IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	2020-2021
Long title	Devices, Power and Communications		
New code	ELEC40009	New short title	

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

The aim of this module is to introduce you to the interdisciplinary nature of electrical engineering. It provides insight into how different engineering areas covered in this and next year's modules are interconnected. Modules are not isolated; concepts in one module support those in another.
In this module, we will cover three engineering areas: semiconductor devices, power electronics, and communications.
For instance, consider the pn diode, the basic structure for all other devices such as the MOSFET and the BJT. Understanding the operation of the MOSFET and BJT facilitates comprehension of analogue and, to a lesser extent, digital circuits. In the Spring term, the module "Analysis and Design of Circuits" will heavily rely on your knowledge of these devices.
The pn diode is also the basic structure of the solar cell, or photovoltaic cell. Photovoltaics is one of the most widely distributed renewable energy sources and is covered in the topic of power electronics. PV cells generate DC power, but how do you introduce them into the AC grid? This is addressed in the Power Electronics topic. This second topic will explore energy distribution in the grid and the role of renewables in that system. It will also provide a glimpse into power management approaches.
In our interconnected world, communication is the backbone of modern technology. Devices, machines, and systems all depend on smooth data exchange. At the core of this network is a crucial element – the communication module. Whether in smartphones, smart homes, industrial automation, or advanced healthcare, communication modules are essential for enabling systems to interact seamlessly. This third topic also applies some mathematical concepts covered in the Mathematics module in and engineering context.

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 4			

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	16	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	151.5	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement	0	*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		Other	Term 1 and Term 2

Ownership

Primary department	EEE
Additional teaching departments	NA
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		Kristel	Fobelets
Lecturer		Tim	Green
Lecturer		Kin	Leung

Learning and teaching

Module description

Learning outcomes	At the end of the module you will be able to: 1.Describe the transport processes in a pn diode, the BJT and the MOSFET. 2.Derive the formulae for the output and control characteristics of these devices. 3.Explain how the pn diode can be used as a light intensity sensor and as a solar cell. 4.Derive the equivalent circuit components from physical principles. 5.Summarise how national electricity systems are configured. 6.Explain the electronic circuit required for using solar cells in the national grid. 7.Appraise the challenges facing electricity systems as the drive to net zero carbon emissions progresses 8.Describe how signals can be represented in the time and frequency domain. 9.Recall the basic principles of communications systems. 10.Formulate modulation and demodulation techniques to transport signals. 11.Apply this knowledge in other modules.

Module content	Syllabus: •Electrons and holes in nSi and pSi •Energy Band Diagrams •pn Diode •Solar Cell •Bipolar Junction Transistor •Metal Oxide Semiconductor Field Effect Transistor •Electrical supply systems •Solar energy •Interfaces for photovoltaic panels •Switch-mode power supplies •Transformation of electricity grids •Types of electrical signals •Frequency components of signals and signal convolution •Amplitude modulation •Frequency modulation •Brief introduction to digital communications (if time permits)
Learning and Teaching Approach	Teaching will take place in the classroom, where module leaders will explain concepts and provide opportunities for questions and answers. Each topic will have associated problem classes, offering a great chance to solve problems and engage in further Q&A sessions. These problem classes will be supported by GTAs (Graduate Teaching Assistants). Additionally, classes will often be supplemented with quizzes to reinforce learning. The topics covered per term (lecture hours/classes): Autumn term: Semiconductor devices (10 hrs/6hrs) Spring term: Electrical power (5 hrs/5 hrs) Communications (5 hrs/5hrs)
Assessment Strategy	All assessments are in-class computer-based (Wiseflow) time-limited and invigilated sessions for each topic area. Semiconductor devices will be assessed at the start of Spring term. Power Electronics will be assessed during the Spring mid-term assessment period. Communications will be assessed during the main Summer term examination period.
Feedback	Feedback on progress will be given electronically by participating in quizzes (e.g. Mentimeter).
Reading list	B.P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, Oxford University Press. B. Streetman and S.K. Banerjee, Solid State Electronic Devices, Chapter 5, Pearson Education Inc. Prentice Hall

Quality assurance

Date of first approval	October 2020
Date of last revision	January 2025
Date of this approval	January 2025
Module leader	Kristel Fobelets

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	40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	Semiconductor devices	34%	40%	N
Examinations	Power Electronics	33%	40%	N
Examinations	Communications	33%	40%	N
		100%		