# 640-215 Electromagnetism and Optics

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| **Credit Points:** | 12.50 |
| **Level:** | 2 (Undergraduate) |
| **Dates & Locations:** | 2009,<br>This subject commences in the following study period/s:<br>Semester 2, - Taught on campus.<br>Lectures, tutorials and practical laboratory classes. |
| **Time Commitment:** | Contact Hours: Three 1-hour lectures per week (total 27 lectures); one 1-hour tutorial per week (total 9 classes); one 3-hour laboratory class per week (total 6 classes). Total 54 hours. Total Time Commitment: 120 hours total time commitment. |
| **Prerequisites:** | One of<br># *Physics 1: Advanced*<br># *Physics 1*<br># *Physics 1: Fundamentals*<br>Plus one of<br># *Physics 2: Advanced*<br># *Physics 2: Physical Science and Technology*<br># *Physics 2: Life Sciences and Environment*<br>Plus one of<br># *Accelerated Mathematics 2* (620-158 Mathematics 2 prior to 2009)<br># *Calculus 2*<br>Plus one of<br># *Accelerated Mathematics 1* (620-157 Mathematics 1 prior to 2009)<br># *Linear Algebra* (may be taken concurrently). |
| **Corequisites:** | None |
| **Recommended Background Knowledge:** | None |
| **Non Allowed Subjects:** | 640-225, 640-245 Electromagnetism and Special Relativity |
| **Core Participation Requirements:** | It is University policy to take all reasonable steps to minimise the impact of disability upon academic study and reasonable steps will be made to enhance a student's participation in the University's programs. This subject requires all students to actively and safely participate in laboratory activities. Students who feel their disability may impact upon their participation are encouraged to discuss this with the subject coordinator and the Disability Liaison Unit. |
| **Coordinator:** | Assoc Prof Robert Scholten |
| **Subject Overview:** | This subject extends knowledge of the fundamental principles of electromagnetism, introducing Maxwell's equations in differential form, and introduces key topics in optics. Electromagnetism topics include the electric field (e.g. Gauss's law in integral and differential form, scalar potential and gradient, Poisson and Laplace equations), the magnetic field (e.g. Ampere's law in integral and differential forms), Maxwell's equations in vacuum (integral and differential forms), Maxwell's equations in matter (polarization, electric displacement, magnetic vector potential), time-varying electric and magnetic fields (Maxwell's equations in general form, wave equations for E and B, plane electromagnetic wave, Poynting vector). Optics topics include an introduction to Fourier optics, Fourier transforms in 1 and 2D, Dirac delta function and comb, discrete Fourier transforms and the sampling theorem, convolution, cross and autocorrelation. Fresnel and Fraunhofer diffraction are treated explicitly and a description of polarized light with methods of producing and controlling polarisation. |

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| **Objectives:** | To challenge students to expand their knowledge of fundamental physics principles and develop their capacity to:<br># explain the physical basis of Maxwell's equations and solve and analyse simple problems in electromagnetism by applying Maxwell's equations;<br># explain Fraunhofer and Fresnel diffraction and solve and analyse simple problems in optics using Fourier transforms and related analytical tools.<br># acquire and interpret experimental data and perform computer modelling. |
| **Assessment:** | Ongoing assessment of practical work during the semester including:log-book record keeping and participation (10%)a written report of up to 2,000 words (10%) Satisfactory completion of practical work is necessary to pass the subject, including attendance and submission of work for at least 80% of workshop sessions, together with a result for assessed work of at least 50%.One written test with a total duration of up to 30 minutes, held mid semester (5%)Two written assignments requiring a total of up to 8 hours of work outside class time during the semester (10% in total)A 3-hour written examination in the examination period (65%) |
| **Prescribed Texts:** | R H Good, Classical Electromagnetism, Saunders E Hecht, Optics 4th edn, Addison-Wesley |
| **Breadth Options:** | This subject potentially can be taken as a breadth subject component for the following courses:<br># **Bachelor of Arts (https://handbook.unimelb.edu.au/view/2009/D09)**<br># **Bachelor of Commerce (https://handbook.unimelb.edu.au/view/2009/F04)**<br># **Bachelor of Environments (https://handbook.unimelb.edu.au/view/2009/A04)**<br># **Bachelor of Music (https://handbook.unimelb.edu.au/view/2009/M05)**<br>You should visit **learn more about breadth subjects (http://breadth.unimelb.edu.au/breadth/info/index.html)** and read the breadth requirements for your degree, and should discuss your choice with your student adviser, before deciding on your subjects. |
| **Fees Information:** | Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees |
| **Generic Skills:** | A student who completes this subject should be able to:<br># explain their understanding of physics principles and applications lucidly, both in writing and orally;<br># acquire and interpret experimental data and design experimental investigations;<br># participate as an effective member of a group in tutorial discussions, laboratory and study groups;<br># think independently and analytically, and direct his or her own learning;<br># manage time effectively in order to be prepared for regular practical and tutorial classes, tests, the examination and to complete assignments. |
| **Notes:** | Students enrolled in the BSc (both pre-2008 and new degrees), BASc or a combined BSc course will receive science credit for the completion of this subject. |