

## UNC - Charlotte, Department of Electrical and Computer Eng.

### Syllabus for ECGR 4101/5101 - Embedded Systems – Fall 2006

Instructor: James M. Conrad, Associate Professor of ECE

Office: Woodward 210C, Office hours: Whenever the door is open. Also: Mon/Wed 8:30 – 10:00 a.m.

Email: [jmconrad@uncc.edu](mailto:jmconrad@uncc.edu)

Lecture: TTH 11:00 – 12:15, Woodward 140.

Lab Assistants: Doug Isenberg, [drisenbe@uncc.edu](mailto:drisenbe@uncc.edu), Office: Woodward 203 or 200.

Website: <http://www.coe.uncc.edu/~jmconrad/ECGR4101-2006-08>

*Check the web site frequently!*

### Prerequisite

Grade of C or better in ITCS 3182 or ECGR 3183; or equivalent.

### Textbook and Class Materials

Required: Students will be required to purchase a microcontroller evaluation board with software tools to use for the laboratory; they will keep this board after the class ends for use in other classes (e.g. Senior Design, Advanced Embedded Systems). The cost per student is TBD (likely \$30-60).

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.

### 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 (Woodward 203) 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 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.

## 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 turned in at **the beginning of lecture (before I begin lecturing)**. Homework must be done individually (you will learn the most from this). Any evidence of 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:

- 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.
- Staple all pages together
- Do not fold the assignment when you turn it in.
- Hand in a hard copy of your homework
- 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 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 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. **No calculators** may be used on exams. Exams are open-book, open-notes. Exams will include material from the lecture, the readings, homework, and laboratories.

### **Exam dates:**

- Mid-semester exam: Thursday, October 5, class time
- Final exam: Tuesday, December 12, 2006, 12:00 – 3:00 p.m.

**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.

## 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.

## Project for ECGR5101

It is expected that students registered for will do an additional project, the scope of which is agreed-upon by the instructor. Some ideas include:

- Converting class note chapter to an Atmel chip.
- Assessing new sensors/actuators.
- Implement wireless communications.
- Assist in the development of an Embedded Systems text book (i.e. written materials search and summation of the papers/books of each particular topic) early to late semester project.
- Identify a 32-bit processing board and successfully load Embedded Linux.
- Create via ORCAD a daughterboard to plug into the Renesas Evaluation Board (with motor drivers, RS-232 chip, RS-232 connector).

The deliverables include:

- October 12: 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. (20 points)
- November 16: A report on initial activity of the project, including project plans, bibliographical 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 (40 points)
- December 14, 12:00 noon: A final report **and** demonstration on activity of the project, including biographical references, code listing, designs, etc. You will be graded on content and proper use of English. (40 points)
- The end-results of the project will be graded as follows:
  - Value to the professor of the work: 20 points
  - Completeness of the activity – adherence to the plan: 60 points
  - Quality of the work: 20 points

## Grading Percentages

	<b>ECGR4101</b>	<b>ECGR5101</b>
Homework assignments	20% (200 points)	16.6% (200 points)
Lab assignments	20% (200 points)	16.6% (200 points)
Quizzes	15% (150 points)	12.5% (150 points)
Midterm Exam	15% (150 points)	12.5% (150 points)
Final Exam	30% (300 points)	25% (300 points)
Project	None	16.6% (200 points)
Total	100% (1000 points)	100% (1200 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.

## Course Calendar

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