EE 4710 Course Syllabus  
Real-Time Embedded Systems

Description: An advanced course on real-time embedded system design. Topics include task concurrency, scheduling paradigms, synchronization, resource access control, and inter-process communication. Lecture and Lab combination.

Prerequisite: EE 3710.

Credits: 4 credit hours, 6 contact hours per week.

Text: Liu, Real-Time Systems, Prentice Hall.

Student Learning Outcomes: The student will be able to:

1. Describe the characteristics of a real-time system.
2. Write multi-threaded real-time applications.
3. Use synchronization primitives.
4. Control access to resources shared by multiple threads.
5. Design applications with cooperative threads.
6. Determine whether a set of tasks is schedulable.

Student Assessment:

1. Homework 20%
2. Class Project (Laboratory) 20%
3. Midterm Exams 30%
4. Final Project 20%
5. Final Exam 15%

Topic Outline

1. Timing Constraints
2. Concurrent Programming
3. Synchronization
4. Resource Control
5. Communication
6. Scheduling

Letter grades are assigned according to the scale below. Borderline cases may be promoted (again, at the instructor’s discretion).  
 A 93% or more  
 A- 90% - 92.99%  
 B+ 87% - 89.99%  
 B 83% - 86.99%  
 B- 80% - 82.99%  
 C+ 77% - 79.99%  
 C 73% - 76.99%  
 C- 70% - 72.99%  
 D 60% - 69.99%  
 E below 60%

**Services for Students with Disabilities:** Any student requiring accommodations or services due to a disability must contact Services for Students with Disabilities (SSD) in Room 181 of the Student Services Center. SSD can also arrange to provide course materials (including the syllabus) in alternative formats if necessary.

Tentative Course Schedule

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| Lecture | Topics | Reading |
| 1 | Introduction, Typical Real-Time Applications | 1.1-1.4 |
| 2 | Timing Constraints, Hard v. Soft, periodic v. sporadic tasks. | 2.1-3.3 |
| 3 | Precedence and Data Dependencies | 3.4-3.9 |
| 4 | Static and Dynamic Scheduling, EDF, LST | 4.1-4.8 |
| 5 | Clock Driven Approaches | 5.1-5.9 |
| 6 | Rate and Deadline Monotonic Scheduling | 6.1-6.4 |
| 7 | Schedulability of RM and DM Approaches | 6.5-6.8 |
| 8 | Deferrable, Sporadic and Fair-Queuing Servers | 7.1-7.4 |
| 9 | Review for Exam #1 |  |
| 10 | Exam #1 (Chapters 1-6) |  |
| 11 | Slack Stealing Algorithms | 7.5-7.6 |
| 12 | Scheduling Sporadic Jobs | 7.7-7.9 |
| 13 | Non-preemptive Critical Sections | 8.1-8.3 |
| 14 | Priority Inheritance Protocol | 8.4 |
| 15 | Priority Ceiling Protocol | 8.5-8.7 |
| 16 | Preemption Ceiling Protocol | 8.8 |
| 17 | Access Control for Resources and Data Objects | 8.10-11 |
| 18 | Multiprocessors and distributed systems | 9.1-9.3 |
| 19 | Review for Exam #2 |  |
| 20 | Exam #2 (Chapters 7-8) |  |
| 21 | Scheduling End-to-End Periodic Tasks | 9.4-9.7 |
| 22 | Scheduling Flexible Computations | 10.1 |
| 23 | Temporal Distance Constraints | 10.2 |
| 24 | Priority Based & Round Robin Disciplines | 11.1-11.3 |
| 25 | Real-time Network Protocols | 11.4-11.6 |
| 26 | Communications in Multicomputer Systems | 11.7 |
| 27 | Real-time Operating System Services | 12.1-12.4 |
| 28 | Commercial Real-time Operating Systems | 12.5-12.7 |
| 29 | Review for Final Exam |  |