ECE 4510/5530 MICROCONTROLLER APPLICATIONS  
SPRING 2016  

Instructor: Dr. Janos Grantner  
Lecture: MWF 3:30-4:20pm, Room D-204/205  
Labs: MT 6:30-9:10pm, Room B-210 (Mr. Aous Kurdi)  
R 12:30-3:10pm, Room B-210 (Mr. Aous Kurdi)  
Office: Room A-246  
Phone: (269) 276-3154  
Email: janos.grantner@wmich.edu  
Home Page: http://homepages.wmich.edu/~grantner/ece4510  
Hours: MW 4:30-5:20pm, or by appointment  

Prerequisites (for UG students):  
ECE 2210 Electronics I  
ECE 2510 Introduction to Microprocessors  

Recommended:  
ECE 3550 Digital Design  
ECE 3570 Computer Architecture  

Required Materials:  
- Instructor's Lecture Notes and other support materials, posted on the Class Web Page.  
- STM32F407xx Datasheet by STMicroelectronics, available through the Class Web Page.  

In order to work on lab and homework assignments as well as projects, students are required to have a STM32F-Discovery Evaluation Board by STMicroelectronics, a free copy of the ARM Work Bench (32 KB code limit) software development and debugger system by IAR, a large solderless breadboard and a set of electronic parts (ECE 4510/5530 Parts Kit). With respect to the Discovery EVB and the electronic parts, students can purchase them through the University Bookstore, or through on-line
vendors. Students may already own the required solderless breadboard through a former lab class. If they don’t, they either purchase them through the University Bookstore, or through on-line vendors. With respect to the development software, students should directly download it from the IAR Web site.

**Recommended Material:**

**Course Description**
The primary emphasis of the course will be microcontroller architecture, firmware and embedded software design but hardware interface design issues will also be extensively covered. Students are expected to show expertise in both areas.

Topics to be tentatively covered in this course include:

- Introduction to the ARM Cortex-M Microcontroller Family
- ARM Cortex-M4 Architecture and Memory Map
- ARM Cortex-M4 Programmer's Model
- C Programming with the IAR Work Bench
- Interfacing to the Parallel I/O Ports
- Interrupts and interrupt service routines
- Programming the Timer Module
- Introduction to the µC/OS-III Real-Time Kernel
- Input Capture and Output Compare
- Programming the PWM Module
- Analog Input and Output Interface
- Asynchronous Serial Communications Interface
- SPI Interface
- I2C Interface
- CAN Interface
- Advanced I/O Interfacing Techniques
- Design of Static Memory Systems
- Interfacing Static Memory to the ARM Cortex-M4 External Bus
- Critical Timing Analysis

**Lab Work**
The hardware platform in the lab is the STM32F4DISCOVERY Board by STMicroelectronics. Programs will be created, compiled, and downloaded to the DISCOVERY Board using the IAR Work Bench environment that also supports program debugging. **Outside** of the scheduled and extended lab hours students should use their own copy of the IAR software along with their DISCOVERY Boards to work on the course assignments.

For the laboratory, students will also need a thumb drive, a large solderless breadboard and the Parts Kit as published on the Class Web Page. You will work in the lab in teams. A team is usually made up of two students, however, each student is required to have a DISCOVERY
Board, the IAR Work Bench software, a breadboard, and a Parts Kit. Work will be done simultaneously on lab and homework assignments and the design projects. Lab and project teams will have different make ups.

We will be using standard scientific/engineering procedure regarding laboratory reports. This means that you are expected to come to the labs prepared. Prelab Assignments will be posted on the Class Web Page. The objective and design sections (the latter contains pseudocode of software, circuit schematic diagrams, timing diagrams, math formulas, etc.) of your lab report should be completed before lab as a draft. The finalized design, data/results and conclusion sections of the Team’s Lab Report should be completed either during the lab session, or shortly thereafter. In the conclusions section you will describe major concepts observed/discovered, discuss any anomalies and suggest what caused them.

Prelab Assignments are individual work! Prelabs should be submitted in the appropriate Drop Boxes through Elearning. They will be checked by the Lab TA at the beginning of each lab. Missing, or insufficient Prelabs will be penalized by losing 3 pts (out of 12 pts) for the lab.

Some sections of the lab reports (e.g., schematic diagrams) may be done in pencil (not recommended, though) but typed reports using a word processor are required. The penalty will be severe for illegible writing, sloppy schematics and drawings.

Lab reports in electronic form are due no later than 5:00pm, on Thursday (Monday Lab) and on Monday (Thursday Lab), respectively, following the lab. Late lab reports will be penalized by -10% for each day they are tardy, or will receive a grade 0 after three days unless prior arrangements have been made. Lab reports should be submitted in the appropriate Drop Boxes through Elearning. If you don't show up for a lab, you forfeit the points associated with it and cannot later make up the lab. Exceptions will be made only for those individuals who contact their Lab TA before the lab, giving an adequate reason why they cannot attend that day.

Please note that you must achieve a passing grade in the lab (total 60% out of 100%) in order to pass the course. Plagiarism and/or the copying/duplication of another student's, or team's designs or reports will result in zero scores for the prelab, lab, homework, or design project for all individuals involved.

There will be a Lab Final (worth of three regular labs).

Extended Lab Hours
There will be slide card access to the B-210 Laboratory for students registered for the course. Outside regular work hours it is required that at least two students should be present in the lab. It is for your safety, and it is also required by the CEAS insurance policy.

Homework
There will be regular homework assignments. Late homework submissions will not be accepted and receive a 0 score. Homework solutions should be submitted in the appropriate Drop Boxes through Elearning.
Design Projects
The ECE 5530 Section will be assigned an extra midterm project (Project #1) in addition to a final Lab Project/Project #2 which should be done by both the undergraduate and the graduate sections, respectively. Projects will be carried out using the Parts Kit and equipment readily available in the lab. Projects will be done in teams of two students, or may be worked on individually. The demonstration of the projects working correctly will be worth up to 40% of the credit assigned.

Project #1 is due 5:00pm, on Wednesday, March 2, 2016, and the Lab Project/Project #2 is due 5:00pm, on Wednesday, April 20, 2016. Project reports should be submitted in the appropriate Drop Boxes through Elearning.

Late projects will be accepted up to three business days after due date (not after the last week of classes, though) but will be penalized by -10% for each day that is tardy! Failure to work on any project or submit the project report(s) will result in an X grade for the course.

Exams:
There will be one 50-minute Midterm, a Lab Final Exam, and a two-hour Final Exam. Support materials will be made available on the hard drives of the PC workstations used for the exams. The Midterm and the Final Exams will be given simultaneously in the B-210 Lab and in other designated laboratories. The Midterm Exam is scheduled for 3:30-4:20pm, on Friday, February 19, 2016. Lab Final Exams are scheduled for Thursday, April 14, 2016 and Monday, April 18, 2016, respectively, in the B-210 Lab. The Final Exam is scheduled for 2:45-4:45pm, on Monday, April 25, 2016. The solutions to all exams should be submitted in the appropriate Drop Boxes through Elearning.

The Final Exam is comprehensive, however, more weight will be allocated to course material subsequent to the Midterm Exam. Students are required to attend all exams as scheduled, failure to do so will result in an X grade for the course (if an emergency arises, you must contact the course instructor prior to the examination). There will be no make up exams unless in extreme circumstances.

Grading Policy:
Grades will be determined on the basis of the following:

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<tr>
<th>ECE 4510 Section</th>
<th>ECE 5530 Section</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Lab Work</td>
<td>30%</td>
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<tr>
<td>PROJECT</td>
<td>10%</td>
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<td>MIDTERM</td>
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<tr>
<td>FINAL</td>
<td>35%</td>
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The break up for the letter grades is as follows:

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<th>ECE 4510 Section</th>
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<th>ECE 5530 Section</th>
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<tbody>
<tr>
<td>A:</td>
<td>85 - 100%</td>
<td>A:</td>
<td>91 - 100%</td>
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<td>BA:</td>
<td>80 - 84%</td>
<td>BA:</td>
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<td>B:</td>
<td>70 - 79%</td>
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<td>CB:</td>
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In borderline cases, the Final Exam may be given a higher weight, up to the course instructor's discretion.

**Codes, Policies, Processes and Procedures:**
The ECE 4510/5530 Web Home Page will be used as official communications media for the class.

The WMU College of Engineering and Applied Sciences Honesty Code will apply in this course.

**Homework and Prelabs are individual work! Students may discuss with their classmates the basic approaches to arrive at the solutions in principle. However, they are not allowed to share schematic diagrams, calculations, program files, and the like. Similarly, there must not be leaks of detailed design information among lab and project teams, respectively.**

You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities. If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.

Furthermore, students are encouraged to visit to http://osc.wmich.edu and www.wmich.edu/registrar to access the Code of Honor and general academic policies on such issues as diversity, religious observance, student disabilities, etc.