Department of Electrical and Computer Engineering (ECE)

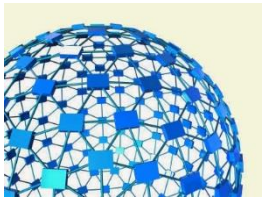
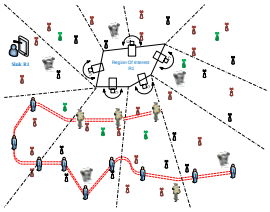
Illinois Institute of Technology (IIT)

IIT ECE Undergraduate Program Tracks

Electrical and Computer Engineers are engaged in contributing to diverse and challenging application areas, from nanotechnology to large scale power grids, from miniature electronics device to networks of billions of nodes among others. Exciting career opportunities in these areas are provided by small to giant product development companies, manufacturers, and service providers in the fields of telecommunications, computer systems, energy systems, control systems, semiconductor, aerospace, health care, biomedical engineering, security, transportation and automotive along with government, defense, and space agencies. The IIT ECE undergraduate program tracks prepare students for successful careers in the corporate sector, government agencies, or for further study in graduate or professional schools and provides them flexibility consistent with their potential and interest.

The program tracks are based on an effective and balanced learning experience with a strong broad background in foundation areas augmented with detailed expertize in selected areas. After receiving conceptual and application oriented multiple disciplinary foundation in their Freshman and Sophomore years, students can select courses from a rich set of options and formulate their study program in Junior and Senior years.

Communications and Networking Systems

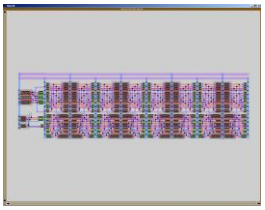
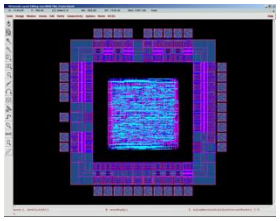



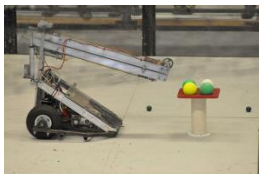

This track is focused on Internet, wireless, and related technologies that can provide multimedia applications over wireless and wireline Internet Protocol (IP) based networks. Strong foundation is provided in Communication Theory, Information Theory, and Bioinformatics. Specific areas covered include communication systems, communication and computer networks, wireless networks, network security, Internet of Things (IoT), and multimedia applications.

Major Opportunities: Telecommunications, Internet of Things (IoT), Sensor Based Networks

For Additional Information: *see attachments (pages 6-13)*

Computer Systems and Microelectronics



The Computer Systems and Microelectronics track focuses on the design and development of digital and computer systems, from novel device technologies and advanced design methodologies to algorithmic and application-specific techniques to support emerging computing platforms and application domains. Microprocessors, Integrated Circuits ("VLSI", silicon chips), Computer Architecture, Robotics, and Embedded Systems are some of the key areas covered.

Major Opportunities: Computer Systems, aerospace, defense and space exploration, portals

For Additional Information: *see attachments (pages 6-13)*

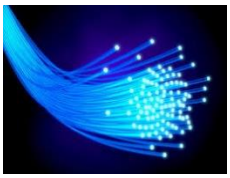
Cyber Security

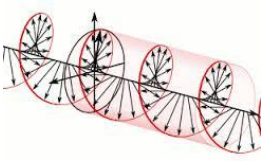

Cyber security is a multidisciplinary program of study which integrates courses from Electrical and Computer Engineering (ECE), Computer Science (CS), and law. Core learning on architecture and design of secure and resilient computer hardware and software systems is augmented with knowledge about human factors, ethical issues, and law. Topics addressed include Data Security, Software Security, System Security, Human Security, Organizational Security, and Societal Security. Emphasis is placed on detection and elimination of vulnerabilities and safe operation of a wide range of applications and environments including Internet of Things (IoT), cloud computing, healthcare, smart/micro grid power systems, computer networks, and wireless communications.

Major Opportunities: Defense, energy, finance, transportation, infrastructure, healthcare

For Additional Information: *see attachments (pages 6-13)*

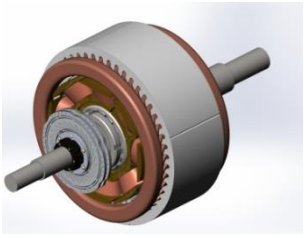
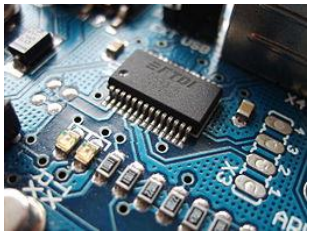
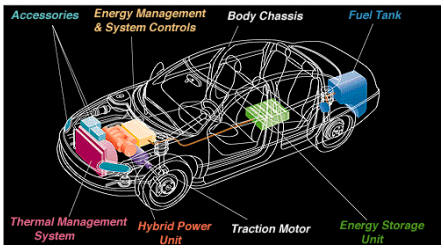
Electronics and Electromagnetics





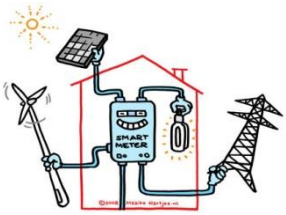

Electronics and Electromagnetics track prepares the student with skills of modeling and design of electronic and microelectronic components, devices, circuits, and systems as well as antenna and transmission systems. Analysis and design of microwave circuits and systems are addressed. The major areas covered include Photonics/Fiber Optics, Radio Frequency (RF), Microwave Links, Integrated Circuits, Semiconductor Devices, and Bio-electronics.
Major Opportunities: Communications, defense, aerospace, radar and navigation systems
For Additional Information: *see attachments (pages 6-13)*

Power Electronics and Control Systems

This track prepares students with fundamental knowledge and skills in power electronics and control systems, which are enablers for sustainable energy, intelligent transportation, smart grid, etc. The emphasis is on improving efficiency of electric machines and developing control strategies for power electronics, motor drive systems and the smart grid. The specific areas covered include design and development of Control Systems, Power Electronics, Motor Drives, Transportation, Hybrid Electric Vehicles and smart grid.
Major Opportunities: Transportation, Green Applications, Home and farm equipment
For Additional Information: *see attachments (pages 6-13)*

Power and Energy Systems

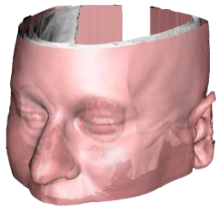
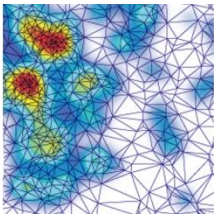

This track focuses on the generation, transmission, distribution, and consumption of electrical energy (including renewable energy) with particular emphasis on reliability, resiliency, efficiency, and sustainability. The areas covered include innovative designs, analysis, simulation, and control strategies for electric power and energy.
Major Opportunities: Energy transmission and distribution, energy generation, energy transactions, smart grid solutions
For Additional Information: *see attachments (pages 6-13)*

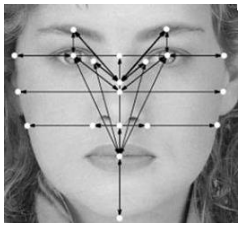
Robotics and Automation



This track prepares students for careers in the field of robotics and automation. It is primarily concerned with design and application of robots and the use of intelligent, self-learning computer systems for automating the manufacturing processes, improving the quality of human life and replacing humans in hazardous environments. Key topics covered in the curriculum include Control and Optimization Theory; Digital Circuits and Embedded System Design; Cyber-Physical Systems, Artificial Intelligence, Machine Learning and Machine Vision.
Major Opportunities: Automotive industry, Aerospace industry, Defense industry, Manufacturing
For Additional Information *see attachments (pages 6-13)*

Signal / Image Processing and Machine Learning



This track addresses advanced applications in medical diagnosis and analysis, meta data analysis, public safety, and artificial intelligence. Students develop learnings in the fundamentals and progression of diseases, automated recognition of vocalizations, the building of medical imaging devices, and imaging to address diseases such as Alzheimer's disease, heart disease, and various forms of cancer. Areas covered include computer vision, medical imaging, multimedia applications, speech recognition, machine learning as well as audio, video, and data analysis.

Major Opportunities: Public safety, Biomedical companies, Medical Services, Financial Services, Artificial Intelligence

For Additional Information: *see attachments (pages 6-13)*

Attachment: Additional Details on Tracks

Following contains additional details on the respective program tracks along with suggested selective courses for the chosen tracks. Students may note that as part of their multidisciplinary learning, they have numerous options of taking courses in Computer Science, Mathematics, Physical Sciences, and other engineering fields. Please visit the undergraduate program study material on the ECE web site for further information. The students also have the opportunity to conduct research with ECE faculty members. Also, IIT Armour College of Engineering provides additional opportunities for undergraduate research under unique multi-disciplinary PURE and MIND programs. For all tracks, students can integrate graduate 5xx level courses into their program of study, subject to approval by their academic advisor.

Communications and Networking Systems

Internet, wireless access, advanced modulation and multi-access techniques, Internet Protocol (IP) based transport are the major areas of study in the communications and networking field. Particular attention is paid to application oriented network architectures, autonomic network management, Internet performance analysis, resource allocation, traffic engineering, network measurement, network security, and wireless/wireline interworking. Practical technologies that can provide Quality-of-Service (QoS) guaranteed multimedia applications over wireless and wireline Internet Protocol (IP) based networks are studied. The topics covered include Space Time coding, Multiple Input Multiple Output (MIMO) communication systems, Wireless Sensor Networks and Advanced Modulation formats for bandwidth and power efficient communications. The application of principles of source and channel coding theory, information theory and pattern recognition and their use in analyzing and modeling genetic structures is introduced as part of bioinformatics area. Designs for spectral efficiency and interference control are emphasized. Simulation of wireless systems under different channel environments is also covered.

Suggested Selective Track Courses:

ECE 308 - Signals and Systems
ECE 401 - Communication Electronics
ECE 403 / ECE 405 - Digital and Data Communication Systems
ECE 406 - Introduction to Wireless Communication Systems
ECE 407 / ECE 408 - Introduction to Computer Networks
ECE 421 / ECE 423 - Microwave Circuits and Systems
ECE 436 / ECE 437 - Digital Signal Processing I
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT & Cyber Physical System
ECE 443 - Introduction to Computer Cyber Security
ECE 444 - Computer Network Security
ECE 481 - Image Processing
ECE 497 - Special Problems on Communications and Networking

Computer Systems and Microelectronics

Computer Systems and Microelectronics track emphasizes System-on-Chip (SoC) designs, reconfigurable architectures, data compression, and neural networks. Particular emphasis is placed on high performance and low power computing platforms targeted at computationally intensive problems in the fields of Signal and Image Processing, Ultrasonic Imaging, and other High Performance Applications. Computing systems. contemporary and advanced analog and design integrated hardware systems designed for Digital Signal Processing (DSP) applications, medical and industrial applications, smart sensors, robotics and transportations, and home automation among others are addressed. Hardware and software development tools, memories, and Interrupt systems associated with microprocessors and microcontrollers systems are studied. The use of Object-Oriented Programming (OOP) to develop computer simulations of engineering problems is also covered.

Suggested Selective Track Courses:

ECE 401 - Communication Electronics
ECE 407 / ECE 408 - Introduction to Computer Networks
ECE 425 - Analysis and Design of Integrated Circuits
ECE 429 - Introduction to VLSI Design
ECE 430 - Fundamentals of Semiconductor Devices
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT & Cyber Physical System
ECE 443 - Introduction to Computer Cyber Security
ECE 446 - Advanced Logic Design
ECE 449 - Object-Oriented Programming and Computer Simulation
ECE 485 - Computer Organization and Design
ECE 497 - Special Problems on Computer Systems and Microelectronics

Cyber Security

The subject matter provides knowledge to counter cyber threats by providing both theoretical fundamentals and actual implementation of cyber infrastructure. Techniques of building safety measures and protecting customers' digital assets are covered. A broad spectrum of security applications including cloud computing, healthcare and body area networks, secure networking protocols, smart grid power systems, and big data analysis and management are addressed. Key components include wireless protocols, wearable sensors, home environment sensors, behavior detection sensors, data fusion, data communications and communication methods. Computer security threats and defense mechanisms to thwart such threats are covered. Advanced methods of cryptography, encryption, authentication, and authorization are studied. Particular emphasis is placed on security and privacy issues in IoT since it is becoming the foundational technology for future applications.

Suggested Selective Track Courses:

ECE 308 - Signals and Systems
ECE 401 - Communication Electronics
ECE 406 - Introduction to Wireless Communication Systems
ECE 407 / ECE 408 - Introduction to Computer Networks
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT & Cyber Physical System
ECE 443 - Introduction to Computer Cyber Security
ECE 444 - Computer Network Security
ECE 446 - Advanced Logic Design
ECE 485 - Computer Architecture and Organization
ECE 497 - Special Problems on Cyber Security

Electronics and Electromagnetics

The goal of Electronics and Electromagnetics is to provide the students with an understanding of the physical and operational principles behind important electronic devices such as transistors, solar cells, and antenna and radar systems. Application of Maxwell's equations to waves in free space, metallic and dielectric waveguides, microstrips, microwave cavity resonators and components, and ultra-high frequency generation and amplification are covered. Semiconductor electron and hole concentrations, carrier transport, and carrier generation and recombination are discussed. P-N junction operation and its application to diodes, solar cells, and LEDs are developed. The field-effect transistor (FET) and bipolar junction transistor (BJT) are also discussed and their terminal operation developed. Application of transistors to bipolar and CMOS analog and digital circuits is introduced.

Suggested Selective Track Courses:

ECE 307 - Electrodynamics
ECE 311 - Engineering Electronics
ECE 312 - Electronic Circuits
ECE 319 - Fundamentals of Power Engineering
ECE 401 - Communication Electronics
ECE 411 - Power Electronics
ECE 412 - Electric Motor Drives
ECE 421 / ECE 423 - Microwave Circuits and Systems
ECE 425 - Analysis and Design of Integrated Circuits
ECE 429 - Introduction to VLSI Design
ECE 430 - Fundamentals of Semiconductor Devices
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT and Cyber Physical Systems
ECE 446 - Advanced Logic Design
ECE 497 - Special Problems on Electronics and Electromagnetics

Power Electronics and Control Systems

Power electronics and energy conversion covers solutions towards sustainable energy technology and transportation. The key areas of power electronics, electric machines, electric motor drives, and vehicular power systems are discussed. Particular emphasis is placed on design and implementation of advanced power electronic converters for automotive systems, embedded controllers for renewable energy systems, innovative machine designs, as well as analysis, simulation, and control strategies for electric motors and generators. Applications of semiconductor switching circuits to adjustable speed drives, robotics, and traction are explored. Switching devices such as power transistors and their applications in dc and ac converters as well as switching power supplies are studied.

Suggested Selective Track Courses:

ECE 307 - Electrodynamics
ECE 308 - Signals and Systems
ECE 311 - Engineering Electronics
ECE 312 - Electronic Circuits
ECE 319 - Fundamentals of Power Engineering
ECE 411 - Power Electronics
ECE 412 - Electric Motor Drives
ECE 430 - Fundamentals of Semiconductor Devices
ECE 438 - Control Systems
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT and Cyber Physical Systems
ECE 446 - Advanced Logic Design
ECE 497 - Special Problems on Power Electronics and Control Systems

Power and Energy Systems

The topics covered include fundamentals and operations of transformers, synchronous machines, induction machines, and fractional horsepower machines. Power network models and per-unit calculations are introduced. Use of PC-based interactive graphical software for load flow, economic dispatch, and fault analysis are covered. Students are introduced to transmission systems analysis and design, large scale network analysis, unsymmetrical short-circuit, and power system stability studies. Particular emphasis is placed on design of reliable power systems, power systems security analysis, optimal scheduling of power generation, and estimation of power system state.

Suggested Selective Track Courses:

ECE 307 - Electrodynamics
ECE 308 - Signals and Systems
ECE 319 - Fundamentals of Power Engineering
ECE 411 - Power Electronics
ECE 412 - Electric Motor Drives
ECE 417 - Power Distribution Engineering
ECE 418 / ECE 419 - Power Systems Analysis
ECE 420 - Analytical Methods in Power Systems
ECE 438 - Control Systems
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT and Cyber Physical Systems
ECE 497 - Special Problems on Power and Energy Systems

Robotics and Automation

Robotics and Automation represents one of the most in-demand engineering careers today. Students can expect to have jobs related to design and development of unmanned aerial vehicles (UAV), autonomous cars, rovers for space exploration missions, robots that accelerate manufacturing and robots that can aid elderly or disabled people. Topics include a broad spectrum of Electrical and Computer Engineering curriculum. Students will learn control theory, signal and image processing, digital circuits and embedded system design as well as machine learning. Internet of Things and cyber-physical system topics are covered with hands-on laboratory experiments. Students are exposed to a variety of CAD software, hardware development tools and programming languages.

Suggested Selective Track Courses:

ECE 308 - Signals and Systems
ECE 311 - Engineering Electronics
ECE 436 / ECE 437 - Digital Signal Processing I
ECE 438 - Control Systems
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT and Cyber Physical Systems
ECE 448 - Application Software Design
ECE 481 - Image Processing
ECE 505 - Applied Optimization for Engineers*
ECE 508 - Video Communications*
ECE 531 - Linear System Theory*
ECE 533 - Robust Control*
ECE 565 - Computer Vision and Image Processing*
ECE 566 - Statistical Pattern Recognition*
ECE 497 - Special Problems on Robotics and Automation

*: With permission from Academic Advisor

Signal / Image Processing and Machine Learning

The subject includes foundation and methods in areas of image acquisition, mathematical image processing and analysis, machine learning, and biological system modeling.
Topics covered include discrete signal analysis, Signal-flow graphs and block diagrams, digital representation of images, and basic color theory. Fundamentals and applications of image enhancement, restoration, reconstruction, compression, and recognition are also addressed.

Suggested Selective Track Courses:

ECE 308 - Signals and Systems
ECE 436 / ECE 437 - Digital Signal Processing I
ECE 441 - Microcomputers and Embedded Systems
ECE 442 - IoT and Cyber Physical Systems
ECE 481 - Image Processing
ECE 505 - Applied Optimization for Engineers*
ECE 508 - Video Communications*
ECE 565 - Computer Vision and Image Processing*
ECE 566 - Statistical Pattern Recognition*
ECE 569 - Digital Signal Processing II*
ECE 497 - Special Problems on Signal / Image Processing and Machine Learning

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