IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort: Latest c:
Long title	HVDC Technology and Control		
New code	ELEC70047	New short title	
Brief description of module *(approx. 600 chars.)*	High voltage direct current (HVDC) is more effective than traditional alternating current (AC) for bulk power transmission via overhead lines over long distances and under-ground/sub-sea cables over relatively shorter distances. This module will provide the knowledge of the two broad HVDC technologies and their system level impact. The focus will be on HVDC converter operation and control, operation of HVDC links and HVDC systems and interaction between HVDC and host AC systems. The role of HVDC in facilitating the decarbonisation of the electric power sector will be covered.		
	583 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	10	*Incl. seminars, tutorials, problem classes.*
Lab/ practical		
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	95	*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	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		Balarko	Chaudhuri
Lecturer		Adria	Junyent-Ferre

Learning and teaching

Module description

Learning outcomes	On successfully completing this module you should be able to: 1) appraise the pros and cons of using HVDC with respect to AC for overhead and cable transmission. 2) describe the operation and control of HVDC converters and HVDC systems. 3) recognise the benefits and limitations of two broad HVDC technologies and their suitability in a specific context. 4) design the control system for HVDC converters and systems. 5) analyse the interaction between HVDC and host AC systems. 6) appreciate the role of HVDC in renewable integration and decarbonisation of the electric power sector.
Module content	Introduction to HVDC: AC vs. HVDC Line Commutated Converter (LCC) based HVDC 1. Six-pulse converter operation and control 2. Control of point-to-point LCC HVDC links 3. Interaction with host AC systems 4. AC-DC power flow 5. Harmonics and filtering 6. System aspects Voltage Source Converter (VSC) based HVDC: 1. Characteristics of VSC vs LCC, basics of VSC for DC 2. Basics of VSC for AC 3. Modular Multi-level Converter (MMC) circuit topology and operation 4. Control of a MMC 5. VSC-HVDC grids: operation, protection and HVDC circuit breakers
Learning and Teaching Approach	The module will be delivered primarily through live or pre-recorded lectures introducing the key concepts and methods. The first half of the module will be delivered via traditional lectures while the second part will adopt a 'flipped-classroom' approach. For the latter you will be asked to watch and revise the material of a series of pre-recoded lectures and attend to their corresponding problem sessions. Learning will be reinforced through non-assessed problem sheets and assessed problem sheets to be during the problem sessionms of the second part of the module.

Assessment Strategy	This module presents opportunities for both formative and summative assessment. You will be summatively assessed by a written examination at the end of the module and by marking the answer report from the group exercise sessions. You will be formatively assessed through group exercise sessions which forms the coursework component of the module, a model solution will be presented at each problem session once the answer sheets have been submitted. You will have additional opportunities to self-assess your learning via non-assessed problem sheets with model solutions.
Feedback	You will receive feedback on examinations in the form of published model answers annotated to highlight the common mistakes, and alternate approaches to the solutions reflecting the performance of the entire cohort. You will receive feedback on the problem sheets of the second half of the module through their module solutions and in-class discussion of the exercises.
Reading list	- Arrillaga, J. High Voltage Direct Current Transmission. 2nd ed. London, UK: Institution of Electrical Engineers, 1998. - Kundur, P. (Prabha), Neal J. Balu, and Mark G. Lauby. Power System Stability and Control. New York ;: McGraw-Hill, 1994. - Arrillaga, J., Y. H. Liu, and N. R. Watson. Flexible Power Transmission : the HVDC Options. Hoboken, N.J: Wiley, 2007. - Sharifabadi, Kamran, Lennart Harnefors, Hans Peter Nee, Staffan Norrga, and Remus

Quality assurance

Date of first approval	
Date of last revision	June 2026
Date of this approval	
Module leader	Balarko Chaudhuri

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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	Final Exam	80%	50%	N
Coursework	Answer report from 5 group problem sessions	20%	50%	N
		100%		