CpE 450 Real-time Embedded Systems
Syllabus – Spring 2007

Catalog Description:

CpE 450 Real-time Embedded Systems (3-0-3)
Unlike typical software-based systems, real-time systems must complete their tasks within specified timeframes. Unlike general purpose computing platforms, embedded systems must perform their tasks while minimizing tight resource constraints. This course addresses the considerations in designing real-time embedded systems, both from a hardware and software perspective. The primary emphasis is on real-time processing for communications and signal processing systems, but applications to seismic and environmental monitoring, process control, and biomedical systems will be addressed. Programming projects in a high level language like C/C++ will be an essential component of the course, as well as hardware design with modern design tools.

Text Book:

Tammy Norgaard, "Embedded Systems Architecture," Newes, 2005, ISBN 0-7506-7792-9

Instructor:

Bruce McNair, Distinguished Service Professor of ECE.

Goals:

The goal of this course is to familiarize students with the issues and technologies involved in designing real-time and hardware-resource constrained systems. Design engineers are often called upon to make decisions about general purpose computing solutions vs. specialized hardware solutions, this course will give students the tools to intelligently make the necessary tradeoffs and understand the business consequences of their choices.

Prerequisites by Topic:

- Familiarity with C/C++
- Probability and statistics – E243
- Switching Theory and Logical Design – CpE358
- Microprocessor Systems – CpE390

Grading Policy:

Weekly assignments	20%
3 Quizzes	20% each
Project	20%

All assignments provide opportunities for extra credit work. Work that goes significantly beyond what is asked will be graded accordingly.

- Engineering - 100%

Course Web Site:

http://koala.stevens-tech.edu/~bmcnair/ADIESRTA-F04

Schedule of Topics

This is the list of detailed topics and likely order. The specific schedule is TBD.

1. Introduction
   a. Definition of embedded system
   b. Constraints on embedded systems vs. standalone systems
   c. Concept of real-time design
   d. Time scales for real-time system
   e. Applications

2. Hardware/software functional partitioning
   a. Relevant hardware technologies: Discrete logic, CPLDs, FPGAs, ASICs
   b. Software environments: HLL vs. assembly coding, DSP vs. general purpose computer vs. RISC

3. Development environments; course project definition

4. System architectures

5. Pipelining, interrupt service routines

6. Software structures:
   a. ISRs
   b. Polling
   c. semaphores

7. Evaluating system performance – correctness, speed

8. Continuation of system performance evaluation

9. Profiling system performance

10. Continuation of performance profiling

11. Performance optimization
    a. Optimizing compilers
    b. Pareto Principle

12. Future directions; course project due

Last revised: January 16, 2007