BEng (Hons) Robotics, Automation and Mechatronic Engineering

UCAS code	SQ02
Institution code	H12
Start date	September 2027
Location	Station Quarter

Why Study a Robotics, Automation and Mechatronics (RAM) Degree?

Businesses worldwide need experts in robotics, automation and mechatronics to help them develop streamlined automated processes, solve problems and create manufacturing facilities of the future. Whether it's developing self-driving cars, new products for military or commercial applications, or creating new robotised production lines, this course is about developing essential transferable skills for the jobs of the future. This unique robotics engineering course develops you as an engineer and roboticist to design new manufacturing systems for our ever-evolving world.

But why Harper Adams University?

Here at Harper, our hands-on degree immerses you in real projects. You'll actively design, test, and evaluate processes, products, and create automated assembly lines, making your learning experience truly dynamic. With our focus firmly on your future career, you will have the opportunity to work with potential employers and industries through case studies, projects and briefs set by our industry partners and academics. We address core issues that align with our values, including sustainability, climate change, society, health, wellbeing, efficiency, ethics and innovation. This approach shapes you into a global engineer that is also an industry-ready graduate.

Harper Adams is a hub of opportunity, with students and staff participating in various STEM and Robotics competitions; including the CLAAS annual Field Robot event, the Efficiency For Access Design Challenge and developing a fully automated and robotised production lines with our Food Engineering Apprentices. Alongside partnering with the UK-RAS (Robotics & Autonomous Systems) network, your Harper community extends well beyond your own course. Our RAM degree connects with the whole engineering department at Harper, fostering a dynamic network that also includes our cutting-edge Applied Data Science course at Station Quarter.

Studying this robotics engineering degree opens diverse career paths, providing knowledge in autonomous vehicles, drones, computing, software development, mechanics, AI, machine learning, computer vision, sensor systems, and advanced materials. Through hands-on projects, students collaborate with esteemed

employers like Cap Gemini, Denso, EPSON, RBSL, Avara Foods, Magna, and more, enriching their practical experience and industry connections.

Through industry links, students may also pursue micro-credentials throughout their degree, including courses through AWS, Google, CISCO, and Microsoft in areas like Cloud Computing and Cyber Security.

A-level entry requirements

- **Entry requirements for 2027 entry are not currently available. Please contact Admissions for advice**

How will I be taught?

At Harper Adams, our RAM degree prioritizes hands-on learning, allowing you to continuously demonstrate your skills through quizzes, assignments, and engaging projects. As you progress, the culmination of your studies involves applying your knowledge to tackle practical challenges faced by real-world businesses.

As a student, you'll engage in workshops, seminars, and learn from industry experts throughout the course. Additionally, you'll have access to online learning materials to prepare and test your knowledge, enabling you to put theory into practice during class. We offer a blend of dynamic online and in-person collaborative experiences for a comprehensive understanding.

To support your academic success, we offer supplementary online learning and access to tutoring services. Our program is designed to prepare you not just for academic success, but also for a future in the field of robotics, equipping you with practical skills and the knowledge necessary for an incredible career in engineering and/or further education. If you're not confident in your mathematical, coding or technical skills, we also provide personalised support to help you thrive there too. Recognizing each student's unique strengths and challenges, we embrace a broad spectrum of entry requirements and offer contextualised offers where possible.

What will I study?

Year 1		Year 2		Year 3	
Computing Technology (SQ4007)	20	Interdisciplinary Project	20	Honours Engineering Project	40
Mechanical Science and Systems (SQ4008)	20	Mechatronics and Control	20	Intelligent Systems	20
Professional and Study Skills (SQ4003)	20	Smart Manufacturing and Rapid Prototyping	20	Artificial Intelligence (AI) Frameworks for Engineers	20
Actuation for Mechatronic Systems (SQ4009)	20	Sustainability and Ethics for Machines and Humans	20	Group Mechatronics Project	20
Programming Concepts (SQ4011)	20	Design and Validation (SQ)	20	IoT (Internet of Things) Data Communications	20
Real World Systems and Automation (SQ4010)	20	Robotics Automation Systems and Applications	20		

Computing Technology

Year of study 1
Code SQ4007
Credits 20
Core/option Core

The "Computing Technology" module is designed to provide a broad introduction to computer science and to a range of programming languages, suitable for those with or without prior programming experience. This module emphasises problem-solving techniques, both computational and non-computational, focusing on correctness, design, and style. It provides a foundational understanding of computational thinking, abstraction, algorithms, data structures, and the broader spectrum of computer science. The module transitions through various programming languages, starting with C and moving to Python, SQL, HTML, CSS, and JavaScript, thus offering a broad understanding of the field. The flexible structure of this module ensures its relevance and adaptability for both current industry practices and future technological advancements. This module is an overview of basic algorithms and a survey of many different computational language implementations.

Intended Learning Outcomes:

1. Analyse and solve problems using computational thinking, applying fundamental concepts of computer science across various domains.

2. Design and implement algorithms in different programming languages, demonstrating a clear understanding of functions, variables, conditionals, loops, and data structures.

3. Evaluate and improve the correctness, design, and style of code, showcasing the ability to assess and optimise computational solutions.

4. Synthesise knowledge of programming concepts to create web and mobile applications, employing technologies like HTML, CSS, and JavaScript.

5. Apply the principles of data management using SQL for effective storage and retrieval of information.

Mechanical Science and Systems

Year of study 1
Code SQ4008
Credits 20
Core/option Core

In this module you will be introduced to the connection between mathematical tools and techniques, accepted theories of mechanics and the use of software applications in the modelling, analysis and prediction of the behaviour of mechanical systems. These could be mechanisms, components of machines, or moving bodies, on any scale. It uses a combination of teaching and learning approaches including practical laboratory-based exercises and use of industry-standard software to model mechanical systems. This module is essential to your understanding of a wide range of other subjects at this level and further your understanding of mechanical science and systems used in robotics and mechatronic systems.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Review the value of theoretical methods to predict real-world behaviour of mechanical systems.

2. Select and apply a range of mathematical techniques to solve static and dynamic problems.

3. Apply physical and software resources to investigate, analyse and communicate solutions to engineering scenarios.

Professional and Study Skills

Year of study 1
Code SQ4003
Credits 20
Core/option Core
Module contact Dr Edwin Harris

"Professional and Study Skills" is a module designed to equip students in data science, business, and engineering with essential professional and academic skills. This module provides an opportunity to develop capabilities in key areas such as research, writing, web technology, Markdown, Excel, tidy data management, introductory programming, and effective presentation techniques. By integrating these skills, the module supports students in becoming proficient and adaptable professionals, capable of excelling in their academic and future career pursuits.

Intended Learning Outcomes:

1. Research and synthesise literature relevant to data science, business, and engineering, demonstrating effective information gathering and analysis skills.

2. Develop and maintain web pages using GitHub and Markdown, showcasing an understanding of basic web development principles.

3. Utilise Excel for data analysis and management, applying principles of tidy data for efficient data handling.

4. Implement basic programming concepts using tools like Code Copilot and command line interfaces.

5. Design and deliver compelling presentations, effectively communicating complex ideas to diverse audiences both technical and non-technical.

Actuation for Mechatronic Systems

Year of study 1
Code SQ4009
Credits 20
Core/option Core

This module is providing you with a thorough grounding in the development of mechanisms and technologies for actuation, for example, chain drives, fluid power, levers, gears, motor drives. This is the module that will take you from entrant with no or minimal experience of actuation technology to become knowledgeable and be able to work confidently with actuation technology.

Through a range of teaching and learning techniques, such as tutorials, laboratories and reading, the module will investigate the development of actuation science, methodologies and technologies relevant to robotics, automation and mechatronic systems. The module will be assessed using a two-part process. Firstly, a spreadsheet will be developed to determine component specification and performance. This will be complemented with a professional discussion, based on the application of actuation technologies relevant to robotics, automation and mechatronic engineering disciplines.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Design and develop mechanisms to translate force, torque and velocity to meet given requirements.

2. Select and specify the components required to satisfy the functional performance needs for a given actuation system.

3. Explain the operation of fundamental fluid power components and simple systems.

Programming Concepts

Year of study 1
Code SQ4011
Credits 20
Core/option Core

This module offers an engaging introduction and an overview to programming, utilising a modern programming language (typically Python). Designed to accommodate both novices and those with some programming background, it covers a spectrum of fundamental concepts of coding. Key topics include reading and writing code, testing, debugging, and utilising Python-specific features. This module provides essential underpinning skills for other computer science modules. The content will be highly relevant and adaptable, enhancing employability and professional development in technology-driven industries. This module focuses on a single programming language such as Python as a modern, scalable toolbox, building on The Computing Technology module which is an overview of basic algorithms and a survey of many different computational language implementations.

Intended Learning Outcomes:

1. Analyse and apply programming concepts to develop functional code, showcasing the ability to

interpret and create basic programming structures.

2. Construct and execute scripts, using loops, conditionals, and data structures, demonstrating comprehension and practical application.

3. Evaluate and debug code, applying systematic approaches to identify and resolve coding issues, enhancing code reliability and performance.

4. Create and manipulate classes and objects, illustrating understanding of object-oriented programming principles.

5. Synthesise knowledge of programming to develop solutions for real-world problems, demonstrating creativity and adaptability in coding.

Real World Systems and Automation

Year of study 1
Code SQ4010
Credits 20
Core/option Core

This module will cover the fundamentals of automation principles as applied to industry. The student will already be aware of actuation methods, drive and gearing techniques from another module (Actuation for Mechatronic Systems), and they will learn and apply sequence programming to these devices to enable useful applications to be developed. The micro-controller or Programmable Logic Controller (PLC) will be examined and applied to operating these actuators along with the use of sensors to read the environment and to verify the actuator state. Programming will be introduced in a practical way to allow the actuators to operate in a dynamic environment.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Identify and select common sensors and their application for a range of engineering and manufacturing applications.

2. Choose and analyse an actuator that is relevant and appropriate for a given application.

3. Describe and critique an automation system and its application in a wider context.

Interdisciplinary Project

Year of study 2
Credits 20
Core/option Core

This module engages students in an interdisciplinary approach to problem-solving and research within a design and consultancy context. It emphasises the identification and solution of real-world problems, requiring students to critically analyse a subject domain, establish design boundaries, and devise innovative solutions. This module cultivates essential skills in project planning, execution, and presentation, preparing students for diverse professional environments. Workshops supporting project design, methodology, and presentation skills are integral, enhancing the student's ability to contribute effectively in varied

interdisciplinary settings. This module is crucial for developing the agility and adaptability required in contemporary professional fields.

Intended Learning Outcomes:

1. Critque the current state of understanding of a problem, utilising appropriate information and research techniques.

2. Formulate advanced and creative solutions or proposals to enhance the current state of knowledge in the subject domain.

3. Design effective methods to deliver a solution to the identified problem, demonstrating innovative thinking and practical skills.

4. Interpret, report, and present the project rationale and solution coherently within the context of the existing knowledge base, utilising appropriate communication skills and formats.

Mechatronics and Control

Year of study 2
Credits 20
Core/option Core

The module offers students a comprehensive exploration into the dynamic field of mechatronics, where mechanical and electronic systems synergistically converge. This module delves into the principles and applications of mechatronics, emphasising the integration of mechanical design, electronics, computer science, and control theory. Students will develop an understanding of the symbiotic relationship between mechanical components and intelligent control systems, preparing them for the challenges of designing and implementing sophisticated mechatronic systems. The module adopts a hands-on approach, encouraging application through laboratory exercises and projects. Through a blend of theoretical insights and practical experiences, students will gain the skills necessary to design, model, and control complex mechatronic systems, fostering a solid foundation for their continued academic and professional journey in the realm of robotics and automation. The module's content is designed to instill a holistic perspective on mechatronics and its role in shaping the future of engineering solutions.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Specify, select and integrate appropriate components such as controllers and sensors to build a mechatronic system.

2. Develop, implement and evaluate an algorithm to control a mechatronic system.

3. Identify and specify key considerations when developing and signing off mechatronic systems.

Smart Manufacturing and Rapid Prototyping

Year of study 2
Credits 20
Core/option Core

This module will provide an opportunity for the learner to understand and appreciate the context and

interconnectivity of Industry 4.0 as applied to modern manufacturing. You will apply a range of digitally augmented manufacturing techniques such as such as CNC and additive manufacturing you create real components to a design specification. This will enable you to understand the impact, opportunities, and limitations of these techniques on quality. Whole-process capability will be examined and modelled, using a range of cutting-edge techniques such as discrete event simulation so you can propose improvements to the efficiency of manufacturing systems. Throughout, solutions will be evaluated for environmental, social and financial sustainability of smart manufacturing systems for industrial applications with an emphasis on regulations, legislation and UN SDGs.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Apply selection methodologies, based on capabilities, cost and sustainability for materials and processes for a given application in industry.

2. Manufacture, assemble and assess a simple multi-component system.

3. Propose and implement manufacturing solutions utilising tools, techniques and philosophies integral to Industry 4.0 for a given sector.

4. Use and apply software tools and techniques such as discrete event simulation to develop, systematically, and improve the efficiency of manufacturing systems.

Sustainability and Ethics for Machines and Humans

Year of study 2
Credits 20
Core/option Core

"Sustainability and Ethics for Machines and Humans" is a pivotal module designed to address the broad spectrum of ethical issues emerging in fields such as artificial intelligence, robotics, and engineering. The course delves into the complexities and challenges posed by the integration of advanced technologies in society. It critically examines the ethical implications including deploying AI and automation systems, as well as the responsibilities of individuals in creating technology that aligns with societal values and ethical standards. The module emphasises the importance of ethical decision-making in the development and application of these technologies, highlighting the impact on various aspects of human life.

Intended Learning Outcomes:

1. Evaluate the ethical implications and challenges of AI, robotics, and engineering projects in various real-world scenarios.

2. Assess the balance between technological advancement and ethical considerations in robotics and engineering.

3. Analyse case studies on the ethical deployment of AI and robotic systems, focusing on the societal and moral impact.

4. Apply ethical principles in the design, development, and implementation of AI and robotics, ensuring responsible and sustainable technological solutions.

5. Synthesise knowledge through practical projects, demonstrating the ability to address ethical

dilemmas in AI, robotics, and engineering contexts.

Design and Validation

Year of study 2
Code SQ
Credits 20
Core/option Core
Module contact Mr James Croxford

The design and validation involved in the engineering of a product is key to its success.

As well as the ability to rigorously apply engineering theory to an application, a professional engineer also needs a good understanding of the wider world in which their product will operate, and of the customer who will purchase it.

In this module you develop your professionalism and wider communication and teamworking skills, by following a structured design process to deliver a product that meets a customer brief.

You will design and validate a product from beginning to end, improving your capability in defining a problem, utilising specialist methodologies and techniques, working in a team, and liaising with customers and technical specialists.

Students who successfully complete this module will be able to:

- Identify requirements and constraints within a client brief, in order to create a product design specification.
- Engineer a product to meet a product design specification.
- Develop a product to meet 'design for manufacture' and 'design for assembly' constraints.
- Plan and execute a test, to evaluate a design against a product design specification.

Robotics Automation Systems and Applications

Year of study 2
Credits 20
Core/option Core

There are many aspects of industry that could benefit from the development of automation and robotics. This module will begin by discussing the current applications of robotic systems highlighting the areas which will benefit from robotics as well as the engineering challenges these present. The technical aspect of the module will build on the core Mechatronics modules to integrate the current state of the art in Robotic Engineering with contextualised industrial and research applications. Future trends will be examined from the foundation of knowledge in robotic technology, placing the learner in the position to understand, create, and apply advanced techniques in robotics. Techniques including Image Processing, multi-tasking operating systems, advanced libraries of application, swarming, navigation, vehicle communication, machine state and behaviour programming will be covered with practical examples.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Design and implement an autonomous mobile robot to perform a given task or challenge.

2. Create and implement an algorithm and software to control a robot arm in a real situation.

Honours Engineering Project

Year of study 3
Credits 40
Core/option Core

The ability to resolve complex problems is a fundamental capability of a professional engineer. Fundamental elements of this capability include being able to define a problem, being able to select and correctly apply relevant tools, techniques, methods and practices in the resolution of the problem and the ability to critically evaluate the effectivity of the applied process.

Successful completion of your Honours Engineering Project will demonstrate your motivation, resilience, and ability to select and apply appropriate methodologies in the resolution of an engineering problem selected from your chosen field of specialisation. The Honours Engineering Project functionally assesses in a holistic way your ability to engage with and deliver a successful body of work and as such forms the capstone activity for the curriculum and a culmination of study on the course.

Students who successfully complete this module will be able to:

- Select, justify and use appropriate tools and techniques to define and constrain an engineering problem or challenge. for resolution.
- Plan and utilise appropriate methods to ethically and sustainably deliver a solution to the engineering problem.
- Conduct a technical evaluation of the project outcomes in relation to the satisfaction of the project requirements.
- Conduct a reflective evaluation of the project outcomes in relation to the methods and practices adopted.
- Present project conclusions and recommendations to a technical and non-technical audience.

Intelligent Systems

Year of study 3
Credits 20
Core/option Core

The deployment of intelligent robotic and autonomous systems mitigates the ever-decreasing availability of personnel for industry whilst contributing to the potential increase in productivity and indeed reliability. In this module, you will be exposed to new and emerging technologies in relation to designing and deploying intelligent manufacturing systems. Equally, you will appreciate the need to embed cyber-security throughout the manufacturing operations. This includes security in terms of hardware, software and peopleware.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Create and validate using advanced software tools in a automated manufacturing processes.

2. Summarise the relevance and application of intelligent robotics in a manufacturing environment.

3. Critically appraise the cyber-physical security requirements in mechatronic systems for relevance in business operations.

Artificial Intelligence (AI) Frameworks for Engineers

Year of study 3
Credits 20
Core/option Core

This module addresses concepts and algorithms of modern artificial intelligence (AI), introducing the theories, practices and tools that underpin AI technologies, such as game-playing engines, handwriting recognition, and machine translation. The module emphasises hands-on learning, where students will actively engage with graph search algorithms, classification, optimisation, machine learning, and large language models. By integrating these concepts into programming projects, students will gain a working understanding of AI frameworks and acquire the skills to design and implement intelligent systems.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Analyse and understand the foundational concepts and algorithms that underpin modern artificial intelligence.

2. Develop Python programs that incorporate AI technologies, demonstrating practical application of AI frameworks.

3. Analyse and apply graph search algorithms, classification, and optimisation techniques in AI.

4. Design and implement intelligent systems using principles learned from machine learning and large language models.

5. Curate knowledge of AI frameworks with practical programming skills to create AI solutions.

Group Mechatronics Project

Year of study 3
Credits 20
Core/option Core

Engineers are expected to be able to work effectively both independently and as a member of a team in the delivery of solutions to agreed standards and deadlines. Engineers, to be effective, must be able to study a given situation and be able to calculate delivery feasibility against time and resource availability. It is also a normal expectation that engineers are required to resolve complex problems in parallel to other work, and to work effectively with colleagues.

You will have gained group work experience in prior study. This module aims to provide you with the opportunity to demonstrate your capability of working as a member of a project team having joint and several responsibilities for the delivery of the project. Further, to demonstrate, in an applied context an appropriate depth and breadth of technical knowledge and management capability, professional engineering behaviours, and an understanding of project delivery risks.

Each group project is generally sourced from companies within the engineering industry - companies typically provide background information, details of the problem or challenge, and some references for the team at the outset. Project deliverables and success criteria will be negotiated between the client and team early in the project.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Devise, negotiate and agree deliverables in response to a given automation-based project presented by industry or a business.

2. Plan, conduct and manage the delivery of a programme of work to deliver stakeholder value in a

timescale negotiated with the company.

3. Present project conclusions and recommendations to client company with due consideration for a technical and non-technical audience.

IoT (Internet of Things) Data Communications

Year of study 3
Credits 20
Core/option Core

The use of Intelligent IoT (Internet of Things) devices has proliferated across many sectors both commercial and domestic to assist in the monitoring of cyber-physical systems in manufacturing and the natural environment for a seamless integration to the internet thus enabling organisations to analyse performance and behaviour leading to rapid decision making through human or non-human intervention. This module on IoT (Internet of Things) Data Communications is designed to provide you with a comprehensive knowledge of interconnected intelligent devices that capture data and communicate with multiple devices connected to objects of all types. You will explore in-depth the operation and implementation of smart IoT sensors and systems and understand the architecture and the ever-growing number of applications across manufacturing and many other sectors. The module will also focus on communications and security's critical role in transporting and exchanging data between IoT devices via the Internet.

Intended Learning Outcomes:

Students who successfully complete this module will be able to:

1. Critique and analyse the core concepts and architecture of an IoT devices and networks.

2. Apply knowledge and technical skills to design, build and test an IoT systems for a given specification and application.

3. Critically appraise the end-to-end functional, operational and security requirements of an IoT system for a given application.