What is ECSE?
EE vs. CSE. vs. CS

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Layers of Abstraction of a Computer

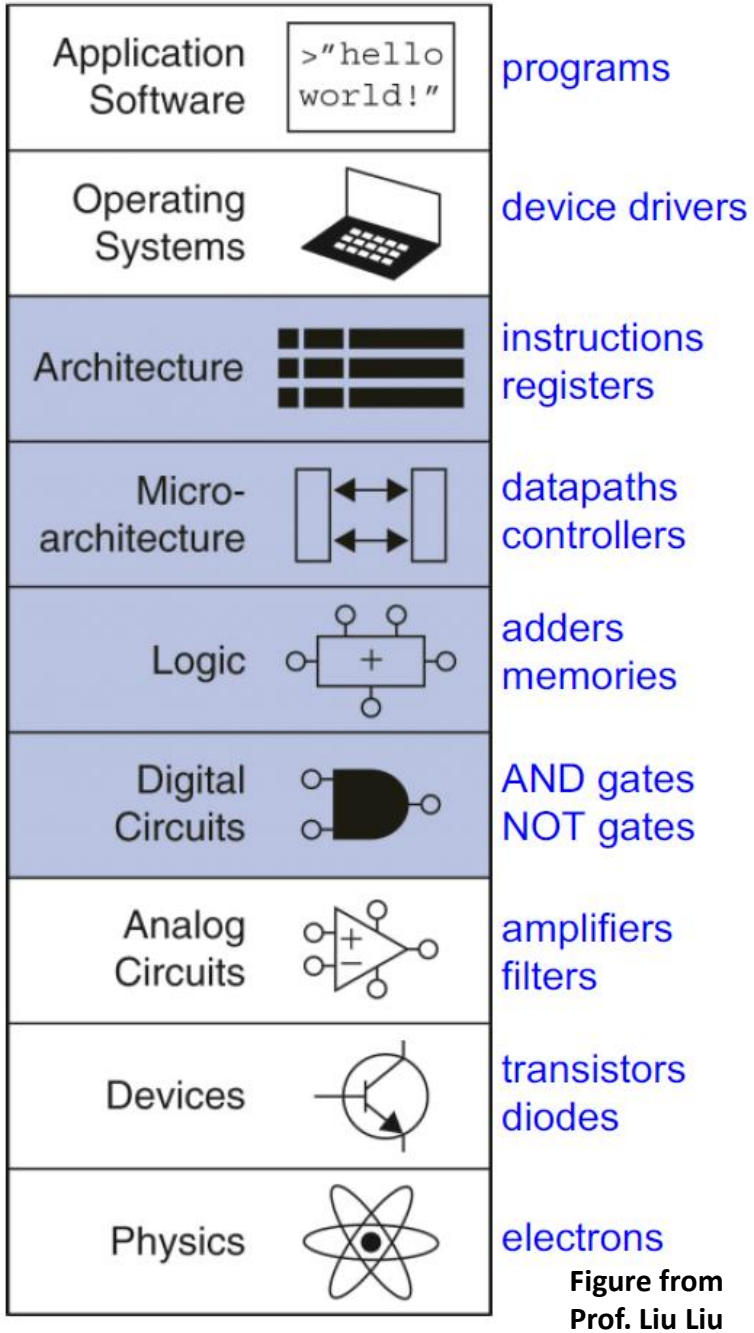

Figure from Prof. Liu Liu

Who does what?

Who works on each layer of abstraction of a computer from physics all the way up to application software?

Take 2 minutes to think about this for yourself and assign each layer of abstraction to EE, CSE, and/or CS

Compare and discuss with your neighbor for 3 minutes. Do you agree? Do you disagree? Why did you place them where you did?

EE	CSE	CS
	Application Software	Application Software
	Operating Systems	Operating Systems
Architecture (?)	Architecture	Architecture
Micro-architecture (VLSI?)	Micro-architecture	Micro-architecture (?)
Logic	Logic	Logic (?)
Digital Circuits	Digital Circuits	
Analog Circuits	Analog Circuits	
Devices	Devices (?)	
Physics	Physics (?)	

How are EE and CSE different?

https://ecse.rpi.edu/academics/undergraduate-programs/what-are-ee-and-cse

- ## Where do EE and CSE overlap?

The two majors have many similarities. In either one, you'll get a solid foundation in applied math and physics, computer programming, circuit theory and electronics, engineering design, and professional development. You can take a look at our curriculum and templates for more details.

- ## How is EE different than CSE?

EEs generally focus more on hardware and physics. This is where you'll learn about machines, devices, and systems that consume a lot of power, and how that power is managed. This is also where you'll build circuits and systems at a small scale, like designing and fabricating your own microchips and sensors.

- ## How is CSE different than EE?

CSEs generally focus more on algorithms and systems. Compared to an EE, you'll do more computer programming and learn more mathematical theory related to areas like artificial intelligence. This is where you can learn about the Internet of Things, computer vision, communication networks, and robotics.

EE and CSE Core Curricula

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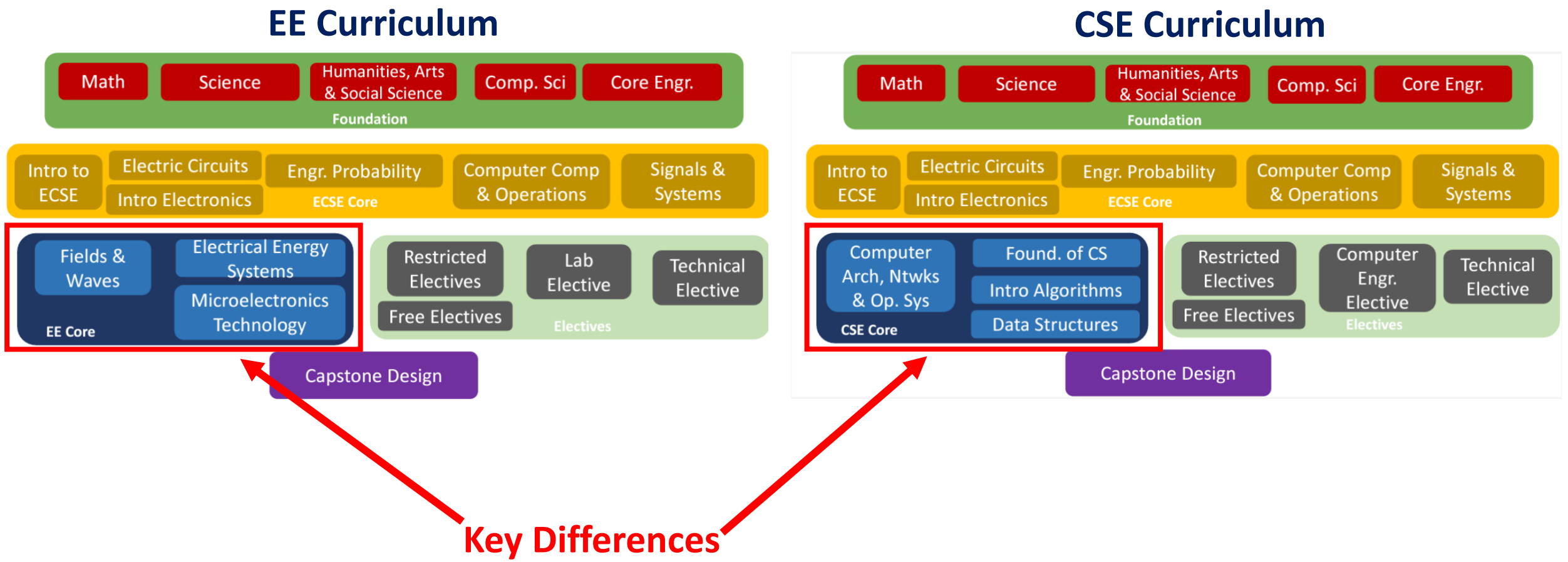

How are CSE and CS different?

- How is CSE different than Computer Science?

A simple answer is that Computer Science is more focused on what computers can do, and Computer Systems Engineering is more focused on how computers are built. You can get a CS degree without taking your hands off the keyboard, but in CSE you will get them dirty with all sorts of sensors and devices! You'll learn a lot of ways of applying math to model the real world in the CSE major that you won't see in a CS degree.

- Can I do both?

Yes! It's extremely common for students to dual major in CSE and CS to get exposed to both ways of thinking.

What is ECSE (at RPI)?

- Artificial Intelligence and Machine Learning
- Computer Vision and Image Processing
- Communications and Computer Networks
- Control Systems
- Robotics and Automation
- Computer Hardware Systems
- Electric Power and Energy
- Microelectronics and Photonics
- Mixed Signal Electronics

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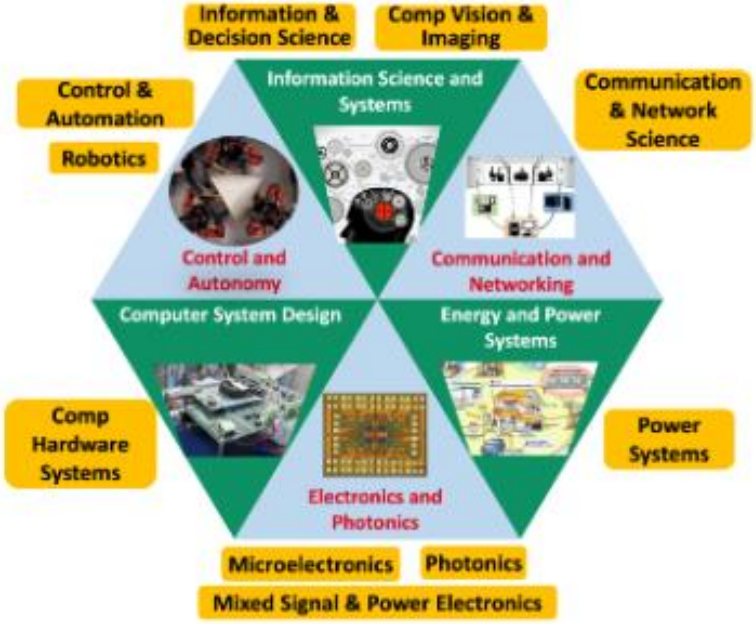

Focus Areas

Information Science and Systems

The next industrial revolution will largely be driven by Intelligent Technologies (ITs). It will mark with the ubiquitous presence and applications of intelligent algorithms and systems, such as autonomous machines and smart devices. ECSE faculty has a long tradition in developing intelligent technologies. The AI and Machine Learning Systems (AI/ML Systems) group performs fundamental research in AI and machine learning as well as their applications to various physical systems.

Artificial Intelligence and Machine Learning

- Required:
  - ECSE 4840 - Introduction to Machine Learning
- ECSE Electives (take two from list)
  - ECSE 4850 – Intro to Deep Learning
  - ECSE 4810 – Intro to Probabilistic Graphical Models
  - ECSE 4740 – Parallel Computing
  - CSCI 4100 - Machine Learning from Data
  - ECSE 4760 – Real Time Control & Communication
  - ECSE 4962 (Spring 2022) - Trustworthy Machine Learning
  - ECSE 4964 (Spring 2022) - Distributed Machine Learning

Computer Vision and Image Processing

- ECSE Electives (take three from list)
  - ECSE 4540 – Introduction to Image Processing
  - ECSE 4620 – Computer Vision for Visual Effects
  - ECSE 4750 - Computer Graphics
  - ECSE 4850 - Intro to Deep Learning
  - ECSE 4961/6650 - Computer Vision

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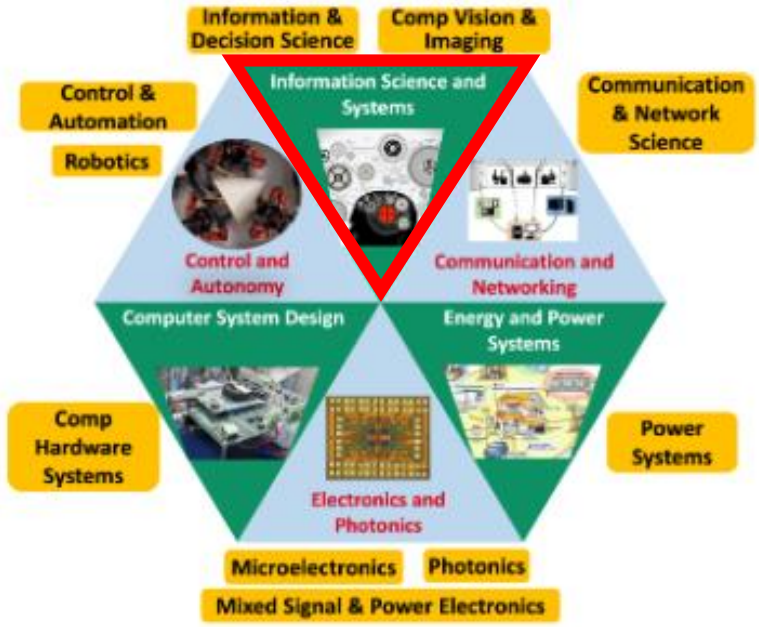

Focus Areas

Communications & Networking

This field deals with the encoding, transmission, retrieval, and interpretation of information in many forms. Students may pursue programs of study focusing on mathematical modeling and analysis, algorithm design, and hardware/software implementation of solutions for efficient information transmission and retrieval.

Communications and Computer Networks

- Required:
  - ECSE 4660 – Internetworking of Things
- ECSE Electives (take two from list)
  - ECSE 4670 – Computer Communication Networks
  - ECSE 4520 – Communication Systems
  - ECSE 4530 - Digital Signal Processing
  - ECSE 4560 - Digital Communications

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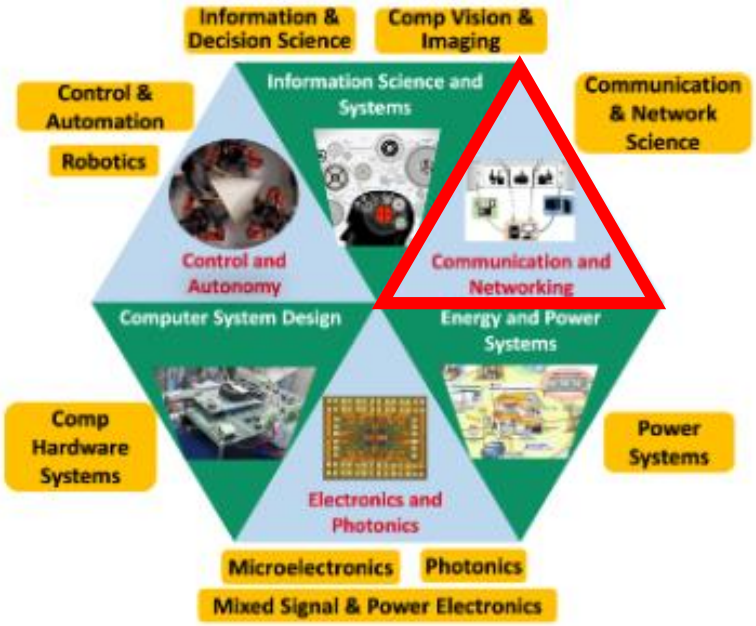
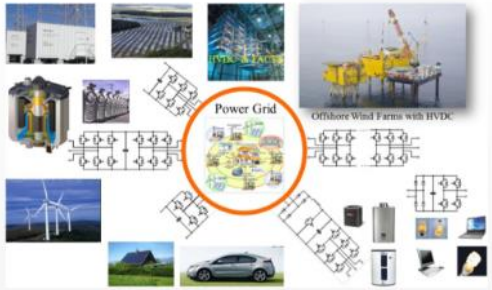


Focus Areas



Energy and Power Systems

The program includes the study of power system dynamics and control, and the role of power electronics in renewable resource integration in large power grids. The programs apply techniques from other disciplines on the various aspects of power system operation, such as cyber security and data analytics.

Electric Power and Energy

- Required:
  - ECSE 4130 – EPE Laboratory
- ECSE Electives (take two from list)
  - ECSE 4080 – Semiconductor Power Electronics
  - ECSE 4110 – Power Engineering Analysis
  - ECSE 4120 – Electromechanics
  - ECSE 4170 – Modeling & Simulation of Cyberphysical Systems

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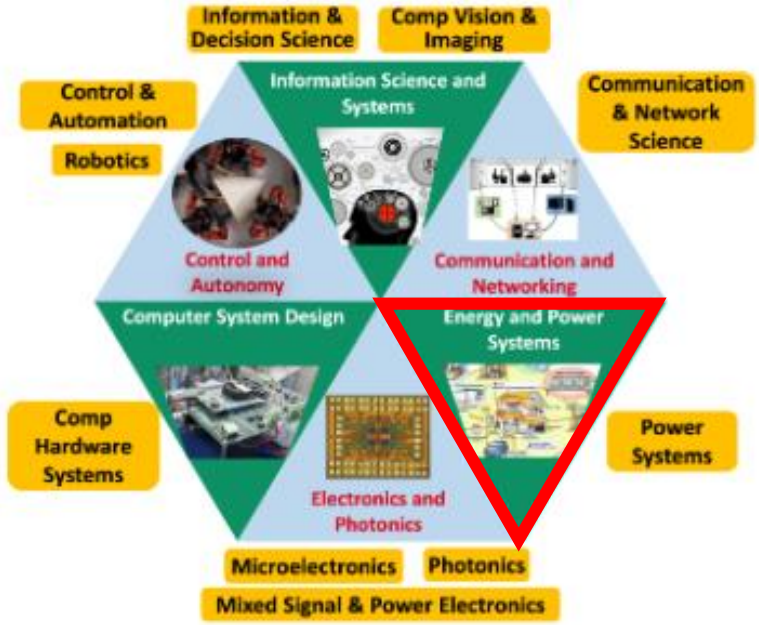
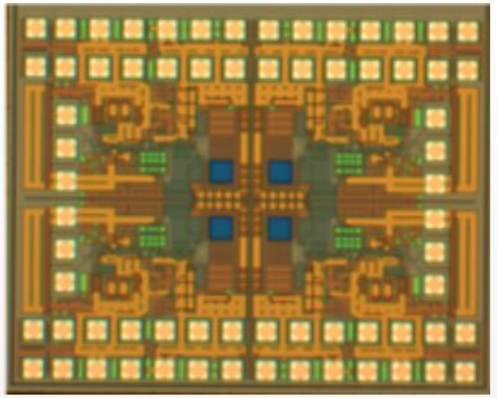


Focus Areas



Electronics & Photonics

Work in this area primarily focuses in developing new devices using cutting edge technology and then employing them in building state of the art systems with the aim of improving the modern electronic industry.

Microelectronics and Photonics

- Required:
  - ECSE 4220 – VLSI Design
- ECSE Electives (take two from list)
  - ECSE 4040 - Digital Electronics OR ECSE 4030 - Analog Electronics
  - ECSE 4250 - IC Processing and Design
  - ECSE 4370 – Optoelectronics Technology
  - ECSE 4380 – Fundamentals of Solid State Lighting
  - ECSE 4080 - Semiconductor Power Electronics
  - ECSE 4720 – Solid State Physics

Mixed Signal Electronics

- Required:
  - ECSE 4220 – VLSI Design
- ECSE Electives (take two from list)
  - ECSE 4030 – Analog IC Design
  - ECSE 4040 – Digital Electronics
  - ECSE 4050 – Advanced Electronics
  - ECSE 4310/ECSE 630 - Fundamentals of RF/Microwave Engineering

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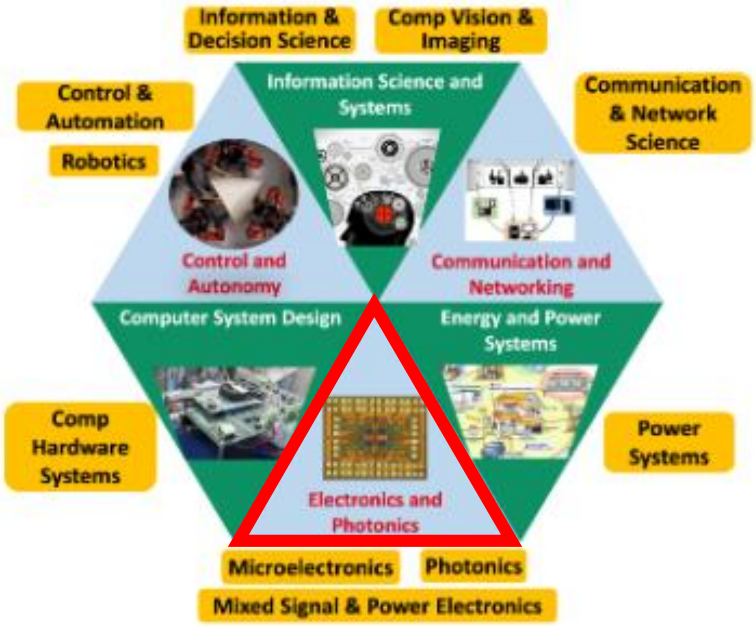
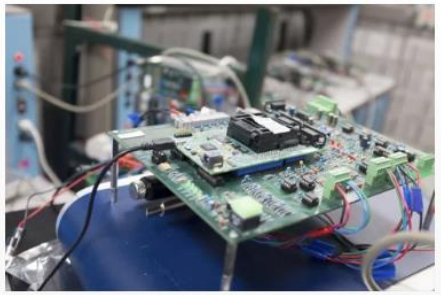


Focus Areas



Computer Systems Design

Computers have become almost as pervasive as food. While there are many users of computer technology and many who write programs, the future of computing depends on the underlying electronic devices that compose them and the digital logic operations they perform. Computers use circuits that connect these devises. While current computers are nearly exclusively fabricated with CMOS, progress has been largely obtained by device scaling. This becomes difficult as the physical dimensions of the devices become so small that only a handful of dopant atoms can be used to define their operation. As such, novel approaches to computing are needed along with new devices.

Computer Hardware Systems

- Required:
  - ECSE 4770 – Computer Hardware Design
- ECSE Electives (take two from list)
  - ECSE 4040 – Digital Electronics
  - ECSE 4220- VLSI Design
  - ECSE 4250 – IC Process & Design

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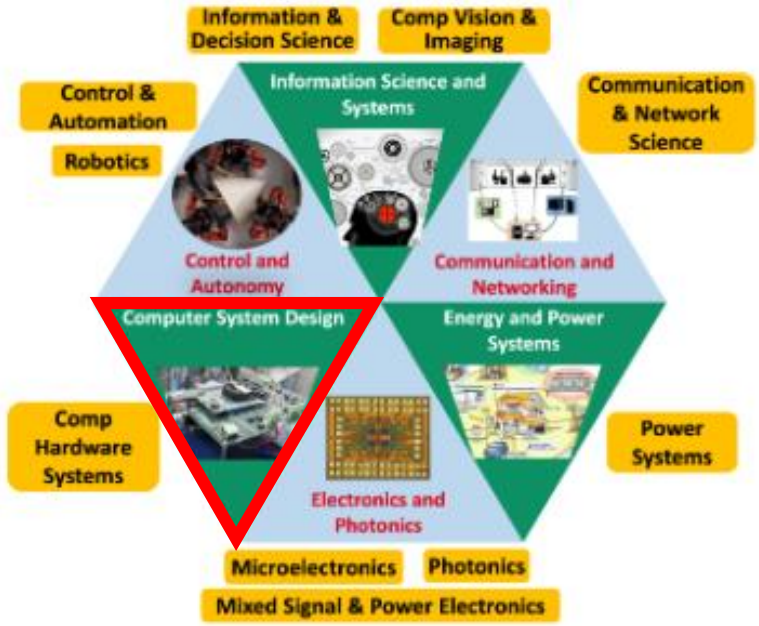

Focus Areas

Control and Autonomy

With focuses on the methodologies and applications in control, robotics, and automation the ECSE faculty in this area conduct multi-disciplinary cutting-edge research with emphasis on high impact applications. Methodological tools include complex large-scale systems, network science, formal methods, machine learning, vision and perception, and cognitive engineering. Applications span human-robot systems, advanced manufacturing, cyber-physical systems, autonomous systems, power systems, thermal management, biological systems, human health, micro-robotics, and materials processing.

Control Systems

- Required:
  - ECSE 4440 - Control Systems Engineering
- ECSE Electives (take two from list)
  - ECSE 4760 - Real Time Control & Communication (Lab or CE Elective)
  - ECSE 4170 – Modeling & Simulation of Cyberphysical Systems
  - ECSE 4090 - Mechatronics (Lab or CE Elective)

Robotics and Automation

- Required:
  - ECSE 4480 - Robotics I
- ECSE Electives (take two from list)
  - ECSE 4490 - Robotics II
  - ECSE 4850 - Intro to Deep Learning
  - ECSE 4170 – Modeling & Simulation of Cyberphysical Systems
  - ENGR 4710 - Manufacturing Process and System Lab I (Lab Elective)

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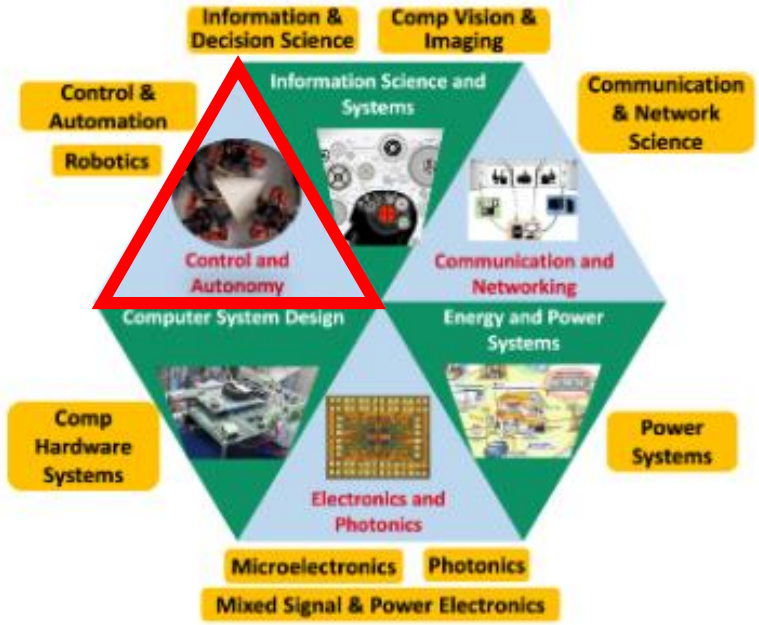

Where do the Labs in ECSE 1010 Fit?

- Artificial Intelligence and Machine Learning
- Computer Vision and Image Processing **Lab03**
- Communications and Computer Networks **Lab03**
- Control Systems **Lab02** **Lab03**
- Robotics and Automation **Lab03**
- Computer Hardware Systems **Lab01**
- Electric Power and Energy **Lab01**
- Microelectronics and Photonics **Lab02***
- Mixed Signal Electronics **Lab01** **Lab02**

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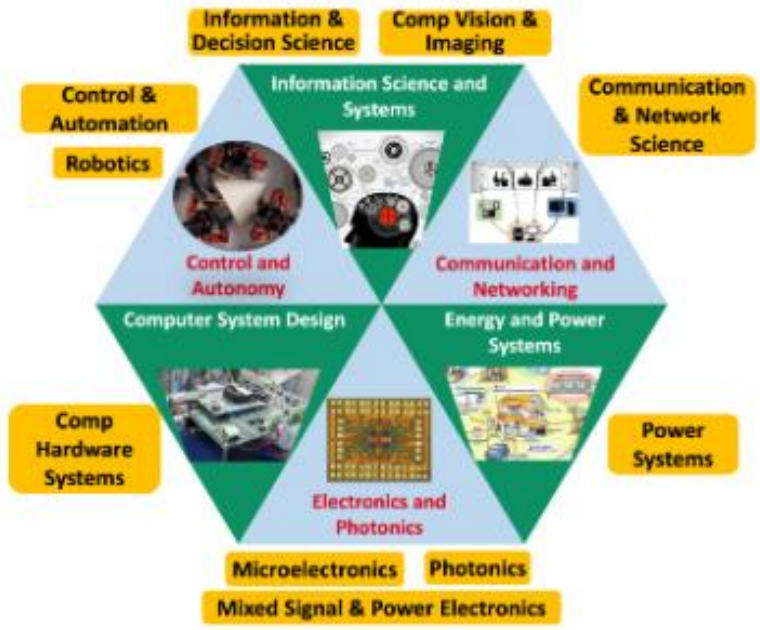

Lab01 – Basics of Electric Circuits

Lab02 – Linear Systems and Op-Amps

Lab03 – Signals (Frequency & Time Domain)

***Diode Omega Lab**