EE 542 Syllabus
Spring 2017

Catalog Data....

EE 542 Advanced Embedded Systems Design(5) - The course examines contemporary issues and problems in the design, development, and test of contemporary real-time embedded systems while emphasizing solid design practices to ensure safety and reliability. Specific topics will address leading edge material of current interest and will vary with each offering. The course is team based, highly participatory, and comprises three components: formal lectures introducing contemporary embedded systems design issues, student research, presentation, and directed discussion of relevant important journal papers in the current literature related to the topics introduced, and the development of substantial, real world, projects.

Course Goals....

The main objectives of this course are….

- To provide a strong theoretical background and practical experience in the design and development of sophisticated embedded systems of moderate complexity through the use of contemporary tools and formal design methodologies.
- To understand the importance of safety and reliability in contemporary embedded systems.
- To investigate and apply techniques for performance optimization.
- To introduce the growing area of distributed embedded systems.

The final grade will be based upon the project development efforts and contributions as well as their research presentations and discussions.

Admission....

The class is open to both graduates and undergraduates. For the graduate student, the class can provide the basis for either a Master's project or thesis and for the undergraduate student it will provide the opportunity to participate in and contribute to challenging research in embedded systems projects.

Course Syllabus and Topic Outline - Spring 2017....

Today, embedded systems touch almost every aspect of our daily lives. Examples such as PDA's, cellular phones, and GPS systems are familiar to most consumers. Other applications include modern automobile electronic systems, robotics, and toys and games. Such applications can comprise thousands of lines code, large heterogeneous collections of microprocessors, VLSI components, and array logics that may be distributed around an office or around the world. The designs are developed subject to contradictory constraints on cost, size, power, speed, safety, and reliability. The typical developer needs to use methodologies and principles that can address the complexities and demands required in the design and implementation of these modern systems.

Successful deployment of embedded applications demands formal approaches and new tools that can deal with these complexities. Computer based tools and methods are essential to that process. The modern creative design and development process begins with an abstracted notion of the system to be built then moves through an iterative series of transformations to the final product. This course will study several aspects of the design and development of embedded applications in depth through the use of these tools and methodologies.

Introduction

- Motivation and Course Objectives
- Review
    - Terminology and Basic Concepts
    - Embedded Machines
    - Systems and Formal Models
    - System Development Life Cycle

Hardware - Software Codesign

- Introduction and Motivation
- Codesign Process Overview
- Development Lifecycles
- Specification
- Modeling Tools and Languages
- Techniques of Hardware Software Codesign
    - Partitioning
    - Co-Simulation
    - Co-Synthesis
    - Co-Verification

Safety and Reliability

- Techniques
- Proactive Approach
    - Software Solutions
        - Approaches
    - Hardware Solutions

        - Approaches
    - Steps to a Safe Design
    - Extreme Reliability
        - Long Life Applications
        - Critical Components
    - Dealing with Failure
    - Specification

System Optimization and Performance Analysis

- Introduction
- Basic Measures
- Real-time Considerations
    - Hard, Soft, Firm
- Time Loading
    - Simulation
    - Instrumentation
- Response Time
- Memory Loading
- Performance Evaluation
- Performance Optimization
- Hardware Accelerators
- Hardware Platforms - Microprocessors and FPGAS
- Optimizing Power Consumption
- Trade-offs

Distributed Systems

- Introduction
- Local and Remote Models
- Intra and Inter System Communication
- Protocols
- Error Management
    - Failure Detection
    - Reconfiguration
    - Recovery
    - idempotent Systems
- Pipes, Streams, and Sockets
- Remote Services and Procedures
- Design Issues
- Synchronous and Asynchronous Procedures

Topics of Current Interest

Signals and Signal Management

- Major Issues

    - Signal Integrity
    - Signals, Ringing, and Crosstalk
    - Noise and Noise Immunity
    - Power Supply Noise
    - Ground Bounce, Distortion
    - Delay
    - Metastability
- Wiring
    - Point to Point
    - Transmission Lines
    - Serial and Parallel Termination
    - High Speed Bus Design
    - Bandwidth