IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort: Latest:
Long title	Optimal Control		
New code	ELEC70065	New short title	

Brief description of module *(approx. 600 chars.)*

This module introduces the theory of optimal control, which involves control laws that maximise defined performance measures of linear and nonlinear dynamical systems. Optimal control problems are infinite-dimensional, and special emphasis is given to the use of computer tools for their solution. The topics covered include calculus of variations, Pontryagin's maximum principle, and dynamic programming. Part of the module will involve calculating numerically solutions to optimal control problems with the use of modern optimal control software.

548 characters

Available as a standalone module/ short course? N

Statutory details

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

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	0	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	105	*Incl. wider reading/ practice, follow-up work, completion of assessment*
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	

Delivery campus	South Kensington

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		Simos	Evangelou

Learning and teaching

Module description

Learning outcomes	By the end of this course you will be able to: 1) Formulate dynamic optimisation problems of practical significance, for linear and nonlinear systems, as optimal control problems. 2) Specify precise statements of the maximum principle for various general categories of optimal control problems, including free-time, fixed-time, free-endpoint, and fixed-endpoint problems. 3) Derive solutions to continuous-time optimal control problems by application of the maximum principle. 4) Signify solution concepts for optimal control problems, including bang-bang solutions and singular controls. 5) Calculate solutions to optimal control problems by dynamic programming techniques.
Module content	Calculus of variations: Euler-Lagrange equation, Hamiltonian formalism, variational problems with constraints. Pontryagin's maximum principle: proof of PMP, transversality condition, nonlinear two-point boundary-value problem, path constraints, corner conditions, bang-bang control, singular arcs. Dynamic programming: discrete problem, principle of optimality, Hamilton-Jacobi-Bellman equation, linear quadratic optimal control. Optimal control numerical solver software.
Learning and Teaching Approach	Duration: 10 weeks. Lectures: 2h / week. The lectures will include both asynchronous lectures and weekly interactive sessions during which solved examples will be presented and discussed, Q&A will take place, and will also involve classroom study through problem classes.
Assessment Strategy	Three hour open-book exam (75%), Coursework (25%). The Coursework includes a) an individual assignment, b) problem classes (formative), and peer assessment.
Feedback	Feedback on coursework (individual assignment report and problem class solutions) will be provided within two weeks from coursework submission deadline.
Reading list	1) Daniel Liberzon. Calculus of Variations and Optimal Control Theory: A concise introduction. Princeton, United States of America: Princeton University Press, 2012. 2) Donald E Kirk. Optimal control theory: An Introduction. New York, United States of America: Dover Publications, 2004. 3) Arthur Bryson and Yu-Chi Ho. Applied Optimal Control: Optimization, Estimation and Control. London, United Kingdom: John Wiley & Sons, 1975. 4) Peter Dorato, Chaouki T Abdallah, and Vito Cerone. Linear Quadratic Control: An Introduction. Krieger Publishing Company, 2000.

Quality assurance

Office use only

Date of first approval		QA Lead	
Date of last revision		Department staff	
Date of this approval		Date of collection	
		Date exported	
Module leader	Simos Evangelou	Date imported	

Notes/ comments	

Template version #####

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	3 hour written open-book examination	75%	50%	N
Coursework	Individual assignment report, problem class solutions, peer assessment	25%	50%	N
		100%		