1. **ECE 4510 Microcontroller Applications**

2. Credit Hours: 4 hours (3 – 3)

3. Coordinator: Dr. Janos L. Grantner, Professor of Electrical and Computer Engineering
   Instructor in the Spring 2016 Semester: Dr. Janos L. Grantner

4. Textbook(s) and/or Required Materials:
   b. Instructor's Lecture Notes and other support materials, disseminated using the ECE 4510 Class Web Page,(the official media for the class)
   c. STM32F4 DISCOVERY Board along with the ECE 4510 Parts Kit
   d. Current ARM Work Bench (32 KB code limit) software development and debugger system by IAR
   e. Advanced ARM-based 32-bit MCUs Reference Manual by Advanced RISC Machines, available through the Class Web Page
   f. Cortex-M4 Programming Manual by Advanced RISC Machines, available through the Class Web Page
   g. Cortex-M4 Technical Reference Manual by Advanced RISC Machines, available through the Class Web Page
   h. STM32F407xx Datasheet by STMicroelectronics, available through the Class Web Page
   i. STM32F4 DISCOVERY Board User’s Manual, available through the Class Web Page

Recommended Materials:

References:
   a. Tutorials for the use of ARM Work Bench and STM Cube, available through the Class Web Page

5. Course information:
   a. 2016-17 Catalog: Hardware and software design of real-time embedded microcontroller systems.
   b. Prerequisites: ECE 2210 and ECE 2510; with a grade of “C” or better in all prerequisites.
   c. Prerequisites by topic:
      1. Introductory level digital logic design
      2. Introductory level analog circuit design
      3. C language programming skills
   d. Required course in the Computer Engineering program

6. Course Objectives: (ABET Learning Outcomes)
   1. To provide experience to design digital and analog hardware interface for microcontroller-based systems (a, b, c, e).
   2. To provide experience to integrate hardware and software for microcontroller applications systems (k).
3. To provide experience to debug a microcontroller-based system and to analyze its performance using advanced debug tools and electronic test instrumentation (b, k)
4. To provide experience develop, run, and experimentally validate code written in a high-level language for a microcontroller system (b, k).
5. To develop skills to prepare effective written technical communications for engineering analysis and design work through project reports (g).
6. To provide experience to work in a multi-disciplinary team (d).
7. To assess the students’ ability to design, conduct experiments, and interpret data (b).
8. To assess the students’ skills to use modern tools of engineering practice (k).

7. Topics:
   a. ARM Cortex-M4 Architecture and Memory Map
   b. ARM Cortex-M4 Programmer’s Model, C programming with the IAR Work Bench
   c. Interfacing to the Parallel I/O Ports, interrupts and interrupt service routines
   d. Programming the Timer Module, Input Capture and Output Compare, PWM
   e. Analog input and output interface
   f. Asynchronous Serial Communications interface and SPI interface
   g. CAN interface
   h. Advanced I/O interfacing techniques
   i. Design of static memory systems
   j. Interfacing static memory to the ARM Cortex-M4 External Bus, critical timing
      analysis

8. Design Projects:
   a. Design, implementation, and demonstration of a model of a conveyor belt control
      system (bonus projects are also offered). A report is required.

9. Laboratory: 11 laboratory experiments

10. Evaluation:
    a. Examinations (50%)  
    b. Design projects (20%)  
    c. Laboratory (20%)  
    d. Homework (10%)  

11. Contribution to Professional Component:
    ABET professional component content as estimated by faculty member who prepared this
course description:
    Engineering sciences: 2 credits or 50%
    Engineering design: 2 credits or 50%

Prepared by: Dr. Janos L. Grantner
Date: March 20, 2016