1 Course Staff and Consultation

<table>
<thead>
<tr>
<th>Course convenor</th>
<th>EE Rm 207</th>
<th>Dr Ray Eaton EE Rm 207</th>
<th><a href="mailto:R.Eaton@unsw.edu.au">R.Eaton@unsw.edu.au</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures/Tutorials</td>
<td>As above</td>
<td>Dr Ray Eaton</td>
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<td>Nonie Politi</td>
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<td>As above</td>
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</tr>
<tr>
<td>Laboratory teaching staff</td>
<td></td>
<td>Postgraduate/4th Year Undergraduate Students</td>
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Consultation time for this subject will be Wednesday 9am-11am. Please make sure that you restrict your enquiries to this time.

Consultation via email is also possible, provided that all email enquiries come from your student email address. All email enquiries will be answered in bulk at a couple of chosen times during the week, rather than at the time each email arrives.

2 Course Details

Elec2142 is a 6 UOC course.

Teaching Methods

Lectures = 3hr/week; Tutorials = 1hr/week; Labs = 2hrs/week

Lectures, Tutorials and Laboratories

<table>
<thead>
<tr>
<th>Lecture (all)</th>
<th>Wed 13-15</th>
<th>Thu 12-13</th>
<th>EE G25</th>
<th>Webst ThB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutorial (only one)</td>
<td>Mon 10-11</td>
<td>Mon 13-14</td>
<td>Quad G035</td>
<td>Quad G035</td>
</tr>
<tr>
<td></td>
<td>Tue 11-12</td>
<td>Tue 12-13</td>
<td>Quad G045</td>
<td>Quad G045</td>
</tr>
<tr>
<td>Laboratory (only one)</td>
<td>Mon 16-18</td>
<td>Tue 9-11, 13-15</td>
<td>EE233</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thu 9-11, 13-15</td>
<td>15-17</td>
<td></td>
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<td></td>
<td>Fri 11-13</td>
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Laboratory classes officially start in week 3.
Tutorial classes officially start in week 2.
3 Course Overview

Embedded Systems Design is intended to provide students with a firm foundation in the design and understanding of dedicated systems, to which a microprocessor or microcontroller is central and embedded within. ELEC2142 will follow on from ELEC2141 (Digital Circuit Design) and the computing subjects COMP1911/1921, and will act as a pre-requisite for further courses involving embedded microprocessor applications and design, including ELEC3041 (Real-Time Engineering).

Assumed Knowledge

The subject is built upon the first course in digital circuits, ELEC2141 as well as COMP1911/1921. Assumed knowledge includes the design of sequential and combinational circuits, HDL programming and use, C language programming and use.

4 Course Objectives

The objective of this course is to equip students with the necessary fundamental knowledge and skills to design and analyse basic embedded systems, where a microprocessor or microcontroller is the central element. Such embedded systems are pervasive in all areas of today’s society, and as such, knowledge of how to design them is a vital skill for all electrical engineers.

The course aims to give students fundamental knowledge of embedded systems with respect to several different levels of abstraction, from a low level dealing with hardware interaction and driving the processor via assembly language, through to high level software design, multitasking, and programming with the C language, plus much in the middle.

5 Learning Objectives

The aim of this subject is to generally provide you with an understanding and an appreciation of the fundamentals of embedded systems. To this end, at the successful completion of this course, you should be able to:

- demonstrate an understanding of what an embedded system is, and what its main components are;
- demonstrate the principles of “good” software design;
- demonstrate competency in working with, and manipulating, number systems;
- demonstrate the fundamentals of assembly language programming, as well as a competency in using the C programming language for embedded applications;
- demonstrate an understanding of how a CPU operates, in particular the ARM processor;
- demonstrate an understanding of the principles in converting high level code to low level instructions;
- demonstrate an understanding of what “real-time” is in relation to embedded systems, and why “real-time” is important;
• use a mix of C and assembly to design simple embedded systems which involve the use of interrupts, multitasking, and I/O.

6 Graduate Attributes

Graduate attributes are those which the University and/or Faculty of Engineering agrees students should develop during their degree. Further information can be obtained in the document, http://www.ltu.unsw.edu.au/content/userDocs/GradAttrEng.pdf. This course aims to contribute to students attaining the following graduate attributes:

• The skills involved in scholarly enquiry.
• Information literacy - the skills to appropriately locate, evaluate and use relevant information.
• The ability to engage in independent and reflective learning.
• The capacity for enterprise, initiative and creativity.
• The capacity for analytical and critical thinking and for creative problem-solving.

7 Teaching Strategies

The strategies employed in this course are focused on problem-based learning. It is intended that at each section of the course, examples of real embedded systems (or smaller parts of embedded systems) will be introduced as a way of explaining concepts. The analysis and design for each example will lend themselves in assisting students satisfy the learning objectives above. The lab program aims to support the lecture program, and provides the student with hands-on design and hardware experience. The laboratory program is challenging, and lab sessions are relatively short. As such, students MUST come prepared for each laboratory.

Students will be required to do home-based work, which will include self-guided tutorial questions, directly related to course material covered in lectures, as well as three homework exercises to be completed and handed in during session for assessment.

8 Assessment

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Weightage</th>
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<tbody>
<tr>
<td>Final Examination</td>
<td>60%</td>
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<tr>
<td>Quizzes (2)</td>
<td>8%</td>
</tr>
<tr>
<td>Homework Exercises (3)</td>
<td>12%</td>
</tr>
<tr>
<td>Laboratory Component: Laboratory Checkpoints</td>
<td>20%</td>
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**Final Examination** The final examination will be a 2 hour, closed book exam dealing with material from the lectures and from the supporting laboratory program. The aim of the examination questions will be to specifically address one, or more, of the learning outcomes stated above.

**Quizzes** There will be a total of two quizzes during the session, to be held in lecture times. The quizzes will be held in Weeks 5 and 10. Each quiz will consist of, at most, three (3) questions requiring working out. Marks will be awarded based on the correct answer
being supported by correct working out. The aim of the quiz questions will be to specifically address one, or more, of the learning outcomes stated above.

**Homework** You will be asked to hand in three lots of homework. The homework exercises are to be handed in in Weeks 3, 8, and 12. Each item of homework consists of a series (at most four) questions requiring working out. Marks will be awarded based on the correct answer being supported by correct working out. The aim of the homework questions will be to specifically address one, or more, of the learning outcomes stated above.

**Laboratory Component** Laboratory work commences in Week 3 and all experiments are done in Room 233. Each person will carry out a series of laboratory experiments. With sufficient preparation, each experiment will be nominally two hours in duration. Further details can be found in laboratory handouts which will be made available.

Each lab exercise has a series of checkpoints associated with it. Lab demonstrators and markers will be available to mark each lab checkpoint as it is successfully completed AND understood. Laboratory work is an essential component of this subject. **A pass (10/20) in the laboratory component is necessary to pass this subject.**

**Assessment submission guidelines** Failure to attend any of the quizzes will result in no marks being given for that quiz. Special consideration MUST be applied for in exceptional circumstances.

Failure to hand in homework will attract a 50% penalty per day late. That is, no marks will be awarded if homework is handed in more than one day late.

All homework submissions should be handed into the assignment box outside G12A, clearly labelled with your name, student number, course name AND lecturers name.

It is hoped that quizzes and homework submissions will be marked and returned within 1-2 week of the due date.

9** Syllabus**

**Introduction** What is an embedded system? Components. Structure.

**Revision** C programming language. Data representation. Number Systems.

**Computer Organisation** CPU. Memory. I/O. Addressing modes. Registers. Stack.


**Interrupts and Real-Time Systems** Concept of “time is important”. What is real-time? Foreground/background systems. Interrupt handlers. Event handling. Interrupt-driven I/O. Multitasking.

10** Recommended Textbooks and Reading Material**

Following is a collection of useful references for this subject. The course will not be closely following any one text, but will make use of parts of each text.
Addition reference material:

- There are many suitable texts on the C programming language to choose from.
- All lecture notes/slides, labs, tutorials and their solutions, and any supplementary material will be posted on WebCT Vista.

11 WebCT Vista

All materials available in electronic format, will be available in WebCT:
http://vista.elearning.unsw.edu.au

It is encouraged that students seeking advice/help on matters related to the course material seek help from other students, either in person, or via the discussion board in WebCT.

Note: The discussion board is not to be used as a chat forum for subject matter not related to the subject.
Appendix on Laboratory Notebooks

According to Barrett [Barrett et.al. 2005], "Lab notebooks are used to record the process of scientific discovery, project evolution, design rationale, steps in engineering analysis, procedures followed, and raw data collected. ... Furthermore, a carefully maintained notebook allows for adequate reconstruction of original work years from the original entry ...".

Barrett also offers some guidelines that should be followed in maintaining a "good" lab book. The following points are based on the guidelines.

1. Ensure the book is bound so that individual pages cannot be lost or removed. By the same token, do not record material on loose sheets of paper, unless they are properly bound.

2. Make sure all entries are sequential in chronological order. Do not mix up recorded lab material with lecture or tutorial (or other) notes.

3. Ensure that the material is recorded in a legible fashion, so that others can read it and use it to reconstruct your experiment.

4. Number pages sequentially.

5. Do not obliterate error, cross them out with a single line.

Importantly, the lab notebooks should NOT be written as formal lab reports where much of the elements in the quote above are not included.

Reference

Appendix on Plagiarism

The following is an official, now mandatory inclusion in all UNSW course handouts.

“Plagiarism is the presentation of the thoughts or work of another as one’s own. ¹ Examples include:

- direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement
- paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed. ²

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism.

“The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

“Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

¹The Learning Centre website is the central University online resource for staff and student information on plagiarism

²Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

²²Adapted with kind permission from the University of Melbourne.
and academic honesty. It can be located at:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students,

for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

“Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.”