<table>
<thead>
<tr>
<th>Required Course:</th>
<th>ECE 47100 Embedded Microcontroller, Microprocessor and DSP Based Systems</th>
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<tr>
<td>Credit and contact hours:</td>
<td>(3 cr.) Class 3</td>
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<td>2014-16 IUPUI Campus Bulletin description:</td>
<td>ECE 47100 Embedded Microcontroller, Microprocessor, and DSP-Based Systems (3 cr.) P: ECE 36200 and ECE 26300. Class 3. A structured approach to the development and integration of embedded microcontroller/microprocessor/DSP-based systems. The course provides students with design experience of embedded systems. The course covers the microprocessor selection, the configuration of peripheral components, and the hardware abstraction techniques. The course also covers the C programming techniques for embedded systems and using a fixed point microprocessor for floating point calculations.</td>
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<td>Prerequisite or corequisite:</td>
<td>P: EE264 or equivalent, ECE362</td>
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| Prerequisites by topic: | 1. C Programming  
2. Fundamental knowledge of microprocessor based systems  
3. Electronic measurements using multimeter and oscilloscope |
| Textbook: | ECE471 Lecture Notes |
| Coordinator: | Stanley Chien, Professor of Electrical and Computer Engineering |
| Goals: | To teach senior students the design and development of microcontroller, DSP and microprocessor based systems. The topics include the hardware configuration for peripheral modules, layered software design and system development environment set up. |
| Outcomes: | Upon successful completion of the course, students should be able to  
1. Initialize and use various peripheral modules of a microcontroller. [c]  
2. Write efficient C program for embedded systems. [c]  
3. Explain the concept of real-time operating systems. [c]  
4. Select the proper microcontroller, microprocessor, and DSP for specified industrial applications. [b, c]  
5. Design and implement the hardware and software of an embedded system. [a, b, c, e, k] |
| Topics: | 3. Introduction to embedded systems.  
4. C language review - pointers and macros  
5. Program development tools - compiler & linker, debugger & emulator  
6. Makefile and integrated development environment  
7. Systems and digital I/O configuration  
8. Serial peripheral interface  
9. Interrupts  
10. A/D converter  
11. Timers  
12. Serial communication interface  
13. Programming techniques – function pointers, callback functions, file inclusion in multi-module programs, conditional compilation  
14. Building block development  
15. Debugging techniques  
16. Timing considerations |
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<tr>
<td>17.</td>
<td>Real-time operating systems</td>
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<tr>
<td>18.</td>
<td>Floating point number computation on fixed point processors</td>
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<td>19.</td>
<td>Architecture and development environment of DSP</td>
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<td>20.</td>
<td>Compare microcontroller, microprocessor and DSP</td>
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**Computer usage:**
PC and 68HC12 based single board computer, 68HC12 assembler and linker, integrated development environment. PIC microcontroller and development tools.

**Laboratory projects:**
Students write 68HC12 assembly language programs and do experiments on computer hardware configuration. Each lab experiment workstation has a PC and a 68HC12 based single board computer, which are used to edit, assemble, debug, and execute the program. A digital voltmeter and an oscilloscope are also equipped with each lab experiment workstation. A large project provides students hands-on experience on complete hardware and software design and implementation for a practical control or communication application.

**ABET category:**
Engineering science 50%, engineering design 50%.

**Prepared by:**
Stanley Chien

**Date:**
March 4, 2009