SYSC 3303 – Real-Time Concurrent Systems  
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**SYSC 3303 [0.5 credit] Real-Time Concurrent Systems**

Principles and practice of a systems engineering approach to the development of software for real-time, concurrent, distributed systems. Designing to achieve concurrency, performance, and robustness, using visual notations. Converting designs into programs. Introduction to hard real-time systems. Team project. Prerequisite(s): for students in the Faculty of Engineering and Design: (SYSC 2003 or SYSC 3310) and SYSC 2004. For students in Computer Science: COMP 2401 and COMP 2402.

**Course Objectives**

To introduce students to the principles and practice of software development for systems characterized by one or more of the following terms: real-time, concurrent, event-driven, and embedded. Although a specific implementation technology will be used to provide hands-on programming experience, the goal is to present techniques that are applicable to a diverse range of applications, hardware/software components, programming languages and operating systems.

**Learning Outcomes**

By the end of this course students should be able to:

1. Understand the ISO Protocol Stack with emphasis on UDP inter-process communication.
2. Model the structure and behavior of a concurrent system using Use Case Maps and UML.
3. Write multi-threaded communicating programs in Java.
4. Understand and apply the theory of cyclic executives, rate-monotonic analysis, and priority-based scheduling of a real-time concurrent system.
5. Design, implement, test, and document a reasonably complex and large concurrent system using a development process based on incremental milestones.
6. Work in a team using industrial engineering tools, including version control, development, testing and debugging environments.

**Book**

There is no required textbook. As the term progresses, lecture slides will be posted on the Learning Management System. Note that additional material that is not on the posted slides may be presented in class and will be part of the learning process.
Grades
15% Midterm Exam
35% Project
35% Final Exam
15% Assignments

Office Hours
TBD

Lab Periods

Attendance at the scheduled laboratory periods is mandatory, and attendance will be taken. During the labs you will have a chance to discuss with your TA progress on the project, or work on short exercises that are intended to provide practical experience with tools and techniques related to some of the concepts presented in the lectures.

Your work in each lab period will be graded satisfactory, marginal, or unsatisfactory.

- Satisfactory means that you were present at the lab and made reasonable discussions and/or progress towards completing the lab exercises. (75-100 percent).
- Marginal means that you made some contribution but your effort was not sufficiently to warrant a satisfactory grade. This grade indicates that you may be falling behind and should take steps to remedy this situation. (50-75 percent).
- Unsatisfactory means that you were absent from the lab period, or you attended but made little or no progress and/or discussion. (0-50 percent).

Assignments

Students are encouraged to discuss issues when working on assignments; however, you are expected to submit your own work for grading (assignments are individual work, unless otherwise stated). If you are unable to complete an assignment by the due date, you can submit the work you have completed.

Policy regarding late assignments: Any assignment submitted after the deadline, and up to 48 hours post the deadline will incur a penalty of ten percent of the assignment grade. No assignments are accepted after the 48 hour cutoff, unless with a documented and accepted excuse.

Project

A major component of the course is a team project, done in groups of 4 or 5, which will lead you through the process of building a reasonably complex concurrent system. Each team member must participate in all aspects of the project: design, coding, testing and debugging, etc. You will get your team's mark for the project based on the instructor's
and the TAs' judgement of your contribution to your team. Students must be part of a team and positively contribute to the deliverables of their team; This is mandatory to pass the course regardless of how well performance in other course components is achieved.

**Exams**

There will be one midterm test, which will be held approximately one-half of the way through the term. The date of the midterm will be determined slightly into the semester.

Students who are unable to write the midterm exam because of illness or other circumstances beyond their control must provide, in cases of illness, a medical certificate dated no later than one working day after the exam, or appropriate documents in other cases. If this information is provided to the instructor no later than three working days after the missed midterm exam, the student is eligible to write a deferred midterm exam; otherwise, the mark for the missed midterm exam will be 0.

A final exam will be held during the University's examination period. Students who do not write/attend a final examination because of illness or other circumstances beyond their control may apply to write a deferred examination. The application for a deferral must be made in writing to the Registrar's Office no later than three working days after the original final examination and be fully supported by appropriate documentation and in cases of illness by a medical certificate dated no later than one working day after the examination or by appropriate documents in other cases.

The final examination is for evaluation purposes only and will not be returned to students.

**Students with Disabilities**

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your **LETTER OF ACCOMMODATION** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation *(if applicable)*. **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam *(if applicable)*.
Health and Safety

Every student should have a copy of our Health and Safety Manual. An electronic version of the manual can be found at www.sce.carleton.ca/courses/health-and-safety.pdf.

Proposed Week by Week Outline: Topics Covered

- Nature of Real-Time Systems/Internet Protocols
- The TFTP Protocol, Part 1/Java Threads
- Synchronization of Java Threads/The TFTP Protocol, Part 2
- UML
- Lifecycle and Scheduling of Java Threads/Use Case Maps (UCMs)
- Verification and Validation/Scheduling Schemes for Real-Time Systems
- Recent Developments in Real-Time Concurrent Systems