

# **CpE 450 Architecture, Design and Implementation of Embedded Systems for Real-time Applications**

## **Syllabus – Fall 2004**

### **Catalog Description:**

CpE 450 Architecture, Implementation and Design of Embedded Systems for Real-time Applications (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:**

TBA

### **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%
Midterm	25%
Final	25%
Project	30%

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.

Week 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

Week 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

Week 3. Development environments; course project definition

Week 4. System architectures

Week 5. Pipelining, interrupt service routines

Week 6. Software structures:

- a. ISRs
- b. Polling
- c. semaphores

Week 7. Midterm exam

Week 8. Evaluating system performance – correctness, speed

Week 9. Continuation of system performance evaluation

Week 10. Profiling system performance

Week 11. Continuation of performance profiling

Week 12. Performance optimization

- a. Optimizing compilers
- b. Pareto Principle

Week 13. Future directions; course project due

Week 14. Final exam

Last revised: September 4, 2004