Course Outline

Contents

- Course Details
- Course Summary
- Course Timetable
- Course Aims
- Student Learning Outcomes
- Assumed Knowledge
- Teaching Rationale
- Teaching Strategies
- Assessment
- Supplementary Examinations
- Student Conduct and Plagiarism
- Course Schedule
- Lab Kits
- Resources for Students
- Course Evaluation and Development

Course Details

Course Code	COMP3222/COMP9222
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 familiarizes the student with the implementation of digital circuits using FPGA prototyping boards.

Students are expected to watch recorded lectures, attend live lectures to resolve questions and gain a deeper understanding of theoretical concepts and solve laboratory exercises to gain practical experience.

Students are assessed via the completion of lab exercises, fortnightly quizzes, and final theoretical and practical exams.

Course Timetable

The course timetable is available here (/COMP3222/20T3/timetable) .

Course Aims

This course aims to provide students with a knowledge of designing and implementing simple 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 are introduced to the VHDL hardware description language as a means of describing circuits. Computer-aided design tools are used to specify, simulate and implement a variety of simple digital systems. Students 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 combinational and sequential digital logic circuits,
- describe simple hardware functions using a hardware description language,

- make use of CAD tools to specify, simulate and synthesize circuit designs, and
- perform the 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: 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
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 programming of digital 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, COMP1521, 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 virtual classroom 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:

- Lecture recordings, to introduce concepts, show examples
- On-line discussions of the lecture material and relevant theory
- Self-directed lab work, to introduce technology and put theory into practice
- Recordings and on-line drop-in sessions, to assist with the completion of lab work.

The course will also involve:

- Theory Tests, to encourage study and more formally gauge uptake of theory, 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	40%
Fortnightly quizzes in Weeks 3, 5, 7 & 9	15%
Final Theory Test	15%
Final Practical Test †	30%
TOTAL	**100%**

† Students must obtain more than 40% of the available marks in the Practical Test to pass the course.

Supplementary Examinations

A student will only be offered a supplementary examination (supp) if:

- they miss the Final Tests for medical reasons; the final mark is calculated in the same way as for students who sat the original tests, or
- ~~they have obtained more than 45% of the total marks available AND more than 36% of the available marks in the Practical Test; these students can expect a maximum mark of 50 if they successfully complete the supp.~~

There are no supps for the fortnightly quizzes, nor will late lab submissions be accepted . Students who miss one of these progressive assessments will have their final mark scaled to compensate for the missing result if they provide a valid documented excuse.

Student Conduct and Plagiarism

The **Student Code of Conduct** (Information (https://student.unsw.edu.au/conduct) , Policy (https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf)) sets out what the University expects from students as members of the UNSW community. As well as the learning, teaching and research environment, the University aims to provide an environment that enables students to achieve their full potential and to provide an experience consistent with the University's values and guiding principles. A condition of enrolment is that students *inform themselves* of the University's rules and policies affecting them, and conduct themselves accordingly.

In particular, students have the responsibility to observe standards of equity and respect in dealing with every member of the University community. This applies to all activities on UNSW premises and all external activities related to study and research. This includes behaviour in person as well as behaviour on social media, for example Facebook groups set up for the purpose of discussing UNSW courses or course work. Behaviour that is considered in breach of the Student Code Policy as discriminatory, sexually inappropriate, bullying, harassing, invading another’s privacy or causing any person to fear for their personal safety is serious misconduct and can lead to severe penalties, including suspension or exclusion from UNSW.

If you have any concerns, you may raise them with your lecturer, or approach the School Ethics Officer (mailto:ethics-officer@cse.unsw.edu.au) , Grievance Officer (mailto:grievance-officer@cse.unsw.edu.au) , or one of the student representatives.

Plagiarism is defined as (https://student.unsw.edu.au/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:

- Plagiarism and Academic Integrity (https://student.unsw.edu.au/plagiarism)
- UNSW Plagiarism Procedure (https://www.gs.unsw.edu.au/policy/documents/plagiarismprocedure.pdf)

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

***In particular, you are also responsible that your assignment and/or exam files are not provided to or accessed by anyone but you and course staff,* including: by actively ensuring you do not disseminate your own work or access copies of other students' work irrespective of the year in which it was completed or posted, and by setting correct permissions on directories and code repositories. In this course, disseminating any work, unless expressly permitted, is considered a breach of the UNSW academic integrity standards.**

Note also that plagiarism includes paying or asking another person to do a piece of work for you and then submitting it as your own work.

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.

If you haven't done so yet, please take the time to read the full text of

- UNSW's policy regarding academic honesty and plagiarism (https://student.unsw.edu.au/plagiarism)

The pages below describe the policies and procedures in more detail:

- Student Code Policy (https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf)
- Student Misconduct Procedure (https://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)
- Plagiarism Policy Statement (https://www.gs.unsw.edu.au/policy/documents/plagiarismpolicy.pdf)
- Plagiarism Procedure (https://www.gs.unsw.edu.au/policy/documents/plagiarismprocedure.pdf)

You should also read the following page which describes your rights and responsibilities in the CSE context:

- Essential Advice for CSE Students (https://www.engineering.unsw.edu.au/computer-science-engineering/about-us/organisational-structure/student-services/policies/essential-advice-for-cse-students)

Course Schedule

Week	Lecture	Text *	Lab
1	Introduction & simplifying circuits Optimizing logic functions	Ch 1 & 2 Ch 4.1-4.7 & 4.12	Intro lab
2	Number representation & arithmetic circuits	Ch 5.1-5.5	Lab 1
3	Combinational circuit blocks **Fortnightly quiz on material of Weeks 1 & 2**	Ch 6	Lab 2
4	Flip-flops, Registers & Counters	Ch 7.1-7.16	Lab 3

5	Synchronous sequential circuits **Fortnightly quiz on material of Weeks 1 - 4**	Ch 8.1-8.9	Lab 4
6	Flexibility week		Lab 7
7	Digital system design **Fortnightly quiz on material of Weeks 1 - 5**	Ch 10	Lab 7
8	Digital system design	Ch 10	Lab 9
9	Blackjack player Implementation technology **Fortnightly quiz on material of Weeks 1 - 8**	Ch 3	Lab 11
10	Course wrap-up		Lab 11

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

Lab Kits

We have posted a lab kit to all Australia-based students who responded to our email late-August. These should be received by the end of Week 1. 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 you should return them in the reply-paid envelope we sent 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 a financial block placed on your ZID and be thereby prevented from further enrolment at UNSW until the kit is returned.

Students not based in Australia or who missed out on informing us of your postal address must purchase a lab kit from the supplier and obtain access to a kit prior to Week 2 so as to be able to submit solutions to the first lab exercises. See the Course Notice on "Purchasing a DE0 lab kit" for information on purchasing a kit.

Resources for Students

Course textbook:

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

Useful references:

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

Other resources:

- Altera/Intel on-line User Guides and Data Sheets

Course Evaluation and Development

This course is evaluated each session using myExperience. Your feedback is highly appreciated. Students are encouraged to provide feedback or discuss the course at any time by emailing the lecturer, Oliver Diessel (mailto:o.diessel@unsw.edu.au) .

Feedback received from the on-line offering in Term 3, 2020 indicates students found the course challenging and interesting, particularly the practical aspects; students also felt stressed by the fortnightly quizzes, and commented that providing both recorded and live lectures was unnecessary. For this offering, I have decided to increase the amount of time available to complete the quizzes and decreased their contribution to your final marks. The live lecture component will just review the main points and focus on working through exercises related to the lecture material.

A student from last year commented:

> "How to do well in COMP3222: It's a very practical course, so focus on the lab earlier in the week, and revise theory, in particular designs and applications, later in the week. Don't be intimidated by labs, they really help you learn a lot!"

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