# PHTN221

## Introduction to Optical Science and Technology

S1 Day 2016

*Dept of Physics and Astronomy*

## Contents

# General Information

Unit convenor and teaching staff
Unit Convenor
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Credit points
3

Prerequisites
(MATH132 or MATH135) and [(PHYS140 and PHYS143) or (PHYS106 and PHYS107) or PHYS149]

Corequisites

Co-badged status

Unit description
Optical technology is widely used in industry, telecommunications and modern consumer devices, ranging from the tiny lasers in many disc drives to the thousands of kilometres of optical fibres carrying signals between continents. This unit offers an overview of these technologies, and the science underlying their operation. Topics include: light sources, optical fibres and semiconductor devices. A laboratory program introduces experimental photonics and optical fibre handling skills.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

# Learning Outcomes

On successful completion of this unit, you will be able to:

The students will have knowledge of the key characteristics of selected light sources and

detectors.
The students will understand the origins of a photon and have developed insights into light - matter interactions.
The students will have a broad knowledge and be able to interpret the use of lasers in a diverse range of applications.
The students will understand how an optical fibre works and will be competent in handling optical fibres. They will also have a broad knowledge of their use in a diverse range of applications.
The students will be able to communicate effectively on photonics themes using suitable technical language.
Students will be competent in data analysis, the application of experimental methods and report writing.

# Assessment Tasks

| Name | Weighting | Due |
|---|---|---|
| Exam | 40% | As per exam timetable |
| Mid-semester Test | 20% | Week 6 (1 h) |
| Laboratory reports | 20% | A week after each prac. |
| Assignments | 10% | As indicated |
| Students' talks | 10% | Week 7 and 13 |
| Overview | 0% | End of 1st semester |

## Exam

Due: **As per exam timetable**
Weighting: **40%**

End of semester exam. Questions are weighted between content from Weeks 1-6 (25%) and Weeks 7-13 (75%).

On successful completion you will be able to:

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will understand the origins of a photon and have developed insights into light - matter interactions.

- The students will be able to communicate effectively on photonics themes using suitable technical language.

## Mid-semester Test

Due: **Week 6 (1 h)**
Weighting: **20%**

Covers material form first half of the unit.

On successful completion you will be able to:

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will understand the origins of a photon and have developed insights into light - matter interactions.
- The students will understand how an optical fibre works and will be competent in handling optical fibres. They will also have a broad knowledge of their use in a diverse range of applications.

## Laboratory reports

Due: **A week after each prac.**
Weighting: **20%**

There is seven three hours laboratory sessions in the first half year and six in the second half-year . Laboratory classes begin in Week 1. The reports are due in a week after completing each experiment.

On successful completion you will be able to:

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will have a broad knowledge and be able to interpret the use of lasers in a diverse range of applications.
- The students will understand how an optical fibre works and will be competent in handling optical fibres. They will also have a broad knowledge of their use in a diverse range of applications.
- Students will be competent in data analysis, the application of experimental methods and report writing.

## Assignments

Due: **As indicated**

Weighting: **10%**

Assignments will be set approximately fortnightly. They provide essential practice for questions in tests and examinations. Due dates as indicated on each assignment.

On successful completion you will be able to:

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will have a broad knowledge and be able to interpret the use of lasers in a diverse range of applications.
- The students will be able to communicate effectively on photonics themes using suitable technical language.
- Students will be competent in data analysis, the application of experimental methods and report writing.

## Students' talks

Due: **Week 7 and 13**
Weighting: **10%**

Every student is expected to give 2 talks illustrated by powerpoint presentaions or similar visual aids. Each talk will be about 15 minutes long which includes 3 minutes for questions from the audience.  (depending on the size of the class) . The talk subjects are selected from a list. Talks are given in Week 7 and 13 during practical classes.

On successful completion you will be able to:

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will understand the origins of a photon and have developed insights into light - matter interactions.
- The students will have a broad knowledge and be able to interpret the use of lasers in a diverse range of applications.
- The students will be able to communicate effectively on photonics themes using suitable technical language.

## Overview

Due: **End of 1st semester**
Weighting: **0%**

Students must demonstrate satisfactory performance in all parts of the unit assessment in order to pass the unit. In the case of the laboratory assessment component, satisfactory performance includes submission of a lab report in addition to lab attendance.

On successful completion you will be able to:

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- Students will be competent in data analysis, the application of experimental methods and report writing.

# Delivery and Resources

The unit is delivered on-campus in a day mode. Students are also taken on a tour to see University research labs to see demonstrations of key photonic concepts discussed during lectures.

***Reference texts:***

Some material will be drawn from Optoelectronics (3rd edition) by J. Wilson and J. Hawkes, published by Prentice-Hall. The latter book is out of print, so you will receive handouts based on this material. Other texts you may want to consult are:

R.P. Khare ”Fiber optics and optoelectronics” Oxford, ISBN 0-19-566930-4

S.O. Kasap, “Optoelectronics and Photonics” Prentice Hall ISBN 0-201-61087-6

The popular first year text “University Physics” by Young and Friedman, (editions with Modern Physics, 11 and above, ISBN 0-8053-8684-X) may also be useful, as an adjunct to Halliday and Resnick.

Additional material will be available for downloading on http://ilearn.mq.edu.au

# Unit Schedule

| PHTN221 Lecture content and timing | Topics | Comments |
|---|---|---|
| Week 1 and 2 | Optical fibres | |
| Week 3 | Atoms, light | Assignment 1 due date 18 March |
| Weeks 4-6 | Lasers | Assignment feedback week 4 |
| Weeks 7-9 | Background of solid state physics | Talk 1 in week 7 |
| Week 10 -11 | Semiconductor devices | Week 10 Assignment 2 due date 27th May |

| | | |
|---|---|---|
| Week 12 | Other light detectors | |
| Week 13 | Revision (both lecturers) | Talk 2 in Week 13 |

Comments: Week 1-6 lecturer - Michael Withford, Week 7-12 –Ewa Goldys, week 13 - both.

Mid semester test in Week 6 during one of the lecture time slots.

Test feedback in Week 7.

Assignment feedback in week 4 and 12.

# Learning and Teaching Activities

## Lectures

There are two lecture sessions per week. The timetable and location of classes are on the website www.timetables.mq.edu.au. sessions in the second half-year.

## Laboratory work

The laboratory work will involve experiments in optoelectronics. A separate sheet will give you the laboratory schedule. There are seven 3-hour laboratory sessions in the first half-year and six 3-hour laboratory You will be given a handout on safe working practice in the laboratory, and asked to sign that you have read it. Laboratory classes begin in week 1.

## Student talks

Student talks are scheduled during practical class time in Week 7 and Week 13. Every student is expected to give two talks, which will be illustrated by powerpoint slides or similar visual aids. Each talk will be about 15 minutes long which includes 3 minutes for questions from the audience. Talks will be assessed.

# Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

**New Assessment Policy in effect from Session 2 2016** http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

## Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

# Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

## Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

# Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

# Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

# IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

# Graduate Capabilities

## Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

### Learning outcome

- The students will be able to communicate effectively on photonics themes using suitable technical language.

### Assessment tasks

- Laboratory reports
- Assignments
- Students' talks

### Learning and teaching activities

- The laboratory work will involve experiments in optoelectronics. A separate sheet will give you the laboratory schedule. There are seven 3-hour laboratory sessions in the first half-year and six 3-hour laboratory You will be given a handout on safe working practice in the laboratory, and asked to sign that you have read it. Laboratory classes begin in week 1.
- Student talks are scheduled during practical class time in Week 7 and Week 13. Every student is expected to give two talks, which will be illustrated by powerpoint slides or similar visual aids. Each talk will be about 15 minutes long which includes 3 minutes for questions from the audience. Talks will be assessed.

## Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

## Learning outcomes

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will understand how an optical fibre works and will be competent in handling optical fibres. They will also have a broad knowledge of their use in a diverse range of applications.
- The students will be able to communicate effectively on photonics themes using suitable technical language.
- Students will be competent in data analysis, the application of experimental methods and report writing.

## Assessment tasks

- Mid-semester Test
- Laboratory reports
- Assignments
- Students' talks

## Learning and teaching activities

- There are two lecture sessions per week. The timetable and location of classes are on the website www.timetables.mq.edu.au. sessions in the second half-year.
- The laboratory work will involve experiments in optoelectronics. A separate sheet will give you the laboratory schedule. There are seven 3-hour laboratory sessions in the first half-year and six 3-hour laboratory You will be given a handout on safe working practice in the laboratory, and asked to sign that you have read it. Laboratory classes begin in week 1.
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# Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

## Learning outcomes

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## Assessment tasks

- Mid-semester Test
- Laboratory reports
- Assignments
- Students' talks
- Overview

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# Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

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# Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

## Learning outcomes

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week 1.

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# Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

## Learning outcomes

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will be able to communicate effectively on photonics themes using suitable technical language.
- Students will be competent in data analysis, the application of experimental methods and report writing.

## Assessment tasks

- Exam
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## Learning and teaching activities

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questions from the audience. Talks will be assessed.

# Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

## Learning outcomes

- The students will be able to communicate effectively on photonics themes using suitable technical language.
- Students will be competent in data analysis, the application of experimental methods and report writing.

## Assessment tasks

- Laboratory reports
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# Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

## Learning outcomes

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will have a broad knowledge and be able to interpret the use of lasers in a diverse range of applications.
- The students will be able to communicate effectively on photonics themes using suitable technical language.

## Assessment task

- Students' talks

## Learning and teaching activity

- Student talks are scheduled during practical class time in Week 7 and Week 13. Every student is expected to give two talks, which will be illustrated by powerpoint slides or similar visual aids. Each talk will be about 15 minutes long which includes 3 minutes for questions from the audience. Talks will be assessed.

# Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

## Learning outcomes

- The students will have knowledge of the key characteristics of selected light sources and detectors.
- The students will be able to communicate effectively on photonics themes using suitable technical language.

## Assessment task

- Students' talks

## Learning and teaching activity

- There are two lecture sessions per week. The timetable and location of classes are on the website www.timetables.mq.edu.au. sessions in the second half-year.
- Student talks are scheduled during practical class time in Week 7 and Week 13. Every student is expected to give two talks, which will be illustrated by powerpoint slides or

similar visual aids. Each talk will be about 15 minutes long which includes 3 minutes for questions from the audience. Talks will be assessed.