Concentration vs. Focus Area

1. Listed on the Diploma
2. Get appropriate flowchart
3. See Judy or Trever, EERC 131 for questions
4. Submit request to add a concentration in MyMichiganTech

BSEE concentrations:
- Biomedical Applications
- Environmental Applications
- Photonics (join SPIE/OSA)
- Engineering Enterprise
- Electric Power Engineering (Fall 2017)

BSCpE concentration:
- Engineering Enterprise

1. Not listed on diploma
2. Formed with EE Electives or CpE Tech electives you choose (mix and match)
3. Highlight on resume
4. Leads to job type(s)

Focus Areas: (areas of specialization)
- AI
- Controls/Robotics and Embedded Systems & Control
- Cyber Security
- Data Mining
- Electromagnetics
- Electronics
- Photonics
- Power and Energy
- Signal Processing

“The purpose of a concentration is to give recognition that the student has actively and consciously engaged the intellectual issues central to the concentration”
**ECE Focus Areas**

**Communication and Signal Processing:** The transmission of information including voice, data, location (GPS), and sensor networks. The analysis, interpretation, and manipulation of sound, radar, images, video, digital data and other signals.

Skills of the communication/signal processing engineer: how signals are transmitted, improve transmission performance, simultaneous communication of one point with multiple points, wireless communication technology; Modeling and simulation of systems, algorithm development, probability

**Prerequisites:** EE3160, Signals and Systems, EE3180 Probability and Random Signal Analysis

**Courses:** EE3250, EE5527, EE5525, EE4252, EE4253. CpEs: EE4272, EE4723

Other courses/areas: Electromagnetics, Signal Processing

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**Job types:**
- GPS applications; Satellites
- Computer networks
- Radio, television, telephone
- Wireless communication

**Faculty:**
- Dr. Ashok Ambardar
- Mr. Christopher Cischke, 520
- Dr. Aurenice Oliviera, 712
- Dr. Mike Roggemann, 503
- Dr. Tim Schulz, 505
- Dr. Zhaohui Wang, 506
ECE Focus Areas

Controls/Robotics, Embedded Systems & Control: The design of electrical systems that control a mechanical system.

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

Prerequisites: EE3160, Signals and Systems

CpE's: Take EE3160 as semester 5 choice

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

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

Job types:

- Autonomous vehicles, drones, satellites
- Cruise control, auto-pilot systems
- Defense – missile guidance
- Robotics – factory automation

Faculty:

- Dr. Jeffrey Burl, 710
- Dr. Jeremy Bos, 623
- Dr. Roger Kieckhafer, 713

If approved: MEEM4707 – CpE-Technical Elective; EE-Approved Elective
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, EE4723, 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. Timothy Havens, 504
• Dr. Roger Kieckhafer, 713
• Dr. Saeid Nooshabadi, 512
• Dr. Tony Pinar, 731 (EE, Robotics)
• Dr. Zhaohui Wang, 506
ECE Focus Areas

**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…

**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

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**Job types:**

- EMC Engineer in hybrid electric vehicle design
- Electromagnetic interference/compatibility
- 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
ECE Focus Areas

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 electronic devices and components
- Operate and control electronic devices and systems

Faculty:

- Dr. Tony Pinar, 731
- Dr. Elena Semouchkina, 711
- Dr. Paul Bergstrom, 630
ECE Focus Areas

Photonics: 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)

Courses: EE3090, EE3190, EE3290, EE4490, EE4290, EE4256

Other courses/areas: Electronics, Electromagnetics

Job types:
- Design robotic vision system
- Outer-space photography technology
- Satellite design
- Laser applications engineer
- Develop photonic IC-based telecommunication products
- 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
ECE Focus Areas

Power & Energy: The generation, transmission, distribution and utilization of electric power and electrical devices such as motors, power generators, 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

Faculty:
• Dr. Leonard Bohmann, M7M 707
• Mr. Trever Hassell, 131
• Mr. John Lukowski, 233
• Dr. Bruce Mork, 614
• Dr. Joshua Pearce, M&M 504
• Dr. Chee-Wooi Ten, 613

Student chapter: IEEE-PES Power & Energy Society ieee.org MTU lab: EERC 809
CpE Focus Areas from CS Dept
CpE Technical Electives

- Artificial Intelligence
- Computer Networks
- Computer Science
- Cyber Security
- Data Mining
- Game Development
- Software Application Development
CS/CpE Focus Areas

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
• Design drones
• Develop humanoids for NASA
• Computer analysis of OCT scans – speed up treatment start date – macular degeneration

Faculty:
• Dr. Timothy Havens, 504
• Dr. Laura Brown
CS/CpE Focus Areas

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:

- Dr. Bo Chen (CS Dept.)
- Mr. Kit Cischke
- Dr. Jean Mayo

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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

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Job types:
- Application programmer
- Scientific programmer
- Develop operating systems
- Database design

Faculty:
- Dr. Jean Mayo
- Dr. Ching-Kuang Shene
- Dr. Shuai Wang
- Dr. Jianhui Yue
- 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)

Faculty:
- Mr. Kit Cischke
- Dr. Ali Ebnenasir
- Dr. Jean Mayo
- Dr. James Walker
- Dr. Shuai Wang
- Dr. Jianhui Yue
CS/CpE Focus Areas

**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
- Dr. Jianhui Yue
CS/CpE Focus Areas

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
Software Application Development: 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
- Dr. James Walker
- Dr. Shuai Wang
Which focus area is for me?

- Taking core classes and inquire about elective courses which follow.
- 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.