Robotic Engineering and Artificial Intelligence Modules for Visiting Students 2024/25

Robotic Engineering and Artificial Intelligence stand at the cutting edge of technological progress to address some of the most pressing challenges facing society today, encompassing innovations such as industrial robotic arms, autonomous vehicles, aerial drones and space robots.

Launching in September 2024, students on this brand new degree programme will acquire the vital skills and knowledge required to tackle these intricate challenges, opening up a world of possibilities at the intersection of these two potent fields, and ultimately making a significant impact on a global level.

Updated April 2024/PJW

Entry requirements: GPA of 2.75 or above (out of 4.0) or equivalent

Pre-requisites:

- Level 4: prior introductory university-level study of physics/mathematics is very useful.

Taught at: Roehampton Vale campus

Notes:

1. All modules are at undergraduate level only.
2. Students enrolled on Study Option 1 are required to study the entire module over both semesters.
3. Whilst the University makes every effort to ensure that this information is correct at the time of updating (April 2024), it cannot accept responsibility for omissions or subsequent changes. Module availability and content may be subject to change, as part of the University's policy of continuous improvement and development.
4. Details of assessment for students enrolled on either Study Option 2 or 3 where provided are **indicative only** and may also be subject to change as part of the above policy.

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

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KEY TO MODULE DESCRIPTORS
SUITABILITY OF MODULE FOR STUDENTS VISITING KU ON STUDY OPTION ____
1: Indicates module is suitable for students visiting KU on Study Option 1 (Whole Year)
2: Indicates module is suitable for students visiting KU on Study Option 2 (Autumn)
3: Indicates module is suitable for students visiting KU on Study Option 3 (Spring)

INTRODUCTORY - LEVEL 4

MODULE CODE	TITLE	SUITABILITY		
LEVEL 4 – INTRODUCTORY				
ER4003	Introduction to Programming	1		3
ER4004	Introduction to Robotics	1		3
ER4005	Electromechanical Systems Design	1		
ER4006	Microcontrollers and Interface Electronics	1		

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

Kingston University London

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Module Code	**ER4003**
Module Title	**Introduction to Programming**
Level	4
Prerequisites	None
Credits	4 (US) 7.5 (ECTS)
Suitability	• Open to Study Abroad/International Exchange students for Study Options **1** or **3** • Not open to Erasmus students (as Level 4)
Content	This module is designed to introduce students to scripting in one of the most popular programming languages in industry, which is widely used for data processing, automation of tasks and more recently for machine learning (ML) and artificial intelligence (AI) specifically in the engineering industry. The module has been designed to cover all the fundamentals of programming, which should provide a valuable transferrable skill set that can be fed forward to provide the essential skills needed for scripting in other computer languages in further modules. It will also provide the crucial foundations for students to investigate applications involving both ML and AI as they progress through the course. ➢ **Topics:** • The functionality and operation of an integrated development environment (IDE). • Fundamentals of Object-Oriented Programming (OOP). • Structure and syntax of a Python program. • Variables, constants, comments and script formatting. • Basic data structures (Boolean; integer; float; string) and data type conversion. • Inputting data and printing. • Importing functions and modules • Decision structures and looping techniques. • Complex data structures (list; set; dictionary; tuple). • Slicing (lists; strings). • Arrays (1D; 2D; Array methods). • Creating user defined functions. • Plotting data. • Reading and writing to csv files • Classes and methods
Teaching	Lectures, practical workshops and tutorials

Study Option 1 = Whole Year
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Study Option 3 = Spring

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Assessment	• Portfolio of two computer labs (each lasting two hours), 50% each
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Module Code	**ER4004**
Module Title	**Introduction to Robotics**
Level	4
Prerequisites	None
Credits	4 (US) 7.5 (ECTS)
Suitability	• This module is taught entirely during the **Spring semester** • Open to Study Abroad/International Exchange students for Study Options **1** or **3** • Not open to Erasmus students (as Level 4)
Content	In the introduction to robotics module, students will learn the fundamental concepts and principles of robotics. Students will gain a solid understanding of robot components, including actuators, sensors, and manipulators, and how they contribute to the overall functionality of a robot. Students will explore robot kinematics, covering topics such as coordinate systems, forward kinematics, and inverse kinematics, enabling students to calculate the position of robot end effectors. The module will also introduce robot sensing and perception, where students will learn about different types of sensors and how they are used to gather data for robot operation and interaction with the environment. Additionally, students will have the opportunity to program robots and develop strategies to achieve desired movements and tasks. Furthermore, students will engage in collaborative group projects, honing their collaboration skills, adaptability, and resilience, which are essential qualities for working effectively in the field of robotics.
Teaching	Lectures, robotic and programming workshops
Assessment	• Programming exercise (1500 words) (50%) • Laboratory Exercise (lasting 1.5 hours) (50%)
Last updated	07/04/24 PJW

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

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Module Code	**ER4005**
Module Title	**Electromechanical Systems Design**
Level	4
Prerequisites	None
Credits	• Full Year: 8 (US) 15 (ECTS) • Single Semester: 4 (US) 7.5 (ECTS)
Suitability	• Open to Study Abroad/International Exchange students for Study Options **1** or **2** • Not open to Erasmus students (as Level 4)
Content	The aim of this module is to provide students with the key aspects involved in planning an electromechanical project from start to finish, design processes incorporating a sustainability agenda, building an awareness of the interactions across various disciplines, regulatory frameworks and Health and Safety procedures. In this module, students will be introduced to the fundamental electronic components, their application in the design of electromechanical systems and communication of engineering design ideas through integrating engineering drawing and 3D solid modelling. This module encourages the use of simulation tools for the design and analysis of the systems to enhance analytical as well as employability skills. ➢ **Topics:** • Mechanical and electrical engineering design processes. • Health and Safety and risk assessment procedures. • Communication of engineering design ideas through integrating engineering drawing and 3D solid modelling. • Basic electrical theory: AC & DC, electronic components and power supplies. • Analysis of simple linear circuits: parameters, parallel & series, ohms law, energy and power. • Voltage and current divider circuits • Digital electronics • Number Systems and Logic gates • Boolean algebra • Combinational logic circuits
Teaching	Lectures, tutorials and pc laboratory sessions

Study Option 1 = Whole Year
Study Option 2 = Autumn
Study Option 3 = Spring

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Assessment	Study Option **1:** • Two Electronics Lab Exercises (3 hours) (50%) • IMechE Design Challenge Prototype (50%)
	Study Option **2:** •
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Module Code	**ER4006**
Module Title	**Microcontrollers and Interface Electronics**
Level	4
Prerequisites	none
Credits	8 (US) 15 (ECTS)
Suitability	• Open to Study Abroad/International Exchange students for Study Option **1** • Not open to Erasmus students (as Level 4)
Content	This module is designed to introduce students to both the operation and functionality of microcontrollers and the techniques used to interface them to sensors and transducers, with the aim to monitor and control a closed loop system. Interface circuitry, operation of sensors and actuator control is covered in depth, along with the inclusion of devices to extend the number of analogue and digital port lines on a microcontroller. ➢ **Topics:** **Microcontrollers** • Introduction to microcontrollers; using an IDE to create, test and debug programs. • Data types, variables, constants, comments, mathematical and Boolean operators. • Data type conversion, in-built functions. • Techniques to display text and waveforms on an eternal computer screen during program execution. • The use of on-line virtual development software to simulate circuits, program microcontrollers and interface sensors and actuators. • Accessing and controlling analogue and digital ports.

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	• Decision structures and loops (While, If, For, Case, Nesting). • Pulse width modulation (PWM). • Arrays and sound. • User defined functions. • Driving LCD modules. • Multi-tasking techniques. • DC motor control circuits. • Keypad and keyboard data input. **Interfacing electronics** • Introduction to op-amps (unity gain buffer; inverting and non-inverting amplifiers). • Implementing DAC chips (unipolar & bipolar). • ADC chips and range optimising circuits. • Interfacing to sensors (temp; pressure; light; sound; tilt; hall; touch; displacement). • Interfacing to a range of actuators and devices (speaker; DC motor; LED; LCD). • T-bridge and H-bridge DC motor control designs. • Digital potentiometers (implementation in amplifiers; filter circuits). • Optical isolators. • IR sensor systems (optical switches). • Digital signal recovery using a Schmitt trigger. • Circuits to drive high current devices (NPN; PNP; Darlington; FETs; solid state & mechanical relays). • Use of multiplexors to expand digital I/O ports. • The use of de-multiplexors to increase analogue input port capacity.
Teaching	Lectures, computing and electronics workshops and tutorials
Assessment	• Lab Exercise (30%) • Portfolio of two online exercises (lasting two hours) (70%)
Last updated	07/04/24 PJW

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Study Option 3 = Spring