

## Computer Hardware First Year course (DoC 112)

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### Course Materials

All course materials can be obtained from the course website:

<http://www.doc.ic.ac.uk/dfg/hardware/hardware.html>

These include (in .pdf format) lecture notes, lecture slides, tutorial sheets, tutorial solution sheets, coursework documents and software. Tutorial solutions are posted a few days after the corresponding tutorial session. The weekly tutorial sheets will be printed for you. If you want printed copies of the other material then you can print them using your allowance, however bear in mind that the notes and slides may be revised up to and including the day of the lecture.

Note about email: Please do not send any of your questions or problems by e-mail. Answering technical problems by email is very difficult. If you are stuck, bring your problem to the weekly tutorial and ask one of the tutors or lectures at the beginning of the session for help. If you are still stuck email us to fix an appointment.

### Online Discussion Forum

The piazza system can be used as an open online discussion forum for the course. A link to the course piazza page can be found on the course webpage.

### Lectures

The course does not assume any previous knowledge of digital circuit design. Emphasis will be on how digital systems work and how they can be designed. Although it is not possible in the time allotted to cover the whole subject exhaustively, the course aims to cover enough material for students to understand how a simple digital computer works and is designed.

- Lecture 1: Introduction to Boolean Algebra
- Lecture 2: Gates, Integrated Circuits and Boolean Functions
- Lecture 3: Canonical Forms and Karnaugh Maps
- Lecture 4: Combinational Circuit Design
- Lecture 5: Physical Realisation of Boolean gates
- Lecture 6: Physical Time-Dependent Behaviour of Digital Circuits and Feedback
- Lecture 7: Introduction to Sequential Circuits and Flip Flops
- Lecture 8: Synchronous Digital Systems
- Lecture 9: Finite State representation of Digital Circuits
- Lecture 10: Traffic Lights - a design example.
- Lecture 11: Registers
- Lecture 12: Registers, Multiplexers, Decoders, Comparitors etc
- Lecture 13: Arithmetic
- Lecture 14: A Manual Processor Part 1
- Lecture 15: A Manual Processor Part 2
- Lecture 16: Random Access memory
- Lecture 17: A 32 bit Computer Part 1
- Lecture 18: A 32 bit Computer Part 2

## Tutorials

For each tutorial you will be given a problem sheet with space for you to complete the solution. The tutorials are primarily intended to reinforce the lecture material using practical design examples. They also provide you examples of the types of question that will be found in the exams. In addition to helping you with the problem sheets, the tutors will be pleased to answer any other questions on the course material. Solutions to the tutorial problem sheets will be posted on the website the after the tutorial session.

- Tutorial 1: Propositional Calculus, de Morgan's Theorem
- Tutorial 2: Boolean Algebra and Truth Tables
- Tutorial 3: Karnaugh Maps
- Tutorial 4: Timing in Logic Circuits
- Tutorial 5: Two mode counter design
- Tutorial 6: Binary sequence recogniser
- Tutorial 7: Binary coded decimal adder
- Tutorial 9: A Manual Processor

## Course Work

The coursework assessment is in two parts:

**Combinatorial Circuit Design:** You will be given the specification of a combinational circuit which you have to design and test. The exercise can be started after lecture 4 in week 3. Check the hand in date on CATE and submit it in good time. It will be corrected, marked and returned to you two weeks after the hand in date. It contributes 60% of the coursework marks.

**Sequential Circuit Design (Spring term):** You will be given a sequential circuit design problem which involves using a professional hardware design system - Quartus II - which is installed in the laboratories. This exercise will be done during the first two weeks of term 2. It contributes 40% of the coursework marks.

## Examination

Of course, unfortunately for you, there will be an examination paper on this material in May. The exam paper contains 2 questions and you need to answer both of them.

## Recommended Books

Our recommendation is that you don't buy a book until you really need one. This one is fairly well known and may be helpful, but it goes into far more detail than you will need.

Morris Mano and Charles Kime: Logic and Computer Design Fundamentals (Second Edition) Prentice Hall International (2001)