IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort	Latest c
Long title	Stability of Low-Carbon Power Systems			
New code	ELEC70087	New short title		

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

High proportion of clean energy sources such as wind, solar photovoltaic in the generation mix 'weakens' the electric power grid. Such a weakened power grid has limited capability to absorb the power generated by the clean energy sources without risking instability and is thus a major barrier towards decarbonisation of the electricity sector. This module will help you recognise this conundrum by providing the knowhow of stability and control challenges encountered in a low (or zero) carbon electric power system and also appreciate the remedial measures necessary.

569 characters

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		*Incl. seminars, tutorials, problem classes.*
Lab/ practical		
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	105	*Incl. wider reading/ practice, follow-up work, completion of assessments*
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	Electrical and Electronic Engineering
Additional teaching departments	None

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
Lecturer		Adria	Junyent Ferre
Lecturer		Balarko	Chaudhuri
Lecturer		Yunjie	Gu

Learning and teaching

Module description

Learning outcomes	On successfully completing this module you should be able to: 1) assess the challenges associated with operation of a low carbon power system. 2) evaluate the operation and control of inverter-based resources (IBRs). 3) design the PLL and outer control loops of IBRs for a given specification. 4) analyse converter-driven sub-synchronous instability for single- and multi-IBR systems. 5) evaluate the role of IBRs in grid-following vs. grid-forming modes.
Module content	Topics to be covered 1. Overview of challenges associated with operation of a low carbon power system 2. Operation of 3-phase inverters 3. Control options for inverter-based resources (IBRs) – P or Vdc and Q or Vac with and without droop 4. Vector control 5. Inner current control loop design 6. Design of PLL 7. Outer control loop design 8. Converter-driven sub-synchronous instability 9. Grid-following (GFL) vs. grid-forming operation (GFM) 10. Impact on converter-driven sub-synchronous instability 11. Single IBR (GFL/GFM) connected to a large power grid 12. System stability with multiple IBRs – different mix of GFL and GFM
Learning and Teaching Approach	The module will be delivered primarily through lectures introducing the key concepts and methods. Learning will be reinforced through a combination of non-assessed problem sheets and assessed coursework elements.
Assessment Strategy	You will be formatively assessed through the coursework component of the module. You will have additional opportunities to self-assess your learning via non-assessed problem sheets.
Feedback	You will receive detailed feedback in the form of in-line annotations and a general feedback summary on each of the submitted coursework reports.
Reading list	The reading list is available via the Library's Leganto system.

Quality assurance

Date of first approval	February 2022
Date of last revision	January 2024
Date of this approval	February 2024
Module leader	Balarko Chaudhuri
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?
Coursework	Coursework 1	30%	50%	N
Coursework	coursework 2	30%	50%	N
Coursework	coursework 3	40%	50%	N
		100%		