EE - 3171
Microcontroller Applications

Catalog Description:
EE 3171 – 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 C and assembly language programming, polled, interrupt and DMA input/output, assembly language, instruction set architecture interface and ASICS.

Credits: 3.0 Lec-Rec-Lab: (3-0-2) Semesters Offered: Fall, Spring, Summer Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering Pre-requisites: (EE 2241 or CS 1121 or CS 1111) and (EE 2174 or EE 2173)

Textbooks(s) and/or Other Required Materials:

Prerequisites by Topic:
1. Mastery of combinational logic design by Karnaugh map of 4-to 5-variable functions.
2. Mastery of number representation in binary, octal and hexadecimal, twos complement addition, binary multiplication.
3. Familiarity with synchronous sequential logic design with D flip-flops, including finite state machines.
4. Exposure to multiplexers, decoders, encoders and code converters.

Course Objectives:
1. Mastery of the topics associated with using a microcontroller in an embedded system environment.
2. Familiarity with differences between instruction sets, characteristics of instruction sets, RISC vs. CISC distinction and attributes.
3. Familiarity with ARM THUMB assembly language and C 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.
4. Introduction to integrated circuit design and manufacture, focused on ASICs and microprocessors.

Topics Covered:
1. Assembly Language
   (a) Theory of Microprocessors (Fetch-decode-execute cycle, pipelining)
   (b) ARM THUMB Instruction Set, Addressing Modes
2. C Language
   (a) Basic Programming Review
   (b) Embedded Programming Concepts
3. 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 and 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
(g) Pulse Width Modulation

Relationship of the Course Content to Program Outcomes:

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<th>Outcome</th>
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<td>a. an ability to apply knowledge of mathematics, science and engineering</td>
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<td>b. an ability to design and conduct experiments, as well as to analyze and interpret data</td>
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<td>c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability and sustainability</td>
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<td>d. an ability to function on multi-disciplinary teams</td>
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<td>e. an ability to identify, formulate and solve engineering problems</td>
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<td>f. an understanding of professional and ethical responsibility</td>
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<td>g. an ability to communicate effectively</td>
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<td>h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context</td>
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<td>i. a recognition of the need for, and an ability to engage in life-long learning</td>
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<td>j. a knowledge of contemporary issues</td>
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<td>k. the ability to use the techniques, skills, and modern engineering tools necessary for the practice of electrical engineering</td>
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Contribution of Course to Meeting Degree Requirements:

3 Credit Hours – Engineering Topics

Class/Laboratory Schedule (note: 1 hour = 50 minutes):
Lecture: 42 hours = 3 hours/week for 14 weeks
Lab: 28 hours = 2 hours/week for 14 weeks

Prepared by:
Christopher (Kit) Cischke, Senior Lecturer, November 29, 2016