University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Advanced Optics			
Code: PHYS09001	**SCQF Level: 9 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Maximilien Barbier		

Summary of Module

This module is an optional module at Level 9 on Institute of Physics (IoP) accredited Physics programmes.

This module will cover:

Wave equation for optical waves, plane waves, monochromatic light, light polarization (linear, circular, elliptical), Fresnel formulas for oblique incidence of optical waves incident on dielectric interfaces, including the cases of TE and TM polarizations, Brewster angle.

Dispersion, Lorentz model of dielectrics, phase and group velocities, optical waves in absorptive media, introduction to optics of metals.

Anisotropic media, birefringence, elements of crystal optics, quarter and half-wave plates, awareness of Kerr, Pockels and Faraday effects.

Review of interference, scalar diffraction theory, Fresnel and Fraunhofer approximations, elements of Fourier optics.

Natural line width, spontaneous emission, Einstein's equations, stimulated emission, population inversion, lasing, rate equations. Introduction to gas, solid state and semiconductor lasers and their applications.

We have defined a set of Graduate Attributes that are the skills, personal qualities and understanding to be developed through your university experience that will prepare for life and work in the 21st century (https://www.uws.ac.uk/current- students/your-graduate-attributes/). The Graduate Attributes relevant to this module are listed below.

- Graduate Attributes - Academic: critical thinker; analytical; inquiring; knowledgeable; digitally literate; problem solver; autonomous; incisive; innovative
- Graduate Attributes - Personal: effective communicator; influential; motivated
- Graduate Attributes - Professional: collaborative; research-minded; enterprising; ambitious; driven

Module Delivery Method					
Face-To-Face	**Blended**	**Fully Online**	**HybridC**	**Hybrid 0**	**Work-Based Learning**
☒	☐	☐	☐	☐	☐
See Guidance Note for details.					

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	Add name

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☒	Term 3	☐

Learning Outcomes: (maximum of 5 statements) **These should take cognisance of the SCQF level descriptors and be at the appropriate level for the module.** At the end of this module the student will be able to:	
L1	Understand the theory of light propagation through different media including interfaces, absorptive and anisotropic materials.
L2	Understand polarization of light, including elliptic polarisation.
L3	Appreciate Fresnel and Fraunhofer diffraction.
L4	Understand the working principles and applications of lasers.
L5	Perform laboratory experiments appropriate to the content of the topics covered in lectures.

Employability Skills and Personal Development Planning (PDP) Skills		
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:	
Knowledge and Understanding (K and U)	SCQF Level **9** A broad knowledge of optical theory with a strong underpinning of experimental work.	
Practice: Applied Knowledge and Understanding	SCQF Level **9** Understanding the working principles and applications of optical instruments, including lasers.	
Generic Cognitive skills	SCQF Level **9** Problem-solving skills, mathematical reasoning, practical skills.	
Communication, ICT and Numeracy Skills	SCQF Level **9** The communication of complex physical ideas, and calculations appropriate to SCQF Level 9.	
Autonomy, Accountability and Working with others	SCQF Level **9** Academic integrity, working together with laboratory partners, presenting the results of joint experiments as an individual.	
Pre-requisites:	Before undertaking this module, the student should have undertaken the following:	
	Module Code: PHYS08002 PHYS08004 PHYS08006 PHYS08007 PHYS08009	**Module Title:** Optics & Electronics Properties of Matter Mathematics for Physics 1 Classical Mechanics Modern Physics
	Other:	or equivalent
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching
In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours. The delivery of this complex advanced Physics module is primarily lecture based, having a strong additional focus on supplementary tutorials and practical work, which is incorporated by a series of 4 highly relevant laboratory experiments. All lecture and tutorial materials are published on the VLE. Students are encouraged to use the VLE communication tools to give feedback on the presented material and to discuss topics

with their peers and the lecturing staff. Group work is highly encouraged, as long as academic integrity is maintained. The lecturing staff expects the students to extend their knowledge in private study which will be essential for the delivery of the coursework. The students can refer to a collection of relevant material provided by the lecturing staff on the VLE.

Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	24
Tutorial/Synchronous Support Activity	12
Laboratory/Practical Demonstration/Workshop	12
Independent Study	152
	200 Hours Total

****Indicative Resources: (eg. Core text, journals, internet access)**

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

J. Peatross and M. Ware, Physics of Light and Optics, 2015 edition, available at optics.byu.edu

F Graham Smith, Terry A King & Dan Wilkins, Optics and Photonics, John Wiley & Sons 2008

Kenyon IR, “The Light Fantastic: A Modern Introduction to Classical and Quantum Optics, Second Edition”, Oxford, 2011

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure: Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

Equality and Diversity

The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code. Please ensure any specific requirements are detailed in this section. Module Co-ordinators should consider the accessibility of their module for groups with protected characteristics.
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	Engineering and Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Physical Sciences
Moderator	Shigeng Song
External Examiner	D Faux
Accreditation Details	Institute of Physics (IoP)
Changes/Version Number	**3.0** Module descriptor amended to conform to the new template format and to reflect outcomes from ILR 2023.

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment 1 – Class Test (60%)
Assessment 2 – Written Coursework and Laboratory Work (40%)
(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Assessment Outcome Grids (**See Guidance Note)**

Component 1							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of**	**Timetabled Contact Hours**

						Assessment Element	
Class Test	✔	✔	✔	✔		60	2

Component 2							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Laboratory				✔	✔	20	12
Portfolio of Written Work	✔	✔	✔	✔		20	0
Combined Total for All Components						100	14