MECHTRON 3TB4 - Embedded Systems II

COURSE WEBSITE:

`http://elm.mcmaster.ca/`

INSTRUCTOR:

Dr. Mark Lawford
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E-mail: lawford@mcmaster.ca
Office Hours: TBA

Teaching Assistants:

Honghan Deng & Alvin Ihsani
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Office: ITB/205 TBA

LECTURES:

Location: BSB/108 Time: Mon, Wed 11:30-12:20, Fri 13:30-14:20

TUTORIALS & LABS:

Location: ITB/238 (NOTE THESE MAY CHANGE FROM CURRENT TIMETABLE!)

Time:

Section	Tutorial Time	Lab Time
1	Mon 9:30-11:20	Tues 08:30-11:20
2	Wed 14:30-16:20	Mon 14:30-17:20

DESCRIPTION:

Design and implementation of embedded systems interacting with analog systems. Software design and implementation for embedded systems and DSP systems. Simulation and testing of embedded systems.

MISSION:

- To connect theory with practice in the design and development of embedded control systems
- To understand the importance of the "environment" (system under control - a.k.a. "the plant") and how to interface to it
- To explore technologies used to build embedded systems.
- To explore different components of embedded systems (e.g. memory system, microprocessor architecture, bus protocols...) in depth.
- To learn how to build embedded hardware at a low level (RTL).

- To explore hardware/software trade-offs in embedded system design.
- Gain hands on experience in the design and development of FPGA based systems.
- To have fun building various embedded systems.

TENTATIVE SCHEDULE OF TOPICS:

The following schedule of topics and labs is tentative. The instructor reserves the right to modify the schedule and lab topics depending up availability of equipment & progress of the class. *Please be sure to check the course website regularly for updates.*

- Introduction: Hardware Software co-design
- Stepper Motors and how to control them
- Interrupts
- Review of Digital Design Concepts
- Introduction to Verilog HDL
- Introduction to CAD tools for design, simulation, testing and debugging of embedded systems
- Introduction to IC manufacturing technologies
- Details of field programmable devices (PAL, PLA, CPLDs, FPGAs)
- Interfaces and bus protocols
- Memory Hierarchy
- Microprocessor Architecture
- Use of Finite State Machines to express the behaviour of digital systems
- Digital Signal Processing and introduction to digital filters
- Testing of Embedded Systems

GRADING:

Two marking schemes are provided. In order to have your assignments count in your final mark (Scheme A), you must pass (obtain $\geq 50\%$) on the combination of your midterm and final (Scheme B). Provided you pass by Scheme B *AND* you completed all of the labs, your final mark will be the max(Scheme A, Scheme B). Otherwise your mark will be min(Scheme A, Scheme B).

Scheme A	
Midterm exam (1-2 hours)	20%
Labs	30%
Tutorial Exercises	5%
Final exam (3 hours)	45%

or

Scheme B	
Midterm exam (1-2 hours)	30%
Labs	0%
Tutorial Exercises	5%
Final exam (3 hours)	65%

The instructor reserves the right to conduct deferred examinations orally.

One lab report will be submitted and marked for each group and all team members will receive the same mark unless there is a demonstrable lack of participation/effort by a team member in performing and writing up the work. In that case the lab report grade will be assigned to individual team members based upon their contribution as judged by the TAs and Instructor.

TEXTS:

1. Frank Vahid Tony D. Givargis, *Embedded System Design: A Unified Hardware/Software Introduction*, John Wiley & Sons, 2002. ISBN: 978-0-471-38678-0 - AKA "Vahid"

2. Richard H. Barnett, P.E., Ph.D.; Sarah Cox; Larry O'Cull, *Embedded C Programming and the Atmel AVR*, 2nd Edition, Thomson, 2007. ISBN 13: 9781418039592, ISBN 10: 1418039594 - AKA "Barnett"

ADDITIONAL REFERENCES:

- Robert B. Reese and Mitchell A. Thornton, *Introduction to Logic Synthesis using Verilog HDL*, A Publication in the Morgan & Claypool Publishers series SYNTHESIS LECTURES ON DIGITAL CIRCUITS AND SYSTEMS #6, 2006. ISBN-10: 1598291076 (ebook) 1598291068 (paperback) `http://www.morganclaypool.com/doi/abs/10.2200/S00060ED1V01Y200610DCS006`.

- James K Peckol, *Embedded Systems: A Contemporary Design Tool*, John Wiley & Sons Inc., 2008. ISBN 978-0-471-72180-2

- Zainalabedin Navabi, *Embedded Core Design with FPGAs*, McGraw Hill, 2007, ISBN 978-0-07-148470-1.

- Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with Verilog Design*, 2nd edition, Boston: McGraw-Hill Higher Education, 2008., ISBN: 978-0077211646

- Joe Pardue, *C Programming for Microcontrollers Featuring ATMEL's AVR Butterfly and the free WinAVR Compiler*, Smiley Micros, 2005. ISBN-10: 0976682206 ISBN-13: 978-0976682202

- MECHTRON 3TA4 Course Pack (Available at the bookstore). - AKA "CP"

CALCULATOR:

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the McMaster Bookstore.

NOTES:

Announcements & Updates:

Announcements, updates and other important information will be done in class and via the course website. You may be informed of announcements via your McMaster email account. You are expected to attend classes, tutorials and labs where these announcements will be made. If you miss a class, lecture or lab, *it is your responsibility to check these resources and stay informed!*

Missed Lab Work:

Lab work missed due to illness or personal circumstances may be made up. You must submit appropriate documentation (e.g. note from physician) to your Faculty/Program office. It is your responsibility to follow-up with the lab supervisor. No mark will be entered for the missed work unless the Faculty/Program office gives its approval.

Academic Dishonesty:

You are expected to exhibit honesty and use ethical behavior in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behavior can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at `http://www.mcmaster.ca/academicintegrity` The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not ones own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

In case of discrepancy between the online and handout version of the course outline, the handout version shall be taken as correct.

Disclaimer

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes

FORMAT:

- The class has lectures three times per week. Discussion is encouraged in class.
- There will be hands-on tutorials or labs alternate weeks.
- Discussion groups, links to resources, grading, lecture slides, lab handouts and other course related material will be available through WebCT.
- Students will submit their source code and lab reports via a course subversion version control repository unless otherwise indicated.
- Lab work will be done in groups of 2-3 students to be determined by the Instructor.