Introduction to Real-Time Systems

Course Guide

Course Instructor
Dr. Phillip A. Laplante, CSDP, PE, PhD

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Welcome to Introduction to Introduction to Real-Time Systems!

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In this course guide, you will find:

- Course Instructor Biography
- Course Syllabus
- Grading Policy, Academic Policy and Course Outline
- Discussion Guidelines
- Glossary
- References

Throughout your course adventure, the course staff is here to help and to guide. To get help with the course, click the Discussion tab and post a question. To get help with a technical problem, click Help to send a message to edX Student Support.

Again, thank you for joining us. Best wishes for an informative and fun experience.
Dr. Phillip A. Laplante is Professor of Software and Systems Engineering at The Pennsylvania State University. He received his B.S., M.Eng., and Ph.D. from Stevens Institute of Technology and an MBA from the University of Colorado. He is a Fellow of the IEEE and SPIE and has won international awards for his teaching, research and service. Since 2010 he has led the effort to develop a national licensing exam for software engineers. He has worked in avionics, CAD, and software testing systems and he has published more than 30 books 200 scholarly papers. He is a licensed professional engineer in the Commonwealth of Pennsylvania.

He is also a frequent technology advisor to senior executives, investors, entrepreneurs and attorneys and actively serves on corporate technology advisory boards. His research interests are in software testing, requirements engineering and software quality and management. Prior to his appointment at Penn State he was a software development professional, technology executive, college president and entrepreneur.
About This Course
This broad overview of techniques in real-time systems design and analysis provides a practical and quick introduction to the subject. The treatment is pragmatic and example-oriented, drawing on extensive experience rather than abstract and theoretically rigorous derivations; but it covers a great deal of territory, including real-time operating systems, software system design, and performance analysis and optimization, among others.

Prerequisites
A minimum understanding of computing principles at a high school level is suggested.

Time Commitment
Approximately six hours total.

Deadlines
All course requirements must be completed by 22 December 2015 at 23:30 UTC.

What You Will Learn
- What is so different and special about real-time systems
- The unique challenges in the requirements and specifications for real-time systems
- Introduction to real-time operating systems design
- An overview of how to build real-time systems

Course Survey
Your feedback is important. Please complete the IEEEx survey for this course at: http://ieee.fluids-surveys.com/surveys/stevew/introduction-to-real-time-systems-t42015/.
Grading Policy

<table>
<thead>
<tr>
<th>Assignment Type</th>
<th># of Assignments</th>
<th># Droppable</th>
<th># of Attempts Allowed</th>
<th>% of Overall Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Check</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>Final Test</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>50</td>
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This course will not award traditional letter grades based on a numbers system. Rather, learners will receive either a passing grade (over 50%) or a failing grade (under 50%).

Academic Policy

All participants are expected to follow the edX Honor Code in this course. The edX Honor Code is available at [https://www.edx.org/edx-terms-service](https://www.edx.org/edx-terms-service).

Course Outline

Part 1 Overview and Requirements Specifications

Module 1 What are Real-Time Systems?

- Welcome
- What are Real-Time Systems 1-1
- Reading Assignment
- What are Real-Time Systems 1-2
- Quiz 1
- Optional Reading Assignment
Module 2 Requirements Specifications

- Requirements Specifications 2-1
- Getting the Requirements Right
- Requirements Specifications 2-2
- Quiz 2
- Tried and Tested Techniques
- Requirements Specifications 2-3
- Optional Reading Assignment
- Quiz 3

Part 2 Operating Systems and Building Real-Time Systems

Module 3 Real-Time Operating Systems

- Real-Time Design Approaches
- Real-Time Operating Systems 3-1
- Quiz 4
- Rate Monotonic Systems
- Real-Time Operating Systems 3-2
- Quiz 5
- Optional Reading Assignment

Part 4 Building Real-Time Systems

- Synchronization Mechanisms
- Building Real-Time Systems 4-1
- Conclusion
- Final Test
- Optional Reading
We ask you to build community and share, in your own words, your thoughts about the course content and any about news or research related to the class.

We ask that you use the discussion space as:

- A forum for discussing topics raised in the course and demonstrate your understanding or application of the course material
- A medium to discuss questions about assignments, readings, and course content with peers and course staff
- A medium for collaboration and the exchange of ideas.
- An online meeting place for social interaction among peers.

*Discussion boards are moderated by the course instructional team.*

For more information on discussion boards, please see below and refer to the discussion board details [https://www.edx.org/blog/getting-most-out-edx-discussion-forums](https://www.edx.org/blog/getting-most-out-edx-discussion-forums).

In order for the discussion board to run smoothly, please refer to the guidelines below for basic discussion board etiquette. How you phrase your posts is important. Please remember that the participants in the course come from all over the world, representing a variety of cultures and speaking many different languages. Be respectful of others and be aware of the tone of your posts. Think through and re-read your posts before posting!
A few guidelines for the discussion board are outlined below.

- Please limit your posts/responses to 200 words or less (by request of edX). In other words, be concise in your posts/responses.

- Reflect on and respond to Discussion Board questions and post your contribution, in your own words.

- To build community, we ask that you review 1-2 items posted by your classmates and respond to at least one of those postings.

- Before posting, read what others have previously posted to avoid repeating comments. You can always upvote good posts. Click on the green “plus” button so that good posts and/or responses can be found more easily. You can search by votes to find the most interesting posts.

- Never use derogatory language or make insensitive comments. (You should flag inappropriate posts.)

- Do not personally attack people. It’s fine to disagree, but use facts and reasons to back up an argument, not personal attacks.

- Stick to the topic of the discussion board.

- Remember that humor is often difficult to convey in text – avoid it if people might not understand what you are trying to say.

- Avoid slang and use appropriate spelling – given the diversity in the class, what might mean something to you will not mean the same thing to someone else. Correct spelling and grammar will help others to understand you and provide useful responses. Avoid using ALL CAPS, abbrv of wrds (abbreviation of words), and excessive punctuation!!!!!!!!!

- Use correct grammar.

- If you reference something, provide everyone with the link or reference.

- Notify the course staff of bugs. Include [STAFF] at the beginning of your post’s title – this will help us identify your question or problem and respond to it.
Coroutine
A scheme in which two or more tasks are divided into states or phases, determined by a finite state machine. Calls to a central dispatcher are made after each phase is complete. Also known as cooperative multitasking.

Event
Any occurrence that results in a change in the sequential execution of instructions.

Firm real-time system
A real-time system that can fail to meet a few deadlines without system failure.

Hard real-time system
A real-time system in which missing even one deadline results in system failure.

Interrupt
An input to a processor that signals the occurrence of an asynchronous event.

Polled loop system
A real-time system in which a single and repetitive test instruction is used to test a flag, which indicates that some event has occurred.

Preemptive-priority system
A system that uses preemption schemes instead of round-robin or first-come, first-served scheduling.

Rate-monotonic system
A fixed-rate, preemptive, prioritized real-time system where the task priorities are assigned so that the higher the execution rate, the higher the priority.

Round-robin system
A system in which several tasks are executed sequentially to completion, often in conjunction with a cyclic executive.

Soft real-time system
A real-time system in which failure to meet deadlines results in performance degradation but not necessarily failure.
References


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