PHYC90006 Quantum and Advanced Optics

Credit Points:	12.5
Level:	9 (Graduate/Postgraduate)
Dates & Locations:	2016, Parkville This subject commences in the following study period/s: Semester 2, Parkville - Taught on campus.
Time Commitment:	Contact Hours: 36 hours comprising 3 one-hour lectures/week Total Time Commitment: 170 hours

Prerequisites:

Subject	Study Period Commencement:	Credit Points:
PHYC90007 Quantum Mechanics	Semester 1	12.50

and the following subject, or equivalent

Subject	Study Period Commencement:	Credit Points:
PHYC20011 Electromagnetism and Optics	Semester 2	12.50

Corequisites:	None
Recommended Background Knowledge:	None
Non Allowed Subjects:	None
Core Participation Requirements:	For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Student Support and Engagement Policy, academic requirements for this subject are articulated in the Subject Overview, Learning Outcomes, Assessment and Generic Skills sections of this entry. It is University policy to take all reasonable steps to minimise the impact of disability upon academic study, and reasonable adjustments will be made to enhance a student's participation in the University's programs. Students who feel their disability may impact on meeting the requirements of this subject are encouraged to discuss this matter with a Faculty Student Adviser and Student Equity and Disability Support: http://services.unimelb.edu.au/disability
Coordinator:	Assoc Prof Jeffrey Mccallum
Contact:	Email: **msc@physics.unimelb.edu.au (mailto:n.bell@unimelb.edu.au)**
Subject Overview:	Optics and photonics are vibrant international research areas, advancing many aspects of modern life. From the determination of the structure and function of biomolecules to the study of stars and galaxies; from high-efficiency lighting to innovative display technologies, our understanding of optics relies on fundamental underpinnings in advanced quantum mechanics and wave theory. The course includes the foundations of modern optical theory, including Fourier transforms in optics and diffraction-based imaging; non-linear optical processes such as generation of white light from femtosecond laser pulses, gigahertz optical modulators, and liquid crystal displays; light-atom interactions, the Einstein description of lasers, and optical Bloch equations; holography; quantumoptics including zero-point energy and vacuum fluctuations; quantum states of light and quantum squeezing; laser cooling of atoms, atom interferometry, and Bose-Einstein condensation.

	Students will develop both analytic and computational problem-solving methods, the latter using standard tools such as MATLAB.
Learning Outcomes:	The objectives of this subject are to provide: # understanding of classical optical diffraction theory and development of the ability to solve quantitative problems using the canonical mathematical techniques of that theory, in particular Fourier methods; # knowledge of important optical and photonic applications of classical wave theory, in imaging and non-linear optical processes; # understanding the semi-classical model of light-atom interactions, and its applications to laser theory and laser cooling of atoms; # a rigorous understanding of the quantum nature of light, including both photon statistics and non-classical fields; # an appreciation of the technological relevance of modern physical and quantum optics.
Assessment:	Four assignments totalling up to 36 pages of written work (20%), spaced equally during the semester, plus one 4-hour end-of-semester written examination (80%).
Prescribed Texts:	None
Recommended Texts:	Fundamentals of Photonics, 2e, BEA Saleh and MC Teich, Wiley. The quantum theory of light, 2e, R Loudon, Oxford. Introduction to Fourier Optics, JW Goodman, McGraw-Hill. Optics, 4e, E Hecht, Addison-Wesley.
Breadth Options:	This subject is not available as a breadth subject.
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Generic Skills:	At the completion of this subject, students should have gained skills in: # analysing how to solve a problem by applying simple fundamental laws to more complicated situations; # applying abstract concepts to real-world situations; # solving relatively complicated problems using approximations; # participating as an effective member of a group in discussions and collaborative assignments; # managing time effectively in order to be prepared for group discussions and undertake the assignments and exam.
Notes:	Students undertaking this subject will be expected to access a computer occasionally. Computational facilities will be provided within the School.
Related Course(s):	Doctor of Philosophy - Engineering Master of Philosophy - Engineering Master of Science (Physics)
Related Majors/Minors/ Specialisations:	Physics Physics