School of Physics & Astronomy

Head of School

Professor A Miller

Degree Programmes

Graduate Diploma: Photonics and Optoelectronic Devices

M.Sc.: Photonics and Optoelectronic Devices

Programme Requirements

Photonics and Optoelectronic Devices

The primary aim of this one-year, full-time course is to provide specialist postgraduate training in modern optics and semiconductor physics, tailored to the needs of the Photonics industrial sector. The secondary aim is to provide the education required for those wishing to continue in academia on PhD research projects in photonics.

Graduates from the course will have gained an in-depth understanding of the fundamental properties of optoelectronic materials and practical experience of the technology and operation of a wide range of laser and semiconductor devices. They will additionally have had 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 the School of Physics and Astronomy of the University of St Andrews and the Department of Physics at Heriot Watt University. Each organisation will act in turn as host for the course and provide the first half of the teaching. In 2001-02 the course will be hosted by Heriot-Watt, and in 2002-03 by St Andrews. At the start of February each year students transfer to the other university to complete the taught part of the course. An industrial project is undertaken during the summer months and is assessed in September.

The course is approved by the Engineering and Physical Sciences Research Council (EPSRC) and a number of EPSRC Advanced Course Studentships are available.

Graduate Diploma: PH5171 – PH5176

MSc: PH5171 – PH5177

Modules

PH5171 Lasers

Credits: 24.0 Semester: Whole Year

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: 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 semi-classical 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.

Class Hour: To be arranged.

Teaching: Three lectures each week and occasional tutorials.

Assessment: Examinations totaling 3 hours, spread over 2 semesters = 100%

PH5172 Modern Optics

Credits: 24.0 Semester: Whole Year

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: 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 modulator section looks at the electro-optic and acousto-optic effects and their use in optical modulators. The section on Fourier Optics and Holography includes diffraction theory, Fourier transforms in optics, spatial filtering, and holographic techniques. The section on photonic guiding explains how micro-structuring of materials can lead to designer light guides and emitters.

Class Hour: To be arranged.

Teaching: Three lectures each week and occasional tutorials.

Assessment: Examinations totaling 3 hours, spread over 2 semesters = 100%

PH5173 Photonic Materials

Credits: 12.0 Semester: Whole Year

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: The physics of semiconductors is covered, including areas of particular importance in optoelectronics such as band theory, optical and electronic properties, mobility and diffusion, and low dimensional structures. 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 section on materials growth and fabrication aims to give an overview of the science and technology involved in the growth of materials relevant in the photonics field.

Class Hour: To be arranged.

Teaching: Two lectures each week and occasional tutorials.

Assessment: Examinations totaling 1.5 hours, spread over 2 semesters = 100%

PH5174 Optoelectronic Devices

Credits: 24.0 Semester: Whole Year

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: The main core of this module consists of sections on semiconductor devices and on telecommunications and optical fibres. Building on ideas developed in the module on Photonic materials, devices such as LEDs, VCSELs, optical amplifiers, and all-optical switches are examined in detail. The physics underpinning the design of optical fibre links is covered, including optical sources, amplifiers, and detectors, coding schemes, and fibre sensors. The final sections of the course may change from year to year, and may include lectures on two of: optical informatics, lasers in medicine, optical instrumentation and sensors, and optical packaging.

Class Hour: To be arranged.

Teaching: Three lectures each week and occasional tutorials.

Assessment: Examinations totaling 3 hours, spread over 2 semesters = 100%

PH5175 Technical Communication and Business Awareness

Credits: 24.0 Semester: Whole Year

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: This module addresses issues of the application of science in the photonics industry; many transferable skills should be developed. A series of lectures will be given by industrial scientists in different topic areas. A section on innovation and team work will look at how ideas are born, nurtured, and engineered into a final product. Business awareness will include material on intellectual property rights, business formation, and leadership skills. This module also includes a major literature review and the writing of a review essay related to the topic of the industrial project. Students also practise their poster and oral communication skills by presenting work to members of the industrial advisory committee.

Class Hour: To be arranged.

Teaching: Two hours each week and occasional tutorials.

Assessment: Continuous Assessment = 100%

PH5176 Laboratory

Credits: 36.0 Semester: Whole Year

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: The teaching laboratory allows students to explore concepts in photonics in a practical setting. It also develops skills in instrumentation, experimental design, and problem solving. Many of the experiments are "open-ended", which encourages further independent thinking. Experiments include diode pumped lasers, resonator design, optical parametric oscillator, modulators, spectroscopy, mobility measurements, optical communications and optical amplifiers.

Class Hour: To be arranged.

Teaching: Three 3-hour sessions per week.

Assessment: Continuous Assessment = 100%

PH5177 Research project

Credits: 36.0 Semester: Summer

Programme(s): Compulsory module for Photonics and Optoelectronic Devices Postgraduate Taught Programme.

Description: All MSc students carry out a 3-month research project, in almost all cases carried out at a UK company. Part-time students who are industry employees may carry out the project at their own company. Students will have completed a literature survey prior to the project, and write a dissertation on the project which is submitted in early September.

Class Hour: To be arranged.

Assessment: Dissertation, Continuous Assessment & Oral Examination= 100%