UNIVERSITY OF LIVERPOOL

Mechatronics and Robotic Systems

BEng (Hons)

COURSE DETAILS

- A level requirements: ABB
- UCAS code: HH67
- Study mode: Full-time
- Length: 3 years

KEY DATES

- Apply by: 31 January 2024
- Starts: 23 September 2024

Course overview

Immerse yourself in technologies in the areas of mechanical, control and electrical engineering, electronics, and computing. Mechatronics and Robotic Systems covers everything from driverless cars and automated robots at manufacturing assembly lines, to remotely operated vehicles on Mars.

INTRODUCTION

You'll receive a thorough grounding in a range of electrical and computer control systems, and technologies in mechanical engineering, electronics, electrical engineering, control engineering and computing.

Whilst many products are essentially mechanical in nature, most could not function without electrical and computer control systems. There are also numerous automotive applications; modern high-performance cars have more than 100 computers hidden in the engine management system, anti-lock brakes, active suspension control and elsewhere. Engineers with experience in mechatronics and robotic systems are therefore in high demand.

We work closely with industry leaders to develop all of our programmes. Building on the core principles of electrical/electronic engineering, you will develop advanced skills in and experience with industry standard tools, technologies and working methods.

WHAT YOU'LL LEARN

- Working as part of a team to undertake major projects
- The numerous real-world applications of mechatronics and robotic systems
- Advanced skills in design and implementation

- Be prepared for the global workplace
- Different systems, technologies and cultures within the global industry

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ACCREDITATION

Accredited by the Institution of Engineering and Technology (IET) on behalf of the Engineering Council for the purposes of fully meeting the academic requirement for registration as an Incorporated Engineer and partly meeting the academic requirement for registration as a Chartered Engineer.

Course content

Discover what you'll learn, what you'll study, and how you'll be taught and assessed.

YEAR ONE

COMPULSORY MODULES

DIGITAL & INTEGRATED ELECTRONICS DESIGN (ELEC143)

Credits: 15 / Semester: semester 2

The module comprises of two parts Digital Electronics and Integrated Electronics. For the Digital part, students are provided with the knowledge of number systems, laws of Boolean algebra and introduced to the basic methods for designing combinational and sequential logic circuits. For the Integrated part, students are introduced to various silicon electronic devices and provided with the opportunity to understand the basic principles of silicon microelectronics designs processes including designing layouts for simple circuit.

ELECTRICAL CIRCUITS & SYSTEMS (ELEC142)

Credits: 15 / Semester: whole session

Fundamental course on circuit analysis techniques.

ELECTRONIC CIRCUITS (ELEC104)

Credits: 15 / Semester: whole session

This module aims to introduce students to fundamental electronic devices (diodes and transistors), and how these devices are used in amplifier and switching circuits. The module is assessed via two laboratory sessions (20%) and two coursework online assignments (80%).

EXPERIMENTAL SKILLS (ELEC172)

Credits: 7.5 / Semester: semester 1

Introductory module that teaches practical skills for electrical engineering students, focusing on basic laboratory skills. The practical skills are linked with theory presented in other Year 1 modules including those on analogue and digital electronics. The module also includes an introduction to a technical programming language (MATLAB) and an introduction to some of the ethical and sustainability issues that face modern engineers.

INTRODUCTION TO MECHATRONICS (ELEC123)

Credits: 7.5 / Semester: semester 2

This module covers electromechanics, including the principles and construction of DC and AC machines, transformers and linear actuators.

INTRODUCTION TO PROGRAMMING IN C (ELEC129)

Credits: 15 / Semester: semester 1

This module is an introductory course to the C computer programming language. The module provides a comprehensive overview of the fundamentals of C programming (variables, data types, operators, pointers, arrays, strings, structures, functions, input/output operations and flow control) and the software development method (specification, analysis, design, implementation/coding and testing).

SOLIDS AND STRUCTURES 1 (ENGG110)

Credits: 15 / Semester: whole session

This module aims to introduce students to the fundamental concepts and theory of how engineering structures work to sustain loads. It will also show how stress analysis leads to the design of safer structures. It will also provide students with the means to analyse and design basic structural elements as used in modern engineering structures.

MATHEMATICS A FOR ELECTRICAL ENGINEERS (ELEC191)

Credits: 15 / Semester: semester 1

Mathematics for students registered in the Department of Electrical Engineering and Electronics, to support their technical modules.

MATHEMATICS B FOR ELECTRICAL ENGINEERS (ELEC192)

Credits: 15 / Semester: semester 2

Basic mathematics for students registered in the Department of Electrical Engineering and Electronics, concentrating on those groups of students who have, on the average, weaker preparation for University level Maths such as entrants with the BTEC qualification (but not limited to that group). Exam practice is another important component of this module. This module follows on from ELEC191

Programme details and modules listed are illustrative only and subject to change.

YEAR TWO

COMPULSORY MODULES

DIGITAL ELECTRONICS & MICROPROCESSOR SYSTEMS (ELEC211)

Credits: 15 / Semester: semester 2

This module covers two areas. In digital electronics, it covers topics which build on the basic knowledge gained in the first year digital electronics programme and learning some hardware description language (HDL) programming. In microprocessor systems, it introduces the topic from the basics describing how a microprocessor works and learning some assembly language programming.

DYNAMIC SYSTEMS (MECH215)

Credits: 15 / Semester: whole session

Dynamic systems are encountered in most engineering disciplines such as mechanical engineering, aerospace engineering, electrical engineering. These systems require specific techniques to be analysed for design or monitoring purpose.

In this module, students will learn the main methods for analysing dynamic systems in time and frequency domains. They will learn how to solve dynamical problems, how to evaluate and control the stability, the accuracy and the rapidity of a dynamical system.

This module will be mainly delivered through class lectures and assessed through a final exam. Additionally, students will be taught some experimental techniques related to second-order dynamical systems through an assessed laboratory work.

ELECTRICAL CIRCUITS & POWER SYSTEMS (ELEC209)

Credits: 15 / Semester: semester 1

This module is aimed at equipping students with tools to analyse inter-related electrical circuits and systems and to provide students with an introduction to the components and composition of an electric power system. It also covers the different primary energy sources and the way in which power is delivered to the customers. Teaching and learning are provided through variety of means like formal lectures, problem sheets, supplementary question sheets, worked example sheets along with formative and summative online tests (through CANVAS, the electronic VLE system). Assessment is carried out by means of coursework and final (written) exam.

ELECTRONIC CIRCUITS AND SYSTEMS (ELEC271)

Credits: 15 / Semester: semester 2

The module concerns the understanding of how electronic amplifier circuits work and some basic ideas on how to design them. This requires an appreciation of linear small-signal equivalent circuits based on device physics and how to use them to assist the design process. Students will also learn how to break down complex circuits into simpler building blocks and how these blocks in turn, represented by linear equivalent circuits, can be combined to achieve the desired functionality. How negative feedback can be applied to produce high performance, stable circuits with high tolerance. The current state of the art is emphasised together with a historical perspective, noting some of the pioneers in the field.

FIELD THEORY AND PARTIAL DIFFERENTIAL EQUATIONS (MATH283)

Credits: 7.5 / Semester: semester 1

(This module is for those EEE students who have not studied at XJTLU).

Maxwell's equations elegantly describe the physical laws governing such things as electrodynamics. Related problems may be posed in terms of vector calculus, or in terms of differential equations. In this module, we revise vector calculus and field theory in three dimensions, using Stokes' theorem and Gauss' theorem to solve explicit physical problems; we evaluate path, surface and volume integrals, and derive general electrodynamic laws. We also consider both the ordinary and partial differential equations arising from real world problems related to Maxwell's equations, and solve them using Fourier series methods.

INSTRUMENTATION & CONTROL (ELEC207)

Credits: 15 / Semester: whole session

This module covers the design and operation of instrumentation devices as well as the design of continuous time control systems.

PROJECT, PROBLEM SOLVING & INDUSTRIAL AWARENESS (ELEC222)

Credits: 7.5 / Semester: whole session

The aim of this module is to provide students with practical work which underpins, confirms and gives application focus for academic study, while testing a wide range of skills.

SIGNALS AND SYSTEMS (ELEC270)

Credits: 15 / Semester: semester 1

Introduces continuous and discrete signal operations and analysis, the frequency domain and spectral analysis, including Fourier Series and Fourier, Laplace and z Transforms. Introduces system quantification and analysis, including pole-zero plots, feedback, basic stability criteria and block diagrams.

ROBOTIC SYSTEMS (ELEC230)

Credits: 15 / Semester: whole session

This module aims to give students an understanding of the basic knowledge required to develop a mobile robot system. Initially they will be taught the features of Linux and how to program using the Object-Oriented approach with C++, along with aspects of sensors and actuators for mobile robots. Subsequently students will be taught the key features of ROS for simulation and then use ROS to explore aspects of development of a mobile robot system.

Programme details and modules listed are illustrative only and subject to change.

YEAR THREE

You will study both compulsory mechatronics and robotic systems modules, plus optional modules chosen from a wide-ranging list of advanced topics. You will also undertake an extended individual project.

COMPULSORY MODULES

DRIVES (ELEC331)

Credits: 7.5 / Semester: semester 1

This module introduces students to a range of electrical machines (AC & DC) using the concepts of rotating magnetic fields and co-energy. This allow students to model their behaviour and select the most appropriate electrical machine for their application.

LOW POWER COMPUTER ARCHITECTURE (ELEC370)

Credits: 15 / Semester: semester 1

In this module students gain an understanding of the architecture and operation of embedded computer systems and their components. Furthermore, they gain an understanding of how computer performance is dependent upon the design of computer architectures and sub-circuits.

BENG PROJECT (ELEC340)

Credits: 30 / Semester: whole session

Students undertake an extended individual project. Projects are specified by academic staff and cover the whole range of Electrical and Electronic Engineering including hardware (both analogue and digital), software and simulation or a mixture of these. Students can also suggest their own projects which need to be approved by an academic supervisor. Students work closely with their academic supervisor to realize their project aims and assessment is split between a preliminary report, an oral presentation, the bench inspection and the final report.

ROBOTIC SYSTEMS II (ELEC330)

Credits: 15 / Semester: whole session

The purpose of this module is to provide an introduction to robotics applications, cover basics of modelling, design, planning anc control of robot systems.
Topics include forward and inverse kinematics, velocity kinematics, dynamics, actuators and drive systems, robot mechnisms, trajectory planning, sensing and machine vision.

ENGINEERING MANAGEMENT & ENTREPRENEURIAL SKILLS (ELEC352)

Credits: 7.5 / Semester: semester 1

This module covers project management for year 3 students registered in the Department of Electrical Engineering and Electronics. Entrepreneurial skills are also be covered.

DIGITAL CONTROL AND OPTIMISATION (ELEC303)

Credits: 15 / Semester: semester 2

A broad range of topics are covered. Case studies and example tutorials emphasise the practical aspects of digital control design and optimisation.

INDUSTRIAL ROBOTICS & AUTOMATED ASSEMBLY (MNFG309)

Credits: 15 / Semester: semester 2

This module investigates how industrial robots and other equipment are used and integrated into more complex automated systems. The module emphasis is upon the application and use of these systems, with less emphasis on the underlying theoretical mechanisms. The module is based in the concept of learning through doing, the underlying content being presented as videos, while the contact time is used in practical sessions using industrial robots and in the development of robotic systems using industrial simulation software. The assessments are designed to help reinforce understanding rather than short term memory.

OPTIONAL MODULES

APPLICATION DEVELOPMENT WITH C++ (ELEC362)

Credits: 15 / Semester: semester 1

This course will help student to understand the object-oriented design concept and to gain knowledge and practical skills of C++ as an advanced programming language.

On successful completion of the module, students should be able to understand/design/develop C++ applications (both console and GUI-based) with a specific emphasis on developing GUI-based applications.

DIGITAL SYSTEM DESIGN (ELEC373)

Credits: 15 / Semester: whole session

This module introduces students to the digital design techniques used in industry and research. The methods for describing digital systems using the Verilog Hardware Description Language (HDL) are introduced. Student will examine the operation of the MIPS Processor and will also be introduced to Altera's NIOS-II Processor. The module is assessed via 4 assignments and two class tests. Altera's Quartus package is used for synthesising the digital systems.

ELECTRONICS FOR INSTRUMENTATION & COMMUNICATIONS (ELEC317)

Credits: 15 / Semester: semester 2

The module introduces basic concepts of the electronic circuits required for instrumentation and communication. It deals with a wide range of amplifiers and the problems that might be encountered in a actual application. It also deals with circuitry needed in communication for example oscillators and phase-locked-loops.

IMAGE PROCESSING (ELEC319)

Credits: 7.5 / Semester: semester 1

This module covers the fundamentals of how images are generated, represented, compressed and processed to extract features of interest.

NEURAL NETWORKS (ELEC320)

Credits: 7.5 / Semester: semester 2

Introduction to neural network theory, applications and artificial intelligence.

SIGNAL PROCESSING AND DIGITAL FILTERING (ELEC309)

Credits: 15 / Semester: semester 2

This module is aimed at developing the basic framework for signal processing and to demonstrate its applications. Also, the module provides students with a good understanding of the types, behaviours and design of FIR and IIR digital filters.

Teaching and learning are provided through a variety of means like formal lectures, problem sheets, supplementary questions, along with formative and summative online tests (through CANVAS, the electronic VLE system).

Assessment is carried out by means of two assignments and final (written) exam.

POWER SYSTEMS AND POWER ELECTRONICS (ELEC301)

Credits: 15 / Semester: semester 1

A core module of electrical engineering for delivering fundamental principles of power systems: including electricity generation, transmission and distribution, and power electronics for conversion of electricity with different frequency and magnitude.

PHOTONICS AND OPTICAL INFORMATION SYSTEMS (ELEC313)

Credits: 15 / Semester: semester 1

The aims of this module are: To introduce students to the fundamental principles of opto/electronic systems for the transfer of information. To introduce the duality of light as both wave and ray. To show intensity and phase related optical principles. To demonstrate optical information transfer through a number of applications.

PLASMA SYSTEM ENGINEERING (ELEC391)

Credits: 7.5 / Semester: semester 1

The module introduces to the students the basic concepts of electrical plasmas and how they are used in industry. It concentrates on the engineering principles behind plasma technology rather than the physics of the discharge, however some mathematical approaches are explored so that quantification of the action of plasmas upon material surfaces can be made. The module explains how a gas can turn into a plasma and how high energy ions in the plasma can be generated to process a substrate, such as silicon wafer in micro-electronics fabrication. The module is taught by a mixture of power points notes and chalk and talk. There are a number of question sheets given out to help the students understand the basis plasma-material processes. On completion, students will understand how plasmas are used in industry, they will have an appreciation of some aspects of simple design and how plasmas can be configured for the next generation of fusion power stations.

ADVANCED MODERN MANAGEMENT (MNGT352)

Credits: 7.5 / Semester: semester 1

The Aims of this module are as follows:

To introduce the student to various aspects of advanced modern management.

To develop a knowledge and understanding of modern management tools.

To stimulate an appreciation of management and its importance in organisational success.

Programme details and modules listed are illustrative only and subject to change.

HOW YOU'LL LEARN

All programmes are taught over two semesters with examinations at the end of each semester. Modules vary from those which are assessed by examination only to others which are continuous assessment only. All programmes incorporate a substantial practical

component, with an increasing emphasis on project work as you progress through to the final year. You can select your final year individual project in consultation with members of staff.

HOW YOU'RE ASSESSED

Assessment is carried out through a mixture of exams, coursework and projects.

LIVERPOOL HALLMARKS

We have a distinctive approach to education, the Liverpool Curriculum Framework, which focuses on research-connected teaching, active learning, and authentic assessment to ensure our students graduate as digitally fluent and confident global citizens.

Careers and employability

There is a high demand for engineers with experience in mechatronics and robotic systems in a number of industries. For example, there are numerous automotive applications, with modern high-performance cars having more than 100 computers hidden within their systems.

Some of our graduates go on to work in the industrial sector, in government and in education, whilst others enter non-technical professions such as banking, accountancy, management and law.

Recent employers include companies from the following industries:

- Technology/electronics: ARM Holdings Ltd, Ericsson Ltd, Marconi, Deva Electronic Controls, Siemens UK, Logica CMG
- Energy/utilities: Energetix Group PLC, Scottish Power, United Utilities PLC
- Research/science: Daresbury Laboratory, Science and Technology Facilities Council, Ministry of Defence, Royal Liverpool University Hospital (Clinical Engineering)
- Engineering and manufacturing: Heap and Partners Ltd, Siemens UK, The Highways Agency, British Nuclear Group.

100% **OF ELECTRICAL ENGINEERING AND ELECTRONICS STUDENTS ARE IN WORK AND/OR FURTHER STUDY 15 MONTHS AFTER GRADUATION.**

Discover Uni, 2018-19.

Fees and funding

Your tuition fees, how to pay, and other costs to consider.

TUITION FEES

UK fees (applies to Channel Islands, Isle of Man and Republic of Ireland)	
Full-time place, per year	£9,250

International fees	
Full-time place, per year	£27,200

Fees are correct for the academic year 2024/25
Tuition fees cover the cost of your teaching, assessment, and operating University facilities such as libraries, IT equipment, and access to academic and personal support.

ADDITIONAL COSTS

We understand that budgeting for your time at university is important, and we want to make sure you understand any course-related costs that are not covered by your tuition fee. This may include a laptop, books, or stationery. All safety equipment, other than boots, is provided free of charge by the department.

Find out more about the additional study costs that may apply to this course.

SCHOLARSHIPS AND BURSARIES

We offer a range of scholarships and bursaries to provide tuition fee discounts and help with living expenses while at university.

Check out our Undergraduate Global Advancement Scholarship. This offers a tuition fee discount of up to £5,000 for eligible students starting an undergraduate degree from September 2024. There's also the Liverpool Bursary which is worth £2,000 per year for eligible students.

Discover our full range of undergraduate scholarships and bursaries

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Entry requirements

The qualifications and exam results you'll need to apply for this course.

Your qualification	**Requirements** About our typical entry requirements
A levels	ABB Applicants with the Extended Project Qualification (EPQ) are eligible for a reduction in grade requirements. For this course, the offer is **BBB** with **A** in the EPQ. You may automatically qualify for reduced entry requirements through our contextual offers scheme. If you don't meet the entry requirements, you may be able to complete a foundation year which would allow you to progress to this course. Available foundation years: • Engineering Foundation BEng (Hons) (4 year route including a Foundation Year at Carmel College)
GCSE	4/C in English and 4/C in Mathematics
Subject requirements	A level Mathematics and a science subject (Chemistry, Computer Science, Further Mathematics, Physics or Electronics). For applicants from England: For science A Levels that include the separately graded practical endorsement, a Pass is required.
BTEC Level 3 Subsidiary Diploma	Distinction in BTEC (any subject) plus AB in A Levels. A Levels must include Mathematics and a science subject (Chemistry, Computer Science, Further Mathematics, Physics or Electronics).
BTEC Level 3 Diploma	D*D in a relevant BTEC considered alongside grade B in A

Your qualification	**Requirements** About our typical entry requirements
	Level Mathematics.
BTEC Level 3 National Extended Diploma	D*D*D in a relevant Diploma, including Distinction in 'Further Mathematics for Engineering Technicians' unit. Students will also be required to take an online Mathematics assessment, please contact the University for further information.
International Baccalaureate	33 overall, including 5 in Higher Level Mathematics and 5 in a Higher Level science subject.
Irish Leaving Certificate	H1, H2, H2, H2, H3, H3 including H2 or above in Mathematics and a science subject (Chemistry, Computer Science, Further Mathematics, Physics or Electronics).
Scottish Higher/Advanced Higher	ABB in Advanced Highers including Mathematics and a science subject (Chemistry, Computer Science, Further Mathematics, Physics or Electronics).
Welsh Baccalaureate Advanced	Accepted at grade B alongside A Level grades AB in Mathematics and a science subject (Chemistry, Computer Science, Further Mathematics, Physics or Electronics).
Cambridge Pre-U Diploma	D3 in Cambridge Pre U Principal Subject is accepted as equivalent to A-Level grade A M2 in Cambridge Pre U Principal Subject is accepted as equivalent to A-Level grade B Global Perspectives and Short Courses are not accepted.
Access	Considered if taking a relevant subject. 42 Level 3 credits at Distinction, including 15 Level 3 credits in Mathematics is required. GCSE English and Mathematics grade C/4 or above also required. Students will be required to take an online Mathematics assessment, please contact the University for further information.

Your qualification	Requirements About our typical entry requirements
International qualifications	Many countries have a different education system to that of the UK, meaning your qualifications may not meet our entry requirements. Completing your Foundation Certificate, such as that offered by the University of Liverpool International College, means you're guaranteed a place on your chosen course.

ALTERNATIVE ENTRY REQUIREMENTS

- If your qualification isn't listed here, or you're taking a combination of qualifications, contact us for advice
- Applications from mature students are welcome.

THE ORIGINAL REDBRICK