ECE 3411: Microprocessor Application Laboratory

Credits and contact hours: 3 Credits (Two 50-minute lectures and two 100-minute labs per week)

Instructor: Sung Yeul Park

Textbook: Make: AVR Programming, Elliot Williams (2014)

a. *Other supplemental materials*: Selected reference materials/articles posted online

***Specific course information*:**

a. *Catalog Description*: Design of software and interface hardware to use a microcomputer as an on-line, real-time element in data acquisition, filtering and control systems. Use of clocks, DAC's, ADC's, speech synthesis modules, and movement generators. Design project. Written and oral presentations of laboratory results.

b. *Prerequisite*: None, Open only to students in the School of Engineering

c. *Required, elective, or selected elective:* Selected elective

***Specific goals for the course*:**

a. *Specific outcomes of instruction*: The student will be able to
   - define the specifications of embedded systems in real-life applications.
   - design a task-based program using timer /counter.
   - select, specify, and design basic microcontroller systems' components and subsystems for various applications.
   - demonstrate how to manipulate peripherals of microcontrollers

b. *ABET Criterion 3 Student Outcomes addressed by the course*:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Students learn to identify the needed functions of a microprocessor in the specific design requirement situations and to organize the program procedures.

(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
n/a

(3) an ability to communicate effectively with a range of audiences
n/a

(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
n/a

(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
During lab activities, students are encouraged to help each other for programming, debugging, and discussing about lab activities. In addition, for the RedBot project, two students form a team and work together.

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
Students learn to program the basic microcontroller functions and demonstrate its operation using external devices such as LEDs, buzzer, LCD, I2C temperature sensor, and SPI DAC IC. In addition, students learn to program high level programming practice (e.g. task based programming, event driven programming, and real time operating systems)

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
Students use the web, library databases, and other resources for their programming practices.

Topics covered:

- Introduction
- GPIO / LED Blinking / Interrupt
- Timer / Counter / Pulse Width Modulation
- Analog digital converter / Analog comparator
- Communication using UART, I2C, SPI
- Combinational programming using GPIO, RTC, LCD, and buzzer
- Combinational programming using PWM, ADC, and communication
- Combinational programming using Keyboard, buzzer, and communication
- RedBot project demonstration and presentation