UNC - Charlotte, Department of Electrical and Computer Engineering

Syllabus for ECGR 4101/5101, Embedded Systems, Fall 2014

Instructor: James (Jim) Conrad, Professor of ECE, Email: jmconrad@uncc.edu
NOTE: there is a student named James Conrad – make sure you choose ***JIM*** Conrad.

Office: EPIC 2164; Office hours: Tue/Thurs 11:00 am – 12:00 p.m.

Lecture: Section 001: EPIC G222, Tue/Thurs, 3:30 - 4:45 pm,
Section 002: EPIC 1249, Tue/Thurs, 9:30 - 10:45 am

Grader/Lab Assistants: Sam Shue, Bala Chandrasekaran, Dharmik Mehta. See the course web page for office hours and contact info.

Website: http://webpages.uncc.edu/~jmconrad/ECGR4101-2014-08 ***Check the web site frequently!*** Solutions and grades posted to the Moodle site.

Prerequisite

Course: ECGR3183 or departmental approval.

- Knowledge of C, C++, Java, or other high-level programming
- Knowledge of complex digital circuits, including computer architectures
- Knowledge of analog circuits
- Knowledge of modern computer-based design tools

Textbook and Class Materials

Required Textbook: Introduction to Embedded Systems using the Renesas RX63N Microcontroller. Free book available online - see course web site.

Required: Students will need to buy a Renesas RX63N YRDKRX63N Demonstration board with software tools to use for the laboratory – one per lab pair. They can use the board after the class ends for use in other classes (e.g. Senior Design, Advanced Embedded Systems). The cost per board is about $99 (http://www.renesas.com, also other electronics vendors and eBay!).

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

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

Catalog Description

Introduction to designing microcontroller-based embedded computer systems using assembly and C programs. Examination of Real-time Operating Systems and their impact on performance. Computer engineering applications will be emphasized.

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:

1. Recognize and identify the constraints facing embedded system designers, and determine how to assess them.
2. Program a modern microcontroller in assembly language and operate its peripheral devices.
3. Interpret how the assembly code generated by a compiler relates to the original C code.
4. Implement embedded systems using different peripheral devices, input, and communications devices.
5. Practice thread-based program design with a real-time operating system.
6. Develop programs controlling embedded systems using quick and efficient methods.

Students should be able to demonstrate the following competencies and knowledge:

1. An ability to design an embedded system (including hardware and software) that meet a written set of requirements.
2. An ability to identify, design, and implement an embedded system (including hardware and software) that solves a real world problem using engineering processes.
3. An ability to use hardware and software development techniques, skills, and computer tools to solve a real-world problem.

Course Topics

1. Introduction to Embedded Systems and Microcontroller-based Circuit Design
2. Instruction Set Architecture
3. C Programming Review and Dissection
4. C Start-Up Module and Simple Digital I/O
5. Analog to Digital Conversion
6. Disciplined Software Development
7. Serial Communications
8. Interrupt concepts and behavior and how to program with them in C
9. Interrupt-Driven Serial Communications and Sharing Data
10. Non-Preemptive Scheduling
11. Software Testing
12. Preemptive Scheduling
13. Process Coordination and Scheduling

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 (EPIC 2130/2132) or on your own 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 homeworks and 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. Lab reports must be uploaded to Moodle.

All lab assignments will require demonstrating the exercise working on the board.

Homework

Homework is another example of learning by doing. Although not as exciting as a lab, homework is essential to learning the concepts in this course. Homework will be in the form of reading assignments and problem sets, with a due date 2-3 lectures after it is assigned. **No late homework will be accepted.** Homework must be done individually or in a group of two (you will learn the most from this). Any evidence of larger group participation will be interpreted as academic dishonesty. There will be 10-13 assignments, of which the highest 10 will be used in your final grade. Here are some guidelines for homework assignments:

- Homework will typically be turned in class as a hardcopy, as announced in the assignment.
- You will typically get better grades on homework if they are typed
- Do not repeat the question on the homework sheet.
- Do not put a printout of the assignment sheet anywhere in your turned-in homework.
- You should turn in a pdf version only.
- Check the class web site for a MS Word file which is a template for homework. Replace the information in the header with your particular information.

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 got the problem wrong.
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. They will listen to your concern, and act on it, at their discretion. In any case, they will sign the homework verifying that they saw it again.
3. If you are still not satisfied with the resolution, you may bring the homework to me for review. I will not review homework that has not been seen and signed by the TA.

We record all "disputed" points separately. 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" points.

Quizzes

There will be fifteen to seventeen quizzes given throughout the semester, of which the highest fifteen will be used in your final grade. These will be to reward students who consistently show up to class, but will be more than just attendance points.

Exams

There will be one mid-semester exam and one final exam. Exams NOT open-book, open-notes. You will be allowed one page (*.5 x 11) of notes, two sided. Mobiles phones are not permitted.

Exams will include material from the lecture, the readings, homework, and laboratories. Exam dates are:

- Mid-semester exam: Thursday, October 9, class time, Regular classroom
- Final exam: Section 001: Thursday, December 11, 2:00 - 4:30 pm, EPIC G222
  Section 002: Thursday, December 11, 8:00 - 10:30 am, EPIC 1246

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/exams due to many reasons. Most of the reasons will not be accepted as an "excused" absence. That is why a few of the quizzes and homeworks are dropped when determining your final grade. Plus, you can always email your homework. For example:

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.

Project for ECGR5101 (Grad Students)

It is expected that students registered for ECGR5101 will do additional work. The specific work will be to develop and solve a lab exercise based on one of the topics covered in the RX63N Advanced Book, specifically based on one of the Advanced Book chapters.

The deliverables include (uploaded to Moodle):

- October 17, 12:00 noon (Friday): The lab assignment with instructions and requirements. See the lab assignment template for the format. You will be graded on content and proper use of English. (20 points)
- November 14, 12:00 noon: The updated lab assignment and major attempt at the code solution. You will be graded on content and proper use of English. You also will be graded on content and progress made (30 points)
- December 5, 12:00 noon (Friday): The final lab assignment and code project of the solution, including grading rubric. You will need to demonstrate the working lab to the professor. You

will be graded on content and proper use of English. (50 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.

Grading Percentages

	ECGR4101	ECGR5101
Homework assignments	20% (200 points)	18.2% (200 points)
Lab assignments	20% (200 points)	18.2% (200 points)
Quizzes	15% (150 points)	13.6% (150 points)
Midterm Exam	15% (150 points)	13.6% (150 points)
Final Exam	30% (300 points)	27.3% (300 points)
Project	None	9.1% (100 points)
Total	100% (1000 points)	100% (1100 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 4101/5101 on the web page. For homework and laboratory projects, while discussion 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! The only exception is that lab partners work closely on the lab assignment and turn in one lab report.

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 . 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.

Course Calendar

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

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 be asked to leave the room for every transgression, and may lose course points. This penalty will be at the sole discretion of the instructor.

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.

Communication: I will try and answer emails and phone calls received during the hours of Monday – Friday, 9 am to 4 pm within 48 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 48 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.

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 maybe 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.