CSE 475 Embedded Systems Capstone

Credits

5.0 (2 hrs lecture, 3 hrs lab, additional meetings times tbd)

Lead Instructor

James Peckol

Textbook

John F. Wakerly, *Digital Design Principles and Practices*, Prentice-Hall, 4th. ed., 2006.

Course Description

Capstone design experience. Prototype a substantial project mixing hardware, software, and communications. Focuses on embedded processors, programmable logic devices, and emerging platforms for the development of digital systems. Provides a comprehensive experience in specification, design, and management of contemporary embedded systems.

Prerequisites

either E E 271 or CSE 369; either CSE 466, E E 472, or CSE 474/E E 474. Offered: jointly with E E 475

CE Major Status

Selected Elective

Course Objectives

- *Introduce and explain* in-depth embedded systems concepts, design principles, practices, and techniques, and then *apply and practice* such methods in real-world applications.
- *Introduce* the system design and development process and steps.
- *Practice* written and oral communications skills.
- *Utilize* concepts studied in the design and development of several real-world contemporary digital electronics, software, and computer systems projects then ultimately bringing together in the design and development of a self-proposed comprehensive capstone design project.

ABET Outcomes

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics* **(H)** These are all done as an integral and routine part of the material taught. Theory is presented as a standard part of the homeworks, exams, and laboratories in the context of its application to real-world problems and its limitations under real-world constraints. The laboratory exercises require the student to assess and analyze the assignment, then apply basic engineering knowledge to either solve the problem or state why (based upon their analysis) they are unable to fully satisfy the requirements. For each of the lab projects, the student must analyze the requirements, then design, implement, and test a hardware/software system that meets the stated requirements. The student must then propose a test plan and demonstrate that their design meets the initial requirements. The final project requires the application of such knowledge to a project of the student's own choice.

(2) *An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors* **(H)** Students design and implement two significant real world systems followed by a substantial final project. Each of the two laboratory projects provides a high-level requirements specification for the problem to be solved. For the final project, the students must develop their own requirements and design specifications.

(3) *An ability to communicate effectively with a range of audiences* **(M)** Teams must research, prepare a formal report on a topic of current interest, and present their report to the class. They must also prepare an oral presentation to the class describing their final project, discussing any problems and how they were solved, and proposing how they might alter their design should they begin again.

(4) *An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.* **(H)** Ethics and professional behavior are strongly stressed throughout the course. Considered areas include copyrights, national and international patents, licensed material, intellectual property, plagiarism, citing sources for material or idea, and using published algorithms and designs. Projects, lab assignments, and research projects that do not cite sources are given failing marks. Lecture material routinely stresses the need for designs to consider international markets and the need to satisfy international standards, including those for safety and health.

(5) *An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives*. **(M)** Although not multidisciplinary since the class is in the student's selected major, the students work as members of 2-3 person teams to execute each of the labs and the final project.

(6) *An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.* **(H)** Students will use modern computers, development tools and debugging techniques. A significant component of designing and

developing a real world application is ensuring that one's system performs to specification in the intended environment. Such assurance can only be gained by testing the system in such a context then analyzing the results of those tests. Such a process is integral to this class, to each of the labs and to the final project.

(7) *An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.* **(M)** Discussions of contemporary technologies, corporate needs and responsibilities, the legal impacts of designs, and the ever-evolving engineering discipline are an integral part of the lecture material. Lecture material continually emphasizes that today's technology is transitory and that the students must learn the basics so that these may form a foundation upon which they will build future technologies.

Course Topics

- Introduction to Basic Laboratory Tools and Techniques
- System Specification, Modeling, and Design
- Review of Analog and Digital Concepts
- Programmable Logic Devices
- Busses and Networks
- Signal Integrity
- High Speed Signals and Signal Management
- Memory Systems
- Reliability, Fault Tolerance, and Test
- Topics of Current Interest