EE-3170
Microcontroller Applications

Curricular Designation:  
- CpE: N/A
- EE: elective

Catalog Description:

**EE 3170 - Microcontroller Applications**  
Introduces the concept of microcontroller-based systems. Describes some basic characteristics of microcontrollers and then goes into significant depth in the applications of a single microcontroller. Topics include polled, interrupt and DMA input/output, assembly language, instruction set architecture interface and ASICs.  
*Credits:* 3.0  
*Lec-Rec-Lab:* (3-0-0)  
*Semesters Offered:* Fall Spring  
*Restrictions:* Must be enrolled in one of the following Major(s): Electrical Engineering  
*Pre-requisites:* EE 2171

Textbooks(s) and/or Other Required Materials:


OR


Required Software: TEXaS: Test Execute and Simulate. *Motorola 6502/6808/6811/6812*  

Prerequisites by Topic:

Mastery of combinational logic design by Karnaugh map of 4- to 5- variable functions.

Mastery of number representation in binary, octal and hexadecimal, two’s complement addition, binary multiplication and BCD addition

Familiarity with synchronous sequential logic design with D flipflops, including finite state machines.

Exposure to multiplexers, decoders, encoders and code converters.

Course Objectives:

Mastery of the topics associated with using a microcontroller in an embedded system environment.

Familiarity with differences between instruction sets, characteristics of instruction sets, RISC vs. CISC distinction and attributes.

Familiarity with 68HC11 assembly language programming, including but not limited to addressing modes, polled, interrupt and DMA I/O, interrupt service routines, and using on-board I/O systems.

Introduction to integrated circuit design and manufacture, focused on ASICs and microprocessors.
Topics Covered:

1. Assembly Language
   a. Theory of Microprocessors (Fetch-execute cycle, pipelining)
   b. 68HC11 Instruction Set, Addressing Modes
   c. The assembly process – features of assemblers, compilers and linkers
   d. Stacks, subroutines, parameters and recursive programming
   e. Software engineering – appropriate flowcharting, documentation and project management

2. Embedded System Design Concepts
   a. System hierarchy – memory and interconnect, functional blocks, differences among microprocessors, microcontrollers, ASICs and System-on-a-chips
   b. Clocks, Timers, Real-time Interrupts & Real-time operating systems
   c. Interrupt, Polled and DMA I/O
   d. Interrupt Service Handlers
   e. Parallel vs. Serial I/O
   f. Analog-to-Digital and Digital-to-Analog conversion

3. ASIC Fabrication
   a. Integrated Circuit (IC) Costs – impact of volumes and commonality
   b. Integrated Circuit feature sizes – impact upon size, clock and timing
   c. Silicon ingot production
   d. Lithographic techniques – visible light, UV and beyond
   e. System-on-a-Chip design methodology

Relationship of Course to Program Objectives (See UPAC SOP, Tables 1 and 2):

- **EE:**
  Outcome: a via topic(s): all
  Outcome: c via topic(s): 2
  Outcome : k via topic(s): 1(c-e), 2(b-f)
  Outcome: m via topic(s): all

- **CpE:** N/A

Contribution of Course to Meeting the Professional Component

- **EE:** Engineering Topics
- **CpE:** N/A

Class/Laboratory Schedule (note: 1 hour = 50 minutes):

Lecture: 45 hours = 3 hours/week for 15 weeks

Prepared by: Martha Sloan, Professor, 1 June 2004