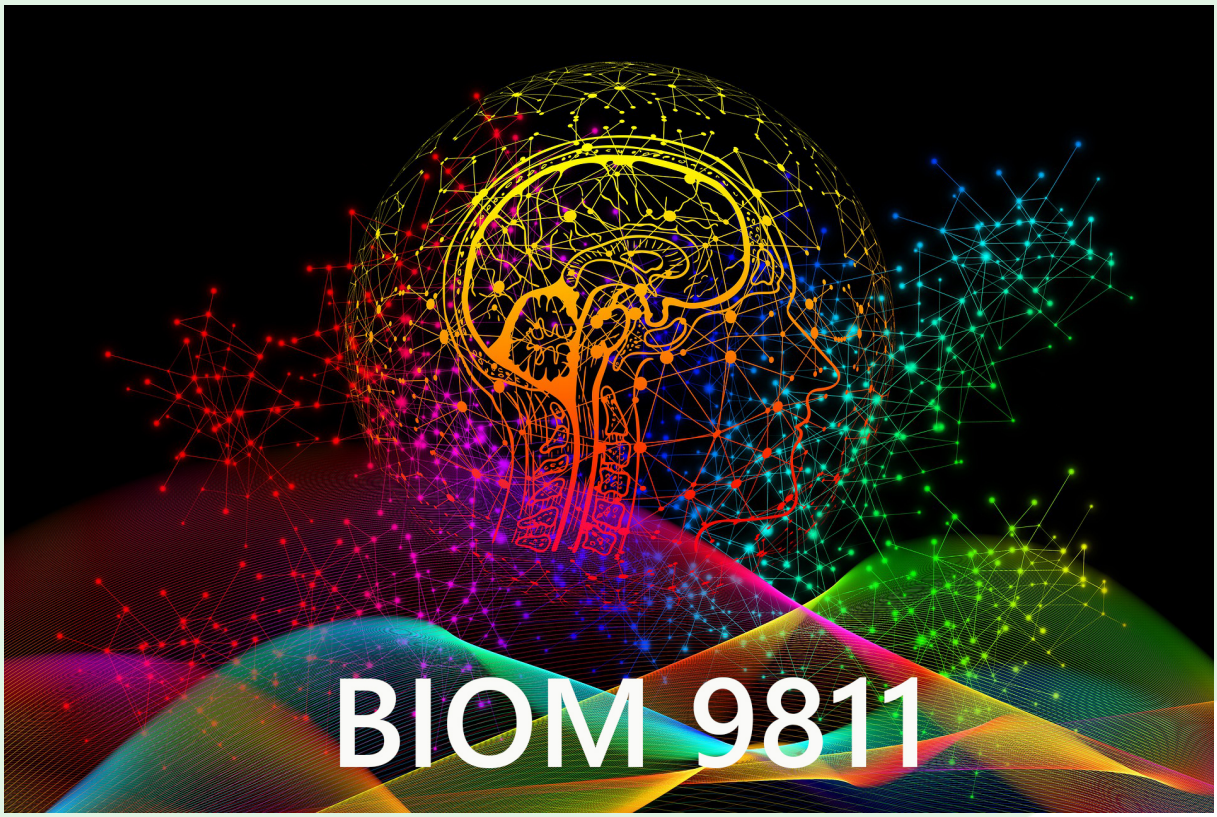
BIOM9811

Applications of Light in Engineering, Technology and the Life Sciences

Term 1, 2023



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Ewa Goldys	e.goldys@unsw.edu.au	During scheduled lectures, Wed 11 am -1 pm	E26 rom 1006	0421318145

Lecturers

Name	Email	Availability	Location	Phone
Akanksha Bhargava	a.bhargava@unsw.edu.au		E26 level 1	
Abbas Habibalahi	a.habibalahi@unsw.edu.au		E26 level 1	
Yi Li	yi.li6@unsw.edu.au		E26 level 1	
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Jared Campbell	j.campbell@unsw.edu.au		E26 level 1	

School Contact Information

Student Services can be contacted via unsw.to/webforms.

Course Details

Units of Credit 6

Summary of the Course

Can you imagine the world, nature and humanity without light? Would the economy even exist without light? How can light save lives?

Light plays a central role in human activity and it provides solutions to current global challenges. Light is ubiquitous in our daily lives: from technologies that improve vision and power the smartphones in our hands, to state-of-the-art technologies that provide us with tools to explore space and better understand our planet, and fibre optics that help us communicate via the Internet. They have revolutionized society through medicine, communications, entertainment and culture. Industries based on light are major economic drivers, and light-based technologies directly respond to the needs of humankind by providing access to information, promoting sustainable development, and increasing societal health and well-being.

Welcome to “Applications of light in engineering and life sciences”. This course aims to provide the students with a perspective on the real-world applications of light technologies which have shaped our society and will continue to act as key enabling technologies of the future.

It will cover technologies such as lasers, light emitting diodes (LEDs), digital cameras, optical fibres and more. Students will learn about the application of light to monitor industrial processes and light-based imaging and image analysis in industrially relevant areas ranging from satellite imaging through to microscopy. Students will gain an appreciation of current and future commercial opportunities offered in this area.

The course will culminate in a design project where students will learn how to design, build and test diverse light based detection, sensing and imaging systems. On the completion of the course students will be able use light to measure, probe and interrogate diverse effects in various industrial and clinical scenarios and in the environment.

The course is self-contained and it provides all the required fundamentals. All assessments are open-book. The course is suitable for students from diverse backgrounds.

Course Aims

The goal of this course is to provide the students with insights into the broad perspective of applications of light technologies in the life sciences and in the industry. It will focus on the interaction between light and various systems as well as various optical imaging and light-based therapeutic techniques.

Course Learning Outcomes

1. Describe the foundational concepts and methods from the science of light
2. Apply these concepts to the operation of light-based systems detecting, sensing, measuring and quantifying physical and life science phenomena.
3. Conduct and explain practical investigations related to light detection, sensing and imaging.
4. Design and evaluate a simple light-based measurement system and communicate how to solve practical issues arising in the system application.

5. Review and assess potential commercial opportunities provided by light technologies.
6. Explain the safety constraints of using light in the industry and the life sciences and medicine

Teaching Strategies

The contents of the course will be delivered by taking the students through a sequence of weekly topics. The arrangement of weekly topics is as follows:

- Fundamentals of light
- Creating light
- Detecting and manipulating light
- Light based technologies on a macroscale
- Light based technologies on a microscale
- What light can tell us: colour
- What light can tell us: shapes
- Image analysis
- Active use of light

The course includes:

- Lectures
- Tutorials
- Practicals
- Self-driven study of the materials provided
- Design task

Activity based learning methods will be implemented by blending the presentation of new content with learning activities designed to engage students with the material, within the weekly constraints of time which students are expected to dedicate for this course. The activities are provided in the course handouts and other online tools which will also be available on the course website.

Lectures: Student learning will be supported by a scaffold of lecture presentations designed to guide students though the material. The flipped learning principles will be applied. Relevant learning activities will support each topic being introduced. Lectures will not be the primary means of delivering the information as students will draw information from a variety of the resources provided to them.

Practicals will extend the scope and format of different learning activities in this course. Students will get exposed to laboratory equipment, data collection, data analysis and interpretation of results.

They will have the opportunity to master the techniques and approaches introduced to them and communicating the outcomes. They will be exposed to software and data analytics and statistics that represent an important generic skill they will build in this course.

Design task: This part of the course will allow students to integrate the knowledge they built across the entire unit. They will work in groups allowing them to build collaborative working skills and the ability to communicate in a professional setting. A group reflection at the end of the design task will raise their awareness of how a team setting should function to be effective.

BIOM9811 will use a combination of pre-recorded lectures / tutorials and face-to-face laboratory classes.

All lecture and tutorial notes and practical instructions will be made available on Moodle. There is no textbook for the course. The recommended book resources (3 e-books) will need to be uploaded by students **on their own** from SPIE website https://spie.org/publications/open-access. These are

1. **Fundamentals of Photonics, 2:Photonics: Technical applications of light, 3: Discovering Light: Fun Experiments with**
Optics

Moodle will be used for file sharing, announcements and other communications. You are expected to check the platform regularly. Questions should be discussed during tutorials or posted in the Discussion Forum in Moodle. Your academic staff will actively monitor these posts. If required, emails must be made from your student email address with BIOM9811 in the subject line.

Additional Course Information

Some mathematics background is essential. You should have prior exposure to algebra (equivalent to completion of 1st year mathematics – Maths 1A and 1B). It is helpful but not essential that you have some knowledge of first year physics (optics) or electrical circuits and systems. The essential material will be reviewed during the course.

The course is independent from other BIOM courses and can be taken in isolation.

Assessment

Weekly quizzes are also available on Moodle. These are not formally assessed, but they are provided as a study aid. Students are encourages to do these quizzes regularly.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Lab practical	20%	Not Applicable	3
2. Design Task	30%	Not Applicable	2, 3, 4
3. Midterm Online Test	20%	27/03/2023 02:00 PM	1, 6
4. Final Exam	30%	05/05/2023 12:00 PM	1, 2, 5

Assessment 1: Lab practical

Assessment length: In 2023 each student will spend 5x2 = 10 hours carrying out scheduled practicals.
Submission notes: The required content of reports is accessible from Moodle from the beginning of the course. Students submit reports at the end of each completed practicals.
Deadline for absolute fail: Students who do not complete selected practicals and submit reports by the end of Week 10 will have failed these selected practicals.
Marks returned: The outcome of marking will be communicated to the students during the practical

Students will apply concepts in the class to relevant experimental challenges.

Lab work will be assessed by individual reports, which will be marked during the practicals.

In 2023 students will complete 5 different practicals each. They will work on their practicals in pairs, but will submit individual reports.

Assessment criteria

1) Completeness of the report tasks

2) Correctness of the completion of the report tasks.

Additional details

Practicals can be taken in arbitrary order. Student pairs will be assigned to the practicals as rostered by unit convenor.

Assessment 2: Design Task (Group)

Deadline for absolute fail: 28 April 2023
Marks returned: no

Students will work on a group project designing an optical system similar to those taught in the course.

30%of the total mark includes: 10% of marks for the quality of individual peer reflection; 20% for the quality of the group report.

Students are asked to spend more time on their design task in weeks when they have no practicals.

Groups are encouraged to choose their design task in week 1, but this must be finalised no later than Week 3.

Assessment criteria

The student will prepare a formal report from their design task that
will include results, discussion, error sources and reference to relevant literature. The objectives of this major report are to consolidate information learned in the course and to develop critical data analysis and
literature research skills. Details on how to complete the major lab report will be provided after week 7.

- Related graduate capabilities include:
- Capable of independent and collaborative inquiry
- Capable of effective communication
- Information literate
- Enterprising, innovative and creative
- Collaborative and effective team workers
- Understanding of the discipline in its interdisciplinary context
- Rigorous in analysis, critique and reflection
- Able to apply knowledge and skills to solving problems
- Capable of independent, self-directed practice
- Capable of lifelong learning

Assessment 3: Midterm Online Test

Start date: 27/03/2023 01:00 PM
Assessment length: One hour
Submission notes: This exam will be administered through Moodle. A trial mock up exam will be available on Moodle, to test if students are able to make an online submission within the required timescale.
Due date: 27/03/2023 02:00 PM
Deadline for absolute fail: 27/03/2023 02:10 PM
Marks returned: yes

Midterm exam - 1 hour.

This is an open book exam. Submission will be via Moodle.

Assessment criteria

The exam may be made up of any of the following: true/false, multiple choice, matching, short answer and essay questions, but no problem solving. The aims of this assessment are to encourage

students to review the lectures and tutorials for the first half of the course. aThis assessment is a direct test of the degree to which the knowledge-based learning outcomes have been achieved.

Assessment 4: Final Exam

Start date: 05/05/2023 10:00 AM
Assessment length: Two hours
Due date: 05/05/2023 12:00 PM
Deadline for absolute fail: 05/05/2023 12:10 PM
Marks returned: No

Final open book exam will assess the theoretical content of the course.

Submission will be via Moodle.

Assessment criteria

The final exam may contain a mixture of questions for which descriptive answers will be required.

It will also contains specific problems to solve. These will be closely related to problems solved during the course.

Problem solving is a major apect of the course. Students are expected to choose the appropriate model, clearly explain their reasoning, implementing it correctly and arrive at the correct answer. To complete the exam problems, students will use
fundamental material from the lectures. T

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

All lectures are pre-recorded and there are no face-to-face lectures. Tutorials are only face to face and are not recorded. Practical classess are only face to face.

View class timetable

Timetable

Date	Type	Content
Week 1: 13 February - 17 February		
Week 2: 20 February - 24 February		
Week 3: 27 February - 3 March		
Week 4: 6 March - 10 March		
Week 5: 13 March - 17 March		
Week 6: 20 March - 24 March		
Week 7: 27 March - 31 March		
	Assessment	Midterm Online Test : This exam will be administered through Moodle. A trial mock up exam will be available on Moodle, to test if students are able to make an online submission within the required timescale.
Week 8: 3 April - 7 April		
Week 9: 10 April - 14 April		
Week 10: 17 April - 21 April		

Resources

Recommended Resources

We recommend the following three open access books:

1, **FUNDAMENTALS OF PHOTONICS - MODULES** available for download at https://spie.org/publications/fundamentals-of-photonics-modules

2. **Photonics - technical applications of light** - Wenko Suptlitz, Sophie Heimes (SPIE). available for download

Access from https://spie.org/publications/open-access

or directly at:

https://www.spiedigitallibrary.org/ebooks/PM/Photonics-Technical-Applications-of-Light/eISBN-9781510622678/10.1117/3.2507083?webSyncID=8e6ece0a-ac63-4db2-b6b1-7450c5726c21&sessionGUID=3b93c076-7e88-041e-be36-dca58817433a&_ga=2.108863810.1380773814.1675048500-1377568356.1663290425&cm_mc_uid=06262356561416632904248&cm_mc_sid_50300000=51258061675048500202&SSO=1

3. **Discovering light, fun experiments with optics -** Maria Vinas Pena

available for download

https://www.spiedigitallibrary.org/ebooks/PM/Discovering-Light-Fun-Experiments-with-Optics/2/Discovering-Light-Fun-Experiments-with-Optics-Full-Book/10.1117/3.2579764.sup2

Course Evaluation and Development

Informal student feedback is welcome throughout the course. Formal evaluations will be sought upon the conclusion of the course.

Laboratory Workshop Information

There are two available timeslots for the practicals, both on Fridays. Students need to choose one of them no later than end of Week 1, by using the form available from the main Moodle page of the course. A roster with individual allocations of practicals will be available on Moodle. Practical instructions are available from Moodle as well. They should be read before the class, so that proactical time can be used efficiently.

Submission of Assessment Tasks

Laboratory reports and major assignments will require a Non Plagiarism Declaration Cover Sheet.

Assignments should be submitted on time. A daily penalty of 5% of the marks available for that assignment will apply for work received after the due date. Any assignment more than 5 days late will not be accepted. The only exemption will be when prior permission for late submission has been granted by the Course coordinator. Extensions will be granted only on medical or compassionate grounds under extreme circumstances.

Academic Honesty and Plagiarism

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise will have their names entered on a plagiarism register and will be liable to disciplinary action, including exclusion from enrolment.

It is expected that all students must at all times submit their own work for assessment. Submitting the work or ideas of someone else without clearly acknowledging the source of borrowed material or ideas is plagiarism.

All assessments which you hand in must have a Non Plagiarism Declaration Cover Sheet. This is for both individual and group work. Attach it to your assignment before submitting it to the Course Coordinator or at the School Office.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:
https://student.unsw.edu.au/plagiarism

Academic Information

COURSE EVALUATION AND DEVELOPMENT
Student feedback has helped to shape and develop this course, including feedback obtained from on-line evaluations as part of UNSW's as part of UNSW's myExperience process. You are highly encouraged to complete such an on-line evaluation toward the end of Term. Feedback and suggestions provided will be important in improving the course for future students.

DATES TO NOTE
Refer to MyUNSW for Important Dates, available at:
https://my.unsw.edu.au/student/resources/KeyDates.html

ACADEMIC ADVICE
For information about:

- Notes on assessments and plagiarism,
- Special Considerations,
- School Student Ethics Officer, and
- BESS

refer to the School website available at
http://www.engineering.unsw.edu.au/biomedical-engineering/

Supplementary Examinations:

Supplementary Examinations for Term 1 2023 will be held on (TBC) should you be required to sit one.

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW

Kensington campus is located.