ECE 350 Special Topics Classes for Fall 2018

ECE 350-014 (CRN 42952): Advanced Topics in Memory Systems
Technical Elective Category – Computers Prof Xiaochen Guo

This course covers cache and memory internal implementations, timing constraints, high performance memory controllers, advanced memory interfaces, emerging memory technologies, 3D stacked memories, and processing-in-memory architectures. This course will also review the state-of-the-art research topics on energy, performance, and reliability issues in cache and memory systems.

ECE 350-011 (CRN 44428): Introduction to Robotics
Technical Elective Category – Computers Prof Richard Decker

Introduction to the science, technology and practice of autonomous and intelligent systems. Integration, control and programming of complex mobile systems comprised of sensors and electromechanical devices with high-performance, computerized electronic control systems and autonomous behavioral algorithms. Theory and implementation of small, mobile autonomous robots that can move independently and adapt to their environment to accomplish simple tasks. Sensor integration, navigation and mapping, motion control and wireless communication techniques in the context of small, physical robots.

Prerequisites: ECE 081 and ECE 033 or permission of instructor.

ECE 350-010 (CRN 42204): Communications and Networking for Smart Grids
Technical Elective Category – Computers Prof Shalinee Kishore

The self-healing, adaptive, and secure smart grid will require sophisticated communications networks. Ranging from the networking of in-home appliances and smart meters to the integration of sensor and actuator components across the grids, several communications and networking technologies will partake in the development and maintenance of the grid. This course aims to overview these key technologies and, in the process, will convey several core concepts behind communications and network engineering. The goal will be to study approaches that will enable secure, real-time, two way communications across the numerous entities within the grid so that it can 1) heal itself; 2) operate efficiently; and 3) engage customers in its improved operation. Course discussion in the first part of the semester will overview power system operations, electricity markets, legacy grid communications, and the smart grid vision and objectives. The remainder of the course will focus on relevant smart grid communication architectures, models, and objectives. The models and networks covered include home networks, smart meters, and Automated Meter Reading Infrastructure (AMRI), wireless mesh networks, sensor networks, metropolitan and wide area networks. The course will also cover related topics in the design and implementation of the Supervisory Control and Data Acquisition (SCADA) system as well as other models for networked control in the smart grid. The course will address relevant overlaps with telecommunications technologies (e.g., Ethernet, G.hm, WiMAX, Wi-Fi, Zigbe, TCP/IP, etc.) and how these approaches may be used to enhance grid functionality and response. Smart grid objectives such as demand response, grid security, state estimation, market interactions, and vehicle-to-grid integration will be covered as they pertain to grid’s communication architecture. Finally, time-permitting, field trials and deployments will be discussed.
ECE 350-012 (CRN 44409): Applied Quantum Mechanics

Technical Elective Category – Microwaves and Lightwaves       Prof Nelson Tansu

This course covers the fundamentals of quantum mechanics, and applications of quantum mechanics to engineering and applied physics problems. Classical physics is an approximation of quantum physics, in the case that the dimensions of interest are many orders magnitude larger than those of atoms. Though classical physics can explain and approximate some of the phenomena quite accurately, in reality, our world is a quantum world and it should only be described with quantum physics. As the technology is rapidly moving toward the nano-scale dimension (so-called nanotechnology), classical physics fails to describe quantum phenomena observed in nanotechnology. Today, quantum mechanics have been the foundations of many applications in the fields of engineering, biology, chemistry, and others. Applications in the fields of engineering have included photonics, semiconductor lasers, semiconductor optoelectronic devices, resonant tunneling diodes, semiconductor transistors, quantum optics, and many other important novel applications that truly utilize quantum phenomena in their operation principles.

Quantum Mechanics have also been commonly thought as a difficult course, which is only intended for physics students. The advancement of nanotechnology has required engineers and applied scientists to fully understand quantum mechanics, and to appreciate and to apply the quantum ideas on engineering problems. The knowledge of quantum mechanics is essential and fundamental to provide engineers with strong foundation for understanding quantum devices based on semiconductor nanostructure, and the ability to utilize this knowledge for exploring new semiconductor nanostructure devices utilizing quantum phenomena.

The purpose of this course for engineers and applied physicists is 1) to provide strong, essential, important methods and foundations of quantum mechanics, and 2) to understand the fundamental principle operations of various applications in semiconductor nanostructure and heterostructure devices. This course will apply quantum mechanics on engineering fields, in particular related to semiconductor electronic-optoelectronic devices, and semiconductor nanostructure & heterostructure devices.

Prerequisites: PHY 011, PHY 021, ECE 203, ECE 126

ECE 350-013 (CRN 44413) - Semiconductor Optoelectronics

Technical Elective Category – Microwaves and Lightwaves       Prof Jonathan Wierer

This course explores the theory and practical implementation of semiconductor optoelectronic devices. Broadly covers the fundamentals of the propagation, modulation, generation, and detection of light. Topics include the energy transfer between photons and electron-hole pairs, light emission and absorption, radiative and non-radiative processes, electrical and optical characteristics, carrier diffusion and mobility, light extraction and trapping. Specific devices include laser diodes, light-emitting diodes, electroabsorption modulators, photodetectors, and solar cells.

Prerequisites: ECE 126, ECE 202