

PHYS3112: Photonics

Callaghan

Semester 1 - 2024



OVERVIEW

Course Description Photonics deals with the applied concepts and constructs of electromagnetism across the boundaries of science and engineering. The time dynamics of electromagnetic fields, as solutions to Maxwell's equations, underpin all of optics, communication signal and power propagation in transmission lines, waveguides and antennas. Specific instances of photon-induced amplification forming laser systems are of central focus in this holistic and balanced course. Lectorials and blended delivery of knowledge together with engaging laboratory and computational experiments will elucidate electromagnetism and laser technologies to allow advanced understanding of EM applications as learning outcomes.

Academic Progress Requirements Nil

Requisites Students must have successfully completed MATH2310, and either PHYS2112 or PHYS2160 or PHYS2260 to enrol in this course. If students have successfully completed PHYS3360 they cannot enrol in this course.

Contact Hours
Callaghan Laboratory
Face to Face On Campus
3 hour(s) per week(s) for 11 week(s) starting Week 2

Lectorial
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1

Unit Weighting Workload 10
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

COURSE OUTLINE

CONTACTS

Course Coordinator **Callaghan**
Dr Lachlan Rogers
Lachlan.Rogers@newcastle.edu.au
(02) 40557574
Consultation: by appointment or in labs

Teaching Staff Other teaching staff will be advised on the course Canvas site.

School Office **School of Information and Physical Sciences**
SR233, Social Sciences Building
Callaghan
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9am-5pm (Mon-Fri)

SYLLABUS

Course Content The topics to be covered include:

- Electromagnetism: wave theory and wave propagation
- Reflections, transmission and scatter
- Waveguides and Cavities
- Photons: sources and properties
- Spontaneous emission, stimulated emission and lasers
- Transport of photons
- Applications of light in industry, research and the spectrum of STEMM

Course Learning Outcomes **On successful completion of this course, students will be able to:**

1. Explain the importance of electromagnetism in human endeavour based on a profound understanding of light as an EM wave, its sources, including lasers sources, properties and behaviour, uses and guidance.
2. Solve qualitative and quantitative problems, using appropriate mathematical and computing techniques.
3. Perform experiments which involve making correct and appropriate use of a range of scientific equipment, keeping an accurate record of experimental work and analysing results and reaching non-trivial conclusions from them.
4. Communicate the results of both theoretical and experimental work in various forms including written reports, oral presentations and poster presentations.
5. Contribute to team and group work for scientific investigations and for the process of learning.

Course Materials

SCHEDULE

ASSESSMENTS

This course has 4 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Weekly Quiz	Each week before the lectorial.	Individual	10%	1, 2
2	Assignments	Wednesday March 27 2024, 23:59pm; Wednesday 8 May 2024, 23:59pm; Wednesday June 5 2024, 23:59pm	Individual	10%	1, 2
3	Laboratory Exercises	One week after you have completed the laboratory.	Individual	40%	3, 4, 5
4	Formal Examination	During the formal examination period.	Individual	40%	1, 2

Late Submissions

The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Weekly Quiz

Assessment Type	Quiz
Purpose	Assessment used to reinforce learning of recent course material, track success of learning and growth in knowledge, identify areas of strength and weakness.
Description	There will be 12 online quizzes, each consisting of 5 multiple choice questions. The quizzes will be made available at the end of each week's lectorial.
Weighting	10%
Due Date	Each week before the lectorial.
Submission Method	Online
Assessment Criteria	The quizzes will be graded online. One attempt will be allowed for each quiz.
Return Method	Online
Feedback Provided	Online - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - Assignments

Assessment Type	Written Assignment
Purpose	Offer an opportunity for the students to demonstrate that they understand the course materials, and give deeper thought and apply their knowledge to problems. To demonstrate that the students can explain key ideas and information in their own words, and to show that they can use what they have learned to solve problems.
Description	There will be a total of three assignments, one for each module (Electromagnetism, Photonics and Laser Physics). The assignment questions will require written responses consisting of mathematically worked solutions (with working shown) and/or qualitative descriptions of the physics consisting of a few sentences or short paragraphs, with diagrams if they aid the descriptions. The marks awarded for each question will be shown on the assignments.
Weighting	10%
Due Date	Wednesday March 27 2024, 23:59pm; Wednesday 8 May 2024, 23:59pm; Wednesday June 5 2024, 23:59pm
Submission Method	Online
Assessment Criteria	The assignment questions will require written responses consisting of mathematically worked solutions (with working shown) and/or qualitative descriptions consisting of a few sentences or short paragraphs, with diagrams if they aid the descriptions. The marks awarded for each question will be shown on the assignments.
Return Method	Online
Feedback Provided	Online - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Laboratory Exercises

Assessment Type	Tutorial / Laboratory Exercises
Purpose	Opportunity to learn experimental techniques and through experiment learn scientific concepts, and through scientific methods, understand the nature of science and practical applications. This reinforces the material learned elsewhere in the course. Develop scientific communication through lab reports and interactions with peers and scientists.
Description	The experiments will be conducted in groups of two or three students in a cycle throughout the semester. It is important to complete the preparatory questions since it is likely that the relevant material has not been covered in the lectures yet
Weighting	40%
Due Date	One week after you have completed the laboratory.
Submission Method	Online
Assessment Criteria	You will be assessed on three full laboratory reports (maximum 10 pages long;) and summary reports (maximum 2 pages) for the remaining laboratory experiments. Rubrics are given on each lab report.
Return Method	Online
Feedback Provided	Online - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 4 - Formal Examination

Assessment Type	Formal Examination
Purpose	To assess how well the students have understood the course material, and their suitability for further learning building on these course materials. Assess the ability to think critically and to apply their knowledge to solve well-defined problems.
Description	Standard 2 hour long, formal exam. Students may bring a single A4 page dual-sided into the examination room as a memory aid. Students may also bring any non-programmable calculator, ruler, pens and pencils into the examination room, however instruction booklets or cards (e.g. reference cards) on the operation of calculators are not permitted in the examination room.
Weighting	40%
Length	2 Hour
Due Date	During the formal examination period.
Submission Method	Formal Exam
Assessment Criteria	The exam will be two hours long and consist of six questions that will require written responses consisting of mathematically worked solutions (with working shown) and/or qualitative descriptions consisting of a few sentences or short paragraphs, with diagrams if they aid the descriptions. The marks awarded for each question will be shown in the examination paper.
Return Method	Not Returned
Feedback Provided	No Feedback - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.

65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Communication Methods

Communication methods used in this course include:

Course Evaluation

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

Oral Interviews (Vivas)

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the [Oral Examination \(viva\) Procedure](#). In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the [Student Conduct Rule](#).

Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to <https://policies.newcastle.edu.au/document/view-current.php?id=35>.

Adverse Circumstances

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;
3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:

<https://policies.newcastle.edu.au/document/view-current.php?id=236>

Important Policy Information

The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at <https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures> that support a safe and respectful environment at the University.

This course outline was approved by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.

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