COE718: Embedded Systems Design
Course Management - Fall 2021

Introduction:
This document provides a summary of the course while complete details are available at COE718 course http://www.ee.ryerson.ca/~courses/coe718/.

Course Objectives:
This course will cover the basics of embedded system organization, system on programmable-chip technologies and real-time systems. It provides the advance knowledge required for embedded computer design and development as well as real-time operating systems. Students are introduced to software development concepts applicable to real-time and embedded systems. Particularly ARM Cortex M3/M4 will be studied as a representative embedded CPU and embedded software development are carried out for ARM Cortex CPUs. The students will be able to grasp the main principles of embedded system design and understand the concept of hardware-software codesign, RTOS and real-time scheduling techniques. Embedded system co-specification and partitioning is also introduced in the course. SystemC or other languages (e.g. UML, C, etc.) can be employed to present a unified view of the embedded systems. SystemC is introduced as a representative Co-specification language. Embedded hardware-software design and development tools (such as Keil MDK and RTX as well as Altera Quartus II and SOPC builder) will be employed in the labs and project.

Contact Hours (3+2), Pre-Requisite: COE538

Text Books:
Daniel W. Lewis, Fundamentals of Embedded Software with the ARM Cortex M3, 2nd Edition Pearson 2013, ISBN 978-0-13-291654-7

Reference Books and Related Material:
T. Martin, The Designer's Guide to the Cortex-M Processor Family: A Tutorial Approach, Elsevier, 2013, ISBN 978-0080982960

M. Wolf, Computer as Components: Principles of Embedded Computing System Design, 4th Edition Morgan Kaufman Publishers 2016, ISBN 978-0-12-805387-4

J. Yiu, The Definitive Guide to the ARM Cortex-M3, 2nd Edition, Elsevier, 2010, ISBN 978-1856179638

Alan Burns and Andy Wellings, Real-time Systems and Programming Languages, Addison-Wesley 2001, ISBN 0 201 72988 1

Some relevant review articles to be identified by the instructor and will be available at the course web page.

Course Evaluation and Marking Scheme:
- Labs: 20% (4+5+6+5)
- Project: 15%
- Mid-Term Test: 25% (Week 8)
- Final Exam: 40%

Lab Instructors/Supervisors:
Sunbal Cheema, e-mail: sunbal.cheema@ryerson.ca, Lab Sections 1, 4 AND 8
Yoga Suhas Kuruba Manjunath, e-mail: yoga.kuruba@ryerson.ca, Lab Sections 3 AND 5
Radin Hamidi Rad, e-mail: radin@ryerson.ca, Lab Sections 2, 6 AND 7

Additional Information:
- Labs and project are mainly based on embedded system design using uVision, RTX and MDK. Labs and project will also involve ARM Cortex M3 CPU based multitasking, real-time scheduling and embedded application design and development.
- There may be a 5% per day penalty of marks for late submission of labs or project.
- The students must follow and adhere to the senate policy 60 on Student Code of Academic Conduct.

Tentative Course Topics and Schedule

Weeks	Lectures - Main Topics	Labs/Project Venue - ENG408
1	Introduction to Embedded Systems Real-time Systems	
2	Embedded Processor Architecture (ARM7, Cortex M3 and other CPU Cores)	**Lab-1:** Introduction to uVision and ARM Cortex M3
3	ARMv7 and Cortex M3 Architecture	**Lab-2:** Exploring ARM Cortex-M3 Features
4	ARM Cortex M3 for Multitasking Applications	**Lab-3:** RTX based Task Scheduling and Multitasking.
5	RTOS: Real time Operating Systems RTX operating system environment	**Lab-3**: RTX based Task Scheduling and Multitasking.
6	Introduction to Real-time Scheduling Pre-emptive and Non-pre-emptive Scheduling	**Lab-4:** Real-time Scheduling **(Start of Course Project)**
7	Real-time Scheduling Techniques	
8	***Mid-term Exam*** (October 26, 2021) Real-time Scheduling Techniques	
9	Rate-Monotonic and Earliest-Deadline-First Scheduling (RMS and EDF). Priority Inversion	
10	Hardware Software Co-design and Embedded SoPC (System on Programmable Chips)	**Project Progress**
11	Accelerator based Embedded System Fault-tolerant Systems	
12	Fault-tolerant Embedded Systems.	**Final Project Demo**
13	Catching up and Course review	**Final Project Report**

Note: The above topics and the schedule of lectures and labs are tentative. There may be some changes in the topics schedule that will be announced in the class and posted at the course website.

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