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OFFICE OF THE SENATE COUNCIL

# APPLICATION FOR NEW COURSE

1. Submitted by College of Engineering Date 11/22/05

   Department/Division offering course Electrical and Computer Engineering

2. Proposed designation and Bulletin description of this course

   a. Prefix and Number EE 588 b. Title* Real-Time Digital Systems

   *NOTE: If the title is longer than 24 characters (including spaces), write A sensible title (not exceeding 24 characters) for use on transcripts Real-Time Systems

   c. Lecture/Discussion hours per week 3 d. Laboratory hours per week 0

   e. Studio hours per week 0 f. Credits 3

   g. Course description

   This course will cover features typically found in real-time and embedded systems. Topics will include scheduling synchronization, and architectural features of single and multiple processor real-time and embedded systems.

   h. Prerequisites (if any)

   EE 380, C programming experience, engineering standing or upper division computer science standing, or consent of instructor.

   i. May be repeated to a maximum of _____ (if applicable)

4. To be cross-listed as

   _____ Prefix and Number _____ Signature, Chairman, cross-listing department

5. Effective Date Fall 2006 (semester and year)

6. Course to be offered ☑ Fall ☐ Spring ☐ Summer

7. Will the course be offered each year? ☑ Yes ☐ No
   (Explain if not annually)

8. Why is this course needed?

   This course is needed to improve our offering of graduate and undergraduate computer engineering courses.

9. a. By whom will the course be taught? Dr. William Dieter or other computer engineering staff.

   b. Are facilities for teaching the course now available? ☑ Yes ☐ No
   If not, what plans have been made for providing them?

## APPLICATION FOR NEW COURSE

10. What enrollment may be reasonably anticipated? 15-20 students

11. Will this course serve students in the Department primarily? ☑ Yes ☐ No

Will it be of service to a significant number of students outside the Department? ☑ Yes ☐ No
If so, explain.

As a computer engineering course, students from both ECE and CS will be expected to enroll.

Will the course serve as a University Studies Program course? ☐ Yes ☑ No

If yes, under what Area? _____

12. Check the category most applicable to this course

☑ traditional; offered in corresponding departments elsewhere;

☐ relatively new, now being widely established

☐ not yet to be found in many (or any) other universities

13. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? ☑ Yes ☐ No

14. Is this course part of a proposed new program: ☐ Yes ☑ No
If yes, which?
This course is not required, but will supplement existing classes in the Computer Engineering program.

15. Will adding this course change the degree requirements in one or more programs?* ☑ Yes ☐ No
If yes, explain the change(s) below

This course will be accepted as an EE or COE technical elective.

16. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

17. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted. ☐

18. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate students in assignments, grading criteria, and grading scales. ☑

19. Within the Department, who should be contacted for further information about the proposed course?

Name Dr. William R. Dieter Phone Extension 257-1768

*NOTE: Approval of this course will constitute approval of the program change unless other program modifications are proposed.

## APPLICATION FOR NEW COURSE

**Signatures of Approval:**

| | |
|---|---|
| Department Chair | 11/22/06 Date |
| Dean of the College | 3/28/07 Date |
| 21 In favor / 0 Against | 10/07/2005 Date of Notice to the Faculty |
| *Undergraduate Council | 4/24/07 Date |
| *University Studies | Date |
| Approved by Graduate Council *Graduate Council | 4/12/07 Date |
| *Academic Council for the Medical Center | Date |
| *Senate Council (Chair) | Date of Notice to University Senate |

*If applicable, as provided by the Rules of the University Senate

ACTION OTHER THAN APPROVAL

# Fall 2006, EE 599-006: Real-Time Digital Systems

## Instructor Information

**Professor:** Dr. William R. Dieter
**Email:** dieter@engr.uky.edu
**Office:** 683 F. Paul Anderson Tower
**Office Phone:** 257-1768
**Office Hours:** MWF 3:00 PM to 3:50 PM or by arrangement

I am available for consultation outside of class during office hours. I am generally willing to consult with students any time my door is open regardless of whether it is office hours or not. If you would like to meet with me outside of office hours, it is a good idea to send email first to arrange a meeting time.

## Course Information

**Textbook:** Jane W. S. Liu, *Real-Time Systems*, Prentice-Hall, Inc. 2000, ISBN: 0-13-099651-3
**Supplementary Reading:** Additional reading material may be assigned during the semester. The additional material will be supplied on the web site or available through the library.
**Course URL:** http://courses.engr.uky.edu/fall06/ECE/ee599-006
**Prerequisites:** Equivalent of two 400 level courses in Electrical Engineering or Computer Science, engineering standing, EE 380 or equivalent, and familiarity with C programming, or consent of the instructor.
**Location:** FPAT 267
**Time:** MWF 2:00 PM - 2:50 PM

## Outcomes

From systems as small as a toaster to those as sophisticated as a TiVo or a computer controlling heavy machinery in a factory, computer systems are everywhere. These embedded computer systems often have different constraints on their operation than do their desktop or mainframe counterparts. For example, a word processor on a desktop machine pauses while the user is typing, it is merely annoying. In the case of a robotic welder, it a pause in processing could cause the robot to leave the welder on too long, destroying the work and possibly starting a fire.

This class will cover features typically found in real-time and embedded systems with those found in more traditional computer systems. Topics will include scheduling, synchronization, memory management, and architectural features of real-time and embedded systems.

After successfully completing this course, students will be able to:

- Choose an appropriate scheduling algorithm and use it to schedule tasks in a real-time operating system.
- Use synchronization primitives to synchronize interprocess communications between tasks with different priorities
- Understand the basics of interprocessor communication, including mechanisms for real-time communication
- Schedule real-time tasks on multiprocessor real-time systems.
- Discuss strategies for reducing power consumption

## Topics

Below is a list of topics I would like to cover during this semester. The actual topics covered may vary from what is listed

below:

- System Modeling
- Static scheduling
- Priority driven scheduling
- Synchronization & mutual exclusion (real-time and non-real-time)
- Flash-based filesystems
- Real-time communication
- Multiprocessor real-time scheduling
- Power aware scheduling
- Implementing Real-Time Systems in Linux

# Grading

Grading will be based on homework assignments, projects, and exams. Assignments will be weighted as follows:

| | |
|---|---|
| **Exams** | 50 % |
| **Homework, Projects, and Quizzes** | 50 % |

Points in each category will be totaled and weighted as described above to arrive at a final grade using the standard grading scale.

**Grading Scale for Undergraduate Students**

| Weighted Avg. | Grade |
|---|---|
| 90 - 100 | A |
| 80 - 89 | B |
| 70 - 79 | C |
| 60 - 69 | D |
| 0 - 59 | E |

**Grading Scale for Graduate Students**

| Weighted Avg. | Grade |
|---|---|
| 90 - 100 | A |
| 80 - 89 | B |
| 70 - 79 | C |
| 0 - 69 | E |

Though unlikely, a curve based on the distribution of final scores may be applied to adjust final grades. If used, the curve will be only make small adjustements based on the statistical distribution of overall scores. Scores clumped near the top will get A's, the next major clump gets B's, etc. If anything the curve will only raise your grade. A curve will never lower a grade. That is, the lowest grade an 89 overall score can get is B, but if there is a curve it might be worth an A.

All students need to have good communication skills. While proofs, mathematical equations, and source code do not follow the normal rules of English, they should be written clearly. Written answers to questions and program documentation should follow the normal rules of English. Even though it may not be explicitly stated in any assignment, poor use of language including misspellings, incorrect grammar, incomplete sentences, and poor organization may result in a lower grade.

## Homework

Homework will be assigned as needed and collected at the start of class on the due date. Each assignment will be worth 10 to 100 points, depending on the length of the assignment. Depending on the material covered and length of the homework problems, homework assignments will be assigned roughly once a week or every two weeks. Homework may include problems from the book or short computer programs.

## Projects

There will be two to four projects during the semester. Projects are similar to homework assignments, but larger and scope

and with longer deadlines. Point values of the projects will depend on the difficulty of the project and be announced with the project. Source code and documentation will be submitted electronically (details will be given with the first project). In addition to code inspection and documentation, grading will be based on a short demonstration of the running program during which students will explain the code.

### Exams

There will be one midterm exam held in class on October 4, and a final exam, Monday, December 11 at 10:30 AM. The midterm will be worth 40% of the exam grade. The final exam, which will be comprehensive, will be worth 60% of the exam grade.

### Quizzes

Formative quizzes may be given throughout the semester, but will only provide a minor contribution toward the final grade.

### Late Policy

Homework assignment due dates will be announced in class. All homework assignments are due at the start of class on the day they are due. No late homework assignments will be accepted.

Projects are due at the start of class on the day they are due. Late projects lose 3% for each day they are late up to three *working* days. For the purpose of this policy, a working day is any day the University holds class, i.e. Monday through Friday except for academic holidays. Projects later than three working days late will not be accepted. Projects turned in late are not eligible for extra credit points if extra credit points are offered on a project.

### Makeup Policy

Students who have excused absences on the day of exams, as described in *Students Rights and Responsibilities*, can take a makeup exam at a later scheduled time. Students with conflicts known prior to the exam must arrange for a makeup exam at least one week prior to the regularly scheduled exam in writing. Students who miss an exam due to circumstances not known at least one week before the exam, such as sudden serious illness, must notify me as soon as possible. The makeup exam may differ significantly from the exam given at the regularly scheduled time.

### Re-grades

I make a significant effort to grade fairly and uniformly on all assignments. Students should not be penalized, however, for occasional mistakes like incorrectly totaling the number of points on an exam or homework. You may submit and exam or assignment for a re-grade, if you feel a mistake has been made, by attaching a sheet of paper describing what you think the error is. Submit the description attached to the front of the assignment to me. The request must be submitted within two days of the class period in which it was returned (not necessarily the class period in which you pick it up). Once submitted for re-grade, the entire exam or assignment will be open for re-grading.

### Undergraduate vs. Graduate Grading

As a 500 level class EE 599-006 is open to both graduate and undergraduate students. Graduate students will be assigned additional questions on some homework assignments, and will have to do additional work on the projects. Moreover, I expect the graduate work to be more thorough and thoughtful on the parts of assignments that are the same for graduate and undergraduate students.

## Computer Accounts

Several of the projects, and possibly some of the homework assignments, will require accounts in the Open Computing Lab (OCL), located in FPAT 577. Accounts will be created for all students registered for the class. Details will be

announced in class. You are welcome to develop and test your solutions on any another system, but the final solution must compile and run correctly in the OCL.

Some of the projects we develop may use RTLinux or RTAI, a real-time version of the Linux operating system. Some familiarity with Unix or Linux is assumed. Linux documentation covering subjects from introductory Linux commands to advanced networking and kernel hacking is available from the Linux Documentation Project at http://www.tldp.org.

The number of students EE 599 this semester may be larger than the number of available workstations in the lab. Be sure to start your assignments far enough in advance that you can finish even if other studentes are filling the lab. "The lab was full" will not be considered a valid excuse for a late programming assignment.

# Academic Honesty

Academic honesty is very important to me. For this class, academic honesty applies mostly to plagiarism and computer use.

## Plagiarism

To evaluate each student fairly, I need to know that the work each student submits for grading is their own. Copying verbatim from another student or some outside source on a homework, project, quiz, or exam is cheating. Students may consult with each other or outside references about homework assignments and projects, but each student must turn in their own work. In addition, the student must document which parts of what they have submitted is based on consultation with other students or outside references. Please read my plagiarism policy which is linked to by the course web page and the electronic version of this syllabus. It provides some detailed examples of what is and is not acceptable and links to other web sites with more information.

If you are uncertain whether a certain act may be construed as cheating ask me about it **before** you submit the assignment. If you ask before submitting an assignment, and it turns out that what you planned to do is plagiarism then you can do the work differently to avoid plagiarism without penalty. If you do something that is construed as plagiarism, you may be subject to suspension and/or expulsion from the university depending on the severity of the incident.

## Computer Use

Use of computers is governed by the *Policy Governing Access to and Use of University of Kentucky Computing Resources* at http://ukcc.uky.edu/policy.html. You are responsible for reading the guidelines. Examples of activities that would considered violations include executing code that would allow you or someone else to gain privileges beyond what you are given, intercepting email intended for other users, launching attacks against other systems, and accessing files owned by others without their permission.

You will be given permission to use certain facilities on the machines in the OCL that would allow you to subvert normal system security. Anyone found bypassing system security will immediately fail the course and lose all lab privileges.

# Attendance

I strongly encourage all students to attend class and participate. No attendance will be taken, but students are responsible for all material covered in class, which will include a fair amount of material not in the textbook. Students are also responsible for material in the assigned readings whether or not they are discussed in class.