IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	2024-25
Long title	Power System Planning		
New code	ELEC70112	New short title	
Brief description of module *(approx. 600 chars.)*	This course aims to teach students how to build and use engineering-economic models that optimize expansion plans for future power systems. To achieve these aims, the lectures will start off with a basic capacity expansion model in Julia/JuMP. Each week's lecture will delve deeper into a technology (e.g., variable renewable energy, storage) or an aspect of the decision context (multiple objectives, spatial complexity, binary decisions, uncertainty, risk), enhancing our model's features or building complementary models. The kind of models we will study are extensively used in government and industry to inform investment and policy decisions. To gain first-hand experience of modeling and analysis, students will work on team projects addressing a real-world planning question for a test system.		
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	20	
Group teaching	0	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	10	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	95	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement		*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	Department of Electrical and Electronic Engineering
Additional teaching departments	N/A
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		Elina	Spyrou
Lecturer		Mark	O'Malley

Learning and teaching

Module description

Learning outcomes	On successfully completing this module, you should be better able to: • Recommend models and metrics for energy policy analysis and power system planning • Modify power system planning models to add new features, required for integration of emerging resources and risk management • Assess alternative approaches for incorporating risk in power system planning • Critique suggested changes in capacity markets/resource adequacy for future systems
Module content	The module has three parts. Part I: Power system planning models • Capacity expansion model using linear programming • Transmission modeling using mixed integer linear programming • Multi-objective programming and trade-off curves Part II: Integrating emerging technologies • Modeling variable renewable energy and storage • Enhancements to capacity markets & resource adequacy processes for net zero power systems Part III: Planning under uncertainty • Multi-stage stochastic programming with recourse • Planning criteria for risk averse decision makers • Planning methods for deep uncertainty
Learning support	Instructors will hold a 2-hour slot for office hours every week.
Pattern of learning and teaching activities	One two-hour lecture a week. A 2-hour practical needs to be scheduled in week 4 or 5 and then four 2-hour slots for presentations of practical need to be scheduled early in the summer term.

Learning and Teaching Approach	The module will be delivered primarily through large-class lectures introducing the key concepts and principles, supported by various example cases. The content will be presented via a combination of slides and whiteboard. Learning will be reinforced through a combination of progress exercises and assessed coursework elements and one oral presentation.
Assessment Strategy	This module presents opportunities for both formative and summative assessment. You will be formatively assessed through exit slips, and in-class polls and quizzes. You will have additional opportunities to self-assess your learning via progress exercises. You will be summatively assessed by coursework, an oral presentation, and a written examination at the end of the module. The exam is specifically formulated to assess design-based learning outcomes in addition to the other learning outcomes for the module.
Feedback	You will receive feedback on examinations in the form of an examination feedback report on the performance of the entire cohort. You will receive feedback on your coursework performance in the form of written comments and suggestions on how to modify your approach. Further individual feedback will be available to you on request via this module's online feedback forum and through office hours with instructors.
Reading list	1) Conejo, A.J., Carrión, M. and Morales, J.M., 2010. Decision making under uncertainty in electricity markets (Vol. 1, pp. 376-384). New York: Springer. 2) Sun, X.A. and Conejo, A.J., 2021. Robust optimization in electric energy systems. Springer International Publishing. 3) Articles and reports e.g., [1] Joshi, P. and Logan, J., 2022. Lessons Learned for Rapid Decarbonization of Power Sectors (No. NREL/PR-6A20-83951). National Renewable Energy Lab.(NREL), Golden, CO (United States);

Quality assurance

Date of first approval	June 2023
Date of last revision	April 2024
Date of this approval	May 2024
Module leader	Elina Spyrou
Notes/ comments	

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Template version

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	Written examination	65%	50%	N
Coursework	Coursework	20%	50%	N
Practical	Oral presentation	15%	50%	N
		100%		