ELEC3117 / TELE3117 / PHTN3117

Electrical Engineering Design

Dr Elias Aboutanios

Course Outline
Session 2, 2010
Course Staff

Course Coordinator and Lecturer in Charge  
Dr. Elias Aboutanios  
Room EE308  
Phone: 9385 5010  
Email: elias@unsw.edu.au

Project Coordinator  
Ben Cassidy  
Email: b.cassidy@unsw.edu.au

Lab Demonstrators  
Greg Stephenson  
Simon Lewis  
Nik Youdale  
Voon Lee  
Alex Kroh  
James Carrapetta  
David Grenet

Class Times and Locations

Lectures  
Elias Aboutanios  
Mon. 9-11am  
EE G25 (G17*)

Labs  
Lab1:  
Mon 3-6pm  
ElecEng101

Lab2:  
Tue 9am-12pm  
ElecEng101

Lab3:  
Wed 9am-12pm  
ElecEng101

Lab4:  
Fri 9am-12pm  
ElecEng101

Lab5:  
Fri 12-3pm  
ElecEng101

*For the map references of the classroom locations see the Campus Map (click the link below):  

Consultation

The lectures and labs are the primary avenues of contact between the teaching staff and the students. The consultations are not meant to replace these, but to allow the students to raise concerns (or ask questions) they might have with the lecturer in charge should the standard contact channels prove inadequate. The consultation will be held on Mondays from 11am to 12pm in Room EE301A. Both the lecturer and project coordinator will be present. Any changes to this or any other matter will be announced on the subject website.

Students may also contact the lecturer by email to seek an appointment for further consultation or ask a question. However, while every effort will be made, a response is not always guaranteed and the students are encouraged to take full advantage of the consultation hour.

Course Information

Course Load and Weight

This course is worth 6 units of credit (UoC).

The University defines a UoC as requiring 25 hours of total learning effort per semester (spread over all the learning activities including lectures, tutorials, labs, and the student’s own study time.) Therefore, it is expected that 150 hours of study be allocated to this course. Thus, a six unit of credit course like this requires a typical average workload of 12 hours per week.
Course Organisation

The content of this course is divided roughly equally between formally taught (lecture-based) content and a group project. Project design teams are nominally composed of only two students. Project teams of three will be considered only where otherwise unavoidable. In order to achieve project teams of two, it is typically necessary for some students to change the laboratory session in which they are enrolled. This is because project team members must all attend the same scheduled laboratory session.

Project selection

You must submit a project selection form (see end of this document) by Monday of Week 3. You should select a partner prior to doing this, so that only one project selection form is submitted for each project team. In the event that you have not been able to find a lab partner, it is possible to submit an individual project selection form and a partner will be found for you. This is not recommended, however. More specific information on projects may be found at the end of this document.

Relationship of the Course to the Program and Other Courses

For most students in Electrical or Telecommunications Engineering, this should be your second real design subject, the first having been ENGG1000. The subject draws heavily on skills in electronic circuit design, which you are expected to have developed through previously taken subjects. Without these, it will be difficult to complete a meaningful design. You are also expected to have developed a habit of maintaining a laboratory notebook, which you will find particularly important for this course. Through this subject, you should gain additional insight into the importance of technical courses such as control, signal processing, embedded systems and the like, although ELEC/TELE/PHTN 3117 projects do not generally depend on such knowledge.

Teaching Methods

The design project plays a major role in the learning process for this course, since it provides an opportunity for you to practice many of the methods which are taught in lectures. In particular, project management, electronic prototyping, properties of electronic components and many other areas of teaching in this course cannot be properly appreciated without undertaking a serious concurrent design project. Lectures also play a very important role in the learning process for this course. Lectures are designed to supply students with much valuable information to assist in their projects, while also providing a broad framework for design, including many facets which cannot be experienced properly within a student project. Lectures cover technical aspects of detailed design, as well as broader aspects of design, including marketing and economics. All material covered in lectures is examinable, not just that which directly relates to student projects. Lecture notes will be provided incrementally, to accompany the lectures. You should note carefully, that the lecture notes and lectures are not the same. By and large, the lecture notes are carefully prepared written materials, designed to be read. With some exceptions, Powerpoint slides are not lecture notes. You should realize by now that Powerpoint slides are aids, designed to accompany an oral presentation. By themselves, lecture slides have little teaching value.

Aims

The course aims to:

1. Expose students to the practical and technical challenges of serious Electrical Engineering design.
2. Develop teamwork and project management skills.
3. Provide a practical context for learning in other courses, so as to cement practical skills in electronic circuit design and reinforce the importance of disciplines such as control, signal processing, embedded systems, etc.
4. Impart an appreciation for the broader aspects of design, including consumer needs, marketing, product economics, manufacturing, standards, intellectual property and systems thinking.
5. Further develop written and oral technical communication skills.
What you are expected to learn (learning outcomes)

By the end of this course, the student should:

- Be capable of initiating, designing and managing an electronic design project.
- Have developed software skills with project management, circuit schematic and PCB design software.
- Be able to work in a small development team, write formal project reports, deliver a product development proposal and present a technical seminar.
- Recognize the conditions under which it is important to conduct patent searches, file patents, follow and/or contribute to standards.
- Be able to apply knowledge of manufacturing processes, electromagnetic compatibility, safety and other areas to the design of quality products.

Plagiarism

The University takes plagiarism very seriously and those committing this act are dealt with strictly. According to the University website, “Plagiarism is taking the ideas or words of others and passing them off as your own. Plagiarism is a type of intellectual theft. Plagiarism can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. Plagiarism can have serious consequences…”

In addition to being dishonest and unethical, plagiarism severely hinders the learning process of the person engaging in it. For more information please refer to the UNSW Plagiarism Policy [http://www.lc.unsw.edu.au/plagiarism/].

Assessment

The marks for this course will be assigned as follows:

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Examination (3 hours)</td>
<td>40%</td>
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<tr>
<td>Project Development Proposal</td>
<td>15%</td>
</tr>
<tr>
<td>Project Seminar and Demonstration</td>
<td>20%</td>
</tr>
<tr>
<td>Final Project Report</td>
<td>25%</td>
</tr>
</tbody>
</table>

The marking criteria for these assessment components are described in the cover sheets and marking sheets which will be handed out later.

**Note:** It is a requirement of this subject that you obtain a mark equal to, or greater than, 30/60 for your project work in order to pass this subject. In addition, you must also obtain a satisfactory exam mark.

Course Schedule

The preliminary course schedule is shown in the table below (next page). Note that as this is a new course, this program is subject to change as necessary to improve students’ experience. Any changes will be posted on the subject website and announced in the lecture.
### Table 1: Preliminary Course Schedule

<table>
<thead>
<tr>
<th>wk</th>
<th>Begins</th>
<th>Lectures</th>
<th>Guide to project activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19 Jul</td>
<td>Project Introduction</td>
<td>Labs open for the purpose of finding a partner.</td>
</tr>
<tr>
<td>2</td>
<td>26 Jul</td>
<td>Introduction to design</td>
<td>Start market research and brainstorm ideas</td>
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<tr>
<td></td>
<td></td>
<td>Project Management</td>
<td>Discuss project ideas with project coordinator, if required.</td>
</tr>
<tr>
<td>3</td>
<td>2 Aug</td>
<td>Marketing</td>
<td>Project selection form due at lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Needs and Requirements</td>
<td>Requirements analysis</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Problem statement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Continue concept generation</td>
</tr>
<tr>
<td>4</td>
<td>9 Aug</td>
<td>Concept generation &amp; development</td>
<td>Concept and feature selection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System Design</td>
<td>Block-level system design</td>
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<tr>
<td></td>
<td></td>
<td>Project Management</td>
<td>Identify critical blocks</td>
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<tr>
<td>5</td>
<td>16 Aug</td>
<td>Technical &amp; Oral Communications</td>
<td>Source reference designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economics of Product Development</td>
<td>Source critical components</td>
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<td></td>
<td></td>
<td></td>
<td>Development planning</td>
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<td></td>
<td></td>
<td></td>
<td>Early prototyping of critical elements</td>
</tr>
<tr>
<td>6</td>
<td>23 Aug</td>
<td>Electronic Components</td>
<td>Write development proposal</td>
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<td></td>
<td></td>
<td></td>
<td>Ongoing planning</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Ongoing prototyping</td>
</tr>
<tr>
<td>7</td>
<td>30 Aug</td>
<td>Electronic Circuit Ideas</td>
<td>Development proposal at Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prototyping Tools &amp; Methods</td>
<td>Start detailed design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ongoing prototyping and testing</td>
</tr>
<tr>
<td>8</td>
<td>13 Sep</td>
<td>Electromagnetic Compatibility</td>
<td>Develop specifications</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Ongoing planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ongoing prototyping</td>
</tr>
<tr>
<td>9</td>
<td>20 Sep</td>
<td>Electromagnetic Compatibility</td>
<td>Construct first functional prototype for preliminary testing against specifications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Safe Design Considerations</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>27 Sep</td>
<td>Manufacturing Processes</td>
<td>Refine functional prototype</td>
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<td></td>
<td></td>
<td>PCB Design</td>
<td></td>
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<tr>
<td>11</td>
<td>4 Oct</td>
<td>Standards</td>
<td>Finish PCB design</td>
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<tr>
<td></td>
<td></td>
<td>Quality Assurance</td>
<td>Prepare seminar presentation and demo</td>
</tr>
<tr>
<td>12</td>
<td>11 Oct</td>
<td>Intellectual Property</td>
<td>Writing final report</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Project seminar and demonstrations</td>
</tr>
<tr>
<td>13</td>
<td>18 Oct</td>
<td>No Lecture</td>
<td>Finish writing final report</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Final report due at Lecture</td>
</tr>
</tbody>
</table>

### Resources

**Website and Course Notes:** For course notes, up-to-date lecture schedules and related links, the primary website for this course will be [http://subjects.ee.unsw.edu.au/elec3117](http://subjects.ee.unsw.edu.au/elec3117). You should check the web-site regularly, especially before attending lectures.

**Recommended Texts:** There are no required texts for this course. If there were one, it would be the first text from the following list of recommended books:

   A good overview of the design process with a number of relevant case studies to illustrate the methods discussed. It includes sections on product costing and project management, as well as methodologies for market analysis and concept generation. This text is easy and enjoyable to read and may be purchased from the UNSW bookstore. However, it does not touch on the details of electronic design, or a number of other topics covered in the course.

   Covers key aspects of design at a high level, but with quite a few examples. Strong on user needs/requirements
and high level design. Covers a variety of design approaches, project management, and costing issues. This text is easy to read and may be purchased from the UNSW bookstore. However, it does not touch on the details of electronic design, or a number of other topics covered in the course.


Other Resources: The students are reminded that the UNSW library is an excellent resource.

Continual Course Improvement

While this is not a new course, it is continually subject to improvement in order to enhance the students’ learning experience. In addition to the standard UNSW Course and Teaching Evaluation and Improvement (CATEI) surveys, we welcome any additional suggestions or feedback (positive or negative) you care to provide during the course.

Administrative Matters

University expectations of students

UNSW expects regular attendance at lectures, laboratories and other scheduled classes. It is also expected that University commitments will take precedence over other activities such as paid work, holidays and so forth. Exceptions to this policy may be granted only in special circumstances. UNSW has rules for computer use, for example, in the use of email and online discussion forums. You would have accepted these conditions when you first accessed the UNSW network.

What you need to bring to the laboratory

You will need a USB drive for storing your personal drawing and other files. In addition you will need a laboratory notebook for recording your work. You should also find a prototyping board useful when developing your circuit. The prototyping board should be permanently labeled with your name and student number (so that there is some chance of getting it back if you accidentally leave it behind). Prototyping boards and documentation are available from the Electronics Workshop in EE G14 (you can use the prototyping board you had in earlier years if it is still reliable). The following tools are essential in laboratories where you work directly with circuit hardware: small screwdriver, small pointed pliers and side cutters. A wire stripping tool is also useful. The small pliers are indispensable for inserting component pigtails in prototyping boards.

Procedures for submission of assignments

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Date Due</th>
<th>Submission Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Development Proposal</td>
<td>Monday, Week 7</td>
<td>Submit at the lecture</td>
</tr>
<tr>
<td>Project Final Report</td>
<td>Monday, Week 13</td>
<td>Submit at the lecture</td>
</tr>
</tbody>
</table>

Other Administrative Issues

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School’s policies and procedures.
Overview of the Design Project

The project is the major component of the work in ELEC/TELE/PHTN 3117. It represents over half of the total marks for the subject. Therefore, to do well in this subject you must do well in your design project. Even more importantly, you must pass the laboratory component. Failure to do so may result in a UF (Unacceptable Fail), even if your overall final mark for the subject is greater than 50%.

This project requires much more than just designing and constructing an electronic circuit. It requires the consideration of a broad range of Engineering and strategic business issues, such as target market, competition, costing, timing etc. In order to ensure a consistent context and approach to the management and costing of the project reports, it is important that we consider project development within a particular framework or scenario:

Imagine you are a young engineer in a large electronics manufacturing company. It is your responsibility to propose and develop new product concepts to management. These product concepts must fulfil actual or perceived user requirements and must be competitive, both in terms of price and technical functionality, with comparable products. Management are looking for product concepts that differentiate their company’s products from those of other manufacturers in the marketplace. They are looking for novel ideas, with intellectual property that can be protected, and product concepts that will give the company a competitive advantage. They are also looking for products which reinforce their existing strengths and command of certain market segments. For this reason, you would do well to identify a realistic market segment in which the fictitious company will be active.

Your task can be broken down into five stages:

1. Defining the scope of a new product concept, i.e., coming up with a concept idea;
2. Writing a proposal detailing the product concept;
3. Designing and testing a functional prototype;
4. Presenting a seminar and demonstrating the prototype to management;
5. Writing a report describing and evaluating the concept prototype and also detailing the work required to take the prototype into production. The success of your company, as well as your career, may depend on how well you can communicate the value of your ideas to management.

This is not the only scenario we could work under. However, the assumption of a large company greatly simplifies the costing/management of project staff and resources. It is in your best interest to write all your reports based on this scenario, as this is the scenario that matches the marking scheme given to the tutors.

To ensure sufficient uniformity for assessment and learning, it is important that your product concept is electronics based. A purely software project is not acceptable for this course, even though practicing Electrical and Telecommunications Engineers often spend a great deal of their time developing software, either for general computing platforms or for embedded systems. Although product concepts which integrate with a PC are sometimes acceptable, you are strongly recommended to incorporate a micro-controller where programmable functionality is required; this forces you to think in terms of self-contained products, with a large potential market.

ELEC/TELE/PHTN 3117 Design Projects for S2, 2010

Obviously good product concepts are not easy to come up with (if they were we would all be rich!). The majority of product concepts that you may be able to think of may not be entirely original or may not be compelling enough to be truly successful in the marketplace. However, it is required that your project has a product concept which you can at least argue has some merit over the competition, i.e., it may offer new features or a new combination of features, or it may be a novel application of a (suitably modified) pre-existing device. Note: the unique selling point of your device cannot be a reduced price or a novel marketing approach alone.

The project coordinator has provided the following 8 broad topics from which you can select a promising project. Alternatively, with the approval of the course coordinator you can select your own topic. However, the project must be electronics-based, so as to facilitate comparison for assessment purposes. You should also consider how you can practically demonstrate your product prototype in Week 12.

1. Children’s Toy:
   This is a bit of an openended topic, which is always available each year. To capture the market here, you will either need to come up with a truly innovative idea, or else jump onto one of the current fads. Popular toys
in the marketplace these days include spy gadgets and laser tag games. There are always new ways to realise such toys, but you need to be careful not to simply reproduce an existing product. For this reason, you will need to do some market research up front (you can pick up a lot by watching the early morning comic shows). Nevertheless, the advantage of a toy product is that the specifications can typically be very loose, since people rarely have high expectations of the performance of a toy.

2. Unsolicited Call Handler:
Over the ages, people have developed many strategies for dealing with unsolicited telephone calls. Some people have gone to such lengths as training a parrot to converse with the caller. Others engage their talkative children, or just leave the phone off the hook. Most people, however, find it hard to say no or rudely hang up the phone. For people such as this, a personalised unsolicited call handling machine may be the answer. Once the nature of the call is determined (by answering the phone in the normal way) the call handler can be activated. Simple versions might simply play an automated message and hang up. Other designs might play a random assortment of customised messages until the caller finally hangs up in confusion. Ingenious solutions might masquerade as automated call handling machines which present the caller with touch tone redirection options ad nauseam. The sky is the limit with this, but be mindful of requirements. What type of customers would this appeal to, and what type of machine would they prefer?

3. Spatial volume measure:
Say you are stuck in a castle with a talkative electrical engineer and your only chance for escape is to measure the volume of an object, but you forgot to bring your tape measure / water tank / scales / electron microscope. Luckily there is a pile of electronic components nearby. Can it be done? Can you think of a really useful product to build based upon this awkwardly contrived scenario? Also give consideration to your potential market segment.

4. Room monitoring system:
You must meet with your 4th year thesis supervisor during the day but every time you check their office, they are not there! Or worse, there is someone else waiting in line to see them. You don’t want to wait in line. You also want to check if there is any milk in the fridge to know if you need to go shopping on the way home. It would be great if you could solve these compelling problems and more using only one device. What is that device? Are there any privacy considerations to manage in your design?

5. Intelligent pet door:
Your cat-dog likes to roam the neighbourhood at night but you are too busy designing an ELEC3117 project and forget to lock the door once your pet is inside. You would much prefer to have an intelligent door which does this work for you. Are there products which currently do this? How will you know it is your cat-dog and not the local wombat which wants to come through your door? There are many variations on this idea which would make a viable and profitable product.

6. Daisy Chaining Earphones:
Are you an avid earphone sharer? Have you ever worried about catching an ear infection (perhaps a nasty brain parasite) from your friends? What about sharing the experience (not the parasites) with multiple friends? Solve these problems and more with daisy chaining earphones. The idea is to build a set of earphones that can plug into a regular MP3 player, iPOD, whatever, but can also be used to send and receive music via an IR (or possibly wireless) link to another nearby audiophile. As with all projects, think carefully about the requirements before selecting a design concept here. There are a variety of physical configurations that you could consider and powering the circuitry is also an issue to be considered.

7. Bicycle Immobiliser:
Bike locks are useful because they keep your bike where you want it. However, these things are a pain to carry around. As a consumer I want to leave my bike as conveniently but safely as possible. Is there a simple electronic solution which is ripe for development? How could you integrate useful extra features? Think laterally to solve this problem and you could create a whole angle to this market.

8. Counting Shoes:
You’ve seen (or maybe worn) shoes that light up when you jump, but what about shoes which count events. The idea behind this project is to integrate counting display(s) and sensors into a pair of shoes (e.g., a pair of old joggers). Things you might sense, count and report via the display include steps, toe only steps, toe and/or heel pressure, and maybe other things. You might consider connecting the shoes together via an IR or wireless link so that you can collect statistics related to coordination, but this will clearly add complexity. You might
only pick one feature to demonstrate via a functional prototype due to time constraints. Think of novel ways for the user to interface with the display. Perhaps the display itself would not reside in the shoes. Clearly, there is a vast array of options here for you to explore if you're up to it. Give a whole new meaning to the term boot strapping as you introduce counting shoes to the market.