

Doctor of Engineering in Applied Photonics

<http://www.idcphotonics.hw.ac.uk/>

The DEng degree in Photonics is a 4-year course involving a blend of specialist postgraduate training in all aspects of photonics, tailored to the needs of the photonics industrial sector, and a significant, challenging and original research project undertaken as a partnership between industry and academia. Each research project provides experience in project management (including financial management) and teamwork as well as the opportunity to gain greater understanding of photonics and the business context in which the research is conducted. A significant proportion of the student's time (typically around 70%) is spent within the sponsoring company.

Graduates from the programme will have gained an in-depth understanding of the fundamental properties of photonic materials and practical experience of the technology and operation of a wide range of photonic devices. They will additionally have had extensive experience of research in an industrial environment and have received training in the transferable skills required in such an environment.

The course is organised jointly by Heriot-Watt, Glasgow, St Andrews, and Strathclyde universities. St Andrews will normally be the location for the start of the course and will provide full time teaching in photonics during the first semester of the first year of the course. Students then have a semester of electronic engineering theory and practice at Glasgow and Strathclyde Universities as additional preparation before embarking on their research. Details at:

<http://www.idcphotonics.hw.ac.uk/sites/www.idcphotonics.hw.ac.uk/files/news/CDT%20Applied%20Photonics%20leaflet.pdf>

PH5181 Photonics Laboratory is a compulsory module, and students then normally choose 45 credits from PH5015, PH5016, PH5025, PH5180, PH5182. Students also take later in their programme modules amongst those taught by Heriot-Watt, Strathclyde, and Glasgow Universities.

Compulsory module:

PH5181 Photonics Laboratory 1				
SCOTCAT Credits:	15	SCQF Level 11	Semester:	1
Planned timetable:	2.00 pm - 5.30 pm Mon, Tue and Thu			
The photonics teaching laboratory gives training in the experimental photonics, and allows students the opportunity to explore photonics practically in a series of chosen open-ended investigations. Students use their knowledge and skills from the lecture modules, supplemented by additional reading, to investigate relevant photonic effects. Phase I involves work in small groups in introductory areas, then phase II allows primarily individual investigation of topics such as the second harmonic generation, optical parametric oscillation, erbium amplifiers, Nd lasers, optical tweezers, spectroscopy, remote sensing of speed, Bragg reflectors, and holography.				
Programme module type:	Compulsory for Photonics and Optoelectronic Devices MSc Programme and EngD Photonics Programme.			
Pre-requisite(s):	Admission to a Taught Postgraduate photonics programme within the School.			
Learning and teaching methods and delivery:	Weekly contact: 3 x 2.5-hour practicals.			
Assessment pattern:	Coursework = 100%			
Module coordinator:	Dr B D Sinclair			
Module teaching staff:	Dr B D Sinclair			

Optional modules:

PH5015 Applications of Quantum Physics				
SCOTCAT Credits:	15	SCQF Level 11	Semester:	1
Planned timetable:	12.00 noon Mon, Tue, Thu (TBC)			
Quantum physics is one of the most powerful theories in physics yet is at odds with our understanding of reality. In this module we show how laboratories around the world can prepare single atomic particles, ensembles of atoms, light and solid state systems in appropriate quantum states and observe their behaviour. The module includes studies of laser cooling, Bose-Einstein condensation, quantum dots and quantum computing. An emphasis throughout will be on how such quantum systems may actually turn into practical devices in the future. The module will include assessment based on tutorial work and a short presentation on a research topic.				
Programme module type:	Optional for Postgraduate programmes in the School			
Pre-requisite(s):	Relevant physics and mathematics			
Learning and teaching methods and delivery:	Weekly contact: 3 lectures/tutorials, 1 x 3-hour research lab visit, 3 hours student presentations during the semester.			
Assessment pattern:	2-hour Written Examination = 80%, Coursework (inc Oral presentation- 10%) = 20%			
Module coordinator:	Dr D Cassettari			
Module teaching staff:	Dr D Cassettari, Dr M Mazilu			

PH5016 Biophotonics				
SCOTCAT Credits:	15	SCQF Level 11	Semester:	1
Planned timetable:	9.00 am Mon, Wed, Fri (TBC)			
The module will expose students to the exciting opportunities offered by applying photonics methods and technology to biomedical sensing and detection. A rudimentary biological background will be provided where needed. Topics include fluorescence microscopy and assays including time-resolved applications, optical tweezers for cell sorting and DNA manipulation, photodynamic therapy, optogenetics, lab-on-a-chip concepts and bio-MEMS. Two thirds of the module will be taught as lectures, including guest lectures by specialists, with the remaining third consisting of problem-solving exercises, such as writing a specific news piece on a research paper, assessed tutorial sheets and a presentation. A visit to a biomedical research laboratory using various photonics methods will also be arranged.				
Programme module type:	Optional for Postgraduate programmes in the School Optional for EngD Photonics Programme			
Pre-requisite(s):	Relevant physics and mathematics			
Learning and teaching methods and delivery:	Weekly contact: 3 lectures/tutorials.			
Assessment pattern:	2-hour Written Examination = 80%, Coursework = 20%			
Module coordinator:	Prof C Brown			
Module teaching staff:	Prof C Brown, Prof M C Gather, Dr C Penedo-Esteiro			

PH5025 Nanophotonics				
SCOTCAT Credits:	15	SCQF Level 11	Semester:	1
Planned timetable:	TBC			
<p>Nanophotonics deals with structured materials on the nanoscale for the manipulation of light. Photonic crystals and plasmonic metamaterials are hot topics in contemporary photonics, and form part of the School's research programme. The properties of these materials can be designed to a significant extent via their structure. Many of the properties of these nanostructured materials can be understood from their dispersion diagram or optical band-structure, which is a core tool that will be explored in the module. Familiar concepts such as optical waveguides and cavities, multilayer mirrors and interference effects will be used to explain more complex features such as slow light propagation and high Q cavities in photonic crystal waveguides and supercontinuum generation in photonic crystal fibres. Propagating and localized plasmons will be explained and will include the novel effects of super-lensing and advanced phase control in metamaterials.</p>				
Programme module type:	Optional for MSc in Photonics and Optoelectronic Devices and EngD in Applied Photonics			
Anti-requisite(s):	PH5183			
Learning and teaching methods and delivery:	Weekly contact: 3 lectures/tutorials (x 10 weeks)			
Assessment pattern:	2-hour Written Examination = 80%, Coursework = 20%			
Module coordinator:	Dr A Di Falco			
Module teaching staff:	Dr A Di Falco, Dr L O'Faolain			

PH5180 Laser Physics				
SCOTCAT Credits:	20	SCQF Level 11	Semester:	1
Planned timetable:	10.00 am Mon, Tue, Wed, Thu (TBC)			
<p>This module presents a description of the main physical concepts upon which an understanding of laser materials, operations, and applications can be based. These concepts include a treatment of light-matter interaction, gain, absorption and refractive index, rate-equation theory of lasers, gain and its saturation, frequency selection and tuning in lasers, transient phenomena, resonator and beam optics, and the principles and techniques of ultrashort pulse generation and measurement.</p>				
Programme module type:	Compulsory for Photonics and Optoelectronic Devices MSc Programme. Optional for EngD Programme			
Pre-requisite(s):	Admission to a Taught Postgraduate programme within the School.			
Learning and teaching methods and delivery:	Weekly contact: 4 lectures/tutorials each week.			
Assessment pattern:	2.5-hour open-notes Examination = 80%, Coursework = 20%			
Module coordinator:	Dr B D Sinclair			
Module teaching staff:	Dr B Sinclair, Prof C Brown, Dr L O'Faolain			

PH5182 Displays and Nonlinear Optics				
SCOTCAT Credits:	10	SCQF Level 11	Semester:	1
Planned timetable:	9.00 am Tue, Thu and 3.00 pm Fri (weeks 10 -12)TBC			
<p>The physics of polymers and liquid crystals is covered, showing the way to the use of semi-conducting polymers as light emitters, and the use of liquid crystals in displays and spatial light modulators. The nonlinear optics section of this module describes the physical ideas and application of second and third order nonlinear optics, including phenomena such as harmonic generation, parametric gain, saturated absorption, nonlinear refraction, Raman scattering, and optical solitons. The final section looks at second order nonlinear effects being exploited in optical parametric amplifiers and oscillators in the optical and THz regions.</p>				
Programme module type:	Compulsory for Photonics and Optoelectronic Devices MSc Programme. Optional for EngD Photonics Programme			
Pre-requisite(s):	Admission to a Taught Postgraduate programme within the School.			
Learning and teaching methods and delivery:	Weekly contact: 2 lectures and occasional tutorials.			
Assessment pattern:	2-hour Written Examination = 80%, Coursework = 20%			
Module coordinator:	Prof I D W Samuel			
Module teaching staff:	Prof I Samuel, Dr M Mazilu, Dr C Rae			