Imperial College London

Module Specification (Curriculum Review)

Basic details

			Earliest cohort	Latest cohort
UID		Cohorts covered	2024-25	
Long title	Vector Fields, Electricity and Magnetism			
New code	PHYS40004	New short title	Vect Fds, Elctrcty & Mag	

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

This module introduces the key concepts of vector calculus and uses them to provide a foundational introduction to electricity and magnetism. Students will gain an understanding of the key mathematical theorems and the fundamental physical concepts relating to electricity and magnetism, in particular the fundamental nature, importance, and usefulness of fields. Upon completion the student will be able to progress on to a full advanced treatment of classical electromagnetism through Maxwell's equations.

507 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: 4

Allocation of study hours

	Hours	
Lectures	36	*VC, Elec, Magn*
Group teaching	12	*Incl. seminars , tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	12	*Incl. PeerWise*
Independent study	127.5	*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: 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		Marina	Galand
		Martin	McCall
		John	Tisch

Learning and teaching

Module description

Learning outcomes	On completion of this module you will be able to: • Explain physical concepts in electricity and magnetism such as charge, force, field, potential, dipole, capacitor, dielectric and apply them. • Select and use vector-field differential operators, multidimensional integrals and other appropriate mathematical tools for solving problems in electricity and magnetism. • Recall, explain and apply Gauss's law in both differential and integral forms • Calculate magnetic fields using the Biot-Savart Law and Ampere's Law • Recall and manipulate Maxwell's equations in integral and differential forms, and use them to solve simple problems analytically. • Describe the relationship between the electric and magnetic fields and light.
Module content	The module will cover the physics of electricity and magnetism, alongside the more advanced mathematical techniques required to calculate the causes and effects of these fields: • Electricity and magnetism: concepts of electric charge, force, field and potential; Electric fields created by static charges, including electric dipoles; Gauss's law and its applications; the continuity equation for the flow of charges; capacitors, dielectrics and the energy they store; the need for a displacement current Magnetism: magnetic fields, both static and time-varying; relationships between current flow and magnetic field via the Biot-Savart Law, Ampere's Law and Faraday's Law (electromagnetic induction); relationship between electric field and magnetic field through Faraday's law; generators and how they work; inductors, the energy they store and mutual-induction. • Mathematical concepts: vector field differential operators - gradient, divergence and associated divergence, Green's, and Stokes' theorems; application in physical situations; Multi-dimensional integrals, including line, surface, and volume integrals; change of variables in an integral and application to polar and spherical co-ordinates.
Learning and Teaching Approach	Students will be taught using a combination of lectures, small-group teaching, office hours, study groups and directed exercises on theoretical, practical and computational work
Assessment Strategy	An exam in term 3 covering all learning outcomes will comprise the main part of the summative assessment and will contribute 80% of the module mark. In-course assessments that may include for example online assessments and handwritten problems will count to 20% of the mark.

Feedback	Formative feedback will be provided throughout the module following formative assessment in forms such as in-class quizzes, online tests, marking of handwritten problems sheet and verbal feedback for any practical or computational exercises. Where appropriate, feedback for any in-course 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: * Mathematical methods for physics and engineering, K.F. Riley, CUP, 2006 • Mathematical methods in the physical sciences (3rd Ed.), M. L. Boas, Wiley, 2006 * Mathematics for Physicists: Introductory Concepts and Methods, Alexander Altland and Jan von Delft, Cambridge University Press, 2019 • University physics with modern physics, H. D. Young & R. A. Freedman, Pearson, 2020 • Introduction to electrodynamics, D. J. Griffiths, CUP, 2023 • Lectures on physics, vol 2, R. P. Feynman, R. B. Leighton & M. L. Sands, New millennuim, 2010

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Marina Galand

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

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Assessment details

		Pass mark
Grading method	Numeric	40%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	2-hour exam	80%		N
Coursework	In-course assessment	20%		N
		100%		