IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Game Theory for Multi-Agent Decision Making		
New code	ELEC70136	New short title	
Brief description of module *(approx. 600 chars.)*	This module will introduce you to fundamental concepts and techniques of games theory, thereby offering you a framework for formulating and solving decision-making problems, involving multiple agents with possibly conflicting objectives. You will gain an understanding of the relevance of game theory to systems science, through examples in such areas as traffic management, smart grid operation and robust controller design. The module will also appeal to those of you with supplementary interests in other game theory application		
Available as a standalone module/ short course?	N	0	

Statutory details

	ECTS	CATS	Non-credit	
Credit value	5	10	N	HECOS codes
FHEQ level	L7			

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 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 1	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		Richard	Vinter
		0	0
		0	0
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Learning and teaching

Module description

Learning outcomes	Upon successful completion of this module, you will be able to: - formulate decision making problems in systems science, involving multiple agents, as games. - contrast different game problems according to the information patterns involved. - decide on the appropriate solution concept for a particular game, according to whether it is based on Nash equilibria, mixed strategies solutions, Stackelberg solutions or some other solution concept. - discriminate between different individual games as to whether they are zero-sum games, cooperative games, static games, dynamic games or belong to some other category and, in each case, infer the appropriate solution technique. - devise strategies based on game-theoretic techniques that provide solutions to real world multi-agent decision problems, in such areas as traffic management and smart grid operation.
Module content	The module will cover the following topic areas: - zero sum games: pure and mixed strategies, existence of saddlepoints, algorithms for solving matrix games - non-zero sum games: information patterns, normal and exterior forms, Nash equilibria, Pareto optimisers, Stackelberg solutions, computational aspects. - Dynamic games: dynamic programming solution techniques, linear quadratic games. - Evolutionary games: models, stabiity and qualitative behaviour of solutions. - Examples of real-world application of dynamic game theory, in such areas as traffic management and smart grid operation
Learning and Teaching Approach	You will be introduced to principles and techniques of game theory (game classification, information patterns and solution concepts) in lectures, alongside examples of their application in systems science. You will be made aware, from the beginning, that game theory is not an abstract entity but a methodology that you can use creatively, to formulate and resolve a wide range of design and decision making problems, involving multiple agents. A MATLAB based coursework assignment will test and develop your ability to set up a challenging practical multi-agent design problem as a dynamic game and solve it using techniques you have learned on the course. You will receive problem sets, followed by model answers after an appropriate delay.
Assessment Strategy	3 hour closed book exam (75%) and 1 coursework assignment (25%).

Feedback	You will be encouraged to arrange in-person meetings with your lecturer to receive clarification regarding lecture content, coursework, examinations and other module related matters. Your lecturer will also regularly check and respond to your message board posts about the module. You will receive comments and remarks on your coursework submission, within 2 weeks.
Reading list	T.Basar and G. J. Olsder, Dynamic noncooperative control theory: Second Edition, SIAM Publications, Philadelphia, 1999, S. Tadelis, Game Theory: An Introduction, Princeton Univ Press, Princeton, 2013, Special Issue on Game-Theoretical Methods in Control Engineering Systems, Ed.C. Ocampo-Martinez and N. Quijano, IEEE Control Systems Magazine, 37.1, 2017

Quality assurance

Date of first approval	May 2024
Date of last revision	
Date of this approval	May 2024
Module leader	Richard Vinter

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?
Examination	Written examination	75%	50%	N
Coursework	Coursework	25%	50%	N
		100%		