Anglia Ruskin University

Course Information Sheet

BEng (Hons) Electronic Engineering

Mode and course length – Full-Time (4 years)

Location – ARU Cambridge Campus

Awarding Body – Anglia Ruskin University. As a registered Higher Education provider Anglia Ruskin University is regulated by the Office for Students.

Overview

Location of study:

Level 3 – ARU Cambridge Campus

Level 4-6 – ARU Chelmsford Campus

Modern life depends on electronics; from industry to the iPhone, they're everywhere. In lectures and in our labs, you'll learn to design, simulate and build a wide variety of electronic systems.

Your course will have the latest technology at your fingertips and be able to collaborate with other students on innovative projects to hone your skills.

Our course will give you detailed knowledge of a branch of technology which is absolutely vital to our modern lifestyle. It will prepare you for a career at the cutting edge of technology development.

You'll focus on the central topics in electronics while learning to design and build electronic systems. You'll also have the opportunity to develop certain skills in more detail to specialize on an area of interest.

Take advantage of our state-of-the-art electronics and microelectronics laboratories, with support and guidance from our in-house team of technical experts. We use industry-standard software including the Xilinx VIVADO and ISE digital systems design software, National Instruments' Multisim and Labview System Design Software and hardware platforms that feature the latest programmable Zynq SoC FPGA circuits and ARM microcontrollers. You'll also use a wide range of central computing and media facilities.

By the time you graduate, you'll be a creative problem-solver and be able to design systems and components. You'll also be able to consider the social, environmental and economic implications of different aspects of electronics.

Course Delivery

Our courses are delivered through teaching and learning methods which provide students with the widest possible exposure to a modern and innovative higher education experience.

These methods vary and could include attendance at lectures and seminars, undertaking laboratory exercises or work-based activities, practical work, performances, presentations, field trips, other relevant visits and e-learning through Canvas, our online learning management system.

Each course is divided into a number of 'modules' which focus on particular areas, each of which has a specific approach to its delivery. This information is published to students for each module they take via the Module Definition Form (MDF) and Canvas.

Assessment

We'll assess you throughout the course to measure your progress. Besides exams and essays, there'll be reports, logbooks, presentations, posters, interviews, and work resulting from practical classes.

Fees

Information about your course fee including any annual fee increases or deposits (if required) can be found in your offer letter.

Additional Costs

Cost of (some) electronic components for the Major Project

Cost can vary and depends on the complexity of the project; approx £100 on parts.

Modules

Core Modules

Year 1: Foundation in Engineering, Computing and Technology

This module will provide students with the necessary skills to begin studying at level 4 in Engineering, Computer Science and related courses.

Students will be introduced to the core skills necessary to succeed in higher education, including thinking critically, researching and referencing appropriately, demonstrating appropriate numeracy and ICT skills, and communicating effectively verbally and in writing.

In addition to these fundamental skills, Students will cover the subjects underpinning the technological disciplines. Fundamental mathematical skills will be covered, alongside pre-calculus, followed by an introduction to calculus and vector and matrix arithmetic. Students will also be introduced to Classical mechanics, and its application to real-world scenarios. Students will be introduced to the fundamentals of computer science, learning about the principles behind programming and applying them through a series of practical coding exercises. Students will undertake a multi-disciplinary group project as they learn about the collaborative nature of engineering, and design from a broader perspective of business.

The module is made up of the following 8 constituent elements:

- Interactive Learning Skills and Communication (ILSC)
- Information Communication Technology (ICT)
- Critical Thinking
- Maths for Scientists
- Maths for Engineers
- Physics for Engineers
- Fundamentals of Computing
- Engineering Design

Year 2: IT, Communications and Research Skills

Students will need specific study skills to enable them to maximise their learning potential and take advantage of opportunities available both in the academic setting and workplace. The module is intended to be both preparatory and supportive, building a strong foundation for learning and later development. Students will gain Information and Communication Technology (ICT) skills for information management and presentation purposes and will be encouraged to use contemporary ICT methods for research and for the production and presentation of reports, in a style suitable both for university coursework requirements and the commercial environment. The students will also develop skills in carrying out desktop research and self-directed study.

In addition to ICT skills, students will also be introduced to workstation-based 2D drafting techniques using a powerful set of tools within Autodesk's AutoCAD software series. Skills in this medium are highly sought after in the engineering industry.

Year 2: Digital Electronics

This module introduces the student to the analysis and design of digital electronic circuits. The module looks at digital devices and examines the fundamentals of Boolean logic. The different logic gates are explained, and techniques are introduced for generating and simplifying logical expressions using Boolean algebra and Karnaugh maps. Practical applications are examined, including the design of fundamental circuits such as decoders, encoders and arithmetic circuits. This is followed by examining how sequential logic techniques allow us to design circuits with memory. Different types of memory are explained, along with their applications. Finally, the design of synchronous and asynchronous counters is examined. The operating principles of all circuit elements are covered by lectures and tutorials, supplemented by practical experiments using both hardware and circuit simulation software. This enables students to compare actual measured results with theory as well as illustrating the effects of component tolerances. The practical work also gives the student experience of the presentation and interpretation of manufacturers' data for real components, and enables the student to explore the limitations of laboratory techniques and instruments.

Year 2: Introduction to Microprocessors

This module introduces students to one of the fundamental building blocks of modern electronic systems - the microprocessor. These small, yet cheap and powerful, devices are the main electronic component in a wide range of modern products from talking teddy bears to motor controllers. Like their big brother computers they are programmable devices capable of a wide variety of tasks. They find widespread application in dedicated systems where the larger more power hungry devices are unsuitable. The module follows a practical approach to these versatile devices. Understanding of the microprocessor is developed through a series of practical exercises supported by formal lectures. The laboratory activities are linked to the lectures and provide a set of progressive practical interactive exercises that reinforce the lecture material and allow the student to develop practical programming skills. Students are required to write their own programmes and are expected to demonstrate a systematic approach to the design process. The skills obtained are directly relevant to the high technology employment environment.

Year 2: Computer Modelling

This module introduces the use of computer tools to solve engineering problems. It is intended to provide a sound understanding of the principles of generating a computer model or solution from a defined specification. The MATLAB software package is introduced, which allows mathematical expressions to be solved using various command functions and simple software statements. Basic ideas of producing plots are presented. Students are also introduced to the basics of C language. Fundamental issues like constants, variables, operators, conditional and iterative statements will be discussed.The emphasis in learning computer languages will be on a structured approach. The applications targeted will be in the area of modelling and solving technological problems relevant to students' courses.

Year 2: Mathematics for Engineers 1

This module is essential for the student who needs a solid background in mathematical techniques and analysis in order to pursue a degree programme in technology or engineering studies. The module will help students to assess their existing mathematical skills and sympathetically enable them to remedy any basic deficiencies. It will then develop the core mathematical skills, knowledge and techniques needed in order that elementary scientific and engineering problems may be solved. Matrices and determinants, and their use in solving simultaneous equations are introduced. Problems involving elementary probability theory are solved. In the complex plane, de Moivre's theorem is introduced and used to find powers and roots. The techniques of calculus - differentiation and integration - and their applications are introduced. Numerical integration is explored.

Year 2: Embedded Systems

The module focuses on the design and operational characteristics and internal architecture of Embedded Systems . It examines the programming techniques that can be applied to real time systems using different programming languages such us C programming and Ladder Logic. The unit also provides the learners with Workshop and laboratory skills. Learners will be given the opportunity to develop Real Time embedded Operating system on dedicated hardware platforms (such us PLC) in order to solve given engineering problems (for example produce a programme for an engineering application, store, evaluate and justify approaches taken). This module forms the basis of embedded controllers for electrical machines and it is a key development of workplace practice and employment. Learners will investigate how to design embedded systems for monitoring inputs and changes outputs using specialised software (such as Siemens Ladder logic and Microchip MPLAB IDE). The created program can include Boolean logic, counting, timing, complex math operations, and communications with other devices such as wireless GSM or WIFI modules. This unit will introduce learners to the principles of microprocessors and give them experience of using and programming a microprocessor system for the operation or control of peripheral devices . This unit will provide an introduction to the terminology (e.g. bits, bytes, words) and concepts related to microprocessor applications. The unit will also develop learners' understanding of the architecture and operation of real time embedded microprocessor-based systems and the use of decimal, binary and hexadecimal number systems, and functions for programming. Successful completion of this module will provide a range of knowledge and skills of value to employers with an interest in microprocessors programming.

Year 2: Analogue Electronics

This module introduces the student to the analysis and design of analogue electronic circuits. The module reviews the fundamentals of analogue components including resistors, capacitors and inductors, and shows how simple circuits are designed using these components. It introduces various forms of diodes, transistors and operational amplifiers and explains their equivalent circuit models. It also introduces the measurement and analysis tools used in the electronics industry. The operating principles of all circuit elements are covered by lectures and tutorials, supplemented by practical experiments using both hardware and circuit simulation software. This enables students to compare actual measured results with theory as well as illustrating the effects of component tolerances. The practical work also gives the student experience of the presentation and interpretation of manufacturers' data for real components, and enables the student to explore the limitations of laboratory techniques and instruments.

Year 3: Microprocessor Systems Design

In this module the student will develop an in-depth understanding of microprocessor system and its relation to the design of modern digital systems. Hands-on programming and simulation of the operation of a commercial microprocessor will be an important part of this module. The module covers different microprocessor architectures, and core elements like ALU, CU, BIU, memories, caches, pipelines, superscalar architectures, RISC and CISC. Real time and non real time hardware and software requirements for embedded microcontroller systems are presented and the relationship between system performance and hardware and software interface is covered. The module delivery strategy combines complex theoretical aspects and case studies presented during lectures, with practical skills - hands on supervised and unsupervised laboratory work, using state-of-the art industry standard CAD tools. Students are encouraged to take responsibility for their assignments and to work in their own time as well as during the timetabled classes. The successful completion of this module will increase students' employability, who will acquire industry standard skills, directly applicable to real world projects.

Year 3: Data Communications

This module is designed to enable students to gain a thorough understanding of the techniques used to enable computer systems to receive and transmit digitised information in a manner which suits a variety of applications and highlights the limitations of the method(s) used. The module introduces the binary representation of real-world data and how that data is communicated over distance using cable or wireless media. Networking and packet switching techniques are introduced and expanded to include the latest forms of baseband and broadband distribution and their current implementations such as DAB, Wireless Internet, 3G, GPRS and modern Ethernet. Topics are covered in a non-mathematical way whenever possible, but the ability to manipulate equations including logarithms is an essential skill. Students who feel they may not have these skills should discuss this with the module tutor and may need to do some extra preparatory study. The module is delivered as a mixture of classroom-based teaching and independent student-managed learning. Students will gain a good understanding of the hardware of computer networks, internet distribution and mobile and wireless media, making them attractive to employers in the fields of IT Services and Support, Network Design and Network Management, Internet Provision.

Year 3: Design Methods and Technology Project

This module is essentially a mini project where students undertake to design some artefact, eg: electronic hardware, software, multimedia production, website etc. The management of the project is in itself a core element and students are expected to produce a formal specification using sound design methods, a time plan and progress indicator. Students will also be expected to produce a number of alternative designs that meet the specification, select the most appropriate design using recognised techniques and carry out design reviews. Students have a free hand at choosing the subject of the project, but close supervision is provided in order to limit over-ambition or to raise the level as appropriate. The lecturer acts as Project Supervisor and assessor as well as a mentoring resource throughout the execution of the project. Students have access to the full resources of the university and may use any laboratory facilities by arrangement with the relevant Lab Technician. At the early stage of the module, guidance is given about design methods and project planning, then students will work independently and may use the lecturer as a resource and mentor if they so wish.

Year 3: Data Acquisition Systems

The module covers the general principles of measurement and instrumentation, sensors and actuators, signal conditioning and data presentation. The module will analyse the role of the elements of a computer-based data acquisition system and will give the students the ability to specify and evaluate a measurement system for a given application. Students will design, simulate and test basic data acquisition systems using common sensors and electronic components, in addition to undertaking a review of the measurement techniques for specific industrial applications. The module introduces virtual instruments based on a practical approach. Students will develop hands on skills in basic system simulations and measurements. The principles of the data acquisition are covered in lectures and tutorials. The practical experiments use both simulation software and hardware, enabling the students to compare actual measured results with theory. The practical work also gives the students the experience of choosing the appropriate components in terms of sensors, signal conditioning circuits, data analysis and display, and enables them to compare the limitations of the laboratory techniques and instruments with the acquisition systems modelled in virtual instrument industry-standard packages. Successful completion of this module will provide a range of knowledge and skills of value to employers with an interest in sensors and instrumentation.

Year 3: Mathematics for Technology 2

Building on the mathematical methods acquired in Mathematics for Technology 1, this module provides essential mathematical knowledge and techniques for the study of engineering and technology-based disciplines. Dimensional analysis provides a tool for checking the validity of equations, whilst linear regression enables the finding of a linear 'best-fit' to data. Numerical techniques for solving equations are explored. Common probability distributions are introduced. Methods for the solution of first and second order differential equations are established and students are introduced to Laplace transforms. The concept of Fourier series representation of simple periodic waveforms is introduced. In learning these new techniques, students are encouraged to use a mathematical software package to provide a check on their solutions and to further their understanding.

Year 3: Electronic Circuits

This module provides the student with an introduction to the analysis and design of electronic circuits. The module will review the fundamentals that relate to analogue and digital circuit design. Analogue circuits comprising various amplifier classifications will be introduced and their theoretical models will be explained for circuit design. The analogue section also includes an introduction to active filters and Bode plots, an essential ingredient for electronic circuit design. The phase lock loop and its applications are also discussed. Advanced combinational logic design is introduced together with synchronous counter design comprising various forms of memory elements. The fundamentals of sequential logic design is discussed and explained by well established design rules. The principles of operation of all electronic circuits are covered by lecture, tutorial and computer simulation.

Year 3: Signals and Signal Processing

A sound understanding of the nature, characteristics and sources of signals is an essential part in any electronics or audio technology programme. This module will provide the student with an opportunity of gaining a broad understand of signals, their sources and how they are processed using analogue and digital techniques. The students will also gain an insight into how signals are characterised, analysed and filtered. Emphasis will be placed on frequency analysis and its application to audio signals in particular.

Year 4: Signals and Control Systems

This module emphasises the underlying unity of apparently different physical systems (electrical, thermal, mechanical, fluid, chemical, biological etc.) by developing the concept of the system model and using the method of analogy. The module is focussed on simple 'lumped parameter' models with particular reference to instrumentation and control systems. The module starts by contrasting signal types and discusses methods of characterisation. The module concentrates on linear systems, developing the use of the Laplace transform, system block diagrams and the system transfer function as key tools. The difference between static and dynamic system models is explored and practical dynamic models developed. The use of computer tools and packages is integral to the module. This module introduces the principles and practice of modern control systems. Although a basic grounding in maths is required, the approach of the course will be that certain mathematical skills are essential tools for the analysis and design of instrumentation and control systems, hence the module will emphasise the ability to use the tools effectively rather than treat them with mathematical rigour. The problems of instability in feedback and control systems are evaluated with a mixture of case studies and methods for determining the absolute and relative limits of stability in practical systems. The module will cover the specification of the complete system in terms of performance criteria. It will then consider a variety of design approaches both analytical and heuristic. .

Year 4: Final Project

The individual Final Project module allows students to engage in a substantial piece of individual research and / or product development work, focused on a topic relevant to their specific discipline. The topic may be drawn from a variety of sources including: Anglia Ruskin research groups, previous / current work experience, the company in which they are currently employed, an Anglia Ruskin lecturer suggested topic or a professional subject of their specific interest (if suitable supervision is available). The project topic will be assessed for suitability to ensure sufficient academic challenge and satisfactory supervision by an academic member of staff. The chosen topic will require the student to identify / formulate problems and issues, conduct literature reviews, evaluate information, investigate and adopt suitable development methodolgies, determine solutions, develop hardware, software and/or media artefacts as appropriate, process data, critically appraise and present their finding using a variety of media. Regular meetings with the project supervisor should take place, so that the project is closely monitored and steered in the right direction. The project developed in this module is the most substantial piece of work that the student is producing during their undergraduate studies. Thus, the choice of project topic and the quality of the work is likely to bear a great influence on the student's career / employability. Therefore, the module will also include aspects of Personal Development Plan and CV preparation. The students are strongly advised to allocate appropriate attention, time and effort to this module. The successful completion of the module will increase students' employability, as they will acquire skills directly applicable to real world projects.

Year 4: Digital Signal Processing

Fundamental to the understanding of digital signal processing is a sound working knowledge of the mathematical principles which underpin the subject. Also a good understanding of the algorithms which are available for implementing digital signal processing techniques which include digital filtering and spectral analysis methods. The module will therefore provide the student with a working maths framework to enable them to understand how digital signal processing techniques can be implemented in commercial digital systems.

Year 4: Digital Systems and Power Control

The module builds on the previous knowledge of electronic principles, digital and analogue electronics. It provides a review of digital electronic systems along with their design philosophy in the light of using modern Electronic Computer Aided Design (ECAD) tools for design, simulation and implementation. A range of digital electronic systems, from off the shelf discrete components to complex full custom design systems are presented. Programmable Logic Devices, Field Programmable Gate Arrays (FPGAs) and Application Specific Integrated Circuits (ASIC) architectures are highlighted. Algorithmic State Machines (ASMs) analysis, design and implementation techniques are presented in detail along with design minimization / optimisation techniques. The module also gives an insight into some control applications of digital systems, thus proividing conceptual foundation links across several disciplines, including electronic devices and circuits, power converters, energy systems (including renewables and energy storage), hybrid electric vehicles and sustainability.

Year 4: Microelectronic Systems Design

The thrust of the module is to develop Electronic System Design skills via theoretical analysis and case studies, which use industry standard software tools, building up on the knowledge from previous modules concerned with electronics. The module provides a review of the design philosophy in light of using modern Electronic Computer Aided Design (ECAD) tools for design, simulation and implementation of complex electronic circuits. Programmable Logic Devices (PLDs), Field Programmable Gate Arrays (FPGAs) and Application Specific Integrated Circuits (ASICs) are briefly reviewed, along modern embedded electronic system platforms, such as ARM architectures, soft and hard cores. The module presents major aspects of the modern top-down approach to VLSI circuit analysis, design and implementation techniques, aiming to shorten the design cycle and to manage an increased complexity. VHDL (Very High Speed Integrated Circuit Hardware Description Language), a hardware description language largely used for holistic modelling of electronic systems and Integrated Circuit (IC) design, is introduced and discussed in detail using practical design examples. Additionally, modern high-level languages (such as Handle-C, System-C, etc.), used in the development and design of electronic system-on-chip and embedded systems are introduced, with practical case studies also presented. The module delivery strategy combines complex theoretical aspects and case studies presented during lectures, with practical skills - hands on supervised and unsupervised laboratory work, using state-of-the art industry standard

CAD tools. The successful completion of this module will increase students' employability, who will acquire industry standard skills, directly applicable to real world projects.