

ECE 455 (3C,1T,1.5L)

Course Title: Embedded Software

Course Short Title: Embedded Software

Calendar Description:

Concepts, theory, tools, and practice to understand, design, and write embedded software. This covers computing elements, structures in embedded software, resource access protocols, uniprocessor scheduling, programming-language support, languages for MDD, worst-case execution time analysis, and overview of embedded distributed systems.

Prereq Topics: programming, software technology, operating systems principles

Prereq Courses: none

Lab description: none

The lab provides the real-world environment to learn and apply the concepts by example. Exercises cover topics such as introductory "Hello World!", simple timing, polling vs. interrupts, reaction testing, COTS RTOS, synchronous model, and a distributed game as bonus exercise.

Tutorial Description:

Question and answer on material covered in lectures, specific help with current homework assignment, background material for labs, and problem solving skills.

Text Book:

- Slides and supplemental material from recommended texts provided in the course

Recommended Texts:

Readings from

- Jane Liu. Real-time Systems. Kluwer , 2000.

Course Owner:

Sebastian Fischmeister

CEAB Math: 0.30

CEAB Basic Sc: 0.10

CEAB Eng Sc: 0.30

CEAB Eng Dgn: 0.30

CEAB CSE: 0.00

CEAB Other: 0.00

Rationale:

Embedded systems are omnipresent; virtually all consumer products contain multiple small processors running embedded software. Such software differs from general software such as spreadsheets or browsers as it (a) fulfills one specific purpose, (b) typically interacts with the environment through sensor and actuators, and (c) must meet stringent timing and resource requirements. These three characteristics force embedded software engineering to think differently, and to understand embedded systems as a future engineer, it is necessary to know the concepts prevalent in this domain, these systems' environment, their properties, and constraints.

Prior to this course, electrical and computer-engineering students obtained knowledge about specifying, designing, and implementing software and hardware systems. This course allows students to integrate prior knowledge and deepen their understanding on the individual topics. Furthermore, students will learn about software technology, communication systems, and analysis methods for non-functional properties such as timing and resource consumption.

This course is complemented by the follow up course ECE.423 which covers the hardware side of embedded computing systems with hardware/software co-design and systems on chip.

CEAB type:

Specific Elective - Computer Engineering, Electrical Engineering, Software Engineering, Mechanical Engineering

Major topics:

1. "You think embedded software is easy?"(3hrs)
2. Computing structures for embedded systems (3hrs)
3. Structures and design of embedded software (6hrs)
4. Non-functional Properties (12hrs)
 - a. Models of time, resources, dependability
 - b. Uniprocessor scheduling
 - c. Worst-case execution time analysis
5. Programming support (6hrs)
 - a. Synchronous languages, scheduled model, logical execution time model
 - b. Survey of programming languages for temporal programming
 - c. Expression and modeling of non-functional properties in software architectures (UML, MARTE, AADL)
6. Embedded distributed systems (3hrs)

Hours/week:

3hours/week, 1h tutorial/week, 1.5h lab/week

Computer Experience:

embedded systems design software

Lab Experience:

microprocessor system, test & measurement equipment