EG–151 Microcontrollers

Assessment and Feedback Brief

Dr C.P. Jobling
Dr T. Davies
Dr B.R. Clifford

September 2022

Course Delivery

[Canvas module - Welcome: Begin Here]

Course Overview

[Canvas page - Course Overview]

EG–151 Microcontrollers is a 10-credit module running in the first semester. It introduces the structure and operation of a basic 8-bit microcontroller. It is intended to give you a grounding in the use of microcontrollers by taking you from some simple C-language programs to a mini-project that addresses a real engineering task. Assessment is by means of laboratory exercises recording in a lab diary, a class test, and a mini-project.

This link to the EG–151 Microcontrollers catalogue page provides details of the module's: *Synopsis*, *Syllabus*, *Learning Outcomes* and other vital information.

A description of the module aims, delivery method and assessment plan are to be found in the following pages and are summarised in the Assessment and Feedback Brief [PDF].

Because it is important that you read everything in the **Course Overview**, we have used *requirements* and *pre-requisites* to control access to the remaining course content. You should visit all sections of this module, preferably in advance of the first laboratory session on Monday 3rd October. You need to have viewed each page, marked some pages as done and contribute to the welcome discussion before you can proceed to the lab introduction module.

A short video is provided on Canvas that explains how *requirements* and *pre-requisites* work in Canvas.

Course Aims

[Canvas page - Course Aims]

EG–151 aims to introduce you to laboratory work in Electronic and Electrical Engineering, the fundamentals of microcontroller structure and operation and to help you to develop skills in low-level programming language and project work. There will be a lab introduction, an introduction to programming in the embedded C-language, an appreciation of low-level programming with assembly code, and opportunities to apply what you have learned to a simple microcontroller-driven instrumentation project.

Summary of assessment

[Canvas page - Summary of assessment]

Module assessment components: Laboratory Introduction (15%) + Laboratory work (20%) + Class test (35%) + Mini-project (30%)

Full details of the assessment and feedback arrangements for this module are to be found [on Canvas] in the Assessment and Feedback module.

Access to the Digital Learning Platform

Access to course resources, on-demand activities, timetabled classes, formative quizzes, discussions and full instructions for the practical exercises for each component are provided in the **Course Content (Modules)** section of the Canvas site for **2223_EG–151 Microcontrollers**. Practice test questions will be made available in the **Assessment and Feedback** section of the Canvas site.

Course Delivery Method

[Canvas paage - Course Delivery Method]

EG–151 will employ a blended approach to delivery using the Canvas Digital Learning Platform for on-campus and self-directed online activity, with live and self-directed on-campus activities each week.

Live learning activities

Lectures and Office Hours

There will be one lecture a week on Fridays at 13:00 on the architecture of the target microcontroller. This will be delivered on-campus and will be supported by on-demand after-class formative tests which aim to reinforce the knowledge gained in lectures by means of retrieval practice.

In addition, there will be an office hour for group activities in support of the lecture course which is designed to address the areas of difficulty that have been identified by the formative tests. The timing of the office-hour is to be confirmed and will be published in the Canvas calendar in due course.

The resources for the lecture course are arranged in modules by week and start here: Week 2: Welcome and Introduction to Data Representation.

Laboratory activities

There will be two two-hour lab sessions per week on Mondays 10:00–12:00 and Thursdays 12:00–14:00. Lab sessions are compulsory, and should you need a Supplementary (resit) assessment in August you must have achieved 80% attendance.

Laboratory introduction

Laboratory sessions during the first three weeks of term (University weeks 2–4) will be used for a laboratory introduction exercise.

The laboratory introduction is COMPULSORY and must be passed before you can continue to work in the laboratory.
Components of the laboratory introduction are as follows:

- Health and safety and safe working in the electronics laboratory
- Breadboard construction exercise
- Circuit simulation exercise using National Instruments Multisim
- Soldering exercise

The maximum mark for the laboratory introduction is 15 awarded as follows:

- Testing of circuit using plug-in breadboard and National Multisim and answers to questions at the end of the laboratory introduction script – Max 10 marks - Assessed by Lab Diary and a Canvas quiz.
- Construction of Tic-Tac box continuity tester – Max 5 marks.

Marking is done and feedback is given by the module coordinator and the chief electronics technician.

The course materials and guidance for the lab introduction module starts here: EG–151: Laboratory Introduction.

Microcontroller programming laboratories

There will be two two-hour microntroller programming lab sessions per week, and these will begin once the lab introduction has been completed at the end of week 3 (University week 4).

The microntroller programming exercises were designed during the height of the Covid 19 pandemic to be taken home and can be completed off-campus if necessary.

The laboratory work will be assessed by means of a lab diary worth 20% of the module marks. The lab diary is to be updated during the lab sessions and will be submitted via Canvas in November.

The Microcontroller laboratories are found (ob Canvas) in the Microcontrollers Laboratory module.

Mini-project

There will be a mini-project which is worth 30% of the marks and will be assessed by a demonstration of the completed project and a short report. The project is designed to be carried out using the resources of the laboratory kit, however additional components e.g. LEDs, resistors, push buttons and so on can be requested from the staff. A program will be provided as a starting point, and you will be required to add additional features as suggested in the project briefing.

We anticipate launching the mini project at the start of week 9 (University week 10).

On-demand learning activities

Knowledge and understanding will be increased via retrieval practice based on weekly formative tests delivered in Canvas.

Class test

The lecture course and the laboratory work will be assessed by an online class test worth 35%. We anticipate that the class test will be held in Week 10 (University week 11) with a resit being held in Week 12 (University week 13).

Timeline for EG–151

[Canvas paage - Timeline for EG–151]

Weeks 2–4: Laboratory introduction. Students enrolling on the Electrical and Electronic degree programs come from a wide range of backgrounds. Some students will have taken a technology-based course in their previous education, and in consequence, they will have some familiarity with electronic components and embedded microcontrollers. Other students will have little or no experience with practical electronics. The laboratory introduction gives everybody an experience of using electronic components in a practical circuit, the use of laboratory instruments, and an introduction to simulation software. The laboratory introduction starts in week 2 and will continue for the first two weeks of teaching. It will make use of the on-campus timetabled lab slots. Assessment of the laboratory introduction is partly “on the spot” in the case of the Tic-Tac construction. The lab diary will be assessed at the end of the exercise and some questions answered by means of a Canvas quiz. The laboratory introduction is worth 15% of the module.

Weeks 2 to 12: On-demand materials and live timetabled online sessions. **There is one lecture per week, starting at 1 pm on Friday afternoons. This lecture includes the architecture of a typical 8-bit microcontroller, and how the internal registers permit different programming structures. Initially, examples will be in the C-language, but examples in assembly language, needed to understand the detailed working of the microcontroller hardware, will be given as the module progresses. Review and preparation for the class test will be given in Week 10; feedback on the class test will be given in Week 12.

Weeks 3 to 8: Following the laboratory introduction, you will embark on a series of experiments designed to build experience in programming the target microcontroller, and the use of an Integrated Development Environment to debug their programs. Detailed records of progress will be recorded in a lab diary which will be assessed at the end of the module. There will be an opportunity for feedback to be given on a lab diary record of a programming exercise before the complete lab diary is submitted for final assessment. Additional support will be available from the module lecturers, technicians and demonstrators during the lab sessions. This part of the module is worth 20% of the total.

Week 9: Briefing about the Mini Project.

Weeks 9 to 12: The mini-project carries 30% of the marks for this module.

All mini-projects will be based on the same core components. This approach has been very successful in Micromouse, where the starting point is the same for all the teams. This year, you will be provided with a project briefing, which will take the form of a suggested breadboard layout and an example program, so that a working system can be constructed. This year, each mini-project team will be given a plug-in breadboard, an Arduino microcontroller and an LCD alphanumeric display, capable of two lines of 16 characters. A suggested layout will be provided, showing how to connect the microcontroller to the LCD using the minimum number of pins. A demonstration program will also be provided to show how the LCD can be updated with ASCII characters.

Each mini-project team must decide on an application for these core components, for example, a digital multimeter, a frequency meter, an ultrasonic rangefinder, and so on. In each case, additional hardware and firmware must be connected to the core components to achieve the chosen application.

Starting from the demonstration program, it is possible to write a program that converts numeric data into ASCII characters. The data could come from the built-in ADC, or from some form of sensor such as an ultrasonic rangefinder. Each team will decide on the method of converting and presenting the information on the LCD.

The marking schedule for the mini-project may be found earlier in this document.

Week 11: The **class test** carries 35% of the module mark. It will be based on the taught material from the lecture course and experience from the laboratory exercises. Many of the questions will be of the form, “what bits will be set on Port X if the following lines of code are executed” and will require a detailed understanding of the operation of the microcontroller. The class test will be delivered electronically via a Canvas Quiz and feedback will therefore be immediate aside from any text or essay questions that will have to be manually marked.

Week 12: Assessment of mini-project. As mentioned above, the mini-project will be assessed on the basis of a successful demonstration of the completed project and a short report. The report should contain a reflection on what has been achieved in the mini-project, a well-commented program listing, and photographs of the completed project. Other evidence may be provided at your discretion.

Assessment and Feedback

[Canvas module Assessment and Feedback]

Learning Outcomes and Transferable Skills

[Canvas page - Learning Outcomes and Transferable Skills

Intended Learning Outcomes

The following AHEP 3 Programme Learning outcomes [1] at Partial CEng (p) are partially addressed at a threshold level by this module:

- EA2p – Identity, classify and describe the performance of systems and components: operation of a microcontroller; computer instructions their execution. (Assessed by Class Test)
- EA3p – Practical and laboratory skills: safe-working; social distancing; use of electronic instrumentation; simulation, implementation and commissioning of an embedded system. (Assessed by the Lab Introduction (Practical))
- D2p – Investigate and define the problem: health and safety; design simple programs in both assembly language and C; design the hardware and software for a simple application. (Assessed by the Lab Introduction (Practical), Lab Exercises and Project)

- S1 – Apply your skills in problem-solving, communication, working with others, information retrieval and the effective use of general IT facilities via the use of a development environment to simulate, implement and commission an embedded system; demonstrate the application of the skills developed in the module to design the hardware and software for a simple application. (Assessed by the mini-project)

Transferable skills

1. Use of electronic instrumentation
2. Keyboard skills
3. Use of IT tools
4. Problem-solving
5. Programming of a microcontroller

Assessment details

Laboratory introduction

[Canvas page Laboratory Introduction]

Start date: 3rd October 2022.

The laboratory introduction is assessed according to the following:

- Health and safety and safe in the electronics laboratory.
- Breadboard construction exercise.
- Testing of the circuit using a plug-in breadboard and National Instruments Multisim.
- Answers to questions at the end of the laboratory introduction script marked automatically by means of a Canvas quiz.
- Construction of a Tic-Tac box continuity tester.

Marking is done and feedback is given jointly by the module coordinator and the chief Electronics technician.

Submission components:

- Lab diary with record of breadboard construction exercise and simulation (5 marks with formative feedback on diary entry)
- Answers to questions - Canvas Quiz (5 marks)
- Inspection of Tic-Tac box continuity tester (5 marks)

Deadline for submission: 14:00 Thursday 20th October 2022.
Deadline for feedback: 17th November 2022.

Microcontroller programming laboratory exercises

[Canvas page - Microcontroller programming laboratory exercises]

Start date: 24th October 2022.

There are five laboratory exercises and the assessment will be based on the lab diary you submit to Canvas.
The lab diary will be marked on the five criteria listed below using the grading rubric. Only non-submissions will score zero.

Criteria

- **Content** – A complete record of the experiment or exercise is recorded in the lab diary. The material that is present is complete, accurate and reproducible.
- **Tools and Equipment** – A detailed description of the tools and equipment needed to complete the laboratory experiment or exercises provided.
- **Analysis and Discussion** – Adequate analysis and discussion are given for all recorded results. There are no errors in the conclusions drawn. You have demonstrated a clear understanding of all the aspects of the tasks carried out.
- **Reflection** – A detailed and thorough reflection is given. The reflection identifies both good and bad experiences in all tasks as well as how improvements can be made for next time where appropriate.
- **Presentation** – The lab diary is very well structured and flows logically. The content is easily readable and experiments could easily be reconstructed by reference to the lab diary.

Grading rubric

Exceeds Standard	Meets Standard	Needs Work	Poor
4 .	3 .	2	1 .

Early feedback on the standards should be sought and facilities will be provided inside Canvas for you to submit the lab diary for assessment of the lab introduction and one further lab diary submission for informal assessment and feedback.

Deadline for optional submission: for formative feedback on presentation of a coding exercise in a lab diary. 14:00 Thursday 3rd November 2022.

Deadline for feedback on optional submission: 17th November 2022.

Deadline for final submission: 14:00 Thursday 24th November 2022.

Deadline for feedback on final submission: 15th December 2022.

Class test

A timed Canvas test on materials covered in the lectures and laboratory exercises will be held during week 11 (5th–9th December 2022). Practice and revision for the class test are the weekly Canvas quizzes which have been provided for retrieval practice and there will be a revision lecture before the test and a review lecture after it.

The class test is automatically marked.

As you must score at least 30% on the class test for the other components to count, there will be one resit of the class test allowed before the end of term.

Mini-project

[Canvas page - Mini Project Assessment]

Start date: 21st November 2022.

Assessment criteria for the mini-project (lab assessment, out of 10):

Marks	Criteria
4	Project specifications achieved.
> 4–7	Project specifications achieved and you are able to explain the program.
> 7–10	Project specifications achieved and you are able to explain the program and successfully answer detailed questions related to the project.

Assessment for the mini-project (report, out of 20)

Marks	Criteria
8	Report contains minimum details. It is difficult to repeat the project with the report.
> 8–14	Report is clear and concise. Some details are missing.
> 14–20	Report is clear and concise. It contains all details that are required to successfully repeat the project.

In lab assessments: during lab on Monday 12th December or Thursday 15th December. Feedback will be verbal and immediate.

Deadline for report submission: 14:00 Thursday 15th December.

Deadline for feedback on report submission: 13th January 2023.

Class Test

[Assignment rubric - EG–151 Class Test]

Guidelines

This is the class test for EG–151 Microcontrollers and makes up 35% of the final module mark. In order to have the marks from the other assessment elements count, students must achieve at least 30% in this assessment. The assessment is made up of 20 multiple choice and short answer questions based on the topics covered in both the lecture and practical sessions. For each topic, a bank of questions exists and the specific questions each student sees will be different and random.

This is a formal exam and the results from this will be used to determine your grade for this module. Students have one attempt at this assessment. Students who fail to meet the required 30% pass mark will have one opportunity to redeem the failure (date to be confirmed).

Rules

- This is an independent assessment; do not work with others.
- You may use class materials if you need to.

Specific rules for passing this module:

This module is assessed by a combination of a class test and practical assessment. In order for the practical assessment marks to count, you must achieve at least 30% in the class test. You will have one attempt to redeem a failure in the class test before the end of semester 1. If you achieve less than 30% in the class test, then the module mark will be just the class test mark and you will be required to take another test in August.

Note

1. For a detailed explanation of AHEP 3 learning outcomes, see the references mentioned on pages 8–12 of the Undergraduate Student Handbook for Year 1 of the BEng/MEng in Electronic and Electrical Engineering, 2022–2023.