Embedded Systems 1 (ENCE361) Course Outline - 2020

Lecturers:

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Course delivery:

The course comprises three lectures per week, weekly 2-hr, supervised laboratory sessions, and at least eight 50-minute tutorials. In Week-1, there is a laboratory session to enable students who are new to the Electronics Lab to familiarize themselves with the instruments. Formal laboratory sessions (Lab-01, 02 & 03) start in Week-2 (see under *Notes*). For other details, such as room numbers and session dates/times, refer to mytimetable. Note that the laboratories are held in the Electronics Lab, Level 2 of the Electrical & Computer Engineering Wing.

Course summary:

The aim of this course is to provide students with essential knowledge of dedicated computer hardware and to develop software and interfacing skills to ensure key competencies for the design and implementation of an embedded system implemented on an advanced microcontroller.

Learning Outcomes:

- Build on a first course in microcontrollers to design, test and debug an embedded system to conform to a project specification.
- Enhance design skills by utilising internal microprocessor peripherals, such as timers, serial interfaces and analogue-to-digital converters to build an embedded system.
- Learn to implement algorithms in the C programming language.
- Understand what is meant by the *hardware and software interface* and the constraints of a real-time embedded application.
- Write well-structured code for the development of software modules to run on an advanced microcontroller.
- Learn how to use a commercial high-level debugger to locate and correct programming errors.
- Show competency in utilising an advanced commercial toolchain to develop an embedded application.
- Understand event-driven programming using interrupts and background task management.
- Learn the basics of scheduling theory and develop a simple task scheduler for a real-time application.

Expectations of students taking the course:

- Familiarity with C language programming to the level of achieving a comfortable pass in ENCE260.
- Experience with programming at least an 8-bit microcontroller, such as Atmel ATMega8.
- An interest in embedded computer programming and software engineering.

Assessment:

There are four major pieces of assessment in this course:

Item	**Theme** (detail)	**Due**	**Worth**
2.	Test (invigilated): 60 min., (19:00, day and venue TBC)	Week-7	20%
3.	Project: *Personal Fitness Monitor* (milestones, demo & report)		40%
	Milestones 1 (in lab):	Week-5	
	Milestone 2 (in lab):	Week-8	
	Demo (in lab):	Week-11	
	Report and code:	Sun 2 June	
	(Students **work in groups of three** for the project; workload & marks are shared)		
4.	Final examination (invigilated): 2 hours (on all material in semester)		40 %

Note: **All students must achieve 40% in the combined invigilated work to achieve a passing grade.**

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Course Resources:

1. **Tiva microcontroller board & display booster**

   At least one Tiva Kit, comprising a Tiva microprocessor evaluation board and pre-mounted Orbit booster pack*, will be required per group from the start of Week-2. All enrolled students can purchase this kit from the UC Copy Centre from Monday 17 February. The Copy Centre is part of Canterbury Educational Printing Services (CEPS) and is on Kirkwood Avenue, near K1. The cost of the Tiva/Orbit unit is $70 and includes a USB cable. ***It is recommended that each student purchases one.***

2. **Required text**

   There is no required text for this course. Detailed course notes, lecture/tutorial material and other documentation will be available via Learn.

3. **Recommended reading**

   3.1 Simon, David, E., "*An Embedded Software Primer*", Addison-Wesley, 1999.

   3.2 Labrosse, "*uC/OS-III, The Real-Time Kernel or a High Performance, Scalable, ROMable, Preemptive, Multitasking Kernel for Microprocessors, Microcontrollers & DSPs*", Micrium Press, 2009.

   3.3 Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", Newnes, Elsevier, 2013.

   3.4 ARM, "*Cortex-M4 Devices Generic User Guide*", 2011. Available from http://infocenter.arm.com/help/topic/com.arm.doc.dui0553b/DUI0553.pdf

Notes:

1. From the start of Week-3, all students should have self-selected membership to a group of three in their same lab stream via our booking system on Learn, or have been assigned to work in a project group of three, again, in their lab session. Clearly, partners will also need to be assigned to the same laboratory session. Due to limited space, swapping lab sessions is not an option once the formal labs have commenced.
2. Any student who has not attended and passed a course which has used the Electrical & Computer Engineering Electronics Lab needs to attend an induction to the Lab and complete an instrumentation lab, *Instrumentation Lab.pdf,* available during Week-1.
3. Further information is available on the ENCE361 page in Learn. Check this page regularly for important updates.

Dishonest Practice:

Plagiarism, collusion, copying and ghost writing are unacceptable and dishonest practices.

- Plagiarism is the presentation of any material (test, data, figures or drawings, on any medium including computer files) from any other source without clear and adequate acknowledgment of the source.
- Collusion is the presentation of work performed in conjunction with another person or persons, but submitted as if it has been completed only by the named author(s).
- Copying is the use of material (in any medium, including computer files) produced by another person(s) with or without their knowledge and approval.
- Ghost writing is the use of another person(s) (with or without payment) to prepare all or part of an item submitted for assessment.
- Laboratory work over the first four weeks of Term-1 is typically completed and assessed on an individual basis. However, from Week-5 students will be expected to work as part of a group. Because project work and marks are shared between students working in the same group, our expectation is that workload will be evenly distributed amongst all group members. Depending on experience, the number of hours and specific tasks associated with the development of your

ENCE361 project is typically left up to each group to discuss. However, from past experience, weekly meetings are essential to take stock of what has been done and to plan next steps. All students should expect a certain amount of "give and take", but this is up to a point. Where excessive imbalances in workload exist and are reported, you can expect the course coordinator to get involved and deliberate on this. If you feel a disproportionate workload within your group, don't leave it to the late week before reporting this. You will find your TAs and Course/Project Coordinator very sympathetic to such discussions.

Do not engage in dishonest practices. The Department reserves the right to refer dishonest practices to the University Proctor and, where appropriate, to not mark the work.

Harassment:

Harassment of any sort will not be tolerated. Each student is here at UC to learn and to experience a friendly and supportive community. It is every student's right to expect: respect and courtesy from staff and other students, including freedom from harassment of any sort; fair treatment; the ability to speak out about any issues that concern them, without fear of consequences for their safety and well-being. Furthermore, each student has the responsibility to: respect the rights and property of others; attend to their own health and safety and that of others; and behave in a manner towards each other that does not reflect badly on the student body or the University.

For more information, or to find out where help is available, refer to:

http://www.canterbury.ac.nz/ucpolicy/GetPolicy.aspx?file=Harassment-Policy.pdf

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