only 400 level courses can be included on degree plan.
   – If you used 400 level hours on your Master’s degree plan, then you must reduce the number of allowed undergraduate hours by that amount.

5. No more than 3 credit hours of Internship (684) are allowed.
   – PHD students cannot take 684 after their dissertation defense.

6. Three (3) hours of Seminar (ECEN/CSCE 681) are required.
7. No more than 2 credit hours of Directed Studies (685) are allowed.
   – Students working on a research project should enroll in Research (691) hours.

8. All PhD students are required to pass the **Departmental Qualifying Examination**
   – All incoming PHD students (64 and 96 hour) 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 written approval from 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.
   – More details of the Qualifying Exam are given later in this handbook.
   – Degree Plans are to be filed within one semester after passing the Qualifier for both 64 and 96 hour PHD students.

9. All PHD students with a degree plan on file are required to submit an **Annual PHD Review**.
   – The Graduate Office will provide this document to the student and his/her research advisor at the beginning of each spring semester.
   – PHD students are responsible for meeting with their research advisor to discuss their progress in the program.
   – After the student and research advisor sign the review document, the student should submit it to the Graduate Office by the specified deadline, which is typically by mid-May.
10. All PHD students are required to pass a **Preliminary Examination**.
   - 64 hour PHD students are required to schedule their prelim exam by the end of their 4th semester (excluding summers) and 6th semester for those with previous degree outside of Electrical or Computer Engineering and 96 hour PHD’s.
   - Students who have not scheduled their prelim by the appointed time will be blocked from further registration until they do so.
   - Date and location of the prelim must be scheduled through the Graduate Office **at least 1 month in advance** so that official notification can be provided to OGAPS.
   - Student must download the checklist and signature page from the OGAPS web site. The checklist must be signed by your advisor and Graduate Coordinator prior to the exam.
   - The prelim exam consists of a written and an oral examination.
   - For students who have passed the departmental Qualifying Exam, the written portion of the prelim exam can be waived subject to the approval of the student’s supervisory committee.
   - Students who fail the prelim exam will have one opportunity to retake the exam within 6 months of the original exam date.
   - **The research proposal must be submitted to the Graduate Office within 5 business days after the prelim.** See pages 58-59 and ecampus page for details.
11. **Final Defense** of dissertation is required for all PHD students.
   - Date and location of the final defense must be scheduled through the Graduate Office **at least 1 month in advance** so that official notification can be provided to OGAPS.
   - Dissertation must be submitted to committee members at least two weeks before defense.
   - Please see ecampus page for details.

12. Composition of supervisory committee – at least 4 members total
   - At least two members from within Computer Engineering Group from ECEN.
   - At least one member not in CE Group, but in ECEN Department.
   - At least one member from outside the ECEN Department.
   - Note: Committee Chair must be ECEN faculty (or CSCE joint faculty appointment). Co-chair may be from outside department.

*See additional course requirements on slide 29 or in Graduate Handbook.*
**Additional Course Requirements**  
*(Applies to MS)*

- STAT 651 and STAT 652 (statistics courses) are for non-science majors and are *not allowed*.  
  Traditionally, *no courses* will be admitted from Engineering Technology because of the non-calculus based curriculum and no approved graduate program.

- Credit for CSCE 614 will normally not be allowed. Take ECEN 651 instead. *(talk to me afterwards)*

- Credit for CSCE 619 and CSCE 612 in addition to ECEN 602 will normally not be allowed.

- No credit will be given for CSCE 601 & 602.
Foundation and First-Level Graduate Courses

• Foundation 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

• Recommended first-level graduate courses
  – ECEN Undergraduate Course: 468
  – CSCE Undergraduate Course: 410
  – ECEN Graduate Courses: 602, 621, 651, 653, 654, 687, 714, 754, 749
  – CSCE Graduate Courses: 629, 662
Tentative List of Courses for Master of Science & PhD CEEN Students

Must take at least 6 courses from the list on slides 31-36.

- **Hardware/VLSI**
  - ECEN 468 Advanced Digital System Design
  - ECEN 654 VLSI System Design
  - ECEN 661 Integrated Systems Design Automation
  - ECEN 680 Test and Diagnosis of Digital Systems
  - ECEN 687 Introduction to VLSI Design Automation
  - ECEN 689 Special Topics Courses
  - ECEN 699 Advances in VLSI Logic Synthesis
  - ECEN 714/454 Digital Integrated Circuit Design
  - ECEN 749/449 Microprocessor System Design
  - ECEN 751 Advanced Computational Methods for Integrated System Design
  - ECEN 752 Advances in VLSI Circuit Design
  - ECEN 759 Hardware Security
• **Networks**
  – ECEN 602 Computer Communications & Networking
  – ECEN 619 Internet Protocols & Modeling
  – ECEN 621 Mobile Wireless Networks
  – CSCE 663 Real-Time Systems
  – CSCE 665 Advanced Networking & Security
  – CSCE 664 Wireless and Mobile Systems
  – ECEN 689 Special Topics Courses in Networks
Tentative List of Courses for Master of Science & PhD CEEN Students

- **Computer Architecture**
  - CSCE 605 Compiler Design
  - CSCE 611 Operating Systems
  - 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
  - ECEN 689 Special Topics Courses in Computer Architecture
Tentative List of Courses for Master of Science & PhD CEEN Students

- **Networking and System Theory**
  - ECEN 663 Data Compression with Applications to Speech and Video
  - ECEN 689 Special Topics Courses in Networking and System Theory
  - ECEN 750 Design and Analysis of Communication Networks
  - ECEN 753 Theory and Applications of Networking Coding
  - ECEN 754/434 Optimization for Electrical and Computer Engineering Applications
  - ECEN 755 Stochastic Systems
  - ECEN 756 Game Theory

- **Data Science**
  - ECEN 689 Special Topics Courses in Data Science
  - ECEN 748 Data Stream Algorithms and Applications
  - ECEN 758 Data Mining and Analysis
Tentative List of Courses for Master of Science & PhD CEEN Students

• 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 652 Optimization II
Tentative List of Courses for Master of Science & PhD CEEN Students

• **Systems and Software**
  – CSCE 410 Operating Systems
  – CSCE 611 Operating Systems
  – CSCE 606 Software Engineering
  – CSCE 629 Analysis of Algorithms
  – CSCE 662 Distributed Processing Systems
  – CSCE 670 Information Retrieval & Storage

*The most up-to-date version of the Graduate Handbook is found on your eCampus / ECEN Graduate Students link.

*See course descriptions in the ECEN catalog.
http://catalog.tamu.edu/graduate/course-descriptions/ecen/
Tentative Course Offerings for Computer Engineering & Systems Classes

Fall 2018 – Spring 2020
Tentative List of Computer Engineering and Systems Classes for Fall 2018

- ECEN 602 Computer Communication and Networking
- ECEN 676 Advanced Computer Architecture
- ECEN 681 Seminar – Computer Engineering
- ECEN 689 Sp. Topics in Dependable Learning Systems
- ECEN 689 Sp. Topics in Online Decision Making and Learning
- ECEN 714 Digital Integrated Circuit Design (Stacked with ECEN 454)
- ECEN 749 Microprocessor Systems Design (Stacked with ECEN 449)
- ECEN 751 Computational Methods for Integrated System Design
- ECEN 753 Theory and Applications of Network Coding
- ECEN 754 Optimization for Electrical and Computer Engineering Applications
- ECEN 758 Data Mining and Analysis
- ECEN 759 Hardware Security
Tentative List of Computer Engineering and Systems Classes for Spring 2019

- ECEN 619 Internet Protocols and Modeling
- ECEN 651 Microprogrammed Control of Digital Systems
- ECEN 654 Very Large Scale Integrated Systems Design
- ECEN 681 Seminar – Computer Engineering
- ECEN 689 Sp. Topics in Architecture and Circuits for Machine Learning
- ECEN 689 VLSI Machine Learning Systems
- ECEN 714 Digital Integrated Circuit Design
  (Stacked with ECEN 454)
- ECEN 748 Data Stream Algorithms and Applications
- ECEN 749 Microprocessor Systems Design
  (Stacked with ECEN 449)
- ECEN 755 Stochastic Systems
- ECEN 756 Game Theory
- ECEN 757 Distributed Systems and Cloud Computing
- ECEN 758 Data Mining and Analysis
Tentative List of Computer Engineering and Systems Classes for Fall 2019

- ECEN 602 Computer Communication and Networking
- ECEN 621 Mobile Wireless Networks
- ECEN 651 Microprogrammed Control of Digital Systems
- ECEN 681 Seminar – Computer Engineering
- ECEN 687 Introduction to VLSI Physical Design Automation
- ECEN 689 Sp. Topics in Processor Memory System Architecture
- ECEN 714 Digital Integrated Circuit Design
  (Stacked with ECEN 454)
- ECEN 749 Microprocessor Systems Design
  (Stacked with ECEN 449)
- ECEN 751 Computational Methods for Integrated System Design
- ECEN 754 Optimization for Electrical and Computer Engineering Applications
- ECEN 758 Data Mining and Analysis
- ECEN 759 Hardware Security
Tentative List of Computer Engineering and Systems Classes for Spring 2020

- ECEN 619 – Internet Protocols and Modeling
- ECEN 653 – Computer Arithmetic Unit Design
- ECEN 654 – Very Large Scale Integrated Systems Design
- ECEN 681 – Seminar – Computer Engineering
- ECEN 689 Sp. Topics in Architecture and Circuits for Machine Learning
- ECEN 689 Sp. Topics in Smartphone Systems
- ECEN 689 Sp. Topics in VLSI Machine Learning Systems
- ECEN 714 Digital Integrated Circuit Design (Stacked with ECEN 454)
- ECEN 748 Data Stream Algorithms and Applications
- ECEN 749 Microprocessor Systems Design (Stacked with ECEN 449)
- ECEN 750 Design and Analysis of Communication Networks
- ECEN 755 Stochastic Systems
- ECEN 758 Data Mining and Analysis
Some Courses to Consider
Computer Engineering & Systems Group

Fall 2018
ECEN 676: Advanced Comp. Arch.

- **Offered**: in Fall 2018
- **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; shared memory architectures; multi-threaded architectures. Achieving performance under strict power constraints

- **Prerequisite**: ECEN 651 or CSCE 614 or approval of instructor.

- **Instructor**: Prof. Paul Gratz

Intel Core i9-7900X
ECEN 753: Theory and Applications of Network Coding

Offered in Fall 2018

Topics:
- Network coding for distributed storage and wireless networks
- Coding for reliability and security
- Regenerating codes
- Codes with locality and availability
- Private information retrieval
- Index coding

Prerequisite:
Graduate standing

Instructor:
Dr. Anoosheh Heidarzadeh
ECEN 689-605: Dependable Learning Systems

Offered in Fall 2018

Objectives:

• Decision-making in uncertain environment
• Reinforcement learning
• Formally verifying correctness of decision and design
• Applications: driverless car, drone, robotic, smart grid, chip and datacenter power management, etc.

Prerequisite:
Basic programming skill and Graduate standing

Instructor:
Jiang Hu
ECEN 759: Hardware Security

Offered in Fall 2018

Objectives:
This course explores design of secure computer design; attacks and defenses on a VLSI system; security analysis of a System-on-Chip; Specter and Meltdown attacks and countermeasures; supply-chain attacks and defenses; and design of high-performance crypto units.

Prerequisite:
ECEN 714/454 or ECEN 350 or approval of instructor

Instructor:
Prof. JV Rajendran
CESG Check-In

• WEB 333 -
  Suite in the NW corner of Wisenbaker includes:
  CESG Offices, Vickie & the Fishbowl

• One-on-one meeting with Ms. Vickie Winston, CESG Program Specialist
  – Assignment of Mentor/Advisor for Course Advice
  – Useful Information

• Drop-In Daily @ WEB 333E: 8:00 – 12:00
  & 1:00 - 4:00
International Students
https://calendar.tamu.edu/iss/#!view/day

- Thursday, August 23 8:00 AM - 4:00 PM
- MSC Ballroom & Rudder Auditorium
OGAPS Orientation

• Highly Recommended

• Friday, August 24, 8:00 AM to 4:00 PM

• Rudder Exhibit Hall

Note: too late to register now but you could try to show up at 8a and you might be allowed to attend w/o lunch
CESG’s Website

• You can find this PowerPoint Thursday at:

https://cesg.tamu.edu/
Questions?