Imperial College London

Module Specification (Curriculum Review)

Basic details

UID		Cohorts covered	Earliest cohort: 2025-26; 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	Term 2	Other	Some assessment in 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		Masaki	Hori

Learning and teaching

Module description

Learning outcomes

On completion of this module you will be able to:
1.Describe the properties of n- and p-type semiconductors, and the operating principle of junction field effect transistor devices;
2.Describe the characteristics of a diode, and its use in circuit design;
3.Analyse simple transistor circuits for amplification;
4.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;
5.Identify and describe the common logic-gates used in digital circuits;
6.Analyse simple digital circuits used for the representation and manipulation of digital numbers;
7.Demonstrate skilful use of simulation software to aid the design and evaluation of circuits;
8.Build simple circuits, using the knowledge gained during this module and the basic electronics covered in the Oscillations and Waves module.

Module content

1. n-type and p-type doped semiconductors, the p-n junction diode, the diode equation, rectification;
2. Junction field effect transistor, saturation and linear operation; current-gain;
3. Features of metal-oxide semiconductor field effect transistor, npn bipolar junction transistor;
4. Common-source amplifier and transistor switch;
5. The operational amplifier used with negative feedback
6. Ideal amplifier circuits analysed using the ‘golden-rules’: voltage-follower, inverting/non-inverting amplifiers, integrator/differentiator, summing and difference amplifiers;
7. Real-world effects: input/output resistance, frequency response and the gain-bandwidth product;
8. Digital logic gates described by truth-tables;
9. Binary number representations; flip-flop circuits to store numbers: counting.

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	Masaki Hori
Notes/ comments	

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Template version 16/06/2017

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%		