# CMPE 423 Embedded Systems Design

<table>
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<tr>
<th>Department:</th>
<th>Computer Engineering</th>
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<tr>
<td>Program Name:</td>
<td>Computer Engineering</td>
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<td>Program Code:</td>
<td>25</td>
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<tr>
<td>Course Number:</td>
<td>CMPE423</td>
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<tr>
<td>Credits:</td>
<td>4 Cr</td>
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<tr>
<td>Year/Semester:</td>
<td>2011-2012  Fall</td>
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<table>
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<tr>
<th>Prerequisite(s):</th>
<th>Required Course</th>
<th>Elective Course</th>
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<tbody>
<tr>
<td>CMPE 224 – Digital Design</td>
<td>(click on and check the appropriate box)</td>
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**Catalog Description:**
The objective of the course is to introduce the concept of Harvard + RISC architecture microcontrollers and design of embedded computing systems on typical applications including interrupts, timers, LCD and LED displays, keypads, a/d converters, rotary coders, stepper motors, serial and parallel communication interfacing. The design applications are introduced on a very widely used typical 16-bit embedded microcontroller unit, PIC18F452. The scope of the course is the simple, distinct PIC18F452 embedded system design with the applications in C and RISC assembly programming. The design/theory scale of the course is around 60/40. (CMPE323).

**Course Web Page:**
http://cmpe.emu.edu.tr/courses/cmpe423

**Textbook(s):**
Ibrahim, Dogan, Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series, Newnes, Elsevier, 2008

**Indicative Basic Reading List:**
Course Notes by M. Bodur.
John B. Peatman, Embedded Design with the PIC18F452 Microcontroller, Pearson Education, 2003

**Topics Covered and Class Schedule:**
(4 hours of lectures per week)

**Weeks 1-2**
Embedded Microcontroller Architecture, and Instruction Set

**Weeks 3-4**
Timing by instruction count, Programming in Assembly.

**Weeks 5-6**
Application of Timer with C coding (First Quiz)

**Weeks 7-8**
LCD initialization; Display strings. (Midterm Exam)

**Weeks 9-10**
Interrupt management, Low-priority and high-priority interrupt structures, Critical regions, External Interrupts. I/O pin considerations

**Weeks 11-12**
Embedded Design Project Specification and Life Cycle. Analog to Digital Conversion, Serial peripheral interface operation (Quiz-2)

**Weeks 13-15**
UART operation, Student Design Project Organization and Discussions, Multi-processor systems, (Final)

**Laboratory Schedule:**
(2 hours of laboratory per week)

**Week 4**
Installation of MPLAB and CC8E

**Week 5**
Timing by Delay Loops

**Week 7**
Egg-Timer with LCD module

**Week 10**
RPG-Counter using Interrupts

**Week 11**
ADC Applications

**Weeks 12-14**
I/O Pins, and UART Applications
Course Learning Outcomes:

Passing students must be able to

1) Write simple programs and translate small C-code segments in a microcontroller assembly language such as Microchip PIC18.
2) Know the structure of a timer unit, and use it in simple C coded programs for various timing tasks.
3) Use switches, LED’s and LCD module procedures in C coded programs
4) Know the latency problems in interrupt servicing, and use it in C coded programs.
5) Know the structure of analog-digital converter unit, and use it in C coded programs.
6) Know the structure of universal-asynchronous-communication unit, and use it in C coded programs.
7) Analyze technical requirements and design simple embedded systems using switches, LED’s, timers, LCD modules, ADC and UART.
8) Analyze and comment on ethical social and environmental responsibilities of an embedded system design,
9) Practice an embedded system design including its documentation starting from detailed technical requirements.

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<tr>
<th>Assessment</th>
<th>No</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Quiz and Attendance</td>
<td>1</td>
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<tr>
<td>Midterm Exam</td>
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<tr>
<td>Lab</td>
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<tr>
<td>Project</td>
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<tr>
<td>Final Examination</td>
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<td>30%</td>
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Contribution of Course to Criterion 5
Credit Hours for:

Mathematics & Basic Science : 0
Engineering Sciences and Design : 4
General Education : 0

Relationship of Course to Program Outcomes

a) apply knowledge of mathematics, science, and engineering,
e) identify, formulate, and solve engineering problems,
k) use the techniques, skills, and modern engineering tools necessary for engineering practice,
l) knowledge of probability and statistics, mathematics through differential and integral calculus, discrete mathematics, basic sciences, computer science, and ...

Prepared by: Dr. Mehmet Bodur
Date Prepared: September 29, 2010