UNC - Charlotte, Department of Electrical and Computer Eng.

Syllabus for ECGR 4892/6090/8090: Advanced Embedded Systems – Spring 2004

Instructor: James M. Conrad, Associate Professor of ECE

Register for: ECE**4892**, Section C01 (undergraduates) or ECE**5090**, Section **C01** (graduate students) or ECE**6090**, Section **C01** (Ph.D. students)

Lecture: Tue/Thurs 3:30 – 4:20 p.m. Smith 202.

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Lab Assistants: Rajan Rai (rrai@uncc.edu), Assad Ansari (ahansari@uncc.edu)

Prerequisite

Grade of C or better in Introduction to Embedded Systems.

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: Each lab pair will be required to purchase a cable set for use in labs ($10). This consists of:

- 3 or 6 foot DB9 female to DB9 male cable
- DB9 male to DB9 male gender changer
- DB9 male to DB9 female null modem adapter

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

Required: Renesas R8C evaluation boards will be loaned to students for the semester for use in projects.

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-bit micro processors. 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 will include:

- Communications via IR LEDs
- Communications via Bluetooth or optical fiber
- Stress gauges
- Accelerometers
- RFID
- Sonar sensors
- Compass
- Stepper motors
- Nitinol actuators
- Performance analysis 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."

Exams

There will be one mid-semester exam and one final. 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: Tuesday, March 2, class time in regular classroom
- Final exam: Thursday, May 13, 3:30 – 6:30 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 ECGR6090/8090

It is expected that students registered for 6090 and 8090 will do an additional project, to scope of which is agreed-upon by the instructor. This will consist of taking a sensor or actuator and making a lab assignment from it that works on the Mini R8C Evaluation board. The lab will be performed by the class students and will be due by the midterm. Sensors/actuators student groups will investigate include:

- Communications via optical fiber
- Stress gauges
- Accelerometers
- RFID
- Sonar sensors
- Compass
- Stepper motors
- Nitinol actuators

This project should have several deliverables:

- A lab assignment sheet, complete with circuit drawings needed to complete the lab, instructional descriptions, and sample designs. (Due 3/4/04)
- A coding solution and grading solution. (due 3/4/04)
- Instructional transparencies (due 3/4/04)
- 15-minute instructional presentation of the lab assignment (2^{nd} half of the semester)
- Application note of the sensor/actuator implementation. (due 4/15/04)
- Updated lab assignment sheet, complete with circuit drawings needed to complete the lab, instructional descriptions, and sample designs. (Due 5/4/04)
- A coding solution and grading solution. (due 5/4/04)
- Instructional transparencies (due 5/4/04)

There is an alternate project – making a PCB, coding the processor, and testing the system of a Renesas R8C/11 – based Stiquito circuit. There is a start (a group did this last semester), but we need a completed and tested circuit done by March 4. If interested, see Dr. Conrad.

Technical Review Assignments

Throughout the semester, you will need to read and review certain technical papers. This may consist of just editing, but may also include a short presentation of the material. These assignments will be posted throughout the semester.

Grading Percentages and Grade distribution

	ECGR4892	ECGR6090	ECGR8090
Technical review assignments	5% (50 points)	4.2% (50 points)	4.0% (50 points)
Lab assignments	40% (400 points)	33.3% (400 points)	32.0% (400 points)
Quizzes	5% (50 points)	4.2% (50 points)	4.0% (50 points)
Midterm Exam	20% (200 points)	16.6% (200 points)	16.0% (200 points)
Final Exam	30% (300 points)	25% (300 points)	24.0% (300 points)
Project	"Extra credit"	16.6% (200 points)	20.0% (250 points)
Total	100% (1000 points)	100% (1200 points)	100% (1250 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 4892/6090/8090 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!