

# CS 589-2 Embedded Systems Design

## Syllabus – Spring 2006

**T 9:30 - 12:00am, Speare 131**

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**Instructor:** Dr. Xiao Qin

**Phone/Office:** 835-5902 / Speare 146

**Office Hours:** T 2:00-4:00pm

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### **Class Web Page**

Lab assignments and announcements are posted on the class web page:  
<http://www.cs.nmt.edu/~xqin/courses/cs589-2>

Handout, lab assignments, and important course information will be posted periodically on the class web page, which you have to regularly check.

**Prerequisite:** CS 221 Computer System Organization,  
CS 335 Principles of Operating Systems

### **Course Information**

Embedded Systems, special-purpose computer systems, have increasingly grown in past years. Examples of embedded systems include mobile phones, PDAs, household appliances, medical equipment, avionics, and the like. The vast majority embedded systems are developed to perform special-purpose functions at a low cost, and some embedded systems have timing constraints. Embedded systems differ themselves from traditional computer systems in several ways. First, embedded systems usually execute a specific program repeatedly. Second, embedded systems have tight constraints on design metrics. Third, many embedded systems have to compute certain results in a real-time manner and continually react to changes in system environments.

This course, which builds on students' prior knowledge of computer organization and operating systems, will address a wide range of issues of designing embedded systems.

### **Topics Covered** (These topics may change)

- Hardware/software systems and codesign
- Embedded processor architecture and programming
- Models of computation for embedded systems
- Behavioral design
- OS primitives for concurrency, timeouts, scheduling, communication and synchronization
- Architecture selection
- Simulation, synthesis, and verification
- Hardware/software implementation

- Performance analysis and optimization
- Application-level embedded system design concepts such as basic signal processing and feedback control
- Design methodologies and tools
- Design examples and case studies

The course will be research intensive, aiming at deriving practical and achievable ground rules for embedded systems design. Graduate students are expected to do an extra project including a written report and an in-class presentation on a topic to be arranged with the instructor. The project will be optional for undergraduates. However, extra credit will be awarded to undergraduate students who have completed the project. You will be expected to collaborate with other students toward the completion of the research project related to real-time systems.

Labs will provide students with hands-on experience with hardware and software widely used in the design of embedded systems.

## Objectives

Students who have completed this course should be capable of doing the following:

- Understand the design challenges of embedded systems
- Gain hands-on experience with hardware and software used in the design of embedded systems
- Understand embedded processor architectures
- Understand embedded system application concepts
- Write software for embedded systems
- Design I/O and device driver interfaces to embedded processors

## Textbook

- F. Vahid and T. Givargis, "Embedded System Design," by Wiley & Sons, 2002, ISBN: 0-471-38678-2. **(Required)**

## References

- Steve Heath, "*Embedded Systems Design*", ISBN: 0-7506-5546-1
- The IEEE POSIX standard.
- Jane Liu, "*Real-Time Systems*", ISBN: 0-13-099651-3

## Exams and Grading

- |                 |     |
|-----------------|-----|
| Mid-term        | 30% |
| Lab Assignments | 30% |
| Project         | 40% |
- Proposal 5%,
  - Progress Report 5%,
  - Presentation 10%, and
  - Demo/Technical Report 20%

## Scale

Letter grades will be awarded based on the following scale. This scale may be adjusted upwards if it is necessary based on the final grades.

A+  $\geq$  97   A  $\geq$  93   A-  $\geq$  90   B+  $\geq$  87   B  $\geq$  83   B-  $\geq$  80   C+  $\geq$  77   C  $\geq$  73  
C-  $\geq$  70   D+  $\geq$  67   D  $\geq$  63   D-  $\geq$  60   F  $<$  60

## Reading

Students are expected to read the appropriate sections of the book before each lecture.

## Assignments

We will probably have two or three homework assignments.

## Late Assignments

There is a 10% deduction for late assignments. The deduction becomes 50% if the homework is five days late. No credit is given after five days. Any exceptions must be arranged at least a day before the homework is due.

## Cheating

Unless otherwise specified in writing, all lab assignments are individual projects. If any assignment permits teamwork, it will be explicitly stated so in the assignment, and the work must be only the work of the people on the team. Students are *encouraged* to work together on homework assignments. However, you have to explicitly acknowledge any help received from other students during the course of the preparation of your homework solutions.

If you make use of ideas obtained from previous work of another person, you must give credit by commenting in your report, explaining where you obtained ideas, what you have used, and who developed the ideas. If you use any code provided by another person, you must obtain permission from the copyright owner, then comment in your code, including a statement explaining where you found the code and who is the author. Failure to follow these rules will be considered a violation of the Academic Honor Code.