



Real-time systems (0630581)

Lecture (1)

Real-Time Systems: An Introduction

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Philadelphia University
Summer Semester, 2011

Lecture Outline:

- What will you learn? And how?
- Course Objectives:
- Intended learning outcomes
- Prerequisites
- Module outline and timetable
- Reading list
- Assessment

Course Title: REAL-TIME SYSTEMS (630581)

- **Prerequisite: Embedded Systems Design (630470)**
- **Instructor:** Prof. Kasim M. Al-Aubidy.
- **Email:** *qmlone@yahoo.com*
- **Semester:** Summer 2010-2011
- **Time:** (8:00-9:00)am, Sunday to Thursday.
- **Office Hours:** (13:15-14:15)pm, Sunday to Thursday.
- Appointments to discuss the course should be made by email.
- **Course Material:** www.philadelphia.edu.jo/

What will you learn? And how?

- PRINCIPLES OF REAL-TIME SYSTEMS
- CONCEPTS OF COMPUTER CONTROL
- HARDWARE REQUIREMENTS FOR REAL-TIME SYSTEMS
- REAL-TIME COMPUTER CONTROL.
- LANGUAGES FOR REAL-TIME APPLICATIONS.
- REAL-TIME SOFTWARE & PROGRAM DESIGN.
- OPERATING SYSTEMS FOR REAL-TIME APPLICATIONS.

» Primarily through:

- **Lectures:** 45 hours/semester, 6 hours/week.
 - **Homework and programming assignments:**
 - **Semester project:** project for each student
- » We will also discuss student projects.

Course Objectives:

The main objective of this course is to :

- Provide a general introduction to real-time computer control systems .
- Provide examples of real-time systems including functionality and implementation platforms.
- Study computer control strategies and their implementation techniques.
- Describe and exemplify design parameters for real-time systems including execution time, implementation, communication & user interface.
- Study a range of methodologies for specifying and designing real time systems.
- Understand hardware and software design and implementation of real-time systems
- Describe and apply systems engineering methods and techniques in the design and analysis of real-time systems.
- The course will involve a real-time system design project.

Intended Learning Outcomes:

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

- Clearly differentiate the different issues that arise in designing soft and hard real-time, concurrent, reactive, safety-critical and embedded systems.
- Explain the various concepts of time that arise in real-time systems.
- Analyze and apply a variety of scheduling mechanisms suitable for soft and hard real-time systems. Conduct simple performance and schedulability analysis to demonstrate that a system can successfully meet real-time constraints.
- Explain the additional problems that arise in developing distributed and networked real-time systems.
- Describe the design and implementation of systems that support real-time applications. Justify and critique facilities provided by real-time operating systems and networks.
- Design, construct and analyze a small, concurrent, reactive, real-time system. Select and use appropriate engineering techniques, and explain the effect of your design decisions on the behavior of the system.

Prerequisites:

- Students are expected to be familiar with, microprocessors and microcontrollers, embedded system design, sensors and actuators, control systems, systems design and implementation, programming with machine language and C++.
- Some basic familiarity with; systems modeling and simulation techniques; discrete mathematics.

Grades:

- Homework and Quizzes: 10%, (3 Quizzes & 3 HWs)
- Semester Project: 10%
- First Exam: 15%
- Second Exam: 15%
- Final Exam: 50%

Projects:

- Define your own project and write a proposal
- Experimental investigation requires a programming project and a final report.
- Final report contents: Project title, Objective, Introduction, Hardware design, Software design, Conclusion, References.
- Team projects are allowed, but they must be significant!

Timetable:

Week	Basic and support material to be covered	HW/Quizzes
1	<ul style="list-style-type: none"> •An introduction to real-time computer systems. •Elements of a real-time microcontroller-based system. 	
2	<ul style="list-style-type: none"> •Classification of RTS, Time constraints, Classification of programs. •Computer Control concepts; Sequence control, DDC, PID control, Adaptive control, Supervisory control, 	Quiz 1 HW1
3	<ul style="list-style-type: none"> •Centralized control, Hierarchical systems, Distributed systems. •Hardware requirements for real-time systems: Analog I/O interfacing. 	1st Exam
4	<ul style="list-style-type: none"> •Digital and Pulse I/O interfacing. •Data Acquisition and Data Distribution system design. 	Quiz 2 HW2
5	<ul style="list-style-type: none"> •Implementation of real-time algorithms. •Realization of real-time algorithms using single processors or more. •Stability analysis of real-time systems. 	HW3 2nd Exam
6	<ul style="list-style-type: none"> • Software design of real-time systems. 	Quiz 3
7	<ul style="list-style-type: none"> •Operating systems for real-time applications: Features of RTOSs, •Scheduling: concepts & implementation. 	Project Submission
8	<ul style="list-style-type: none"> • Mini Projects using Microcontrollers. 	Final Exam

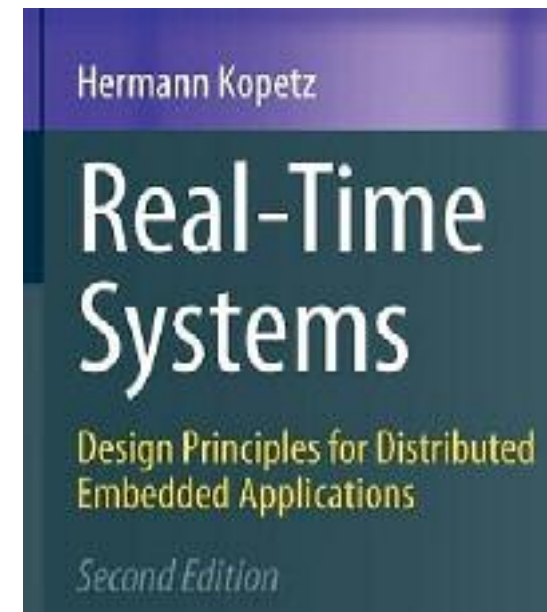
Text Books:

1. **Real-Time Computer Control**, By: Stuart Bennett, Prentice-Hall, 2nd edition, 1994.

- *This book comprises the lecture notes for the course and is required reading for all students.*
- *All selected material in this book is examinable.*

2. **Real-Time Systems: Design Principles for Distributed Embedded Applications**, By H. Kopetz, Springer-Verlag, USA, 2011, ISBN: 1441982361

- *This book is optional, but provides further detail on the practical aspects of the course.*



Reading List:

1. D. IBRAHIM, Microcontroller Based Applied Digital Control, John Wiley & Sons Ltd, UK, 2006, ISBN: 0-470-86335-8
2. J.W.S. LIN, Real-Time Systems, Prentice Hall, 2000.
3. N. NISSANKE, Real-Time Systems, Prentice Hall, 1997.
4. R.J.A. BUHR & D.L. BAILEY, An Introduction to Real-Time Systems, Prentice Hall, 1999.
5. S. BENNETT & G.S. VIRK, Computer Control of Real-Time Processes, IEE 1990.
6. S. HEATH, Embedded Systems Design, Newness 1999.
7. W. VALVANO, Embedded Microcomputer Systems: Real-Time Interfacing, Brooks-Cole Publisher, 2000.
8. J. COOLING, Software Engineering for Real-Time Systems, Addison Wesley, UK 2003. www.pearsopneduc.com