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)

BScP.E concentration:
• Engineering Enterprise

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”
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
• Dr. Reza Zekavat, 825
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

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If approved: *MEEM4707 – CpE-Technical Elective; EE-Approved Elective

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
ECE Focus Areas

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, EE4723, EE4271, EE4737

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

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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 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

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

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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

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

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**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
- 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

Student chapter: IEEE-PES Power & Energy Society  iee.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

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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

Faculty:

• Mr. Kit Cischke, 520
CS/CpE Focus Areas

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. Zhenlin Wang
- Dr. Jianhui Yue
- Dr. Ruihong Zhang
CS/CpE Focus Areas

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

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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)

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**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