PHYS221

Introduction to Optical Science and Technology

S1 Day 2017

Dept of Physics and Astronomy

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General Information

Unit convenor and teaching staff
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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	Hurdle	Due
Exam	40%	No	As per exam timetable
Mid-semester Test	20%	No	Week 6 (1 h)
Laboratory reports	20%	Yes	The following Monday.
Assignments	10%	No	As indicated
Students' talks	10%	No	Week 7 and 13

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%).

If you apply for Disruption to Study for your final examination, you must make yourself available for the week of July 24 – 28, 2017. If you are not available at that time, there is no guarantee an additional examination time will be offered. Specific examination dates and times will be determined at a later date.

On successful completion you will be able to:

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- 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 from first half of the unit. The exam will be held in the lecture room in Week 6.

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: **The following Monday.**
Weighting: **20%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

There are 5 three hour long laboratory classes from Week 2 to 6,and 5 more lab classes from Week 8 to 12 . The completed lab reports are due the following Monday do allow sufficient time for assessment prior to the next lab class. This is a hurdle assessment - students are required to undertake the lab classes and complete the reports for at least 9 experiments.

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- 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%**

The 1st assignment will be set Week 2 and is due before the census date. The 2nd assignment is set early after the mid-semester break. The assignment provide essential practice for questions in tests and examinations. Due dates as indicated on each assignment.

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- 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 presentations or similar visual aids. Depending on class size, each talk will be about 10- 15 minutes long which includes 2-3 minutes for questions from the audience . The talk subjects are selected from a list that will be circulated by the lecturers. The talk topics are drawn from topical subject areas in photonics intended to broaden the understanding of the students beyond the lecture and lab content.

Talks are given in Week 7 and 13 during the time slots normally allocated for lab classes. Venue details for the talks will be provided at least 1 week beforehand.

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.

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	General introduction to photonics; principles of optical fibres	
Week 3	Fibre applications	Assignment 1 due date 17 March
Weeks 4-5	Blackbody emission; atomic energy levels; absorption, spontaneous and stimulated emission; rate equations and population inversion; lasers	Assignment feedback week 4
Weeks 6	Basic optics; laser beam manipulation	Mid semester exam during lecture slot in Week 6.

Week 7-8	Introduction to light sources and irradiance properties	
Week 9-10	Light sources, laser design, light detectors	
Week 11-12	Light detectors and system applications	
Week 13	Revision (both lecturers)	

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.

Assignment feedback in Weeks 4 and 12.

Learning and Teaching Activities

Laboratory work

The laboratory work will involve experiments in optoelectronics. A separate sheet will give you the laboratory schedule. There are ten 3-hour laboratory sessions in total. 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 2.

Lectures

There are two lecture sessions per week. The timetable and location of classes are on the website www.timetables.mq.edu.au. The lectures will incorporate short tutorial sessions to give students additional experience in problem solving and addressing exam-like questions.

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

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy_2016.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 (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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 ten 3-hour laboratory sessions in total. 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 2.
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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
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- There are two lecture sessions per week. The timetable and location of classes are on the website www.timetables.mq.edu.au. The lectures will incorporate short tutorial sessions to give students additional experience in problem solving and addressing exam-like questions.
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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.

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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.

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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:

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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

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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. The lectures will incorporate short tutorial sessions to give students additional experience in problem solving and addressing exam-like questions.

- 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.

Changes from Previous Offering

The lecture material has been revised to expose the students to material on basic optics (lens and beam delivery, laser beam manipulation) and additional material on optical fibre applications. Past content on solid state physics has been removed.