Imperial College London

Module Specification (Curriculum Review)

Basic details

UID		Cohorts covered	Earliest cohort: 2019-20	Latest cohort: 2019-20

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 exercises in the computing suite or the lab and it includes a project element.

369 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	3	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	40	
Other scheduled	12	*Incl. project supervision, fieldwork, external visits.*
Independent study	61	*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	Term 2, 3

Ownership

Primary department: Physics

Additional teaching: None

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		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, Shockley 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 analogue-to-digital and digital-to-analogue conversion.

Learning and Teaching Approach

There will be 9 lectures introducing the topics, supported by 3 tutorials. Students will spend 8 hours a week for 5 weeks in both laboratory and computer-simulation classes, all supported by demonstrators. The first 3 weeks cover set exercises on the above topics and the final 2 weeks are dedicated to a project chosen by each student pair from a list.

Assessment Strategy

The main summative assessment in the module will be through a project report and interview, which will contribute 85% of the mark for the module. In-course assessments comprising handwritten problems will contribute 15% of the mark.

Feedback

Formative feedback will be provided throughout the module following formative assessment in forms such as in-class quizzes (typically one per lecture), two online multi-choice tests, marking of one handwritten problem sheets and verbal feedback for the laboratory and computational exercises. Feedback for continuous assessment will be provided within two weeks of the submission date.

Reading list

No single text covers all the module material; however, the books listed below are useful resources.

Students will be given printed 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

Programme structure
Associated programmes

UID	Legacy code	Programme title	Core?

Assessment details

			Pass mark
Grading method	Numeric		40%

Assessments

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