Imperial College London

Module Specification (Curriculum Review)

Basic details

			Earliest cohort	Latest cohort
UID		Cohorts covered	2020-21	

Long title	Quantum Physics
New code	PHYS50004
New short title	Quantum Physics
Brief description of module *(approx. 600 chars.)*	Quantum Physics is one of the foundations of modern physics. In this module, students will be introduced to the important concepts of quantum physics and the physical evidence for and success of quantum mechanics. Students will study the formal framework of quantum mechanics, including its postulates, mathematical formulation and the Schrödinger equation. This will then be applied to atomic physics to explain the structure and behaviour of hydrogen and more complex atoms. Students will carry out a literature investigation and write a scientific article on a topic of their choosing within the general area of Quantum Physics.

632 characters

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit
Credit value	15	30	N

HECOS codes: (blank)

FHEQ level: 5

Allocation of study hours

	Hours	
Lectures	60	
Group teaching	24	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	48	*Incl. project supervision, fieldwork, external visits.*
Independent study	243	*Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	375	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Year-long	Other	

Ownership

Primary department	Physics
Additional teaching 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		Jonathan	Pritchard
Topic Leader		Jon	Marangos
Topic Leader		Richard	Thompson

Learning and teaching

Module description

Learning outcomes	On completion of this module you will be able to: • Explain the physical evidence for quantum physics • Explain the mathematical and physical framework of quantum mechanics including the role of operators, commutation and how these relate to physical measurable properties. • Use the framework of quantum mechanics to calculate and explain physical systems including a particle in a potential, quantum tunnelling, quantum oscillators, time-independent and time-dependent systems. • Explain the relationship and differences between quantum physics and classical physics and describe the range of applicability of each and their limitations. • Apply quantum mechanics to describe and calculate the physics of simple atoms including hydrogen and helium, explaining key features including atomic states, spectra of hydrogen and helium and how more complex atoms behave and give rise to the periodic table of elements. • Carry out a scientific literature investigation, identifying relevant literature sources, reading and assessing sources critically and to plan and write a coherent review article.

Module content	The module introduces students to the key concepts of and physical evidence for quantum physics, including wave phenomena, evidence for the quantum nature of light and matter, and matter waves. Students will be introduced to the fundamental postulates of quantum mechanics and its mathematical formulation in terms of wavefunctions, operators and eigenvalues and the Schrödinger equation. This will be used to find solutions for simple physical systems such as the harmonic oscillator and particles in simple potential structures. As an application of quantum mechanics, atomic physics builds on the earlier material in the module to give an understanding of the structure and physical behaviour of the hydrogen atom, including spectroscopy, angular momentum properties, fine structure and electronic transitions and radiation from atoms, and moving on to two-electron atoms (helium) and more complex many-electron atoms. As part of the module, students will also research and write a scientific article on a topic of their choice.
Learning and Teaching Approach	Students will be taught over three terms using a combination of lectures, small-group teaching, office hours, study groups and problem sheets with directed exercises on theoretical and computational work. Weekly problem sheets with questions and examples will allow students to gain practice and apply their learning. Students will research literature for and write a science article in independent study with guidance in tutorials.
Assessment Strategy	The main summative assessment in the module will be through an exam in term 3 which will contribute 70% of the mark for the module. In-course assessments comprising online tests, and marking of handwritten problems and a written science article will contribute 30% of the mark.
Feedback	Formative feedback will be provided throughout the module following formative assessment in forms such as in-class quizzes, online tests, verbal feedback on in-class presentation, and marking of handwritten problems sheets and a scientific article. Feedback for any continuous assessment will be provided within two weeks of the submission date. General feedback on written examinations for each module is provided in the form of written reports from the examiners for the students.
Reading list	The module is self-contained and no additional books are required to be purchased by the students. Further discussion of material covered by the module, along with relevant problems can be found in: • Quantum Mechanics, A. I. M. Rae • Introduction to Quantum Mechanics, D. J. Griffith • Atomic Physics, C. J. Foot

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Jonathan Pritchard

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments	

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?
Examination	2-hour exam	70%		
Coursework	3000-word article	15%		
Coursework	In-course assessment	15%		
		100%		