Module Specification (Curriculum Review)

Imperial College London

Basic details

UID	
Cohorts covered	Earliest cohort: 2025-26; Latest cohort:
Long title	Quantum Theory of Matter
New code	PHYS70018
New short title	
Brief description of module *(approx. 600 chars.)*	This course is an introduction to superfluidity and superconductivity, seen in liquid helium, ultracold atomic gases and electronics materials. The course covers the key concepts behind these two phenomena as well as recent developments in topological states of matter which revealed the existence of Majorana fermions in unconventional superconductors.

353 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 7

Allocation of study hours

	Hours	
Lectures	26	
Group teaching	10	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	11	*Incl. project supervision, fieldwork, external visits.*
Independent study	140.5	*Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	187.5	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Term 2	Other	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		Derek	Lee
Module Leader		Frank	Schindler

Learning and teaching

Module description

Learning outcomes	At the end of the course, the student should be able to (1) explain the phenomenology of superfluids and conventional superconductors,using Gross-Pitaevskii theory and Ginzburg-Landau theory (2) apply the basic formalism of second quantisation to many-body systems (2) apply the microscopic theory of neutral superfluids (Bogoliubov theory) and derive their basic predictions (3) explain the BSC theory of superconductors and derive the existence of Cooper pairs (4) apply the Bogoliubov-de-Gennes formalism for quasiparticles in superconductors (5) understand examples in topological superconductors
Module content	1. Phenomenology of neutral superfluids (liquid helium, ultracold gases): superfluidity, quantised vorticity 2. Phenomenology of conventional superconductors: Meissner effect, vortex lattices, dc Josephson effect. 3. Microscopic theory of superfluids: second quantisation, Bogoliubov theory 4. Microscopic theory of superconductors a. BCS theory for conventional (s-wave) superconductors b. Bogoliubov-de Gennes theory of BSC quasiparticles 5 Topological superconductivity: e.g. Majorana fermions in Kitaev chain

Learning and Teaching Approach	
Assessment Strategy	Final written exam of 2 hours.
Feedback	Rapid feedback session weekly with a demonstrator to assist with the problem sheets as well as lecture content.
Reading list	• J Annett, "Superconductivity, superfluidity and condensates" (OUP) • Bernevig & Hughes, “Topological insulators and topological superconductors”.

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Derek Lee

Office use only

QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments	

Programme structure
Associated modules

UID	Legacy code	Module title	Requisite type

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
			50%	
Examination	2 hour written examination.	100%	50%	N