IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Laboratory in C & O		
New code	ELEC70096	New short title	
Brief description of module *(approx. 600 chars.)*	This laboratory module aims to foster best practice in experimental work, while supporting the lecture modules and giving practical exposure to real control systems. The Lab will focus on analysis, modelling and the evaluation of an inverted pendulum.		
Available as a standalone module/ short course?	N		

Statutory details

	ECTS	CATS	Non-credit	
Credit value	10	20	N	HECOS codes
FHEQ level	Level 7			

Allocation of study hours

	Hours	
Lectures		
Group teaching		*Incl. seminars, tutorials, problem classes.*
Lab/ practical	2	*Inc. professional and research skills training*
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	248	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement		*Incl. work-based learning and study that occurs overseas.*
Total hours	250	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed?	No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	~~Year long~~	Other	Term 1, Term 2, Term 3

Ownership

Primary department	Electrical and Electronic Engineering
Additional teaching departments	
Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	N

External institution	
External department	
External campus	

Associated staff

Role	CID	Given name	Surname
Module Leader		David	Angeli

Learning and teaching

Module description

Learning outcomes	By the end of this Laboratory you will be able to: 1- derive mathematical models of mechanical systems by using first principles 2- assess the quality of models by comparing experiments and simulations 3- design controllers for nonlinear systems based on linearised models 4- apply optimal control for the stabilization of an inverted pendulum 5- compare different synthesis techniques in relation to their effectiveness in controlling a pendulum hardware 6- use of dedicated software for real-time control of nonlinear systems
Module content	Modelling of an inverted pendulum using Euler Lagrange Equations Verification of the validity of the model using simulation and experiments Linearisation of nonlinear models around different equilibrium positions Design of linear quadratic regulators and comparison with pole-placements design Swing-up feedback controller for inverted pendulum
Learning and Teaching Approach	The laboratory is not scheduled and students are able to access the lab in their own time. An introductory session will show the hardware equipment and students will then be handed out a coursework assignment to be completed within the summer term. The work is carried out in groups (for more than 50% of the activities).
Assessment Strategy	The laboratory is assessed through the submission of a report that details the modelling, design, validation and simulations performed on the pendulum equipment. This serves both as summative and formative assessment. Completeness of the experiment and quality of presentation are the key assessment criteria. A self-reflection on the performance of the team and of the individual as part of the team will also be assessed in a written report. You will need to desribe team organisation, your role within the team, effectiveness of own contribution and reflection on team working skills acquired.
Feedback	Summative feedback will be provided in the form of a provisional grade and formative feedback comments will be added to the submitted coursework, within 2 weeks of submission. Additional formative feedback, throughout the year, will be provided upon students' request in suitably scheduled group meetings.
Reading list	Applied nonlinear control, by J.J. Slotine and W. Li, Prentice Hall

Quality assurance

Date of first approval	February 2022
Date of last revision	April 2025

Office use only

QA Lead	
Department staff	

Date of this approval		Date of collection	
		Date exported	
Module leader	David Angeli	Date imported	
Notes/ comments			

Template version

Assessment details

		Pass mark
Grading method	Pass/Fail	100%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Coursework	Report on modelling, design, simulation and experiments on an inverted pendulum lab equipment.	100%	50%	N
Coursework	Self-reflection on individual performance as part of the team	0%	50%	Y
		100%	50%	Y