UNIVERSITY OF MASSACHUSETTS LOWELL
Department of Electrical and Computer Engineering

16.472 / 16.572   **Embedded Real-Time Systems**   **Spring 2014**

COURSE OBJECTIVES

1. **System Level C Programming: T**he start of the course will emphasize "advanced" C programming concepts, which are needed for system-level programming.
2. **Microprocessor Organization:** The *ARM Cortex-M3* Microprocessor Architecture will be studied, with particular emphasis on I/O and interrupt architecture, and on writing I/O drivers.
3. **Programming with a RTOS:** The final objective of the course is to learn about programming in the environment of a real-time operating system kernel. This will include implementing programs as collections of independent, concurrent tasks; foreground/background multi-tasking; preemptive multitasking; scheduling; task synchronization; semaphores, mailboxes, message queues, and deterministic memory management.

INSTRUCTOR	Prof. George Cheney
Location	**ECE Department**
Office	BL301
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TEXTBOOK	*MicroC/OS-III The Real-Time Kernel,* 3rd Edition, Jean J. Labrosse, Micrium Press 2009, ISBN 978-0-9823375-3-0.
EVALUATION BOARD	Included with the textbook is an ARM microcomputer evaluation board featuring an STM32F107 microcomputer and a USB cable for connection to a PC.
OTHER REQUIREMENTS	Although it is not included with the text book, you may also need an RS232 M/F serial cable with a male DB9 connector on one end and a female DB9 connector on the other end. Note that this is *not* a null modem cable. In addition, if you do not have a PC with a COM port, you will also need a USB to RS232 adapter.

COURSE REQUIREMENTS AND GRADING POLICY

Homework / Warm-up Programs	20%
Course Project	20%
Hour Exams	30%
Final Exam	30%
NOTE: If the combined Hour Exam / Final Exam average is below 50 the final course grade is an "F."	

HOMEWORK PROGRAMS	These are each intended to introduce a number of new programming concepts. A maximum score of 40 points is assigned. Programs will be submitted by handing in *at the beginning of class* on the due date a CDROM containing all of the files needed to run your program. You are also required to submit hard-copy listings, plus hard-copy sample runs that demonstrate that your program works correctly.
COURSE PROJECT	A substantial program that will employ all or most of the programming concepts from the entire course.
ATTENDANCE	You are responsible for all material and announcements given in class, on the class web site, and on the class discussion group.
LATE PROGRAMS	Late programs will be accepted until 5 days from the due date. A late penalty of 2 points will be assessed for each day after the deadline. After 5 days a score of zero will be given.
EARLY PROGRAMS	Programs submitted early will be awarded a bonus of 1 point per day, up to a maximum of 5 bonus points.

PREREQUISITES

Be advised that all students enrolled in or planning to enroll in 16.572, Embedded Real Time Systems are required to have successfully completed the following prerequisites *before* enrolling:

1. **16.216 ECE Application Programming**

   A student whose undergraduate degree was not obtained from the UMASS Lowell ECE Department may substitute a qualifying 1-semester course in C or C++ programming.

2. **16.317 Microprocessor Systems Design**

   A student whose undergraduate degree was not obtained from the UMASS Lowell ECE Department may substitute a qualifying 1-semester course in microprocessors and assembly language programming.

3. **16.322 Data Structures with C or C++**

   A one-semester course in data structures is also required, mainly to insure more than one semester of C/C++ programming experience.

In order to maintain standards, these prerequisites will be strictly enforced. Any student who is found not to have completed these prerequisites will be administratively withdrawn from the class. Note that this may happen after the deadline for a tuition refund.

In the event that you claim equivalent industrial, professional, or other experience in lieu of university-level course work, you will have an opportunity to demonstrate your qualifications to your instructor.

WEB SUPPORT FOR THIS CLASS

Web Page: http://gcheney.eng.uml.edu/Courses/Spring2014/16572/index.htm

All handouts will be distributed via the class web page, which also has a number of useful links.

Lecture Videos: Video recordings of each lecture will be made available on the class web page.

Class Discussion Group: https://groups.google.com/forum/#!forum/16572-spring-2014

The Student Discussion Group is provided as a forum for students to help each other out. When you have questions, please post them to the discussion group. That way, everyone can benefit from the answer. Students who make substantial contributions to the discussion group will be suitably rewarded.

Be sure to check in to the discussion group and to look for web page updates frequently. *You are responsible for any and all information posted on both the discussion group as well as the web page.*

PROGRAM GRADING

Achieving a good grade on your programs in this class requires more than having a program that produces correct results. First programming classes where you make a program work, hand it in, and then never use it again promote a "throw away code" mentality. In this course, however, you are expected to operate as though you're actually producing a product, which your customers will buy and then use on a regular basis. It becomes important, then, that programs are *more than just correct*. They must also employ good programming practice, be well documented, and well tested. Factors like robustness, readability, elegance, simplicity, efficiency, and generality of your code will be important elements of the grade. A working program, by itself, will earn you a grade of "C." The key to success will be that you allocate enough time to complete your program. This means that once you have a working program you should try to refine and improve it. Managing your time well wi ll be essential to obtaining good program scores.

ACADEMIC HONESTY

The work you submit in this course must be your own individual effort. Submitting another's work as your own qualifies as cheating -- as explained at

http://www.uml.edu/catalog/undergraduate/policies/academic_dishonesty.htm

Cheating incidents will be dealt with according to procedures and punishment spelled out therein. It is acceptable to ask questions of each other and to give assistance. Code sharing, on the other hand *is not acceptable*. Should this occur, the punishment will apply to both the giver and the receiver of the shared material. Be especially careful not to leave your work on a public computer where another student may copy it. If someone copies your work I will consider that you have shared it, which in fact you have, and you will be treated accordingly. When you are done working at a computer, you should copy your file to two removable media (have a backup), and then delete them from the public hard disk.

Working together is not acceptable. What you submit must be your own work.

GRADING

Most of the students in this class are graduate students for whom the only grade below C is F. Actually graduate students are expected to perform at B-level or better. In principle, students admitted to graduate school are among the top students in their bachelor's degree program. An undergraduate GPA of B or better is a requirement to be admitted to graduate school. Sometimes, however, students with GPA's lower than B may be admitted if they show promise otherwise (e.g, high scores on GRE's, or exceptionally good recommendations).

Some people seem to have the impression that the minimum grade in a graduate course is a B. *This is most definitely not true in this course.* Rather, a graduate student is expected to perform at B-level or better. Students who perform below par routinely earn grades of C, or even F in graduate courses.

Finally, there is no scale in this class, i.e., I do not grade on a curve. Rather, there are standards up to which you must perform in order to achieve a certain grade. Do not assume that the class average represents a particular letter grade.

The bottom line: if you want a B grade then it is up to you to earn it.

APPROXIMATE GRADE CONVERSIONS (grad only and undergrad only)

90-100: A-, A, A+; 80-89: B-, B, B+; 70-79: C-, C, C+; 60-69: D, D+

A NOTE ABOUT TIME COMMITMENT

Successful completion of this course will require a substantial investment of time on your part. The assignments and projects are intended to be challenging and demanding. This is, after all, a senior/graduate course. If you do not have sufficient time to complete the requirements of this course on schedule, then do not take it.

If your job is so demanding that you have insufficient time to complete the work, then be prepared to drop the course. Please be aware of the following drop dates:

3 February 2014	Last day for tuition refund
3 February 2014	Last day to drop without record
9 April 2014	Undergraduate last day to withdraw with "W"
25 April 2014	Graduate last day to withdraw with "W"

If you will be unable to drop the course because you must maintain a certain number of credits, then consider changing to a different course. If you are an international student who must maintain a minimum of 9 credits, *this will not be grounds for special treatment.* Your grade will be based solely on your performance in the course.

If your company requires a minimum grade in order to pay your tuition, it is your job to earn an acceptable grade. This will not influence me in assigning your final grade in the course.

Do not even think about asking for special treatment. Haing insufficient time to complete the course on schedule *is not* grounds for an incomplete. The University's rule is that incomplete grades are for emergency situations. If some event prevents you from completing the course on time, then drop the class. Incomplete grades will rarely be given, and then *only if an emergency arises after the deadline for withdrawing*.

In any case, the burden for timely completion of course requirements is on you.

Summarizing then, in order to receive a good grade in this class, you must perform at a level appropriate for a senior/graduate student. This means, among other things, that your work must be completed correctly, and must be submitted in a timely manner. You will find it challenging to complete this work in the allotted time, but this is to be expected of senior/graduate students.

<p style="text-align:center;color:red;font-size:larger;">Good luck to all!</p>