

# ES2C4-15 Computer Architecture and Systems

**21/22**

**Department**

School of Engineering

**Level**

Undergraduate Level 2

**Module leader**

Sam Agbroko

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

50% coursework, 50% exam

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

NA

[Module web page](#)

### Module aims

To provide practical knowledge of how digital computing systems are designed, how they function, and how to program them.

### Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Basic C: Types, operators, loops, pointers, bitwise operations.

Data Representation: Binary numbers, Boolean algebra, unsigned and signed integers, fixed and floating point, codes.

Logic and Digital Arithmetic: Basic function truth tables, Karnaugh maps, multiplexers, encoders,

decoders, half and full adders, multipliers, comparators and division, sequential circuits – latches, flip flops, finite state machines.

Instruction Set Architecture: Assembly language, machine instructions including register, immediate, and jump, addressing modes, program flow.

Processor Microarchitecture: Memory, ALU, program counter, register file, control unit, single-cycle and pipelined processors.

Memory and I/O: Caches, virtual memory, GPIO, UART, SPI, I2C, high speed serial, timers, interrupts, PWM.

Microcontroller Programming: Loops, interrupts, timers, accessing peripherals.

## **Learning outcomes**

By the end of the module, students should be able to:

- Represent different types of data in binary and perform arithmetic operations on them.
- Understand the working of combinational and sequential circuits. Implement logic functions using these building blocks.
- Explain how low-level instructions correspond to the operation of a processor microarchitecture and how complex programs can be decomposed into such instructions.
- Explain the functionality of the basic components in a processor architecture.
- Explain how external peripherals and memory are interfaced with a processor through a variety of interfaces.
- Create basic C programs and C programs for Microcontrollers. Write microcontroller programs in C that go beyond a single iteration loop, taking advantage of interrupts and timers, and communicating with external peripherals.

## **Indicative reading list**

- S. Harris and D. Harris. Digital Design and Computer Architecture: ARM Edition. Publisher: Morgan Kaufmann, 2015, Paperback: 584 pages, ISBN-10: 0128000562, ISBN-13: 978-0-12-800056-4.
- A. G. Dean, Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers, Arm Education Media UK, ISBN 978-1911531036.
- M. R. Mano, C. R. Kime, and T. Martin, Logic and Computer Design Fundamentals, 5th Ed, Pearson 2015. ISBN 978-1292096070

## **Subject specific skills**

Plan and manage the design process, including cost drivers, evaluating outcomes, and working with technical uncertainty.

Ability to apply relevant practical and laboratory skills.

Ability to conceive, make and realise a component, product, system or process.

## **Transferable skills**

Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions.

Apply problem-solving skills, information retrieval, and the effective use of general IT facilities. Communicate (written and oral; to technical and non-technical audiences) and work with others. Plan self-learning and improve performance, as the foundation for lifelong learning/CPD. Exercise initiative and personal responsibility, including time management, which may be as a team member or leader. Overcome difficulties by employing skills, knowledge and understanding in a flexible manner.

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## Study

### Study time

Type	Required
Lectures	18 sessions of 1 hour (12%)
Practical classes	7 sessions of 2 hours (9%)
Other activity	2 hours (1%)
Private study	116 hours (77%)
Total	150 hours

### Private study description

116 hours of guided independent learning

### Other activity description

2 x 1hr Revision Classes

## Costs

No further costs have been identified for this module.

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group C

	Weighting	Study time
One design assignment (up to 15 pages) 50%	50%	
Online Examination	50%	

**QMP 1HR EXAM**

~Platforms - AEP,QMP

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- Online examination: No Answerbook required

**Feedback on assessment**

- Support through advice and feedback hours.
- Written feedback on marked programming assignments.
- Cohort-level feedback on final exam.

[Past exam papers for ES2C4](#)

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**Availability****Post-requisite modules**

If you pass this module, you can take:

- ES3B2-15 Digital Systems Design

**Courses**

This module is Core for:

- Year 2 of UESA-H63W BEng Electronic Engineering
- Year 2 of UESA-H63X MEng Electronic Engineering
- Year 2 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 2 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng

This module is Option list A for:

- Year 2 of UESA-H161 BEng Biomedical Systems Engineering
- Year 2 of UESA-H216 BEng Civil Engineering
- Year 2 of UESA-H113 BEng Engineering
- Year 2 of UESA-HH35 BEng Systems Engineering
- UESA-H112 BSc Engineering
  - Year 2 of H112 Engineering
  - Year 2 of H112 Engineering
- Year 2 of UESA-HN11 BSc Engineering and Business Studies
- Year 2 of UESA-H163 MEng Biomedical Systems Engineering
- Year 2 of UESA-H217 MEng Civil Engineering

- Year 2 of UESA-H114 MEng Engineering
- UESA-HH31 MEng Systems Engineering
  - Year 2 of HH31 Systems Engineering
  - Year 2 of HH35 Systems Engineering