Course Outline

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Course Details

Course Code	COMP3222
Course Title	Digital Circuits & Systems
Units of Credit	6
Course Website	http://cse.unsw.edu.au/~cs3222 (http://cse.unsw.edu.au/~cs3222)
Handbook Entry	http://www.handbook.unsw.edu.au/undergraduate/courses/current/COMP3222.html (http://www.handbook.unsw.edu.au/undergraduate/courses/current/COMP3222.html)

Course Summary

This course teaches students the fundamentals of digital design.

The course introduces the components of digital systems, explains how these are described in the VHDL hardware description language and, through a series of laboratory exercises, familiarizes the student with the implementation of digital circuits using FPGA prototyping boards.

Students are expected to attend lectures, tutorials and laboratories.

Students will be assessed via the hand-in of solutions to problems, the completion of lab exercises, a class test and final theoretical and practical exams.

Course Timetable

The course timetable is available here (/COMP3222/16s2/timetable) .

Course Aims

This course aims to provide students with a knowledge of problem solving with digital logic circuits & systems. The basic building blocks of combinational and sequential circuits are introduced to enable students to develop circuit solutions to problems and to understand the design and operation of hardware models of digital systems. Students will be introduced to the VHDL hardware description language as a means of describing circuits. Computer-aided design tools will be used to specify, simulate and implement a variety of simple digital systems. Students will learn how to implement and test their designs using Field-Programmmable Gate Arrays.

Student Learning Outcomes

After completing this course, students will be able to:

- design and implement combinational and synchronous sequential logic circuits,
- analyse various types of digital logic circuits,
- understand engineering concepts in the design of digital circuits,
- understand the role of hardware description languages in digital circuit implementation,
- describe simple hardware functions using a hardware description language,
- make use of CAD tools to specify, simulate and synthesize circuit designs, and
- understand the purpose of and steps involved in digital circuit implementation using Field-Programmable Gate Arrays.

This course contributes to the development of the following graduate capabilities:

Graduate Capability	**Acquired in**
scholarship: understanding of their discipline in its interdisciplinary context	theoretical and practical aspects of digital circuit design
scholarship: capable of independent and collaborative enquiry	theoretical and practical exercises
scholarship: able to apply their knowledge and skills to solving problems	skills involved in the design and analysis of digital circuits
leadership: enterprising, innovative and creative	digital design using contemporary methods
leadership: collaborative team workers	digital design as a fundamental engineering skill
professionalism: capable of independent, self-directed practice	theoretical and practical exercises

Assumed Knowledge

Before commencing this course, students should:

- be aware of the operation and/or programming of digital and/or computer systems, and
- have a basic understanding of mathematical logic, discrete mathematical concepts, electrical circuit theory and electronics.

These are assumed to have been acquired in the courses ELEC1111, COMP2121, or equivalent courses and their prerequisites.

Teaching Rationale

An in-depth understanding of digital circuits and systems is fundamental to your ability to become a successful digital designer and computer engineer.

This course founds studies in computer architecture, embedded systems and configurable logic design, and also forms the basis for a deeper understanding of the hardware underpinnings of operating systems, compilers, networks, graphics systems, etc.

In this course we attempt to provide you with a rigorous and thorough grounding in the essential skills you will need to carry out digital design activities in the follow-on courses of Computer Architecture, Embedded Systems Design (Design Project A) and Configurable Systems Design (Design Project B).

To that end, we aim to provide a systematic, bottom-up coverage of the essential skills and theory, and to provide a top-down view of the broader area to motivate and highlight the interrelationship of the topics.

In order to learn, students are expected to play an active role in participating by continuously thinking about *HOW* what is said in lectures or read in texts or on the web relates to what you already know from this course and related studies. You are encouraged and expected to ask questions to clarify contradictions or uncertainties in your understanding as we proceed.

In this course, we also place considerable value on putting theory into practice through guided laboratory and tutorial exercises. Staying up-to-date with these will help enormously in picking up the skills we expect you to have acquired by the end of the course.

Teaching Strategies

This course will involve:

- Lectures, to introduce concepts, show examples
- Tutorials, to reinforce concepts and provide additional examples, and
- Lab Work, to introduce technology and put theory into practice.

The course will also involve:

- Hand-in Problems, to encourage practice of the key skills,
- Theory Tests, to encourage study and more formally gauge uptake of theoretical skills, and a
- Practical Test, to encourage participation in laboratory work and to determine whether acquired skill levels are sufficient to pass the course.

Assessment

Assessment Item	**Contribution**
Labs	30%

Week 5 Class Test	10%
Hand-in problems	10%
Final Theory Test	25%
Final Practical Test	25%
TOTAL	**100%**

Academic Honesty and Plagiarism

Plagiarism is defined as (https://student.unsw.edu.au/what-plagiarism) *using the words or ideas of others and presenting them as your own* . UNSW and CSE treat plagiarism as academic misconduct, which means that it carries penalties as severe as being excluded from further study at UNSW. There are several on-line sources to help you understand what plagiarism is and how it is dealt with at UNSW:

- Student Conduct (https://student.unsw.edu.au/conduct)
- Academic Integrity and Plagiarism (https://student.unsw.edu.au/plagiarism)
- CSE: Addendum to UNSW Plagiarism Guidelines (http://www.cse.unsw.edu.au/~chak/plagiarism/plagiarism.html)
- CSE: Yellow Form (http://www.cse.unsw.edu.au/people/studentoffice/policies/yellowform.html) (whose terms you have agreed to)

Make sure that you read and understand these. Ignorance is not accepted as an excuse for plagiarism.

Course Schedule

Note that Monday 3 October (Week 10) is a public holiday.

Week	Lecture	Text	Lab
1	Introduction	Ch 1 & 2	—
2	Optimizing logic functions	Ch 4.1-4.7 & 4.12	Intro
3	Number representation & arithmetic circuits	Ch 5.1-5.5	Lab 1
4	Combinational building blocks	Ch 6	Lab 2
5	**Mon: CLASS TEST** Flip-flops	Ch 7.1-7.7	Lab 3
6	Registers & Counters	Ch 7.8-7.16	Lab 4
7	Synchronous sequential circuits	Ch 8.1-8.4	Lab 7
8	Synchronous sequential circuits	Ch 8.5-8.9	Lab 7
9	Digital system design	Ch 10	Lab 9
BREAK	—	—	—
10	Digital system design	Ch 10	Lab 11
11	Implementation technology	Ch 3	Blackjack
12	Course wrap-up	—	Blackjack
13	—	—	Marking

* Chapter references are to the course textbook — see below.

Lab Kits

Lab kits will be handed out during your first lab session in Week 2. These kits are in short supply and expensive to replace. We therefore ask that you take care of your kit until the final practical exam, after which they will be collected from you.

Should you discontinue the course, please return your kit as soon as practical to avoid inconvenience to yourself and the School. We may seek to recover from you the replacement cost of lost or unreturned kits (currently USD 127). In addition, you may have your mark in the course held at 00FL and/or be blocked from further enrolment at UNSW until the kit is returned.

Resources for Students

Course textbook:

- Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3ed, McGraw-Hill, 2009

Recently used texts (still quite useful):

- Katz and Borriello, Contemporary Logic Design (2nd edition)
- Mano and Kime, Logic and Computer Design Fundamentals (3rd Edition)

Other resources:

- Altera on-line User Guides and Data Sheets

Course Evaluation and Development

This course is evaluated each session using the CATEI system. Your feedback is highly appreciated.

In 2015, students found the course challenging and interesting. They particularly liked the close connection between theory and practice and enjoyed both the lectures and labs. This year, we will reduce the number of hand-ins, and provide suggested solutions for early labs when students find the hardware description language concepts a little daunting.

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