Imperial College London

Module Specification (Curriculum Review)

Basic details

UID		Cohorts covered	Earliest cohort: 2025-26	Latest cohort:

Long title: Optical Design

New code: PHYS70029

New short title:

Brief description of module *(approx. 600 chars.)*: The module introduces Seidel aberration theory to describe and enumerate the aberrations that arise in optical imaging systems such as compound lenses and mirrors. It studies arrangements of optical surfaces that are able to control or minimise aberrations and investigates both theoretical and practical design processes using an industry standard computer aided design package.

380 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	12	
Group teaching		*Incl. seminars, tutorials, problem classes.*
Lab/ practical	30	
Other scheduled		*Incl. project supervision, fieldwork, external visits.*
Independent study	83	*Incl. wider reading/ practice, follow-up work, completion of assessments, revisions.*
Placement		*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 2	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		Mark	Neil

Learning and teaching

Module description

Learning outcomes

On completion of this modules students will be able to:
- evaluate the aberrations arising in optical systems and characterise those present in terms of the primary aberrations
- demonstrate and evaluate how refractive and reflective elements can be combined to minimise certain aberrations
- identify the fundamental limitations to the performance of certain design combinations
- critically analyse and refine the performance of optical systems using industry standard techniques based on

Module content

Seidel aberration theory and the effect on Seidel aberrations of shifting the stop
Refractive index and dispersion in real glasses
Controlling aberrations in thin singlet and doublet lenses
Optimising lens designs on a computer using finite raytracing
More complex compound lens designs including Petzval, Telephotos, Triplets and Double Gauss
Aberrations in mirror systems

Learning and Teaching Approach

The module will be delivered as a combination of formal lectures (12 hours) covering lens design theory and practical sessions (30 hours) using lens design software to both evaluate optical system performance and then to optimise that performance. The practical component will be delivered as a set of exercises that link with and are interspersed with the theory taught in the lectures.

Assessment Strategy

Practical optical design is the application of theoretical principles, using practical computational skills and problem solving skills. To ensure the assessment covers all intended learning outcomes, a short report is assessed part way through the course on specific design exercises and a formal 2 hour written examination, incorporating written and practical (computational) problems, is provided at the end of the course. The examination carries twice the weight of the practical report.

Feedback

A set of problems are provided that students work through in the practical sessions. These interactive sessions provide an opportunity for group discussion and for students to receive formative feedback on the practical exercises as the different exercises are completed.

A summative assessment on a short report - submitted by the student on a subset of the exercises in the practical sessions - completed part way through the course. Formative feedback is provided on the report.

Reading list

Comprehensive notes will be provided to cover both the lectures and the practical exercises.
Lens design:
JM Geary: Introduction to lens design
R Kingslake: Lens design fundamentals
WJ Smith: Modern Optical Engineering
AE Conrady: Applied optics and optical design
Geometrical optics:
M Herzenberger: Modern geometrical optics
JE Greivenkamp: Field guide to geometrical optics
WT Welford: Aberrations in optical systems
Reference book: H Gross: Handbook of optical systems
Text book: JJM Braat & P Török: Imaging optics

Required equipment/ software

Quality assurance

Date of first approval:
Date of last revision: February 2024

Office use only

QA Lead:
Department staff:

Date of this approval		Date of collection	
		Date exported	
Module leader	Mark Neil	Date imported	
Notes/ comments			

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