UNSW SYDNEY

OPTM3201

Ocular Imaging and Applied Vision Science

Course Outline

Term 1, 2023

School of Optometry and Vision Science

Faculty of Medicine & Health

Table of Contents

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor/ Associate Professor	Juno Kim	juno.kim@unsw.edu.au	Room 3.006 Rupert Myers Building (RMB)	+61 2 9065 1218 By email
Professor	Arthur Ho	a.ho@unsw.edu.au	Email for appointment	By email
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Associate Lecturer	Jeremy Chiang	jeremychungbo.chiang@unsw.edu.au		By email

2. Course information

Units of credit: 6

Pre-requisite(s): VISN2111 – Ocular anatomy and physiology (undergraduate)

Assumed knowledge: VISN1221 – Visual Optics

VISN2211 – Organisation and Function of the Visual System

Teaching times and locations:

Lecture 1: Mon 16:00 - 17:00 (Weeks:1-2), Mon 16:00 - 17:00 (Weeks:3-5);

Lecture 2: Thu 09:00 - 10:00 (Weeks:1-5), Thu 09:00 - 10:00 (Weeks:8-10);

Computer labs (2 hours per week attendance in-person at Old Main Building LG21 for using UNSW computers and WiFi).

The online timetable for this course can be found here: *http://www.timetable.unsw.edu.au*

2.1 Course summary

The first two years of the vision science course provided students with a strong foundation in optics, perceptual systems and the psychophysical principles of vision science. In this course, students will learn to apply their foundation knowledge for solving real-world problems important to optometry, ophthalmology and vision science. Students will learn to undertake lighting evaluation supported by the resources of a fully functioning lighting measurement laboratory. Implementation of principles of lens design on a computational platform will be introduced to students who will learn strategies and techniques for minimising common optical aberrations of importance in optical system performance. In the ocular imaging component of this course, foundation knowledge in anatomy, physiology and optical imaging skills will be applied to strengthen understanding of how ophthalmic structure can be imaged to infer visual function. Students will also learn how image analysis routines can be implemented in software to enhance image structure for the objective and subjective assessment of visual function. These skills are important for understanding the research and development lifecycle of ophthalmic imaging, which benefits technicians and clinicians such as optometrists and orthoptists.

2.2 Course aims

This course aims to provide vision science and optometry students with the necessary opportunities to gain experience in applying their foundation knowledge to solve real-world problems. The course takes a holistic approach for students to better understand how concepts in lighting design, optics, imaging and analysis can be used to generate systems to optimise inferences we make about physical structures.

Students will learn to understand how illumination, reflectance, transmittance and the optical systems used to focus light all have consequences on image formation, and in turn, influence the visual assessment of physical structures found in the eye or natural environment. An initial assessment task on lighting will aim to provide students with practical experience in acquiring measurements of scene illumination to understand how lighting systems can be designed to optimise human performance in real-world scenarios.

Students will be given practical examples and experience with the optics of computer-aided lens design, which aims for students to understand how lenses can be configured to compensate for potential artefacts in the imaging process. An assessment task on lens design will seek to provide feedback to students on their understanding of how software tools can be used to design lenses for controlling light and improving the quality of images acquired.

Given that images are not always able to be acquired with the best possible quality due to potential hardware and methodological limitations, it is often important to apply image processing routines to enhance the quality and appearance of image structure. Students will learn about common image processing routines used to enhance image content for visualisation and analysis. Students will undertake an assignment in the form of a written report to learn how image analysis can be tailored to enhance image content to obtain valuable subjective and objective information for making informed assessments of physical structures imaged.

Finally, the course will provide students with an overview of different imaging technologies with an emphasis on a fundamental understanding of optical theory and how they can be used to visualise and quantify different ophthalmic structures for assessing visual function and monitoring changes in eye health. The final exam will test student understanding of all the concepts covered within the scope of the course.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Demonstrate knowledge of lighting, surface reflectance and the measurement of illuminance and luminance for real-world applications.
2. Be able to describe processes involved in lens design, from design input and computer-aided design optimisation to design verification.
3. Demonstrate knowledge of common image processing and analysis routines used to enhance image content for the improved visualisation and objective assessment of different ophthalmic structures.
4. Effectively communicate theoretical knowledge of ophthalmic imaging technologies and their uses for understanding visual function.

2.4 Relationship between course and program learning outcomes and assessments

The following table shows how each of the aforementioned learning outcome statements (each LO Statement) relates to program learning outcomes (PLOs) for the Bachelor of Vision Science (3181) and the Bachelor of Clinical Optometry (3182).

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)*	Related Tasks & Assessment
CLO 1	Apply knowledge of lighting, surface reflectance and the measurement of illuminance and luminance (including radiometry, photometry and colorimetry) for real-world scenarios	3181: [1, 2, 7] 3182: [6, 7]	● Lighting evaluation assessment sheet ● Final exam
CLO 2	Describe processes involved in lens design, from design input and computer-aided design optimisation to design verification.	3181: [2, 3, 4, 5] 3182: [1, 6]	● Lens design computer lab assignment ● Final exam
CLO 3	Devise ways of using common image processing and analysis routines used to enhance image content for improving visualisation and objective assessment of different ophthalmic structures.	3181: [3, 4, 7] 3182: [1, 6, 7]	● Report on image analysis and perception ● Final exam
CLO 4	Effectively communicate theoretical knowledge of ophthalmic imaging technologies and their uses for understanding visual function and image interpretation	3181: [5] 3182: [1, 6]	● Report on image analysis and perception ● Final exam

* Numbers for Program Learning Outcomes (PLOs) correspond to PLOs of each degree listed in **Appendix A**.

3. Strategies and approaches to learning

3.1 Learning and teaching activities

Each week, students will receive two lecture hours of content that have been designed to motivate and engage student interest in the problems of lighting, optics and lens design, image formation, image analysis and some imaging devices available to acquire ophthalmic images for diagnostic assessment. For all weeks 1-10, both streams of lectures will be online. Lectures will be available for viewing synchronously and/or asynchronously as Moodle videos either recorded through Echo 360 or direct uploads to Moodle).

Computer lab classes are two hours in length and will generally run on subsequent weeks to the lecture(s) of most relevance. Each of the computer lab classes will give students hands-on-experience with the processes and concepts discussed in lectures. Tasks will include demonstrations on lighting and its measurement, computer-aided design of optical systems, and an introduction to image processing and analysis tools for image enhancement and data visualisation. The computer labs ensure that students are not just engaged learners, but also are actively involved in their learning during and outside of class time. Group work will also provide the opportunity for students to build connections with their peers in an inclusive but diverse and immersive environment. The computer labs provide the opportunity for students to ask questions and will provide students with research-integrated and research-oriented learning to hone students' problem-solving abilities in real-world applications.

3.2 Expectations of students

Students are reminded that UNSW recommends that a 6 units-of-credit course should involve about 150 hours of study and learning activities. The formal learning activities total approximately 50 hours throughout the term and students are expected (and strongly recommended) to do at least the same number of hours of additional study.

Students are required to attend all lectures (**in-person**) and computer lab classes (**in-person**) to maximise their opportunity to engage with lecturers, tutors and other students. Ongoing attendance to lectures will best enable students to acquire necessary knowledge to supplement computer labs. Attendance to computer lab classes is mandatory as it will ensure students take advantage of the valuable opportunities necessary to hone their skills through hands-on-experience in research techniques. Attendance in computer labs classes will also give students the opportunity to ask questions and engage with their mentor(s) who will be able to most effectively provide guidance and direct feedback on their progress.

Although this course is offered as in-person mode only. If you are offshore, and you cannot return to UNSW for in-person lecture and laboratory classes, please enrol in the laboratory group on Thursday 4-6pm and email the Course Convener, A/Prof Juno Kim, on: juno.kim@unsw.edu.au for further information. In addition to the scheduled lectures, you must also watch pre-recorded lectures in Weeks 7-10.

The following software packages will be installed on the computer laboratory PCs, and you are encouraged to install these software packages on your own device for convenience and to ensure you have multiple modes of access to resources where possible:

- R for statistics and analysis (https://cran.r-project.org/)
- Blender 3D Version 2.79 (https://www.blender.org/)
- Microsoft Word, Excel and Teams (https://www.myit.unsw.edu.au/user/login?destination=/software-students)
- Adobe Acrobat Reader (https://get.adobe.com/reader/)
- Zoom (https://zoom.us/)
- Zemax* (https://www.zemax.com/)

*The software licensing for Zemax (used in computer-aided lens design) will be directly associated with student zID and email information. Separate requests are required to be made to Zemax for each student. Students are required to submit their own license application to Zemax themselves, using instructions provided during the course. If you have any questions about this licensing procedure, then please email Professor Arthur Ho and copy A/Prof Juno Kim.

The University uses email as an official form of communication for students. All UNSW students have their own email account. The School of Optometry and Vision Science will also make use of this form of communication. It is extremely important that you know how to use your Zmail and ensure that you check it regularly.

For more information or if you are having connection or access problems, see:

IT Service Centre

https://www.myit.unsw.edu.au/

Telephone: 02 9385 1333

4. Course schedule and structure

This course consists of 4 hours of class contact hours per week. You are expected to take an additional hour of non-class contact per week to complete assessments, readings and exam preparation.

Week [Date/Session]	Topic [Module]	Activity [Learning opportunity]	Related CLO
Week 1	L1: Introduction to the course (JKim)	Learn about challenges for the subject matter and assessment requirements	1,2,3,4
	L2: Lighting evaluation (NYoshioka)	Introduction to RPC Radiometry	1
	P1: Optics and statistics refresher (optional online through Moodle)	Revision of basic concepts on optics and statistics	NA
Week 2	L1: Image analysis and perception (JKim)	Photometry & Reflection of Light	3
	L2: Lighting evaluation (NYoshioka)	Measurement of lighting and luminance	1
	P1: Lighting practical 1	Photometry & Reflection of Light	1

Week 3	L1: Lens design (AHo)	Principles and fundamentals for computer-assisted optical lens design	1
	L2: Lighting evaluation (NYoshioka)	Source of Optical Radiation Lighting Standards	1
	P1: Psychophysical study on lighting and imaging enhancement (JKim)	Designing and running a psychophysical experiment (part of the report assessment)	3
Week 4	L1: Lens design (AHo)	Basic strategies and techniques for lens design configuration and optimisation	2
	L2: Lighting evaluation (NYoshioka)	Colorimetry 1	1
	P1: Lighting practical 2	Individual assessment on the measurement of environmental lighting	1
Week 5	L1: Lens design (AHo)	Implementation of computer-assisted lens design process and techniques using Zemax OpticStudio	2
	L2: Lighting evaluation (NYoshioka)	Colorimetry 2	1
	P1: Lens design practical 1	Computer aided lens design (Part 1)	2
Week 6			NA
Week 7	L1: Introduction to OCT (Asynchronous Online by CFEH, support: JChiang)	Optical Coherent Tomography **[TO BE POSTED ON MOODLE]**	4
	L1: Introduction to OCTA (Asynchronous Online by CFEH, support: JChiang)	Optical Coherent Tomography with Angiography **[TO BE POSTED ON MOODLE]**	4
	P1: Lens design practical 2	Computer aided lens design (Part 2)	2
Week 8	L1: Introduction to Wide-Field imaging and FAF (Asynchronous Online by CFEH, support: JChiang)	**[TO BE POSTED ON MOODLE]**	4
	L2: Optical Coherence Tomography A (MRoy)	Innovations in Optical Coherence Tomography (OCT) Part 1 **[CONNECTION TO BE ANNOUNCED]**	2,4
	P1: 3D Graphics and Rendering	Learn to use 3D graphical resources to generate images for virtual lighting simulations.	1,3

Week 9	NO LECTURE	Public Holiday	
	L2: Optical Coherence Tomography B (MRoy)	Innovations in Optical Coherence Tomography (OCT) Part 2	2,4
	P1: Computerised 3D Reconstruction	Use 3D graphical reconstruction for data visualisation	1,3
Week 10	L1: Interpretation of corneal imaging (Online by CFEH, support: JChiang)	Latest developments in ocular imaging	4
	L2: Confocal microscopy (MRoy)	Approaches to confocal microscopy **[CONNECTION TO BE ANNOUNCED]**	2,4
	P1: Review of course material	Revision workshop + Sensory Processes Research Lab tour	1,2,3,4

Exam Period: 28 April – 11 May

School managed supplementary exams period:

FOR TERM 1:

- STAGE 1-4* COURSES: WEDNESDAY, 17 MAY 2023 – FRIDAY, 19 MAY 2023
- THERE WILL BE NO SUPPLEMENTARY EXAMINATIONS FOR STAGE 5 STUDENTS IN TERM 1 2023

Supplementary examinations will be held at the scheduled time only. If students who are granted supplementary examinations do not attend, a failure will be recorded for that course. **Students should not make travel arrangements, or any other commitments, before establishing whether or not they have supplementary examinations. Ignorance of these procedures, interstate, overseas or any other absence will not be accepted as an excuse. But usual Special Consideration still applies.**

If additional assessment is not scheduled, this does NOT indicate whether or not a student has passed or failed the course. Results will be received in the usual way. Please do not contact the School in this regard.
Please note the above applies to OPTM and VISN courses only. Any information on supplementary examinations for servicing courses (e.g. CHEM****) is the responsibility of the School conducting the course.

* Stage 4 includes courses in the first year of the MClinOptom program.

5. Assessment

5.1 Assessment tasks

Task	Length	Weight	Due Date
Assessment 1: Lighting assignment sheet and quiz	The assessment will have two parts. Part 1: Submission of practical report (2%) Part 2: Moodle Quiz (In-class) (8%)	Combined total mark is equivalent to 10% of your final mark for the course.	Part 1: During lighting practical class 1 (Week 3) Part 2: During lighting practical class 2 (Week 4)
Assessment 2: Lens design assignment	The assessment will have two equally-weighted parts.	Combined total mark is equivalent to 20% of your final mark for the course.	Both parts due: Thursday 31 March 2023; 23:59 Australian Eastern Standard Time (Week 7)
Assessment 3: Image analysis and perception report	The assessment word limit is 800 words.	30% of your final mark for the course.	Thursday 06 April 2023 at 11:58pm (End of Week 8)
Assessment 4: Final theory exam	2 hours	40% of your final mark for the course.	Exam period.

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

5.2 Assessment criteria and standards

The following criteria will be used to grade student responses to assessment tasks.

Assessment task	Grading criteria
Assessment 1: Lighting assignment sheet and quiz	Part 1: Appropriate measurement, recording, interpretation and discussion of photometric values/concepts Part 2: Accuracy of responses to the written questions.
Assessment 2: Lens design assignment	Degree to which the student's lens design satisfies the set of target requirements for the assessment task.
Assessment 3: Image analysis and perception report	Writing style, referencing style (where appropriate), choice of data to present, accuracy in reporting data and interpreting findings. A detailed rubric will be made available prior to students undertaking this assignment.
Assessment 4: Final theory exam	Accuracy of responses to examination questions.

5.3 Submission of assessment tasks

Late Submission

UNSW has standard late submission penalties as outlined in the UNSW Assessment Implementation Procedure, with no permitted variation. All late assignments (unless extension or exemption previously agreed) will be penalised by 5% of the maximum mark per day (including Saturday, Sunday and public holidays). For example, if an assessment task is worth 30 marks, then 1.5 marks will be lost per day (5% of 30) for each day it is late. So, if the grade earnt is 24/30 and the task is two days late the student receives a grade of 24 – 3 marks = 21 marks.

Late submission is capped at 5 days (120 hours). This means that a student cannot submit an assessment more than 5 days (120 hours) after the due date for that assessment.

Special Consideration

If you experience a short-term event beyond your control (exceptional circumstances) that impacts your performance in a particular assessment task, you can apply for Special Considerations.

You must apply for Special Consideration **before** the start of your exam or due date for your assessment, except where your circumstances of illness or misadventure stop you from doing so.

If your circumstances stop you from applying before your exam or assessment due date, you must **apply within 3 working days** of the assessment, or the period covered by your supporting documentation.

More information can be found on the Special Consideration website.

5.4. Feedback on assessment

Feedback on all assessment tasks will be provided in practical classes. Dates provided in the table below.

Task	Feedback		
	WHO	WHEN	HOW
Assessment 1: Lighting assignment sheet and quiz	Dr Yoshioka	Week 4	Moodle
Assessment 2: Lens design assignment	Prof Arthur Ho	Week 10	Moodle
Assessment 3: Image analysis and perception report	A/Prof Juno Kim	By start of Week 11	Moodle
Assessment 4: Final theory exam		End of exam period	Group feedback

6. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Please use APA referencing style for this course. Change to referencing style used in your course.

Further information about referencing styles can be located at
https://student.unsw.edu.au/referencing

***Academic integrity** is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits:* *honesty, trust, fairness, respect, responsibility and courage.*[1] *At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.*

Further information about academic integrity and ***plagiarism*** *can be located at:*

- *The Current Students site* https://student.unsw.edu.au/plagiarism, *and*
- *The ELISE training site* https://subjectguides.library.unsw.edu.au/elise

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct.

7. Readings and resources

Riedl Max J (2009). Optical Design Applying the Fundamentals. SPIE, ISBN(0819477990).

8. Administrative matters

Student enquiries should be submitted via student portal https://portal.insight.unsw.edu.au/web-forms/

9. Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- *Student Wellbeing and Health* https://www.student.unsw.edu.au/wellbeing
- UNSW IT Service Centre: https://www.myit.unsw.edu.au/services/students
- *UNSW Student Life Hub:* https://student.unsw.edu.au/hub#main-content
- *Student Support and Development:* https://student.unsw.edu.au/support
- *IT, eLearning and Apps:* https://student.unsw.edu.au/elearning
- *Student Support and Success Advisors:* https://student.unsw.edu.au/advisors
- *Equitable Learning Services (Formerly Disability Support Unit):* https://student.unsw.edu.au/els
- *Transitioning to Online Learning* https://www.covid19studyonline.unsw.edu.au/
- *Guide to Online Study* https://student.unsw.edu.au/online-study

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.