EG–151 Microcontrollers

Assessment and Feedback Brief

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Introduction

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 document is also available in PDF form.

Module 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.

Covid–19 Statement

As the University continues to respond to the ongoing Covid–19 pandemic module information may be subject to change to ensure that you receive the best learning experience possible. We will make every effort to engage with you where changes are necessary and any changes will be communicated to you, as soon as possible. Delivery of both teaching and assessment will be blended including live and self-directed activities which can be accessed on-campus and online if necessary.

Summary of assessment

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

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 **2122_EG–151 Microcontrollers**.
Practice test questions will be made available in the **Assessment and Feedback** section of the Canvas site.

Module Delivery Method

EG–151 will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. You may also have the opportunity to engage with online versions of sessions delivered on-campus should circumstances require this.

Laboratory Introduction

Laboratory sessions during the first three weeks of term 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 during the COVID pandemic
- Breadboard construction exercise
- Circuit simulation exercise using National Instruments Multisim
- Soldering exercise

On-demand learning activities

There will be the equivalent of one lecture a week on the architecture of the target microcontroller.

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

Live online activities: there will be one hour a week online examples class for group activities in support of the lecture course and designed to address the areas of particular difficulty that have been identified by the formative tests.

Laboratory induction

The maximum mark for 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.
- Construction of Tic-Tac box continuity tester – Max 5 marks.

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

On-campus laboratories

There will be two two-hour lab sessions per week.

The lab exercises have been designed to be taken home and can be done completely 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 submitted via Canvas in November.

Class test

The lecture course and the laboratory work will be assessed by an online class test worth 35%.

Mini-project

There will be a mini-project which 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 takeaway 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.

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

The laboratory introduction is assessed according to the following:

- Health and safety and safe working during the COVID pandemic.
- Breadboard construction exercise.
- Answers to questions at the end of the laboratory introduction script.
- Testing of the circuit using a plug-in breadboard and National Instruments Multisim.
- Construction of a Tic-Tac box continuity tester.

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

Laboratory exercises

There are four 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 up to a maximum of two early lab diary entries for informal assessment and feedback.

Mini-project

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

Marks	Criteria
4	Project specifications achieved.
5–7	Project specifications achieved and you are able to explain the program.
8–10	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 15)

Marks	Criteria
6	Report contains minimum details. It is difficult to repeat the project with the report.
7–11	Report is clear and concise. Some details are missing.
12–15	Report is clear and concise. It contains all details that are required to successfully repeat the project.

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. 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 12 noon on Monday 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 5 and **7 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 opportunities for feedback to be given on lab diaries before they are submitted for final assessment. As social-distancing rules limit access to the electronics laboratory, the lab exercises have been designed to be taken home. Additional support will be available online via a scheduled weekly support session attended by module lecturers and demonstrators. This part of the module is worth 20% of the total.

Week 6: has been reserved for the **EG–133 Engineering for People Hackathon** activity. There will be no teaching or labs on EG–151 in week 6.

Week 9: Briefing about the Mini Project.

Weeks 9 to 12: The mini-project carries 35% 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.

An alternative project will be provided for you if you are registered for temporary online teaching.

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

Week 11: The **class test** carries 30% 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.

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 page 5 of the Undergraduate Student Handbook for the BEng/MEng in Electronic and Electrical Engineering, 2020–2021.