Imperial College London

Module Specification (Curriculum Review)

Basic details

UID		Cohorts covered	Earliest cohort: 2023-24; Latest cohort:
Long title	Principles of Instrumentation		
New code	PHYS60008	New short title	Principles of Instrumentation

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

The Principles of Instrumentation course provides an introduction to the principles and practice of instrument science. This is a "directed study" course with significant academic engagement through regular contact sessions and a substantial ‘hands-on’ element in the lab. Students will be introduced to concepts in the electronics of scientific instruments through a combination of course notes and problem sheets released weekly, and practical laboratory work. In lab students will use the National Instruments LabVIEW™ ELVIS prototyping system to build and characterise key instrument components such as input/output transducers, amplifiers and filters.

656 characters

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 6

Allocation of study hours

	Hours	
Lectures	2	*induction and revision lectures*
Group teaching	42	*Incl. Q&A sessions, seminars, student-led workshop.*
Lab/ practical	16	
Other scheduled	7	*Incl. project supervision, fieldwork, external visits.*
Independent study	121	*Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	188	
ECTS ratio	25.0	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term		Other	Term 2, exam 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	359053	Henrique	Araujo
Lab Demonstrator		Elisa	Jacquet

Learning and teaching

Module description

Learning outcomes

On completion of this module you will be able to:
- demonstrate knowledge of the principles and practice of instrument science
- demonstrate knowledge of essential concepts in electronics
- build and analyse circuits using the National Instruments LabVIEW™ ELVIS prototyping system
- use Fourier and Laplace methods to solve equations representing signal propagation in a circuit
- describe sources of noise in instruments and methods for its reduction

Module content

- Sensors and transducers; ‘real-world’ sensors and their non-ideal behaviour
- The physical principles of some commonly used sensors
- Signal characteristics; fundamental limits on measurement resolution and accuracy
- A Fourier understanding of signals
- Essential concepts in electronics: passive and active circuits
- Interface matching, buffering and amplification
- Analogue to digital conversion; digital signals
- Use of feedback in the design of sensor systems
- Noise: sources, characterisation, and how to maximise the signal-to-noise ratio
- Frequency-domain characterisation and the Bode plot
- Systems Analysis: linear systems and their differential equations
- Solving linear systems using the Laplace Transform

Learning and Teaching Approach	Students will be taught over one term using a combination of directed study accompanied by weekly Q&A sessions, student-led tutorials, a student-led workshop, and academic-led laboratory sessions. • The timetabled weekly office-hour sessions (9) will include a high-level summary of the week's content and answering questions from the students (and topic-related discussions). • Problem sheets (9) are released weekly, with solutions distributed a week later. At the end of each week one student pair prepares a 1-hr tutorial session for their peers to work through the solutions (or some aspect thereof); their peers assess the quality of the discussion they led. The course academic is not present; an informal report on each session will be solicited from the students along with their marks for the presenting pair. • A student-led workshop will be organised at the end of the course where the student pairs present on a novel sensor technology of their choosing, giving an opportunity for independent research and for extension of their knowledge to the state-of-the-art of sensor technology. • Lab sessions (4, 3 hrs each) are led by the course academic; students work in pairs. • One revision lecture will take place at the end of the module, with additional office hours.
Assessment Strategy	Assessment is based on a written exam (75% of mark) plus a continuous assessment element (adding to 25%). The latter includes observation of the students' work in lab (5%) plus short Q&A sessions/interviews about the technical work and how this relates to the theoretical aspects (10%); peer-assessment of the student-led tutorial sessions completes the continuous assessment mark (5%); the final 5% comes from assessment of the student-led seminar.
Feedback	Problem sheets are provided weekly (9 in total) with questions and examples. One student pair presents solutions to these problems to their peers every week; this will allow all students to test their own understanding on a regular basis and to compare their leaning to the wider group. The peer-assement involves students passing on feedback to the pair presenting, which is collected via Qualtrics by the course lecturer. Feedback will be given in lab and atfer lab interviews with the course leader / demonstrator.
Reading list	Detailed notes are provided to students, released weekly. The notes are designed to be self-contained, and there is no designated textbook for this course. There are, however, excellent textbooks that are suggested as supplementary reading for those wishing to explore some aspects of the course in more detail. Examples are given in the current course info.

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Henrique Araujo
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?
Examination	Written Exam	75%	40%	N
Practical	Continuous assessment	25%	40%	N
		100%		