IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	2024
Long title	Fundamentals and Innovative Applications of Robotics		
New code	ELEC70120	New short title	
Brief description of module *(approx. 600 chars.)*	This module provides an introduction to the fundamental theory and practice of robotics with a strong focus on innovative applications and hands-on practicals using Robot Operating System (ROS). You will learn the basic principles of robotics and how to work with robots using ROS to address real-world problems.		
Available as a standalone module/ short course?	N		

Statutory details

	ECTS	CATS	Non-credit	
Credit value	5	10	N	HECOS codes
FHEQ level	Level 7			

Allocation of study hours

	Hours	
Lectures	14	
Group teaching	0	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	14	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	97	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	125	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed?	No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Term 2	Other	

Ownership

Primary department	Electrical and Electronic Engineering
Additional teaching departments	Computing
Delivery campus	White City

Collaborative delivery

Collaborative delivery?	N

External institution	N/A
External department	N/A
External campus	N/A

Associated staff

Role	CID	Given name	Surname
Module Leader		Sen	Wang
Lecturer		Nicole	Salomons

Learning and teaching

Module description

Learning outcomes	Upon successful completion of this module, you will be able to: - assess the fundamental elements needed to successfully build a working robot. - translate a set of standard algorithms for robot localization, navigation, learning and interaction into practical implementations using Robot Operating System. - program and work with simulated or physical robots using the Robot Operating System. - investigate innovative robotic applications in industry and use the knowledge of robotics to support innovation, apart from understanding the safety and ethical implications of deploying robots in practice.
Module content	- Introduction to Robotics and Robotics Operating System: overview of robotics, applications of robotics, why ROS is industry-standard, ROS concepts and basics - Robot Kinematics: Robot Coordinate Systems, Forward/Inverse Kinematics, Motion Models - Robot Sensing: Sensing Modalities, Sense Models, Sensor Calibration, Sensor Fusion - Robot Learning: Learning from Demonstration, Reinforcement Learning - Applications: Manufacturing and Cobots - Applications: Mobile Robotics - Applications: Social Robotics
Pattern of learning and teaching activities	The module consists of 7 weeks of timetabled sessions plus a group robotic project. Each week consists of a 2-hour lecture and a 2-hour supported lab session. Halfway through the course students will begin working on their final group project.
Learning and Teaching Approach	The module is delivered with an emphasis on hands-on practicals. Each lecture introduces the fundamentals and applications of robotics, and each lab has the opportunity to work on practicals on the Robot Operating System, robot localization and human-robot interaction for a better understanding of the contents introduced during lectures and applying the knowledge in a practical setting. We use innovative applications in the industry to introduce the latest developments, technical advances and ethical and societal topics in robotics.
Assessment Strategy	Robotics is a hands-on field, and you learn best by doing. Therefore, the module is assessed based on two lab courseworks, each contributing 25% of the module's grade, and a group project on simulated or real robots, which is 50%. Each lab runs for ~3 weeks with dedicated support and feedback from the course lecturers and Graduate Teaching Assistants (GTAs) during lab sessions. At the end of each lab, an individual submission is evaluated. A list of open project topics is provided to develop as a group project for each team, and a simulation and a real physical robot is provided for marked final demonstration. You will have ~4 weeks to complete the final project.

Feedback	Students receive frequent formative feedback from the module lecturers during lab sessions. The submitted individual work is assessed against all tasks in each lab, in terms of functionality, performance and implementation. The group project is evaluated through an in-person final demonstration, which receives summative and formative feedback on the demonstrated results and answers to the technical questions.
Reading list	Probabilistic Robotics. Sebastian Thrun, Wolfram Burgard and Dieter Fox, MIT Press. 2005 A Gentle Introduction to ROS. Jason M. O'Kane. 2013

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Sen Wang

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments	

Template version

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Individual Lab 1 on Robot Operating System and robot navigation (500 lines of code)	25%	50%	N
Coursework	Individual Lab 2 on human-robot interaction (500 lines of code)	25%	50%	N
Practical	Group Mini-project including a live demo and 15-min oral presentation with Q&A	50%	50%	N
		100%		