Imperial College London

Module Specification (Curriculum Review)

Basic details

UID		Cohorts covered	Earliest cohort: 2024-25; Latest cohort:
Long title	Advanced Electronics		
New code	PHYS40006	New short title	Advanced Electronics

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

The module will provide an introduction to circuit design with active electronic components for Year 1 physics undergraduates. It will cover an introduction to semiconductors, diodes, transistors, op-amps, feedback amplifiers and digital electronics. Much of the module is delivered through computing exercises and lab work, and it includes a project element.

359 characters

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit
Credit value	5	10	N

HECOS codes:

FHEQ level: 4

Allocation of study hours

	Hours	
Lectures	9	
Group teaching	2	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	27	
Other scheduled	27	*Incl. project supervision, fieldwork, external visits.*
Independent study	60	*Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.*
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		Other	Taught term 2, some assessment term 3

Ownership

Primary department: Physics

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
Module Leader		Christopher	Carr

Learning and teaching

Module description

Learning outcomes

On completion of this module you will be able to:
•Describe the properties of n- and p-type semiconductors, and the operating principle of bipolar junction devices;
•Describe the characteristics of a diode, and its use in circuit design;
•Analyse simple transistor circuits for buffering and amplification;
•Explain the properties of the ideal operational-amplifier; describe and make use of the 'golden rules' used to analyse op-amp circuits, and in particular the use of feedback;
•Identify and describe the common logic-gates used in digital circuits;
•Analyse simple digital circuits used for the representation and manipulation of digital numbers;
•Demonstrate skilful use of simulation software to aid the design and evaluation of circuits;
•Build simple circuits, using the knowledge gained during this module and the basic electronics covered in the Oscillations and Waves module.

Module content

•n-type and p-type doped semiconductors, the p-n junction diode, the diode equation, rectification;
•npn bipolar junction transistor, saturation and linear operation; current-gain;
•Emitter-follower buffer, common-emitter amplifier and transistor switch;
•The operational amplifier used with negative feedback
•Ideal amplifier circuits analysed using the 'golden-rules': voltage-follower, inverting/non-inverting amplifiers, integrator/differentiator, summing and difference amplifiers;
•Real-world effects: input/output resistance, frequency response and the gain-bandwidth product;
•Digital logic gates described by truth-tables;
•Binary and hexadecimal number representations; flip-flop circuits to store numbers: adding and counting;
•Simple methods for digital-to-analogue conversion.

Learning and Teaching Approach	9 lectures introduce the topics, making use of interactive quizzes and time for Q&A. Students will be introduced to the LTSpice simulation software through a 2-hour guided session in the computing suite, with additional support and feedback provided through 3 'drop-in' sessions in sunsequent weeks. Circuit simulation exercises will be set to provide context and preparation for the laboratory work. In the laboratory, students will spend 3 hours a week for 3 weeks following guided exercises building circuits. For the final 3 weeks of term, students pursue an electronics mini-project, spending two half-days a week in the laboratory. All laboratory hours are supported by demonstrators.
Assessment Strategy	The main summative assessment in the module will be through a project report, which will contribute 85% of the mark for the module. In-course assessments, comprising 3 online multiple-choice assessed 'quizzes', contribute the remaining 15%.
Feedback	•In-person feedback throughout the laboratory and project activities by discussions with demonstrators •Drop-in sessions and office hours with the lecturer •Online solutions for the assessed quizzes •Text feedback on the project report itself, together with summarising notes •Individual in-person feedback on the report by the lecturer or their course-associate(s)
Reading list	No single text covers all the module material; however, the books listed below are useful resources. Students will be given online notes on all the topics covered, to provide deeper coverage of lecture material. • The Art of Electronics, Horowitz and Hill • Principles of Electronic Instrumentation, Diefenderfer and Holton • Sears and Zemansky's University Physics With Modern Physics, Young and Freedman

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Christopher Carr
Notes/ comments	

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Programme structure
Associated modules

UID	Legacy code	Module title	Requisite type

UID	Legacy code	Module title	Requisite type

Assessment details

Grading method	Numeric	Pass mark
		40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
			40%	
Practical	Project report	85%		N
Coursework	In-course assessments	15%		N
		100%		