IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Power Electronics and Power Systems		
New code	ELEC50012	New short title	

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

This module describes the generation, transmission and application of electrical power. It covers the principles of converting energy between mechanical and electrical forms in motors and generators, the conversion of energy from one voltage to another using switch-mode circuits and the transfer to energy through lines and cables. The module is supported with seven examples classes and laboratory experiments.

For each major topic, namely: switch-mode power supplies; three-phase power systems, transformers, induction machines, and transmission & distribution networks, the objectives are broadly similar:
•to indicate how the classical system was arrived at,
•to relate the equivalent circuit model to physical properties and
•to perform calculations of power flow and efficiency based on the equivalent circuit.

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit	
Credit value	7.5	15	N	HECOS codes
FHEQ level	Level 5			

Allocation of study hours

	Hours	
Lectures	16	
Group teaching	8	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	12	
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	151.5	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement		*Incl. work-based learning and study that occurs overseas.*
Total hours	187.5	
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		Yunjie	Gu
Lecturer		Mark	O'Malley

Learning and teaching

Module description

Learning outcomes	Upon successful completion of this module, you will be able to: 1. describe operation of a switch-mode power supply (SMPS) and appreciate why it is capable of high efficiency and how step-down and step-up of voltage is possible 2. calculate suitable component values for a given SMPS specification 3. calculate current and power flow for star- and delta-connected three-phase loads, 4. describe the construction and operating principles of a transformer 5. justify elements of the equivalent circuit of a transformer, 6. calculate the current flow, efficiency and voltage regulation in transformer 7. describe qualitatively how a rotating magnetic flux wave is produced by a three-phase winding and how torque is developed by interaction of two fields, 8. justify elements of a per-phase induction machine equivalent circuit, 9. calculate slip, power and torque of an induction machine based on the equivalent circuit. 10. calculate power flow between nodes of a network and the voltages at the nodes 11. describe how voltage is controlled in a network
Module content	1) Voltage conversion: principles of switch-mode power supply (SMPS) circuits, step-down DC/DC converters, design of an SMPS, step-up DC/DC converter, AC transformer 2) Induction machines: general features, principle of operation, equivalent circuit, power flow diagram, torque characteristic 3) Characteristics of AC Grids: three-phase suppies, properties of lines, power flow between nodes, power flow limits, approiaches to voltage control 4) Simulation and experimental examinaton of SMPS.

Learning and Teaching Approach	The lectures will be taught in a large lecture theatre to the whole year group using PowerPoint presentation and interactive teaching technology supported question and answer sessions. These lectures will be recorded. Exercise classes consist of thirty-sixty students will focus on applying the techniques covered in lectures to a variety of problems ranging from the easy to the difficult, with the chance to ask questions and get one-to-one help. These classes will involve both individual as well as group work. In tutorial groups of 3-4 students you will have the opportunity to solve a selection of problems with your personal tutor. Laboratory exercises will link the topics taught directly to their applications. Simulations will be part of the learning in applied settings.
Assessment Strategy	There will be a computer-based test during the midterm week. The laboratory work is a part of the module assessment. This assessment will be based on an oral exam that evaluates your understanding of the concepts and your ability to explain and build the experimental set-up. The final exam will cover all the topics in the module.
Feedback	Feedback will be given in the exercise classes. The computer-based test will generate automatic feedback. Feedback on the oral laboratory exam will be given after the assessments. Feedback on the exams will be giving after re-assessments have been given. This feedback will come in the form of annotated example answers. The annotations will highlight where the student cohort did well and where general problems in understanding were observed.
Reading list	
Required equipment/ software	NA

Quality assurance

Date of first approval	October 2020
Date of last revision	July 2025
Date of this approval	July 2025
Module leader	Yunjie Gu
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	40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Practical	laboratory practicals	30%	40%	N
Examination	Spring Midterm computer-based test	10%	40%	N
Examination	exam at start of summer term	60%	40%	N
		100%		