COMPUTER ENGINEERING (CE)

CE-612 Digital Systems Design 4 Credits
Prerequisites: None
The principles and practices used in the design of modern complex combinational and sequential digital systems are covered in this course. Digital logic design, analysis, simulation, and implementation techniques are covered. Fundamental algorithms underlying computer-aided design (CAD) tools are studied. Schematic diagrams, hardware description languages (HDL), and system-on-programmable chip (SoPC) design tools are used to specify designs targeted for implementation in technologies ranging from discrete ICs to programmable logic devices, ASICs and SoPCs. Topics in testing of logic circuits and hardware-software co-design will be covered. The course is accompanied by laboratory component that allows students to exercise the principles and practices learned.
Lecture: 3, Lab 2, Other 0

CE-620 Microcomputer Systems 4 Credits
Prerequisites: None
The architectural features, design principles, development tools and techniques of advanced embedded microcomputers are covered in this advanced level course. The topics include architectures of contemporary 16-bit and 32-bit RISC microcontrollers (considering Microchip PIC24 and PIC32 as example cases for the practical development experiences), instruction set, addressing modes, software development & debugging, parallel and serial interfacing, interrupts, timer module, ADC module, etc.; The course has a strong laboratory component, which will be carried out on a microcomputer development kit with the latest family of 16-bit and 32-bit microcontrollers. Students will also complete independent projects or research assigned by the instructor on topics such as low-power micro architectures and power-aware computing.
Lecture: 3, Lab 2, Other 0

CE-622 Computer Architecture and Organization 4 Credits
Prerequisites: None
Fundamental concepts in computer architecture and organization are presented. Laboratory assignments using VHDL simulation are a major portion of the course. Topics include fixed point and floating point computer arithmetic; assessing and understanding performance; control unit design; microprogramming; memory organization; cache design; a 32-bit instruction-set architecture; single-cycle, multicycle and pipelined CPU architectures; RISC architecture; examples of commercial computer architectures. An independent study or project will be completed.
Lecture: 3, Lab 2, Other 0

CE-624 VLSI Design 4 Credits
Prerequisites: None
Design techniques and basic theory of integrated circuit design are discussed. Topics include review of the semiconductor physics associated with NMOS and PMOS transistors; fabrication process; CMOS combinational circuits; memory cells; stick diagrams; layout techniques using CAD tools; circuit extraction and analysis. An advanced project is completed.
Lecture: 3, Lab 2, Other 0

CE-626 Real-Time Embedded Systems 4 Credits
Prerequisites: None
Implementation and applications of real-time embedded computers are studied. Topics include the case study of an embedded real-time operating system, typical applications of embedded computers, real-time hardware and software interfacing, and real-time scheduling algorithms. This course includes a lab component with several short design projects and research-oriented final project.
Lecture: 3, Lab 2, Other 0

CE-642 Mobile Robotics 4 Credits
Prerequisites: None
Fundamentals of robotics with an emphasis on mobile robots, which are intelligent integrated mechanical, electrical and computational systems functioning in the physical world will be covered. Topics include state-of-the-art technologies in mobile robotics, such as locomotion, sensing, control, communication, localization, mapping, navigation, etc. Advanced topics such as coordination of multiple mobile robots will also be explored. The course aims to provide both theoretical and practical experience to students through lectures and simulation software. Students will also complete independent projects or research on current topics covering mobile robotics technologies and related fields.
Lecture: 3, Lab 2, Other 0

CE-650 App Devel for Mobile Devices 4 Credits
Prerequisites: None
Terms Offered: Winter of even years; Spring of odd years
This course discusses an overview of how to get started developing mobile apps for Android and iOS platforms. These two app development platforms share similar challenges but have different approaches to addressing them. Both platforms will be taught to encourage students to see how the two different approaches can be used to solve similar issues. Students will choose one platform for their final design project. Topics include user interface design, network, communication, and sensor interfacing. This course includes lab components with design projects and final directed design project.
Lecture: 3, Lab 2, Other 0

CE-651 Introduction to Autonomous Driving 4 Credits
Prerequisites: None
This course provides an overview of theoretical and practical background regarding the design and development of autonomous vehicles. Topics include an overview of autonomous vehicle systems, autonomous vehicle localization technologies, perception in autonomous driving, decision and planning, and control for autonomous driving. This course aims to cover the basics of autonomous driving through lectures, lab assignments, a term project, and readings on current related topics. CE-651 students will be required to complete additional projects or independent review of research topics with approval of the instructor. Students may not receive credit for both CE-451 and CE-651.
Lecture: 3, Lab 2, Other 0

CE-652 Artificial Intelligence for Autonomous Driving 4 Credits
Prerequisites: None
This course will provide introductory theories and technologies in artificial intelligence focusing on machine learning, covering a wide range of machine learning methods, concepts and applications. Machine learning studies algorithms that learn from large quantities of date, identify patterns and make predictions on new data. The major list of machine learning fields are computer vision, robotics, autonomous driving, voice/gesture recognition, and automated planning & scheduling, etc. Students will study the concepts that underlie intelligent systems and investigate advanced topics in intelligent systems through a course project.
Lecture: 3, Lab 2, Other 0

CE-654 Computer Vision for Autonomous Driving 4 Credits
Prerequisites: None
This course will cover introductory theories and modern technologies in computer vision systems for autonomous driving. Data from visual sensors play crucial roles in many fields such as autonomous driving, surveillance camera, and robotics. The computer vision system seeks to automate tasks that the human visual system can do. The goal of this course is to learn technologies that enable a computer automatically to understand the content of visual sensors for autonomous driving. The first half of this course will focus on fundamental models and algorithms in computer vision and in the second half of the course students can learn about computer vision applications and programming skills to accomplish computer vision tasks. Graduate students taking this course are also required to complete independent review or survey of cutting edge research topics in computer vision systems, such as object-detection methods for autonomous driving, Deep Neural Network for environmental perception, and innovative applications, etc., selected by the students with approval of the instructor. The survey or research report must be presented in a conference paper format that is ready for submission to a conference.
Lecture: 3, Lab 1, Other 0

CE-672 Virtual Reality Systems: M&C 4 Credits
Prerequisites: None
This course provides the required theoretical and practical background to design and development of multimodal virtual reality (VR) systems. Particularly, the main focus is onVR-based human-in-the-loop systems that enable users to interact and/or manipulate virtual objects in simulated environments. This course aims to cover basics of these systems through lectures, homework, lab assignments, a term project, and readings on current related topics. Through lab assignments, students acquire hands-on skills to create a multimodal virtual environment. Topics include multimodal virtual reality, current VR technology and devices, human-centered simulation: human perception and psychophysics, basic control and stability analysis of VR systems, and human factors in the design of VR displays. CE-672 students will be required to complete additional projects or independent review of research topics with approval of the instructor.
Lecture: 3, Lab 2, Other 0

CE-680 Computer Networks 4 Credits
Prerequisites: None
Organization, analysis, and design of interconnected systems of computers are studied. Topics include the Open System Interconnection model and the Internet TCP/IP reference architecture. Standard protocols and technologies at each network layer will be covered, such as HTTP and a socket programming API at the application layer, TCP and UDP at the transport layer, and IPv4 and IPv6 along with fundamentals of routing at the network layer. Ethernet and Wi-Fi with their related physical mediums are discussed. The course will also introduce error detection and correction methods, basic network security principles and mobile technologies.Students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both CE-480 and CE-680.
Lecture: 3, Lab 2, Other 0

CE-684 Internet of Things (IoT) 4 Credits
Prerequisites: None
The most important topics of the Internet of Things and its applications will be addressed. Topics include an introduction to network stacks and embedded operating systems, IoT architecture models, smart devices, connections and access technologies, the IoT network layer, application layer protocols relevant to IoT, and IoT security practices. Various IoT application areas will be discussed, such as industrial, home automation, manufacturing, energy, utilities, vehicles, smart cities, agriculture and health care. Students complete a term project to develop a complete IoT application. Students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both CE-484 and CE-684.
Lecture: 3, Lab 2, Other 0

CE-691 Computer Engineering Special Topics 4 Credits
Prerequisites: None
Graduate level Special Topics in Computer Engineering.
Lecture: 4, Lab 2, Other 0

CE-695 Graduate Research in Computer Engineering 8 Credits
Prerequisites: None
This course is directed research towards a master's thesis. Students must take this course under the direction of a faculty advisor, and it is graded Satisfactory/Unsatisfactory. This course may be repeated for credit.
Lecture: 0, Lab 0, Other 0

CE-699 Computer Engineering Independent Study 8 Credits
Prerequisites: None
Terms Offered: As needed
Graduate level Independent Study in Computer Engineering
Lecture: 8, Lab 0, Other 0