IMPERIAL

Module Specification

Basic details

UID		Cohorts covered (Earliest cohort)	
Long title	Semiconductor Devices		
New code	ELEC60029	New short title	
Brief description of module *(approx. 600 chars.)*	During the 1st and 2nd year most of the semiconductor devices - the building blocks of integrated analogue and digital circuits - have been used as black boxes. In this module we will open the lid on these black boxes and discover the physics behind the operation of these devices. Quantum mechanics supports the fundamental transport processes of charged carriers and allows derivation of performance parameters still based on classical formulae. Small signal and large signal characteristics will be explained with an aim to understand the limits and future trend of these devices.		
Available as a standalone module/ short course?	No		

Statutory details

	ECTS	CATS	Non-credit	
Credit value	5	10	N	HECOS codes
FHEQ level	L6			

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	2	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	103	*Incl. wider reading/ practice, follow-up work, completion of assess*
Placement	0	*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 1	Other	

Ownership

Primary department	Department of Electrical and Electronic Engineering
Additional teaching departments	0

Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	No
External institution	
External department	
External campus	

Associated staff

Role	CID	Given name	Surname
Module Leader		Zahid	Durrani
		0	0
		0	0
		0	0
		0	0
		0	0
		0	0
		0	0

Learning and teaching

Module description

Learning outcomes	At the end of this module, you will be able to: 1. Explain basic quantum mechanical principles of charged carrier conduction 2. Apply energy band diagrams to analyse carrier transport processes 3. Classify devices into majority and minority carrier devices and appraise their advantages and disadvantages in different applications 4. Derive device characteristics given the geometry and material parameters. 5. Calculate performance parameters by employing the correct equations and approximations 6. Explain delays in small and large signal operation of devices
Module content	• Quantum Mechanics, the Schodinger equations and energy band diagrams • Doping of semiconductors • Carrier scattering, generation and recombination • Drift and Diffusion processes of electrons and holes • Carrier transport in pn diode, MOSFETs and BJTs • Small signal and large signal operation • A glimpse of modern devices • A short introduction of Technology Computer Aided Design
Learning and Teaching Approach	Teaching will be done by a combination of face-to-face lectures, self-learning supported by video recordings, in-class problem solving and mentimeter questionnaires. Teaching is done during the first seven weeks of autumn term, followed by two weeks of revision and problem classes. Assessment will be in the final weeks of term.
Assessment Strategy	Assessment is by a 3 hour closed book exam. A formulae sheet will be made available with the exam paper and calculators (supplied by the department) will be allowed.
Feedback	In-class feedback duing problem solving excercises. Feedback on exam papers will be after the September examiners' meeting and will be in the form of annotation to the example solutions that reflect on the general performance of the cohort on the different aspects of the exam questions.

Reading list	1) Streetman, B., & Banerjee, B: Solid State Electronic Devices, Pearson Education, 2014.

Quality assurance

Date of first approval	July 2021
Date of last revision	Jul-23
Date of this approval	July 2025
Module leader	Prof Zahid Durrani
Notes/ comments	

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Template version

Assessment details

Grading method	Numerical	Pass mark	40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	Examination	100%	40%	N
	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
0	0	0%	0%	0.00
		100%		