SCHOOL OF ELECTRICAL ENGINEERING
AND TELECOMMUNICATIONS
ELEC2142: Embedded Systems Design
S2 - 2009

1 Course Staff and Consultation

<table>
<thead>
<tr>
<th>Course convened</th>
<th>Dr Ray Eaton</th>
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<tbody>
<tr>
<td>Lectures/Tutorials</td>
<td>Dr Ray Eaton</td>
</tr>
<tr>
<td>Laboratory teaching staff</td>
<td>Postgraduate/4th Year Undergraduate Students</td>
</tr>
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Consultation time for this subject will be Wednesday 4pm-5pm. 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>Tue 16-18</th>
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<tr>
<td></td>
<td>Wed 17-18</td>
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<tr>
<td>Tutorial</td>
<td>Mon 13-14</td>
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<tr>
<td>(only one)</td>
<td>Tue 11-12</td>
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<td></td>
<td>Wed 11-12</td>
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<tr>
<td>Laboratory</td>
<td>Mon 14-16</td>
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<tr>
<td>(only one)</td>
<td>Tue 9-11, 11-13, 13-15</td>
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<td>Wed 9-11</td>
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<td>Thu 15-17</td>
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<td>EE233</td>
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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 ELEC4601 (Digital and Embedded Systems Design) and ELEC4633 (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 analysis and 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 society today, 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.slt.unsw.edu.au/content/userDocs/GradAttrEng.pdf](http://www.slt.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 laboratory program will require students locate/source/understand appropriate information and data sheets for the execution of the lab exercises.

The ability to engage in independent and reflective learning. This ability is encouraged in the use of homework exercises and quizzes.

The capacity for enterprise, initiative and creativity. The laboratory program provides many challenging problems which require students to exhibit initiative and creativity in order to solve.

The capacity for analytical and critical thinking and for creative problem-solving. Labs, homework and quizzes will require students to analyse and apply supplied tools appropriately in solving challenging problems.

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 itself in assisting students to 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 several homework exercises to be completed and handed in during session for assessment.

8 Assessment

<table>
<thead>
<tr>
<th>Assessment Item</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Final Examination</td>
<td>60%</td>
</tr>
<tr>
<td>Quizzes (2)</td>
<td>8%</td>
</tr>
<tr>
<td>Homework Exercises (3)</td>
<td>12%</td>
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<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 6 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 complete three lots of homework. The homework exercises are to be submitted in in Weeks 4, 8, and 12. Each item of homework consists of a series of 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 2 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, and MUST be supported by appropriate documentation. Failure to submit homework will attract a 50% penalty per day late. That is, no marks will be awarded if homework is submitted more than one day late. Special consideration MUST be applied for in exceptional circumstances, and MUST be supported by appropriate documentation. 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.


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.

12 Continual Course Improvement

Students are advised that the course is under constant revision in order to improve the learning outcomes of its students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. This feedback IS vital and IS taken into consideration.

12.1 Feedback/Actions From S2 2008

Feedback from semester 2 2008 highlighted:

- a difficulty by some in completing the challenging laboratory program. This will hopefully be addressed this year via the 12-in-13 week semester, where students will gain an extra week of lab time at the end of session. Also, the labs will open in Week 2 rather than Week 3 for students to complete the lab orientation and administration before tackling the lab exercises in earnest in Week 3.
• the lecture program slightly behind the lab program by one lecture. This was known at the time, and for the most part did not cause significant issue due to strong lab support and instruction. However, for 2009, revision material covered early in lectures will be more brief and supported with recorded lectures, thus allowing lecture material addressed in the labs to precede the appropriate lab exercises.

13 Academic Honesty and Plagiarism

Plagiarism is the presentation of work done by others as one’s own work. This may take the form of copying other student’s assignments (in full or in part), or in copying material found on The Web without acknowledgement. Plagiarism is considered a serious offence by the University and severe penalties may apply. For more information about plagiarism, please see http://www.lc.unsw.edu.au/plagiarism.

14 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