Concentration vs. Focus Area

BSEE concentrations:
- Photonics (join SPIE/OSA)
- Electric Power Engineering
- Engineering Enterprise
- Biomedical Applications
- Environmental Applications

BSCpE concentration:
- Engineering Enterprise

Focus Areas: (area of specialty)
- AI
- Controls/Embedded Systems/Automation
- Cyber Security
- Data Mining
- Electromagnetics
- Electronics
- Photonics
- Power and Energy
- Signal Processing

1. EE Electives or CpE Tech Electives
2. Mix and match
3. Not listed on diploma
4. Highlight on resume
5. Leads to job type(s)

“The purpose of a concentration is to give recognition that the student has actively and consciously engaged the intellectual issues central to the concentration”
Controls: encompassing Robotics, Controls, & Automation: The design of electrical, electronic and computer systems that control physical devices.

Skills of the controls engineer: control algorithm development, mathematical modeling of physical systems, Matlab, Simulink

Prerequisites: EE3160, Signals and Systems  
CpE’s: Take EE3160 as semester 5 choice

Courses: EE3261, EE4262, EE4219/20, EE4777, EE5750, EE3373, EE4373, EE4737

Other courses/areas: EE4252, Signal Processing and It’s Applications

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Job types:
• Autonomous vehicles, drones, satellites
• Cruise control, auto-pilot systems
• Defense – missile guidance
• Robotics – factory automation
• Engineering the Internet of Things

Faculty:
• Dr. Glen Archer, 629
• Dr. Jeremy Bos, 623
• Dr. Jeffrey Burl, 710
• Dr. Roger Kieckhafer, 713

Consider joining Robotic Systems Enterprise (RSE)
Computer Systems: The design of computer systems considering hardware design and interface; Computer system performance

Skills of the computer systems engineer: Micro-controller applications, algorithm development, programming, hardware/software interface, HDL

Prerequisites: EE2174, Digital Logic, C or java programming

Courses: EE3171 or EE3173, EE4173, EE4272, EE4271, EE4737

Other courses/areas: EE4252, Signal Processing and It’s Applications, EE4231 Physical Electronics, CS3421, Computer Organization, CS3411, Systems Programming, CS4321, Algorithms

Job types:
- Computer hardware design
- Firmware development
- Data or image processing
- Computer networks
- Embedded systems

Faculty:
- Mr. Christopher Cischke, 520
- Dr. Zhou Feng, 513
- Dr. Timothy Havins, 504
- Dr. Roger Kieckhafer, 713
- Dr. Saeid Nooshabadi, 512
- Dr. Zhaohui Wang, 506
Electromagnetics: The study of electromagnetic fields and waves, and devices that control and employ them, from DC to Optics: radar, radio, TV broadcasting, MRI, maglev trains, generators, transformers, etc…The foundation for much of what we do in the ECE field.

Skills of the electromagnetics engineer: Understanding concepts of electromagnetic radiation, including AM & FM, cell phone, GPS; EM problem solving for developing and operating EM devices

Prerequisites: PH2200, MA3160, EE2112

Courses: EE3140, EE4411, EE4490

Other courses/areas: Signal Processing, Communications, Physics, Power electronics, Photonics

Job types:
- EMC Engineer in hybrid electric vehicle design
- Electromagnetic interference/compatibility
- Electric power engineering applications
- Antenna design
  - Phased array antennas; Steerable antenna; RF antenna design
- Microwave communications
- Develop EM devices for use in defense, medicine and communications

Faculty:
- Dr. Warren Perger, 819
- Dr. Elena Semouchkina, 711
Electronics: The study of electronic devices, systems, and equipment that use the
effects produced by electrons

Skills: Understanding of electronic processes and functionalities of electronic devices, measure and control
electronic systems.

Prerequisite: EE3131

Courses: EE4231, EE4271, EE4240

Other courses/areas: Photonics, Electronics Materials, Solid State Devices, Power Electronics

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Job types:
- Design and maintain embedded electronic controls
- Electronic hardware design engineer
- New product development in military and aerospace electronics
- Develop electronics for GPS or cell phones; any electronic device
- Operate and control electronic devices and systems

Faculty:
- Dr. Duane Bucheger, 731
- Dr. Elena Semouchkina, 711
- Dr. Wayne Weaver, 236
Photonic & Optics: Photonics is the control of photons in terms of generating and harnessing light and other forms of radiant energy.

Skills of the photonics engineer: light emission, transmission, deflection, amplification and detection by optical components; lasers; fiber optics; electro-optical instrumentation.

Prerequisites: PH2200, EE2112, MA3160, EE3140 (Co-requisite or prereq)

Courses: EE2190, EE3190, EE3290, EE4490, EE4290

Other courses/areas: Digital Signal Processing, Electronics, Electromagnetics

Job types:

- Design robotic vision system
- Outer-space photography technology
- Satellite design
- Laser applications engineer
- Develop photonic IC-based telecommunication products
- Optics; Fiber-optics
- Design and test optical transponders and transceivers

Faculty:
- Dr. Durdu Guney, 729
- Dr. Chris Middlebrook, 628
- Dr. Mike Roggemann, 503

Student chapter: SPIE/OSA International Society for optics and photonics
MTU lab: SB 24

2017-18 contact: Stephen at sjgrulke@mtu.edu or Evan at ejgowron@mtu.edu
Power & Energy: The generation, transmission, distribution and utilization of electric power and electrical devices such as generators, motors and transformers.

Prerequisites: EE3120

Courses: EE4221, EE4222, EE4226, EE5223, EE5250, EE4227, EE4219, EE4295, EE4296

Other courses/areas: Controls, Electronics

Job types:
- Develop technologies to make our power grid more efficient, reliable and secure
- Integrate solar, wind energies into the power grid
- Design wind turbines
- Transmission line engineer
- Utilities and electrical power engineer consultant
- Electric vehicle design

Faculty:
- Dr. Leonard Bohmann, M7M 707
- Dr. Lucia Gaucia, 612
- Mr. Trever Hassell, 131
- Mr. John Lukowski, 233
- Dr. Bruce Mork, 614
- Dr. Sumit Paudyal, 611
- Dr. Joshua Pearce, M&M 504
- Dr. Chee-Wooi Ten, 613
- Dr. Wayne Weaver, 236

Student chapter: IEEE-PES Power & Energy Society  ieee.org MTU lab: EERC 809
**Signal Processing:** The analysis, interpretation, and manipulation of sound, radar, images, video, digital data and other signals.

**Skills** of the signal processing engineer: Modeling and simulations of systems, algorithm development, probability

**Prerequisite:** EE3160

**Courses:** EE4252, EE4253

Other courses/areas: Digital Communications, Control Systems, Probability & Random Signal Analysis

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**Job types:**
- Radar, sonar, communications
- Intelligence, surveillance
- Detect and exploit radar signals
- Data acquisition and signal analysis
- Sensor systems development
- Biomedical signal processing
- Cell phone technology

**Faculty:**
- Dr. Ashok Ambardar
- Dr. Daniel Fuhrmann, 118
- Dr. Michael Roggemann, 503
- Dr. Timothy Schulz, 505
- Dr. Reza Zekavat, 825
CpE Focus Areas from CS Dept
CpE Technical Electives

• Artificial Intelligence
• Computer Networks
• Computer Science
• Cyber Security
• Data Mining
• Game Development
• Software Application Development
## Artificial Intelligence

Computing systems that can behave like humans, perform human tasks, and make human-like decisions. Computing systems that learn and remember in a human-like way.

**Skills**

- problem solving using AI, reasoning, heuristics, search heuristics, machine learning
- formal models, algorithm development

**Prerequisite: CS2311, CS2321**

**Courses:** CS3311, CS4811, CS5811 (Fall of 5th year, w/instructor permission)

Other courses/areas: robotics, controls, embedded systems

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**Job types:**

- Develop flight simulators
- Develop and code task algorithms for drones
- Develop and test humanoids for NASA
- Computer analysis of OCT scans – speed up treatment start date – macular degeneration

**Faculty:**

- Dr. Timothy Havens, 504
Computer Networks: Design computer network architecture for data communication networks, local area networks, wide area networks and wireless networks.

Skills: network architecture and design, network security

Prerequisite: CS3411

Courses: EE4272, EE4723, EE5481, MA3202

Other courses/areas: Cyber Security, electronics

Job types:
- Cloud architect
- Computer network architect or network engineer
- Vehicle Network development

Faculty:
- Mr. Kit Cischke, 520
Computer Science: General computer science focus provides basic topics, and a high level of programming skills to develop software applications across all industries, develop software for the CPU, or work in scientific programming.

Skills: Concurrent programming, Formal Models, OS, DB systems, Compiler design & optimization

Prerequisite: CS1142, CS2311, CS2321, CS3331, CS3421

NOTE: Take CS3331 as semester 5 choice

Courses: CS3331, CS3311, CS4411, CS3425, CS4121, CS4130

Other courses/areas: System performance, architecture

Job types:

- Application programmer
- Develop operating systems
- Database design
- Scientific programmer

Faculty:
- Dr. Jean Mayo
- Dr. Ching-Kuang Shene
- Dr. Ruihong Zhang
Cyber Security: Develop secure systems; protect data and systems from cyber attacks.

**Skills** Computer security, programming, cryptography

**Prerequisite:** CS3411, CS3311, CS3141

**NOTE:** Take CS3331 as semester 5 choice

**Courses:** EE4272, EE4723, CS4471, MA3203, CS4710, CS4711

### Job types:
- Detect and solve security threats
- Design systems that deter cyber attacks
- Secure confidential databases (health; financial)

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**Faculty:**
- Mr. Kit Cischke
- Dr. Ali Ebnenasir
Data Mining: Develop systems to warehouse and access large datasets, for use in decision making and analytics. Analyze data for patterns, trends, and other useful information.

**Skills** Database management and database systems; analysis; statistics

**Prerequisite:** CS2311, CS2321

**NOTE:** Consider taking CS3331 as semester 5 choice

**Courses:** CS3425, CS4821, CS4425

Other courses/areas: Statistics, machine learning, algorithms, multiple-processor computing

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**Job types:**
- Data Science Analyst
- Database system development
- Big data analytics

**Faculty:**
- Dr. Ruihong Zhang
- Dr. Laura Brown

2.5 quintillion = 2,500,000,000,000,000,000

1 zettabyte = 1 trillion gigabytes
**Game Development:** Develop video and device-specific gaming systems for the entertainment industry.

**Skills** Team software build, 3-D Computer graphics, database systems

**Prerequisite:** MA2320, CS2311, CS2321

**NOTE:** Consider taking CS3331 as semester 5 choice

**Courses:** CS3141, CS4760, CS3425, CS4425, EE5496

Other courses/areas: Art, music, computer architecture, software processes and management, HCI

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**Job types:**
- Video game design and development
- Develop multi-platform production software
- iOS engineer
- Virtual reality

**Faculty:**
- Dr. Scott Kuhl
- Dr. Laura Brown
- Dr. Saeid Nooshabadi
CS/CpE Focus Areas

Software Application Development/Application Programming:
Design and build software applications for a wide array of applications in business and industry

Skills: Programming, Formal Models, Team Software development, DB, S/W Processes & Mgmt

Prerequisite: CS2311, CS2321, CS1142, CS3421

NOTE: Take CS3331 as semester 5 choice

Courses: CS3141, CS3311, CS3425, CS4425, CS4121, CS4710, CS4711, CS4411, iOS Development (EE4870?)

Other courses/areas: Software Quality Assurance, Data Mining, Algorithms, Scientific & Technical Writing (HASS)

Job types:
- Application Programmer
- Programmer/Analyst
- Software Engineer

Faculty:
- Dr. Ruihong Zhang
- Dr. Ali Ebnenasir
- Dr. Jean Mayo
Which focus area is for me?

Taking core classes and inquiring

Take a co-op or internship experience; talk with industry professionals and inquire at career center events

Join an enterprise project team that involves an area(s) you are considering

Look for undergraduate research opportunities

Talk with professors