

EE 589 Real-time Embedded Systems

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Office Hours: Posted on Website and Outside Office

Course Description

This course introduces students the recent advances in real-time embedded systems design. Topics cover real-time scheduling approaches such as clock-driven scheduling and static and dynamic priority driven scheduling, resource handling, timing analysis, inter-task communication and synchronization, real-time operating systems (RTOS), hard and soft real-time systems, distributed real-time systems, concepts and software tools involved in the modeling, design, analysis and verification of real-time systems.

Course Contents

Real-time scheduling

Resource handling

Timing analysis

RTOS

Hard and soft real-time problems

MCU-based embedded runtime applications

Verification of real-time systems

Course Outcomes

By the end of the course, students should be able to do the following things:

1. To identify problems as hard, firm or soft real-time system and give justification;
2. To articulate and contrast different definitions in real-time systems
3. To comprehend formal methods based design approaches and utilize design tools to model real-time systems formally or semi-formally;
4. To understand the impact of hardware architectures for real-time performance;
5. To analyze the scheduling feasibility of a set of independent tasks;
6. To understand resource policies and system services for inter tasks communication and synchronization;
7. To differentiate between various performance analysis techniques;
8. To understand real-time issues on distributed communication networks such as SCADA;
9. To understand real-time software testing, verification and system integration.
10. To be aware of performance optimization techniques.
11. To simulate executions and critique different implementation choices.
12. To comprehend the architecture, functions and applications of one or two widely used RTOSs.
13. To use existing tools to develop simple standards-based (i.e. IEC 61131-3) real-time system device drivers.

Course materials

1. Textbooks:
 - “Real-Time Systems Design and Analysis: Tools for the Practitioner” 4th edition, Philipp A. Laplante, Seppo J. Ovaska, Wiley Publisher.
 - “Embedded Systems: Real Time Interfacing to ARM@ Cortex-M Microcontroller”, Volume 2, 3rd Edition, Jonathan W., CreateSpace Independent Publishing Platform.
2. Documents on selected hardware platforms and software systems
3. Research papers in the real-time embedded systems field.
4. Software: FreeRTOS, CoDeSys SP Runtime system, and μ Vision IDE for ARM programming from Keil.
5. Hardware: ATmel or TI MCU development boards

Grading Policy

Individual components of the class will be weighted as follows:

Lab Assignments/Homework	25%
Midterm Exam	20%
Project1	15%
Project2	15%
Research papers presentation	10%
Final Exam*	15%

*The Final must be taken to pass the course.

Grades will be displayed on the D2L, assigned to each student by your Tech ID. It is important that you follow your progress in the course.

Homework

Assignments are due at the beginning of class on the day stated. In the event a hardcopy cannot be turned in at that time, an e-mail containing your completed and finished assignment as a word document, jpeg, or pdf will suffice until you can turn in the hardcopy. It should be expected that late assignments will be penalized at a rate of at least 25% per day. A week after the due date the assignments will no longer be accepted.

Exams

The exams will be given at the time scheduled. If you cannot make that time, talk to the instructor ahead of time to make alternate arrangements. Unexcused absence will result in zero credit. For extenuating circumstances, the student’s final exam percentage will be used in lieu of the missed exam. No electronic devices other than a calculator will be allowed during the exams including (but not limited to): phones, PDAs, MP3/CD players. A passing grade will also require a score of at least 60% on the final exam.

Labs

The labs will be given at the time scheduled. If you cannot make that time, talk to the instructor ahead of time to make alternate arrangements. Unexcused absence will result in zero credit for that lab. For extenuating circumstances, the student’s overall lab

percentage will be used in lieu of the missed lab. After 2 unexcused lab absences, a failing grade will be given for the entire course. Lab reports will not be accepted after a week past due.