1 Course Staff and Consultation

<table>
<thead>
<tr>
<th>Course convenor/Lecturer:</th>
<th>Dr Ray Eaton EE Rm 207 <a href="mailto:R.Eaton@unsw.edu.au">R.Eaton@unsw.edu.au</a></th>
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<tbody>
<tr>
<td>Tutorials:</td>
<td>TBA</td>
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<td>Laboratory teaching staff:</td>
<td>TBA</td>
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Consultation time for this subject will be Tuesday 9am-11am in my office, room 207. 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, otherwise there is no guarantee that emails will be answered.

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

Elec2141 is a 6 UoC course; expected workload is 10-12 hours per week during the 12 week session.

Teaching Methods

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

Lectures, Tutorials and Laboratories

| Lecture (all) Mon Thu 14-16 EEG24 E 9-10 EEG25 |
|-----------|------------------|--|-------------------|
| Tutorial (only one) Mon 17-18 Webst256 |
|           Tue 13-14 OMB G32 |
|           Tue 17-18 Quad G031 |
|           ?? ?? ?? |

| Laboratory (only one) Tue 14-16 EE 233 |
|-----------|------------------|--|-------------------|
|           Tue 16-18 EE101  |
|           Wed 12-14 EE233  |
|           Wed 14-16 EE233  |
|           Wed 16-18 EE233  |
|           Thur 12-14 EE233  |
|           Fri 14-16 EE233  |

Laboratory classes officially start in week 2. Tutorial classes officially start in week 1.
3 Course Overview

Digital Circuit Design is a first complete course in digital systems and, as such, is intended to provide students with a firm foundation in digital circuit analysis and design. ELEC2141 will follow on from the introduction into digital circuits received in ELEC1111, and will act as a pre-requisite for courses involving digital systems, including ELEC2142, Embedded Systems Design.

Assumed Knowledge

The subject is built upon the introductory combinational logic introduced in ELEC1111 (Electrical Engineering). We assume knowledge of basic arithmetic, basic logic, design of combinational circuits and Karnaugh maps.

4 Course Objectives

The objective of this course is to provide students with the necessary fundamental skills to design and analyse digital circuits in the real world. With some further work, students should be in a position to able to design and build reliable and cost-effective digital systems. Such digital systems are an integral part of many areas of engineering and technology such as telecommunications, speech analysis and recognition, control systems, and so on.

The course aims to give students fundamental knowledge of digital systems with respect to several different levels of abstraction, from a low level dealing with electrical circuits, through to a high level dealing with software tools and hardware description languages (HDL’s), 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 digital circuits. To this end, at the successful completion of this course, you should be able to:

- analyse and design combinational circuits,
- design simple synchronous sequential circuits,
- display a basic understanding of standard digital circuit elements such as multiplexors, counters, and so on,
- demonstrate some understanding of the various hardware realisations of the basic digital elements,
- implement simple designs at various levels, from discrete components to programmable logic devices,
- demonstrate knowledge in practical aspects of digital circuits and systems, and their use in more complex systems, such as computers.
- demonstrate basic skills in working with computer-aided design tools, including knowing the rudiments of a hardware description language (VHDL).
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:

- Information literacy - the skills to appropriately locate, evaluate and use relevant information, which is addressed by tutorial and laboratory tasks.
- The ability to engage in independent and reflective learning, which is addressed by the extension laboratory exercises.
- The capacity for enterprise, initiative and creativity, which is addressed by the laboratory program.
- The capacity for analytical and critical thinking and for creative problem-solving, which is addressed by tutorial and homework exercises.

7 Teaching Strategies

The strategies employed in this course are very much focused on problem-based learning. At each section of the course, different examples of real digital circuits are introduced in lectures as a way of explaining the 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 including exposure to CAD tools. 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 two homework exercises to be completed and handed in during session for assessment.

8 Assessment

Final Examination 65%
Quizzes (2) 6%
Homework Exercises (3) 9%
Laboratory Component: Laboratory Checkpoints 20%

Final Examination The final examination will be a 3 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 time. 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 consist 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 2 and all experiments are done in either Room 233 or Room 101. Each person will carry out five or six laboratory experiments. With sufficient preparation, each experiment will be nominally two to three hours in duration. Further details can be found in the Laboratory Handout. Each lab exercise has a series of checkpoints associated with it. Lab demonstrators 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 satisfactory performance in the laboratory 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 labeled with your name, student number, course name AND lecturers name. A cover sheet will be provided for this purpose and MUST be included. It is hoped that quizzes and homework submissions will be marked and returned within 1 week of the due date.

9 Syllabus

Introduction/Revision  Number systems, codes, logic families.

Combinational Logic/Revision  Boolean algebra, switching algebra, combinational circuit analysis and synthesis, Karnaugh maps, two-level logic, multi-level networks.

Sequential Circuits  Concept of memory, latches, flip-flops, edge vs level triggered, sequential circuit analysis, state diagrams, sequential circuit synthesis, transition and excitation tables, Mealy and Moore circuits, synchronous sequential circuits, asynchronous sequential circuits.


Practical Issues  Hazards, non-gate logic, CMOS logic, logic families, memories.

Elements of Computers  Arithmetic circuits, arithmetic and logic units, register and bus structures.

10 Recommended Textbooks and Reading Material


At the conclusion of this subject, you will have covered, in varying degrees of thoroughness depending on the particular topic, the whole of this book.
References

Below are books that provide alternate coverage of many of the topics discussed in this subject.


11 WebCT Vista

All material available in electronic format, will be available in WebCT:

http://vista.elearning.unsw.edu.au

Each student enrolled will be granted access to the ELEC2141 subject page in WebCT Vista, where your login is your standard UniPass login.

WebCT Vista is quite versatile, and will be used for such things as:

- displaying/posting notices/messages;
- posting lecture notes / tutorial handouts / lab exercises / short quizzes;
- hosting discussions (only related to the subject) between class/teacher class/class etc;
- posting grades as they become available.

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.
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.

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

¹Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

²Adapted 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.”