CMPE 423 Embedded Systems Design

Department: Computer Engineering

Instructor Information
Name: Assoc. Prof. Dr. Mehmet Bodur
E-mail: mehmet.bodur@emu.edu.tr
Office: CMPE 107
Office Tel: 0392 630 2841

Assistant Information
Name (Office, Tel): Emre Rıfat Yıldız (Coordinator, CMPE109, Tel 2849),
Uğur Aydın Türeli (CMPE122, Tel 2833),
Hossein Zefheri (CMPE224, Tel 1628)

Meeting times and places
Monday 12:30-14:20, Classroom CMPE126
Thursday 8:30-10:20, Classroom CMPE128
Friday 16:30-18:20, Lab LLAB

Program Name:	**Program Code:**
Computer Engineering /Software Engineering	25/29

Course Code	**Credits**	**Year/Semester**
CMPE 423	4	2018-2019 Fall

☒ Required Course ☐ Elective Course (click on and check the appropriate box)

Prerequisite(s):
CMPE 224 or CMSE222 (Digital Design)

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. (CMPE224).

Course Web Page
https://staff.emu.edu.tr/mehmetbodur/en/teaching/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
M. Bodur, Course Notes 2016.
John B. Peatman, Embedded Design with the PIC18F452 Microcontroller, Pearson Education, 2003

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

Week 1	Introduction to Embedded Microcontroller Architecture
Week 2	Embedded Microcontroller Architecture, Instruction Set, and programming in C
Week 3	Configuration of ports and pins for input and output, LEDs and switches.
Week 4	Instruction counting for precise timing
Week 5	Configuration of Timer unit
Week 6	Using timer in C coding (First Quiz)
Week 7	Using interrupts with Timers and switches,
Week 8	UART configuration and initialization. (Midterm Exam)
Week 9	Using UART in applications, and Embedded Design Project Specification and Life Cycle. Analog to Digital Conversion,
Week 10	LCD Module interfacing with FSM application, and UART with interrupts,
Week 11	Student Design Project Organization and Discussions,
Week 12	ADC configuration and application using an FSM. (quiz-2)
Week 13	ADC oven application, Multi-processor systems, Student Prototype Project Discussions, (Final)

Laboratory Schedule:
(2 hours of laboratory per week)

Week 4	Installation of CC8E compiler, and LED Status Indicator Simulation
Week 5	Detecting status and change of status of input ports
Week 6	Timing by counting executed instructions
Week 7	Timer unit (Timer0) and
Week 8	Interrupts in Embedded Systems
Week10	UART
Week 11	ADC Applications, and team projects
Week 12	LCD Applications, and team projects
Week 13	team projects

Course Learning Outcomes

Upon successful completion of the course, students are expected to have the following competencies
(1) Write simple small C-code segments for a microcontroller such as Microchip PIC18 family (1).
(2) Know the structure of a timer unit, and use it in simple C coded programs for various timing tasks (1).
(3) Use switches, LED's and LCD module procedures in C coded programs (1)
(4) Know the interrupt servicing techniques, and use it in C coded programs (1).
(5) Know the structure of analog-digital converter unit, and use it in C coded programs.(1)
(6) Know the structure of universal-asynchronous-communication unit, and use it in C coded programs (1).
(7) Analyse technical requirements and design simple embedded systems using switches, LED's, timers, LCD modules, ADC and UART (1).
(8) Analyse and comment on ethical social and environmental responsibilities of an embedded system design (4),
(9) Practice an embedded system preliminary design starting from technical requirements (2).
(10) Practice an embedded system design in teams including its tests starting from technical requirements (5).
(11) Prepare a design report in an embedded system design team to document hardware, and software development, tests (6).

	Method		Percentage
Assessment	Quiz, and Homework		20%
	Midterm Exam		20%
	Labs		10%
	Design Project		20%
	Final Examination		30%

Quiz and HW grading: Eight single-question 20-minute quizzes at the end of the unscheduled lecture hours. Two home works before midterm and before final. Many small project-home works related to details of the calculations for a design.

Lab grading: Eight labs (0.5p each), reports of some labs (0.5p each), and hardware implementation (about 4p)

Policy on makeups: For eligibility to take a makeup exam, the student should bring a doctor's report within 3 working days of the missed exam. No make-up exam for quizzes. Final and midterm make-up exams are conducted after final exam. Students may get NG if they miss both midterm and final exam.

Policy on cheating and plagiarism: Any student caught cheating at the exams or assignments will automatically fail the course and may be sent to the disciplinary committee at the discretion of the instructor.

Updated by: Assoc. Prof. Dr. Mehmet Bodur **Update Date:** 29.11.2018
Contribution of Course to ABET Criterion 5
Credit Hours for:

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

Relationship of the course to Program Outcomes

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (CLO 1-7)

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (CLO 8)

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (CLO 9)

5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (CLO 10)

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (CLO 11)

Prepared by: Assoc. Prof. Dr. Mehmet Bodur	**Date Prepared:** 23 September 2019