

**UNC - Charlotte, Department of Electrical and Computer Eng.**  
**Syllabus for ECGR 6185/8185:**  
**Advanced Embedded Systems – Spring 2013**

Instructor: James M. Conrad, Associate Professor of ECE, EPIC2254

Register for: ECE6185, Section 001 (MS students) or ECE8185, Section 001 (Ph.D. students)

Lecture: Mon/Wed 2:00 – 3:15 p.m. EPIC G222.

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## **Prerequisite**

Grade of B or better in Embedded Systems (ECGR 4101 or 5101).

## **Textbook and Class Materials**

Required: Students should have their microcontroller evaluation board with software tools from the Introduction to Embedded Systems course to use for the laboratory.

Required: Note that you will be required to read articles off of the class website.

Required: MSP430 and other evaluation boards will be loaned to students for future lab assignments.

Optional: Class notes are available only online. Since tests are open book, open notes, it is recommended you obtain a copy.

## **Catalog Description**

An advanced course in embedded system design utilizing 16- and 32-bit microprocessors. Architecture, software, and interface techniques. This course is project-oriented, involving the use of a logic analyzer and hardware design tools.

## **Purpose of Course**

The goal of this course is to solidify and build upon a student's knowledge of computer organization by presenting hands-on experience with microcontrollers. Students will also examine a few sensors that are used in commercial and medical products and learn how to interface them in a microcontroller system. Students will:

- Recognize and identify the constraints facing embedded system designers, and determine how to assess them.
- Program a modern microcontroller in assembly language and operate its peripheral devices.
- Interpret how the assembly code generated by a compiler relates to the original C code.
- Practice thread-based program design with a real-time operating system.

- Develop programs controlling embedded systems using quick and efficient methods.
- Predict, measure and manipulate a program's execution time.

## **Labs**

The laboratory projects are an integral part of the course and are intended to provide experience in the application of the design techniques discussed in lecture. These projects will utilize the embedded systems board required for the class. There will be six to ten lab exercises assigned.

Lab exercises can be done in the Embedded Systems Teaching Lab or on your own home PC.

Because almost all of us learn by doing, the laboratory will probably be the most effective method for learning the material, and will help you on exams. Also, ask yourself questions while preparing for the lab and during the lab. Do not just passively and monotonously follow the lab write-up-- ask some of your own questions and then find out the answers with your computer. To learn, you need to do it and you need to creatively think about what you are doing! Lab grades will be based on lab write-ups and demonstrated functionality of problem requirements. One lab report per lab pair is due at the specified time.

Labs will consist of a pre-lab part which will be due one week after the lab is assigned, and the lab report/demonstration. The pre-lab will consist of a design of the lab itself. Each lab group will have one design reviewed by their peers during the semester.

Lab topics may include any of the following:

- Communications via IR LEDs
- Communications via 802.15.4, Bluetooth or optical fiber
- Accelerometers
- Sonar sensors
- Stepper motors
- Operating systems
- Development environments of other boards

## **Homework**

There will be no homework during the semester.

## **Grading**

If you have a dispute with how an assignment is graded, you should follow this procedure:

1. Get the solution to the assignment off the class web site and examine it. You may have just worked the problem incorrectly.
2. If you really believe that your answer is correct (matches the answer given in the solution), contact the TA who graded your assignment and discuss it with them. He/She will listen to your concern, and act on it, at his/her discretion. In any case, they will sign the assignment verifying that they saw it again.
3. If you are still not satisfied with the resolution, you may bring the assignment to me for review. I will not review homework that has not been seen and signed by the TA.

We record all "disputed" points in a separate column. We contend that "disputed" points never add up to a change in your final grade, and we will examine this when final grades are assigned. Note

that TA addition errors should follow the above procedure, but will not be figured in the "disputed" column.

## Quizzes

There will be several "pop" quizzes given throughout the semester. These will be to reward students who consistently show up to class and are prepared. The points will be used more than for "attendance points." If a reading is assigned for discussion for a class, then that reading will be the subject of the quiz.

## Exams

There will be two mid-semester exams. Exams will be open-book and open notes. Exams will include material from the lecture, the readings, homework, and laboratories.

### **Exam dates (preliminary):**

- Mid-semester exam 1: February 27, class time in regular classroom
- Mid-semester exam 2: April 29, class time in regular classroom
- Final exam: Project Presentation, May 6, 2:00 to 4:30 p.m., in regular classroom

**Missed exams:** Attendance at all exams is mandatory. Only legal or debilitating medical excuses will be accepted (read: prison time, major blood loss, etc.), provided that they are accompanied by the appropriate official documentation. Makeup exams are more difficult than the exams they replace; few have passed. Failure to satisfy these criteria will result in a zero grade for the exam.

## Missing Class/Assignments

Throughout the semester, a student may miss classes/assignments/quizzes/exams due to many reasons. Most of the reasons **will not** be accepted as an "excused" absence. For example:

- ECGR or other class exam review sessions: All class and exam times take precedence over any review sessions.
- University sponsored activity: All class and exam times take precedence over any University-sponsored activity.
- Business trips: If you miss an assignment/quiz because you were on a business trip, you miss out on the assignment/quiz points.
- Illness: If you miss an assignment/quiz because were ill, you miss out on the assignment/quiz points.

## Course Lectures.

We will use transparencies to teach this class. You can download them and print them from the web. See the web for the course lecture outline. Also, there will be many lectures which are not from transparencies.

## **Project for ECGR6185/8185**

It is expected that students registered for 6185 and 8185 will do an additional project, to scope of which is agreed-upon by the instructor. The deliverables include the following. Due dates and points will be determined later.

- A one-page write-up on the proposed work. You should talk to the instructor BEFORE you decide on a project. You will be graded on content and proper use of English. **February 15.**
- A report on initial activity of the project, including biographical references, code listing, designs, etc. You will be graded on content and proper use of English. You also will be graded on content and progress made. **March 15**
- A second report on activity of the project, including biographical references, code listing, designs, etc. You will be graded on content and proper use of English. You also will be graded on content and progress made. **April 12.**
- A presentation of the project will be conducted during the class' Final Exam time.
- A final report on activity of the project, including biographical references, code listing, designs, etc. You will be graded on content and proper use of English. Due May 6, noon.
- The end-results of the project will be graded as follows:
  - **Value to the professor of the work**
  - Completeness of the activity – adherence to the plan
  - Quality of the work
  - Level of difficulty – appropriate for the number of participants

## **Technical Review Assignments**

Throughout the semester, you will need to read and review two technical papers or book chapters. The technical review will typically be of a conference paper, with the review to be submitted to the Conference Organizing Committee. However, before you submit the review you should write the comments and meet with Dr. Conrad to discuss them.

## **Paper Presentation**

You will be required to make one 15 minute presentations on a technical paper in the area of embedded systems. You will need to select a paper, obtain approval from the instructor, and provide the instructor with a pdf of the paper. Sign up at the first class.

## **Course Calendar**

Refer to the web page: <http://www.registrar.uncc.edu/calendar.htm> for the academic calendar.

The course calendar will be posted on the course website.

## Grading Percentages and Grade distribution

	<b>Weight/points</b>
Technical review assignments	2.5% (25 points)
Lab assignments	30.0% (300 points)
Quizzes	15.0% (150 points)
Midterm Exam 1	15.0% (150 points)
Midterm Exam 2	15.0% (150 points)
Paper Presentations	2.5% (25 points)
Project	20.0% (200 points)
Total	100% (1000 points)

## Academic Dishonesty

All the provisions of the University code of academic integrity apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid.

Please read the discourse on cheating and ECGR 6185/8185 on the web page. For homework and laboratory projects, while collaboration is allowed, direct copying is not and students must turn in individual submissions. Realize that mastery of the material in the homework and lab assignments will be essential for a good performance on the exams!

*All UNC Charlotte students have the responsibility to be familiar with and to observe the requirements of The UNC Charlotte Code of Student Academic Integrity (see the Catalog). This Code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials (such as Library books on reserve), and complicity in academic dishonesty (helping others to violate the Code). Any further specific requirements or permission regarding academic integrity in this course will be stated by the instructor, and are also binding on the students in this course. Students who violate the Code can be punished to the extent of being permanently expelled from UNC Charlotte and having this fact recorded on their official transcripts. The normal penalty is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases, the course grade is reduced to "F." If you do not have a copy of the Code, you can obtain one from the Dean of Students Office or access it online at [www.legal.uncc.edu/policies/ps-105.html](http://www.legal.uncc.edu/policies/ps-105.html) . Standards of academic integrity will be enforced in this course. Students are expected to report cases of academic dishonesty they become aware of to the course instructor who is responsible for dealing with them.*

## Instructor and Student Conduct

**Syllabus Revisions:** The standards and requirements set forth in this syllabus may be modified at any time by the course instructor. Notice of such changes will be by announcement in class and/or

by email to your UNCC email address.

**Disability Services/Special Needs:** If you have a documented disability and require accommodation in this course, contact the Disability Services office, located in Fretwell building, room 230. Phone 704/687.4355 (voice/TDD). Information about available services can be found at: <http://www.ds.uncc.edu> . Students in this course seeking accommodations to disabilities must first consult with the Office of Disability Services and follow the instructions of that office for obtaining accommodations. Please initiate this process and inform me during the first two weeks of class.

**Diversity:** UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socioeconomic status.

**Cell Phones, PDAs and Such:** Please note that portable phones, pagers, and late arrivals are disruptive to the instructor and to your peers. The use of cell phones, beepers, or communication devices is disruptive and is therefore absolutely prohibited during class. Turn off your cell phone while in class. If I catch you using these devices, your final grade will be reduced by 10 points for each and every transgression. Except in emergencies, students using such devices must leave the classroom for the remainder of the class period. This penalty will be at the sole discretion of the instructor.

**Laptop and G222 Computers:** I know that some of you may wish to take notes directly on your computer and I have no problem with that. If however, you choose to access your email, search the web, play solitaire or other games, or instant messenger your friends during class, you will have 10 points deducted from your final grade for each and every transgression. This penalty will be at the sole discretion of the instructor.

**Communication:** I will try and answer emails and phone calls received during the hours of Monday – Friday, 9 am to 4 pm within 24 hours. If you email and/or call at any other times, it is strictly a random chance that I'll respond in a timely manner. You should check your UNCC email every day as that is the primary way that I will communicate with you when not in class. When communicating with me via email, please put in the subject line the course number so I can readily identify who you are. *If your communication via email is rude, has grammatical, and/or spelling mistakes, I will not respond at all.* If I have not responded to your email within 24 hours as stated within the conditions above, perhaps you need to resend it and/or reword it. You are to conduct yourselves in a professional manner at all times.

**Communications using Moodle:** It is preferred that you ask specific technical and class organizational questions via Moodle. That way, the Instructor, TAs, or classmates have the ability to answer faster than just sending an email to an individual.

**Orderly, Productive and Professional Classroom Conduct:** I will conduct this class in an atmosphere of mutual respect. I encourage your active participation in the classroom. Each of us may have strongly differing opinions on the various topics of class discussions. Remember that not everyone shares these beliefs and opinions and these maybe statements about personal beliefs, values, and opinions rather than fact. The conflict of ideas is encouraged and welcomed. The respectful and open-mindedness of ideas of others, including mine, is similarly welcomed. However, I will exercise my responsibility to manage the discussions so that ideas, comments, and

arguments can proceed in an orderly, productive, and professional manner. You should expect that if your conduct during class seriously disrupts the atmosphere of mutual respect I expect in this class, you will be asked to leave the class, will not be permitted to participate further, and will have your final grade deducted by 10 points for each and every occurrence.

**Turnitin.com:** As a condition of taking this course, some required assignments may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. No student papers will be submitted to Turnitin.com without a student's written consent (<http://www.legal.uncc.edu/turnitinconsentform.pdf>) and permission. If a student does not provide such written consent and permission, the instructor may: (i) require a short reflection paper on research methodology; (ii) require a draft bibliography prior to submission of the final paper; or (iii) require the cover page and first cited page of each reference source to be photocopied and submitted with the final paper.

**Sexual Harassment:** All students are required to abide by the UNC Charlotte Sexual Harassment Policy ( <http://www.legal.uncc.edu/policies/ps-61.html> ) and the policy on Responsible Use of University Computing and Electronic Communication Resources (<http://www.legal.uncc.edu/policies/ps66.html>). Sexual harassment, as defined in the UNC Charlotte Sexual Harassment Policy, is prohibited, even when carried out through computers or other electronic communications systems, including course-based chat rooms or message boards.

**Religious Accommodations for Students:** UNC Charlotte Policy #134 in part states: Students who, acting in accordance with this Policy, miss classes, examinations or other assignments because of a religious practice or belief must be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious observances on which they will be absent by submitting a Request for Religious Accommodation Form to their instructor prior to the census date for enrollment for a given semester. The census date for each semester (typically the tenth day of instruction) can be found in UNC Charlotte's academic calendar. A student who submits a Request for Religious Accommodation Form after the census date must show good cause for the late submission, and the late submission itself may be taken into account in determining whether the student has a religious practice or belief requiring accommodation and whether granting the request would create undue hardship. ( <http://legal.uncc.edu/policies/ps-134.html> ). Read the policy webpage for specific details and the form.

## **Class Learning Objectives:**

Students will learn how to read, understand and review a technical paper. This will help them write good technical papers on their research. Activities to achieve this goal:

- Instruction on the process on how papers are developed
- Instruction and discussion on the important parts of a paper and how to review (example)
- Assignment: review a paper for a conference
- Assignment: Students will read and make a presentation on a technical paper

Students will understand embedded system development. Activities to achieve this goal:

- Instruction on embedded systems development processes.
- Activity: reverse engineering a mobile phone
- Instruction on software/hardware project management
- Activity: develop project management deliverables for a project

Students will understand the concept of resource space (memory) versus time (computation speed). Activities to achieve this goal:

- Instruction on embedded systems space/time tradeoffs (i.e. floating point versus fixed point computation)
- Activity: Lab on analyzing space/time tradeoffs.

Students will understand the concept of energy usage versus time (computation speed). Activities to achieve this goal:

- Instruction on embedded systems energy/speed tradeoffs (i.e. sleeping/wakeup vs computation)
- Activity: Lab on analyzing energy/speed tradeoffs.

Other topics:

- Operating Systems
- Peripherals
- Testing
- Systems Engineering

## **Paper Presentations:**

1/16 - Rhodes  
1/28 - Srinivasan  
1/28 - Alimi  
1/30 - Chitale  
1/30 - Sundaram  
2/4 - Subramanian  
2/4 - Manjunath  
2/6 - Bagewadi  
2/6 - Hunter  
2/13 - Shue  
2/13 - Gokhale  
2/18 - Engle  
2/18 - Wood  
2/20 - Patibandala  
2/20 - Hines  
3/13 - Hebbale  
3/13 - Gandhari  
3/13 - Kuruvila  
3/20 - Collins  
3/20 - Wright  
3/20 - Hill  
3/27 - Alla  
3/27 - Kambam  
3/27 - Henderson  
4/3 - Davidsson  
4/3 - McClellan  
4/3 - Major  
4/10 - Sondur  
4/10 - Kapre  
4/10 - Tamhankar  
4/17 - Deshpande  
4/17 - Rao  
4/17 - Veeraragavan