

CS 331 Course Syllabus

Spring 2003 – *Version 2.0*

Staff

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Additional office hours are available by arrangement.

Web Page and Newsgroup

The course web site is Blackboard (<http://blackboard.cet.uiuc.edu/>). Lecture notes and assignments will be posted there throughout the semester. Login with your NetID and Blackboard password. If you have not used Blackboard before, then your password should be the same as your NetID. If you experience problems, please email Tim (eriksson@uiuc.edu).

The course newsgroup is `uiuc.class.cs331`. Please check it regularly for announcements. The TAs will do their best to promptly respond to questions posted there as well.

Overview

CS 331 is designed to help you master the architecture and application of embedded systems. The focus is on software for embedded systems.

The basics of the microcomputer and how it interfaces with the external world.

- How to program A/D and D/A cards
- Interrupts, serial communications, etc.

Tools of the trade.

- Real Time Operating Systems (RTOS), timers, and periodic tasks
- Programming with threads and processes
- Synchronization and message passing in real time applications

Theory of the trade: How to use Rate Monotonic theory to analyze and design concurrent real time tasks.

- Periodic tasks, aperiodic tasks, synchronization
- Real time networking

CS 331 also teaches the key concepts of the common application domains so that you can work with communication and control engineers effectively.

- Signal processing
- Feedback control

Grading

At the end of the semester, a percentage of the total possible points will be computed for each student using the weights in Table 1. Based on this percentage, the minimum guaranteed letter grades are shown in Table 2. Letter grades will also include pluses and minuses. The instructor reserves the right to lower the range cutoff points at his discretion.

Lab projects	15%
Homework assignments	15%
Mid-term exam	30%
Final exam	40%

Table 1: Weights

Percentage	Grade
≥ 90	A–
≥ 80	B–
≥ 70	C–
≥ 60	D–
< 60	F

Table 2: Minimum Guaranteed Grades

Grades will be stored in the Campus GradeBook system. More information about GradeBook is available on this web page: <http://www.uiuc.edu/ccso/gradebook/>

This class is normally taken for 3 hours or $\frac{3}{4}$ units. Grad students registered for 1 unit must complete an additional lab project. The details of the project will be announced later in the semester.

After homework assignments and lab reports are graded, they will be available for pickup in the bin outside 1252 DCL.

Academic Integrity

Some students find it effective to study in groups. This is encouraged. However, all of the work that you submit must be the result of your own work (for individual homework assignments) or the result of your lab group's work (for group lab reports). Collaboration between individuals and groups over assignments is permitted, but must be limited to general strategies. Discussion of specific solutions is expressly forbidden.

If resources other than documents provided through the Spring 2003 – Version 2.0 CS 331 course are used to complete an assignment, the sources must be cited.

If the course staff determines that this policy has been violated, all involved students will receive a zero on the assignment or exam in question. If a student is determined to violate the policy a second time, they will receive a failing grade in the course.

Assignment Handin

Homework assignments and lab reports may be submitted in two ways:

- Handin to a TA in person during office hours or lab
- Slide under the door to 1102 DCL

Assignments submitted after the deadline incur a 25% penalty for each day¹, or fraction of a day, after the deadline that the paper is received. The TAs will not necessarily check for late papers every day, so you are advised to email both TAs after submitting any assignment late.

¹All seven days of the week count, not just weekdays.

Textbook

There is no textbook for the course. Required reading material will be given to you during the class. Lecture notes will be incrementally posted on the class web site. Several books, including Brey's are reserved in Grainger Library. In the ICES class review form regarding the textbook, the evaluation should be on the lecture notes instead. The class evaluation should include the lectures, the labs and how they interact with each other.

Schedule

The three main components of the course are:

- Two lectures each week: Monday/Wednesday 11:00am – 12:15pm in 1310 DCL.
- Two hours of lab projects each week. The five lab projects will be done in teams of three during the scheduled lab section. The lab room is 1102 DCL.
 - Lab 0 (1 week): Introduction
 - Lab 1 (2 weeks): Basic I/O with the A/D – D/A card
 - Lab 2 (2 weeks): Generating a square wave with timers
 - Lab/HW 3 (1 week): Modeling the water seesaw using MATLAB
 - Lab 4 (2 weeks): Passing messages between processes and threads
 - Lab 5 (2 weeks): Putting it all together to control the water seesaw
- Homework on major topics.
 - HW 1: Assembly and device I/O
 - HW 2: Timers, interrupts, filters, etc.
 - Lab/HW 3: Modeling the water seesaw using MATLAB
 - HW 4: Basic real time scheduling theory and analysis
 - HW 5: Real time synchronization and more analysis

The current schedule is as follows. Changes may be made during the semester if necessary.

Week	Lecture	Lab	Homework
#1	(1/22) #1 Introduction		
#2	(1/27) #2 Assembly Programming I	Lab 0	
	(1/29) #3 Assembly Programming II		
#3	(2/3) #4 A/D and D/A Devices	Lab 1 week 1	(2/3) HW 1 out
	(2/5) #5 Interrupt Handling I		
#4	(2/10) #6 Interrupt handling II	Lab 1 week 2	(2/14) HW 1 due
	(2/12) #7 Real Time Periodic Tasks I		
#5	(2/17) #8 Real Time Periodic Tasks II	Lab 2 week 1	(2/17) HW 2 out
	(2/19) #9 Signals and Filters I	Lab 1 report due	
#6	(2/24) #10 Signals and Filters II	Lab 2 week 2	(2/28) HW 2 due
	(2/26) #11 PID Control I		
#7	(3/3) #12 PID Control II	Lab 2 report due	
	(3/5) Mid-Term Review		
#8	(3/10) Mid-Term Exam (during class)	Lab/HW 3 (EWS lab)	
	(3/12) #13 Simulations with MATLAB		

#9	(3/17) #14 Serial I/O	Lab 4 week 1	
	(3/19) #15 RTOS I	(3/21) Lab/HW 3 report due	
Spring Break			
#10	(3/31) #16 RTOS II	Lab 4 week 2	(3/31) HW 4 out
	(4/2) #17 Real Time Scheduling Theory		
#11	(4/7) #18 Exact Analysis of Periodic Systems	Lab 5 week 1	(4/11) HW 4 due
	(4/9) #19 Practical Software Engineering	Lab 4 report due	
#12	(4/14) #20 Real Time Synchronization I	Lab 5 week 2	
	(4/16) #21 Real Time Synchronization II		
#13	(4/21) #22 Handling Aperiodic Events	Lab 5 report due	(4/21) HW 5 out
	(4/23) #23 Analyzing RT Embedded System		
#14	(4/28) #24 Real Time Networking		(5/2) HW 5 due
	(4/30) Final Review		
Final Exam (date, time, and location TBA)			

Lab Policies

The CS 331 lab is designed to supplement the material covered in lecture. Throughout the semester students will build components required to control a water seesaw. The final lab project will then be to assemble the components and keep the seesaw balanced in real time.

Attendance

Attendance is required for the labs. However, lab groups that have finished the assignment and satisfactorily demonstrated it to the TA are excused until the start of the next lab project.

If you have a planned absence, make arrangements with the members of your group and email your TA at least four days prior to the lab that will be missed.

Lab Reports

A typed lab report must be completed for each lab and is generally due one week after the lab is finished. Each group must hand in one report which should describe, in detail, the contents of the lab. More specific information regarding each report will be included with the lab assignments.

Lab Computers

There are eight computers in the lab named emb[1-8].cs.uiuc.edu. The first seven run LynxOS 4.0 with X11 and Motif. Each of these machines contains a CIO-DAS1600 A/D – D/A card from ComputerBoards and is connected to a water seesaw. The eighth machine runs Red Hat Linux 7.3 and does not have an A/D – D/A card. Students may login to any of the machines remotely using SSH.