Anglia Ruskin University

Course Information Sheet

BEng (Hons) Mechanical 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

Mechanical engineers design, manufacture, repair or operate the things we need in everyday life. Learn in one of the most advanced engineering laboratories in any UK university.

Mechanical engineers solve problems through innovation, helping society to become more advanced and adventurous.

Our course will prepare you to work in competitive commercial and industrial environments. It gives you both academic and practical skills, so you become an analytical and creative problem-solver. You'll develop valuable skills in teamwork, management and leadership and learn an integrated approach to engineering valued by employers. We'll explore how engineering works in the business context, and how to achieve results within financial constraints.

Using test and measurement equipment, you'll learn how to specify and design electronics subsystems. You'll understand how to use computer-based and mathematical methods to model and analyse mechanical-engineering problems.

You'll also consider your professional and ethical responsibilities, including the global and social contexts of engineering. Hands-on experience, plus lectures from visiting engineers, will ensure you're up-to-date with current methods in industry.

Our facilities include a CAD/CAM centre, industrial-scale CNC milling machine, CNC lathe, rapid prototyping machine, scanning electronic microscope, Instron bi-axial fatigue-testing machine, tensile-testing machine, material-preparation facilities, welding equipment and electronic testing and measuring equipment such as oscilloscopes and signal generating and testing facilities.

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 use a range of assessment methods to check your academic and practical progress throughout the course. These include exams, essays and reports, work relating to practical classes and demonstrations, log books, presentations and posters.

Fees

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

Additional Costs

Additional Costs

Safety footwear (steel toe and midsole) - £40

General stationary and calculator - £100

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: Introduction to Engineering Materials

This module is designed to introduce students to the structure and properties of a range of engineering materials. It includes a review of typical load extension curves and their interpretation and the student will carry out tensile tests on engineering materials to support and extend the classroom teaching. The module also contains an introduction to the atomic structure of metals and non metals as a lead into an understanding of the factors that influence the physical properties of materials. Alloying of metals will be explored via equilibrium diagrams and structure will be determined from given information. This module will develop the students' skill of gathering and interpreting scientific information via a series of laboratory experiments. This will involve the use of metallurgical inspection equipment as well as common testing equipment. The module is supported by a well equipped metallurgical laboratory serviced by technical staff.

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: Introduction to Mechatronics

This module covers the components of a Mechatronics system that include sensors, electrical as well as mechanical systems integrated together via computer programming. It is intended to build a solid foundation through theoretical concepts (in-class lectures) and their practical applications (laboratory sessions).

Microcontroller and microprocessors will be introduced along with different types of sensors (such as proximity, distance, force and temperature) and their usage in the real world. This aspect will then be integrated by introducing the fundamentals of electrical actuation systems such as relays, solenoids and motors (stepper, DC, AC etc).

The basics of mechanical actuation systems will be introduced as well to give students a complete understanding of how different components of a Mechatronic system work together. This will include concepts related to gear trains, hydraulic pumps, valves, pneumatic systems, kinematic chains etc. the module will also touch upon some case studies for Mechatronics system so that the students can fully appreciate its applicability in the daily life.

The module will have eight weeks of lectures and four weeks of laboratory sessions. The laboratory sessions will provide students with the opportunity to implement their in-class learning to real world applications by the use of specialised electronic kits and mechanical actuation systems.

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: Manufacturing

This module is designed to provide the student with a basic understanding of manufacturing and joining processes. It particularly gives the insight to the need of selecting the most appropriate manufacturing process in terms of technological feasibility and cost for a component. It explores the necessity to ensure, where possible, that the component design can be manufactured most efficiently and economically by a chosen technology. The students will be introduced to modern equipment such as CNC machine and will have the opportunity to plan and make a component or product. Typical machine processes such as milling and turning will be introduced. Students will conform to the regulations relating to safe workshop practice. About fifty per cent of the module will be based on practical design, plan and manufacture of a component or product. On the practical side, students can work either as a group or individually depending on the complexity of the product they make. But the final report is to be an individual work and includes critical evaluation of the product design, generation of alternative manufacturing processes and final recommendations.

Year 2: Introduction to Engineering Mechanics

This module aims to provide students introductory competency in core mechanical engineering concepts and its wider applications in day to day life as well as in engineering. The module starts with notion of vector and definition of main concepts and international system of units in mechanical engineering including concepts of particle, rigid body, and dimensions. Students then learn fundamental concepts of Newton’s laws and relation between statics and dynamics. The module content include important concepts in statics such as equilibrium, force decomposition, and free body diagrams in two dimensions. The dynamics is covered in one dimension and includes zero and constant acceleration motion of particles and second and third laws of Newton. The concept of friction and reaction force and relevant applications is presented in the module. A wide range of

applications and their theoretical underpinning relevant to the mechanical concepts is presented throughout the module to enable and encourage students to apply and think about applying the concepts in more engineering applications. Furthermore, the module is supported by basic statics laboratory to provide students a hands-on activity and practical vison in the core mechanical concepts and laboratory skills. The module will only require basic maths skills of solving linear equations.

Year 2: Electronic Principles for Robotics

This module covers the components of a Mechatronics system that include sensors, electrical as well as mechanical systems integrated together via computer programming. It is intended to build a solid foundation through theoretical concepts (in-class lectures) and their practical applications (laboratory sessions).

Microcontroller and microprocessors will be introduced along with different types of sensors (such as proximity, distance, force and temperature) and their usage in the real world. This aspect will then be integrated by introducing the fundamentals of electrical actuation systems such as relays, solenoids and motors (stepper, DC, AC etc).

A wide range of electronic components in analogue or digital applications are covered such as filters, operational amplifiers, Schmidt triggers, comparators, counters, flip flops and all digital gates. An assembly of these components towards a robotic control systems are explained and demonstrated.

The module will have eight weeks of lectures and four weeks of laboratory sessions. The laboratory sessions will provide students with the opportunity to implement their in-class learning to real world applications by the use of specialised electronic kits and mechanical actuation systems.

Year 3: Applied Mechanics

This module aims to give the students a broad range of competence in applied mechanics and structural analysis. Emphasis will be on applications of structural analysis of mechanical parts and assemblies. Applied Mechanics is the study of the static and dynamic of particles and rigid bodies under the influence of forces. The module is crucial part of failure analysis of mechanical parts and components and complements students' knowledge on materials and processes as well as stress and strain analysis.

In this module worked examples enable the students to become familiar with, and to grasp important concepts and principles in applied mechanics for example pin-jointed and rigid-jointed frames and deflection of the beams with various support systems and variable loading, and concept of three dimensional force balancing of structures. The module includes engineers' bending and torsion equations relating external forces to the internal stresses. Furthermore, force profiles applied by fluid flow in applied mechanics are covered.

The module includes laboratory experiments in structural analysis and mechanical mechanisms conducted during two weeks delivery of the module.

Year 3: Materials and Processes

This module develops the learning outcomes covered in Introduction to Engineering Materials and reviews the use of equilibrium diagrams as an aid in predicting the structures of binary alloys under equilibrium cooling conditions. The module includes the atomic structure of engineering materials in predicting their behaviour in terms of physical and mechanical properties. Equilibrium and non equilibrium structure of metals will be investigated in the laboratory in order to predict long term behaviour. The use of metals and non metals under repeated loading cycles, the fracture toughness and creep resistance will be explored in order to design components able to withstand a variety of service requirements. The economics of manufacture will cover the most optimum method of manufacturing with engineering materials and the effect of the processing on its structure. The module includes laboratory experiments where the student will be using a variety of test equipment and will be expected to complete full technical reports as part of his assessment. A technical visit will also form part of the module in order to witness industrial design processes and testing procedures.

Year 3: Engineering Design

This module is designed to develop the students' ability to establish a need and design a product and processes working as part of a design team. Students consider marketing elements, cost and payback period, technological obstacles, ethical, regulatory and legal elements of the product and processes and the end user needs to develop a design thinking framework and produce product design and process brief. The product design and development stages such as concept generation and

selection as well as feasibility studies are performed by students within groups. Detailed design methods and design for manufacture and assembly are taught and experienced by students. While the advanced use of 3D design software is vital, areas such as design strategies for 3D printing are explored, in some cases leading to rapid prototyping of the final product. Product lifecycle management, sustainability and environmental issues, adaptability to market change, intellectual property, and innovation management are part of materials covered in this module.

The module designed to bring small groups of students together into teams so that they co-ordinate their individual skills and abilities experiencing positive effect of a diverse teamwork in product and process development and develop skills in leadership, technical communications, brainstorming and team creativity. The scheme of work should allow the individual student an opportunity to take responsibility for their own contribution to the outcome and to demonstrate their ability to work as part of a team. The design brief will include an agreed timescale for the staged development of the product within defined constraints, with the team working towards an acceptable and viable solution to the brief.

Year 3: Dynamics and Fluid Mechanics

This module introduces the fundamentals of engineering principles, encompassing solid and fluid mechanics. It is intended to provide a sound theoretical basis for the analysis and synthesis of mechanical engineering systems. The module will review fundamentals of mechanical dynamics, fluid mechanics, and basic heat transfer.

Basic static systems such as moments of force, simple structural analysis, and friction problems are introduced. Dynamics relating to Newton's laws of motion are also discussed and applied. Fundamental understanding and applications of fluid mechanics, fluid statics, and Bernoulli’s equation are introduced as well as various classifications of fluid flow and concept of laminar and turbulent flow.

Furthermore, idea of pressure and its application in manometers are presented alongside applications of mass conservation in fluid flow problems. In heat transfer basics of conduction, convection and radiation heat transfer introduced and applications for one dimensional composite conduction and combined mode of heat transfer is presented. The module comprises set of laboratory and practical experiments regarding basic conduction and convection heat transfer as well as fundamental of fluid dynamics.

Year 3: Mathematics for Engineers 2

The module is designed to build on work in the pre-requisite module by introducing techniques that lie behind the solution of engineering problems. The methods tend to be hidden within software and the module will provide an insight into the techniques, their application and their limitations so that students can make informed judgements on reliability of software solutions. Calculus is extended to partial differentiation and its applications and Laplace transforms and matrices are considered in depth. A statistics section is also included applied to the numerous areas of civil engineering which use these techniques It is intended that the module will enable students to undertake appropriate analysis in areas such as hydraulics, geotechnics, structural analysis and design.

Year 3: Statistics and Process Quality Assurance

The use of statistical tools in industries for process quality assurance is a very vital part for the growth of an organization. Various quality management theories and philosophies have been proposed and implemented over the years to enhance productivity and gain more rewards. This module provides the students with the knowledge and confidence to use sound statistical techniques in industrial applications for process control and problem solving. The history and implementation of quality management alongside quality standards and statistical analysis of experiments using different control charts for analysing the capability of a process are some of the key topics covered in this module. The module will also give an appreciation of the wider aspects of quality management tools and risks associated with their implementation and continuity of such methods that are vital to the survival of all organisations.

Year 3: Computer Aided Solid Modelling

This module builds on previous CAD experience to create more complex solid part models and consider advanced aspects of CAD. It looks at assemblies made up of a number of parts and sub-assemblies. One of the key elements will be the use of feature-based parametric modelling technique which automates the design and revision procedures by the use of parameters. The module introduces the methods for modelling sculptured surfaces that are seen in plastic mouldings and transition elements.

Moving parts in an assembly are checked with animation and their mechanisms are analysed. The assembly, normal or exploded, are produced with parts list and ballooned references in 2D views.

Year 4: Thermofluids

This module is very conceptual, being based upon two laws which are really statement of observation. In addition the theoretical development requires the manipulation of some fluid and thermal properties which have no physical presence. But, at the same time it is a very practical subject. It enables the energy transfer to be determined in many useful thermal systems with some degree of confidence In preparing this module, care has been taken to ensure that the end result is an integrated work because the module requires the combination of the basic principles of thermodynamic/heat transfer and fluid mechanics, applied to practical engineering problems using computer simulation.

The examination of thermal system enables this to be achieved. Methods will be proposed for predicting how much energy in the form of work and heat is available in the components that make up common thermal system. In this module numerical modelling cases enable the students to grasp important concepts and principles in fluid mechanics such as mass, energy and momentum. The mathematical approach is simple for anyone with prior knowledge of basic maths and physics.

The range of applications for numerical simulation includes incompressible Newtonian fluids, single and multiphase phase flow, followed by compressible, combustion, erosion, aerodynamics, turbomachinery, and non-Newtonian fluids. Analysis of mass and mass transfer, work transfer in non-flow process, heat transfer in non-flow process special characteristics of work and heat transfer in flow and non- flow process are some of the thermofluid studies that will be covered.

Year 4: Modelling and Simulation for Operations Management

This module provides students with the tools and techniques to analyse the supply chain, using a computer simulation system. It covers the need for advanced analysis tools in the manufacturing industry as the pace of change is accelerating and the competition is getting tougher. It compares common supply chain decision support systems that include back of the envelope calculation, use of spreadsheets, queuing theory and simulation. The ability of simulation to represent systems with stochastic nature and its ability to see the system as a whole, considering the relationships and interactions between elements and the embedded logic is discussed. Simulation software is used to build valid shop floor models which may be subjected to varying influencing parameters. The output from the simulation models is used to assess performance. The performance of a supply chain can then be predicted and optimum operating conditions determined.

Year 4: Research Methods and Individual Project

This module enables students to carry out an individual piece of research in the Mechanical engineering field which will require a literature review of current knowledge in the chosen topic area, the formulation of a research question and the collection of primary data - by analytical methods, numerical modelling, case study, interview, questionnaire or experimentation. Advice will be given by Mechanical engineering staff on choosing a research topic in a briefing session delivered towards the end of the academic year prior to that in which the student undertakes their dissertation.

The research will be undertaken under the supervision of an academic member of staff but the early part of the module is supported by classroom sessions to explain the processes of reviewing literature, formulating a research question, and the collection and the evaluation of primary data. A minimum number of four supervision tutorials will take place during the academic year in which the module is studied.

Year 4: Project Management for Technologists

This module is about the planning and control of engineering projects. It covers aspects of planning for engineering projects, operations research techniques, scheduling, quality, people and management skills. The major purpose is to encourage the student thinking about the variety of techniques available that could be used for the control of projects and to give insight to the theoretical underpinning concepts of these techniques. It gives the student the opportunity to take time out to reflect on just what these issues are and what future developments might be envisaged, both in specific work place context and in a general professional development context. The areas this module covers are project life-cycle related to environmental considerations, project constraints, resource utilisation, managing risks, optimum task scheduling, types of contract, and closing a project. Therefore, this module not only supports students' future careers in managing practical projects, it provides them with a view on

commercial, management, and organisation of conducting a project in engineering.

Year 4: Vibration and Control

Mechanical engineering systems, structural or machinery, often experience problems associated with vibration which may lead to failure of design and product. Part of this module will provide the student with fundamental understanding of problem of vibration and analytical tools necessary to model the problem in an

engineering system. This will include classifications of vibration and analytical analysis of free and forced vibration in single degree of freedom systems. The module will discuss methods of vibration control as well as vibration measurements with emphasise on applied engineering. The second part of module provides the students with fundamentals and classifications of control systems, including feedforward vs feedback and open vs closed loop controls as well as use of Laplace transform methods to analyse linear control systems.

The module delivery is based on practical and applied engineering problems and will look at various error management in feedback controls including proportional and integral controllers. The module is also covers topics relating both the vibration and the control elements integrated in engineering applications.

Year 4: Computer Aided Engineering

This module is designed to introduce the student to computer aided engineering as applied in the industry with emphasis on the analysis, manufacture and test of a simple component. The module is predominantly 'hands on' and employs industry-standard software mainly in design and structural analysis. At the theoretical level, students learn to implement hand calculations for stress analysis which is assessed by one-hour in-class test. The theoretical parts show students the detailed process of the problem adaption to computer based solutions using finite element analysis (FEA). For design and analysis course work, students work on optimising a specific design considering external loads and use of material and by considering their learning from theoretical analysis of such problem. The comparison is done between analytical and numerical methods for the task. Depending on the task, students could also build and test the part using laboratory equipment experimentally to compare the results with hand calculations and the numerical analysis on software. The overall strategy is to build a bridge between theory, use of computer modelling, and actual experiment and for student to experience advantages and disadvantages of each method and relevant error and uncertainty sources.