ELEC342
Computer Hardware
S1 Day 2015
Dept of Engineering

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General Information

Unit convenor and teaching staff
Unit Convenor
Gengfa Fang
gengfa.fang@mq.edu.au
Contact via gengfa.fang@mq.edu.au
E6B 148

Credit points
3

Prerequisites
39cp including ELEC241(P)

Corequisites

Co-badged status

Unit description
This unit is a sequence of lectures and practical work on digital circuits and systems, and their application throughout digital computers, from the central processing unit to remote peripherals. Students gain experience in using a range of techniques, including programmable logic devices for constructing various computer sub-systems and a PC-based development system for a small microcontroller (8-bit processor, digital and analogue I/O).

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

- Understand the architecture of a computer
- Understand the functionality of major sections of a computer
- Ability to design sections of a computer
- Understand characteristics of microcontrollers
- Ability to program microcontrollers in assembly language
- Ability to interface microcontrollers to I/O devices
- To be aware of advances in the technology of computer hardware
Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>28%</td>
<td>Week 2 to Week 11</td>
</tr>
<tr>
<td>Report 1</td>
<td>6%</td>
<td>07:00PM 1/5/2015</td>
</tr>
<tr>
<td>Report 2</td>
<td>6%</td>
<td>07:00PM 5/6/2015</td>
</tr>
<tr>
<td>Final Exam</td>
<td>60%</td>
<td>Exam Timetable</td>
</tr>
</tbody>
</table>

Practicals
Due: **Week 2 to Week 11**
Weighting: **28%**

Practicals 1~3 (3 practicals @ 3%): 9%
Practicals 4~6 attendance (3 practicals @ 1%): 3%
Demo (work of Practicals 4~6): 4%
Practicals 7~10 (4 practicals @ 3%): 12

On successful completion you will be able to:
- Understand the architecture of a computer
- Understand the functionality of major sections of a computer
- Ability to design sections of a computer
- Understand characteristics of microcontrollers
- Ability to program microcontrollers in assembly language
- Ability to interface microcontrollers to I/O devices

Report 1
Due: **07:00PM 1/5/2015**
Weighting: **6%**

Report 1 (based on work of Practicals 4~6)

On successful completion you will be able to:
• Understand the architecture of a computer
• To be aware of advances in the technology of computer hardware

Report 2
Due: 07:00PM 5/6/2015
Weighting: 6%
Report2(based on Practical 7~10)

On successful completion you will be able to:
• Understand the architecture of a computer
• To be aware of advances in the technology of computer hardware

Final Exam
Due: Exam Timetable
Weighting: 60%
The final exam will cover all the lectures and Pracs.

On successful completion you will be able to:
• Understand the architecture of a computer
• Understand the functionality of major sections of a computer
• Ability to design sections of a computer
• Understand characteristics of microcontrollers
• Ability to program microcontrollers in assembly language
• Ability to interface microcontrollers to I/O devices
• To be aware of advances in the technology of computer hardware

Delivery and Resources
Access information on this unit on iLearn at https://ilearn.mq.edu.au/login/MQ/

Useful books:
Lab notes will be available on iLearn.

Changes since last offering:
More time will be put on how to program the interfaces.
## Unit Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures</th>
<th>Practical</th>
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<tbody>
<tr>
<td>ABC</td>
<td>ELEC342 Outline + Computer Hardware Computer hardware architecture</td>
<td>No practical</td>
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<tr>
<td></td>
<td>68HC11 microcontroller</td>
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<td></td>
<td>Memory and addressing</td>
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<tr>
<td>1A</td>
<td></td>
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<tr>
<td>GF</td>
<td>Computer Hardware</td>
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<tr>
<td></td>
<td>Instruction set</td>
<td></td>
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<tr>
<td></td>
<td>Instruction execution</td>
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<td></td>
<td>Instruction cycles</td>
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<tr>
<td></td>
<td>Evaluation Board Introduction</td>
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<tr>
<td>1B</td>
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<tr>
<td>GF</td>
<td>Microcontroller Programming</td>
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<tr>
<td></td>
<td>Assembly Language</td>
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<tr>
<td></td>
<td>Instructions</td>
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<td></td>
<td>Addressing</td>
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<tr>
<td>2A</td>
<td></td>
<td>Practical 1: Microcontroller programming</td>
</tr>
<tr>
<td>GF</td>
<td>Microcontroller Programming</td>
<td></td>
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<tr>
<td></td>
<td>68HC11 microprocessor</td>
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<td></td>
<td>Evaluation board</td>
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<tr>
<td></td>
<td>Simple machine-language programs</td>
<td></td>
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<tr>
<td></td>
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<tr>
<td>2B</td>
<td></td>
<td>(Dirkman – Experiment 1 – Straight-line programs and using the accumulator)</td>
</tr>
<tr>
<td>GF</td>
<td>Microcontroller Programming</td>
<td></td>
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<tr>
<td></td>
<td>Basic Operations</td>
<td>(Dirkman – Session 1 – Connecting to the EVB and some BUFFALO commands)</td>
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<tr>
<td></td>
<td>Arithmetic Registers</td>
<td>(Dirkman – Session 2 – Entering and executing machine-language code)</td>
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<tr>
<td></td>
<td>Condition Code Registers</td>
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<td></td>
<td>Flow Control</td>
<td></td>
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<tr>
<td></td>
<td>Cross Assembler process</td>
<td></td>
</tr>
</tbody>
</table>
3A GF 68HC11 Memory Addressing Modes
  Inherent, immediate, direct, extended, indexed, relative
  Stack, subroutines and practice
  Stack introduction and instructions
  Subroutines introduction
  programming using subroutines

3B GF

4A GF Operation Modes and bus
  Concept of operation modes
  Bus and address decoding
  Memory expansion

4B GF Timing circuits
  Timing diagrams
  Bus timing

Machine instruction cycles

3A GF Practical 2: Microcontroller program development

  (Dirkman – Experiment 2 – Condition codes, branching and applications)
  Dirkman – Session 3 – Using the BUFFALO line assembler: breakpoints
  Dirkman – Session 6 – Introduction to the Motorola HC11 cross-assembler)

4A GF Practical 3: Stack, Subroutines, Using the HC11 Cross Assembler

  Dirkman – Experiment 4
<table>
<thead>
<tr>
<th>5A</th>
<th>GF</th>
<th>5B</th>
<th>GF</th>
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<tbody>
<tr>
<td>Memory Technology and Expansion</td>
<td>Memory Technology and Expansion</td>
<td>Alarm Project:</td>
<td></td>
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<tr>
<td>ROM, RAM, RPROM and Flash memory</td>
<td>Bus cycles and timing</td>
<td>Requirements</td>
<td></td>
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<td>Memory expansion and its interface to 68HC11</td>
<td>Information</td>
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<table>
<thead>
<tr>
<th>6A</th>
<th>GF</th>
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<tbody>
<tr>
<td>Concept of Interrupts</td>
<td>Practical 5: Alarm Project 2/3</td>
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<tr>
<td>Interrupt Programming and practices</td>
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<table>
<thead>
<tr>
<th>7A</th>
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<tbody>
<tr>
<td>Timer and Programming</td>
<td>Practical 6: Alarm Project 3/3</td>
</tr>
<tr>
<td>68HC11 timers and principles</td>
<td></td>
</tr>
<tr>
<td>Registers to programme timers</td>
<td></td>
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<tr>
<td>Input/output compare functions</td>
<td></td>
</tr>
</tbody>
</table>
| 8A | Interfacing concepts  
    | Interfacing standards  
    | 68HC11 registers  
    | I/O addressing  
    | Polling and interrupts  
    | Interrupt masking  
  | Alarm Project Report:  
    | Due: 9/05/2014  
| 8B | Parallel interfacing  
    | Data direction  
    | Flags  
    | Configuration  
| 9A | Parallel interfacing  
    | Displays  
    | Switch debouncing  
    | Switch matrices  
    | Multiplexed displays  
| 9B | (Review)  
| 10A | Analogue Digital Converters  
    | 68HC11 system  
    | Accuracy  
| 10B | Procedures for using A/D converter  
    | Examples routines of A/D  
| 10A | Practical 7: Interrupts  
    | (Dirkman – Experiment 7 – Interrupts)  
| 10B | Practical 8: Parallel interfacing  
    | 68HC11 parallel interfacing hardware  
    | (Dirkman – Session 6 – Introduction to the Motorola HC11 Cross-Assembler  
    | Experiment 6 – Interfacing parallel I/O ports)
<table>
<thead>
<tr>
<th>11A</th>
<th>Serial Interfacing</th>
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<tbody>
<tr>
<td>GF</td>
<td>Concept of serial data communications</td>
</tr>
<tr>
<td></td>
<td>EIA232 specification</td>
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</table>

| 11B | 68HC11 SCI subsystem |
| GF  | Subroutines to control SCI |

| 12A | SPI |
| GF  | Concept of Serial Peripheral Interface |
|     | EIA232 specification |
|     | 68HC11 SCI subsystem |

| 12B | Subroutines to control SCI |
| GF  | |

<table>
<thead>
<tr>
<th></th>
<th>Practical 9: Analogue-digital converters</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>68HC11 A/D and D/A converters</td>
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<tr>
<td></td>
<td>(Dirkman - Experiment 8 – A/D converters)</td>
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<tr>
<th></th>
<th>Practical 10: Serial Communication and Serial Peripheral Interfaces – D/A Converters</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(Dirkman – Experiment 10 – The serial interfaces and D/A converters)</td>
</tr>
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</table>
Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:


In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: [https://students.mq.edu.au/support/student_conduct/](https://students.mq.edu.au/support/student_conduct/)


**Student Support**

Macquarie University provides a range of support services for students. For details, visit [http://students.mq.edu.au/support/](http://students.mq.edu.au/support/).

**Learning Skills**

Learning Skills ([mq.edu.au/learningskills](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

**Student Services and Support**

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

**Student Enquiries**

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au).

**IT Help**


When using the University's IT, you must adhere to the [Acceptable Use Policy](http://informatics.mq.edu.au/help/). The policy applies to all who connect to the MQ network including students.

**Graduate Capabilities**

**Creative and Innovative**

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:
Learning outcomes

• Understand the functionality of major sections of a computer
• Understand characteristics of microcontrollers
• Ability to program microcontrollers in assembly language

Assessment tasks

• Practicals
• Final Exam

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

• Ability to design sections of a computer
• Ability to interface microcontrollers to I/O devices
• To be aware of advances in the technology of computer hardware

Assessment tasks

• Practicals
• Report 2
• Final Exam

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

• Ability to interface microcontrollers to I/O devices
• To be aware of advances in the technology of computer hardware
Assessment tasks

- Practicals
- Report 1
- Final Exam

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Understand the architecture of a computer
- Ability to design sections of a computer

Assessment tasks

- Practicals
- Report 1
- Report 2
- Final Exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systematically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Understand the architecture of a computer
- Understand the functionality of major sections of a computer

Assessment tasks

- Practicals
- Report 1
Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

**Learning outcomes**

- Understand the architecture of a computer
- Ability to program microcontrollers in assembly language

**Assessment tasks**

- Practicals
- Report 1
- Report 2
- Final Exam

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

**Learning outcomes**

- Understand the functionality of major sections of a computer
- Understand characteristics of microcontrollers
- Ability to program microcontrollers in assembly language
- To be aware of advances in the technology of computer hardware

**Assessment task**

- Practicals

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's
historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

**Learning outcomes**

- Ability to design sections of a computer
- Understand characteristics of microcontrollers
- To be aware of advances in the technology of computer hardware

**Assessment task**

- Final Exam

**Socially and Environmentally Active and Responsible**

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

**Learning outcomes**

- Ability to design sections of a computer
- Understand characteristics of microcontrollers
- Ability to interface microcontrollers to I/O devices
- To be aware of advances in the technology of computer hardware

**Assessment tasks**

- Practicals
- Final Exam