Imperial College London

Module Specification (Curriculum Review)

Basic details

			Earliest cohort	Latest cohort
UID		Cohorts covered	2024-25	

Long title: Optical Communications Physics

New code: PHYS70007 | New short title:

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

This module builds on the Oscillations and Waves, E&M and Solid State Physics core modules, and develops understanding of how modern optical communications technologies operate. The module considers optical fibres and the surrounding optoelectronic and photonic technology, classical information theory and data encoding, and network infrastructure.

349 characters

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit		
Credit value	5	10	N	HECOS codes	

FHEQ level: Level 7

Allocation of study hours

	Hours	
Lectures	13	
Group teaching	1	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	6	*Incl. project supervision, fieldwork, external visits.*
Independent study	105	*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	Term 1	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		Chris	Dunsby

Learning and teaching

Module description

Learning outcomes	On completion of this module, students will be able to: 1. Explain the operation principles and technology of optical fibre networks 2. Discuss the factors that limit the transmission of information over optical fibres and the methods commonly used to mitigate them 3. Analyse the operation of semiconductor light sources and detectors used in optical communications systems 4. Describe how information is encoded in optical communications systems, information capacity and future developments in intergrated photonics 5. Describe the effect of noise and other factors that limit bit-rates in optical fibre communications 6. Apply their theoretical understanding to design numerical simulations to study fibre modes and their dispersion
Module content	• Ray picture of light propagation in optical fibres: Fresnel's Equations/Total Internal Reflection • Guided-mode solutions of cylinder from Maxwell's equation: optical fibre modes • Light propagation in optical fibres: dispersion, attenuation • Fibre Amplifiers (Erbium doped and Raman) • Dispersion compensation in optical fibres • Revision of semiconductor physics • Revision of light emission from semiconductor materials (LEDs) • Principles of laser action and introduction to semiconductor lasers and strategies for single mode operation • Photodiodes: efficiency, speed and noise • Noise in optical communications systems, bit error rates and eye diagrams • Laser and LED modulation (direct and indirect): Electro-Absorption, Electro-Refraction and Mach Zehnder Interferometers • Data-encoding strategies to maximize data capacity over optical link stations. • Considerations on future developments in nanophotonics, photonic intergrated circuits and waveguides, wavelength division multiplexing
Learning and Teaching Approach	Students will be taught over one term using a combination of lectures, office hours, problem sheets and online quizes. Examinable coursework consists of a group project. Some lecture time will be allocated to support students with both their group project, quizzes and problem-solving.

Assessment Strategy	Summative assessment is based on a final exam and coursework. The coursework will consist of a group project (30% of final mark). The written exam will last 1h and will evaluate ILOs 1-5 (70% of final mark). ILO 6 will be tested by a group project and will not be included in the final exam.
Feedback	Problem sheets are provided with questions and examples students can practise with. Online quizzes will also provide feedback. Summative assessment of the coursework (project) will be accompanied by feedback and comments.
Reading list	Lecture notes are provided to students. The notes are designed to be self-contained, and there is no designated textbook required for this module. There are however also some excellent textbooks that are suggested as supplementary or complementary reading for those of you wishing to explore further some aspects of the module.

Quality assurance

Date of first approval	
Date of last revision	
Date of this approval	
Module leader	Chris Dunsby

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

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	1 hour written Exam	70%	50%	N
Coursework	Group poster presentation of project, submission of code and description of method	30%	50%	N
		100%		