UNSW Course Outline

BIOM9027 Medical Imaging - 2024

Published on the 25 Aug 2024

General Course Information

Course Code : BIOM9027
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : Graduate School of Biomedical Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Medical imaging technologies allow doctors to diagnose and treat diseases with remarkable accuracy. In this course, you will learn about x-ray, magnetic resonance and ultrasound imaging technologies and discover how images are formed and reconstructed from image data. You will learn how to assess the clinical value of new imaging technologies. You will play a central role in

evaluating and developing medical imaging technologies that power modern medicine.

Course Aims

Your role as future engineers in advancing imaging technologies underpin modern medicine is critical. To achieve this, you must comprehend the physical and mathematical principles that facilitate imaging systems' design, selection or repair. You will also need to collaborate with end-users of this technology, including medical personnel and the healthcare system. Although the primary focus will be on comprehending the technologies themselves, it's important to have some understanding of their clinical applications.
As this is a graduate course, your existing knowledge of year 1 engineering maths, including the Fourier Transform, and experience using Matlab software, is highly valued and essential. If you have completed a course in signal analysis, such as BIOM9621 (Biological Signal Analysis), it will greatly enhance your comprehension of imaging artifacts.

The aim of this course is to equip you with an understanding of the physical and mathematical principles underlying x-ray, magnetic resonance, and ultrasound imaging. The course will also allow you to actively engage with developers of new imaging technologies.

Relationship to Other Courses

This course requires an undergraduate understanding of physics and mathematical topics such as the Fourier Transform. It is well-suited for students who are taking or have taken Biological Signal Analysis (BIOM9621), Biomedical Instrumentation (BIOM9640) or Biosensors and Transducers (BIOM9650).

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the physical basis of medical imaging
CLO2 : Apply mathematical and computational tools for image formation
CLO3 : Provide technical explanations for imaging artifacts
CLO4 : Critically evaluate the technical and safety aspects of medical imaging technologies
CLO5 : Communicate effectively with medical professions working in the field of medical imaging

Course Learning Outcomes	Assessment Item
CLO1 : Explain the physical basis of medical imaging	• Assignments • Group presentation
CLO2 : Apply mathematical and computational tools for image formation	• Assignments
CLO3 : Provide technical explanations for imaging artifacts	• Final examination • Assignments
CLO4 : Critically evaluate the technical and safety aspects of medical imaging technologies	• Final examination • Group presentation • Assignments
CLO5 : Communicate effectively with medical professions working in the field of medical imaging	• Final examination • Group presentation

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360 | Microsoft Teams

Additional Course Information

Postgraduate students should have a background in physics and mathematics covered in the first year of Engineering. Students who have an undergraduate degree in life sciences without an engineering background may find this course challenging. If you are unsure whether you have the necessary prerequisites for this course, please get in touch with the course coordinator.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final examination Assessment Format: Individual	50%	Start Date: TBA Due Date: TBA
Assignments Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: Not Applicable
Group presentation Assessment Format: Group	10%	Start Date: 11/11/2024 10:00 AM Due Date: 11/11/2024 10:00 AM

Assessment Details

Final examination

Assessment Overview

The final exam will comprise both multiple-choice and short-answer questions.

Course Learning Outcomes

- CLO3 : Provide technical explanations for imaging artifacts
- CLO4 : Critically evaluate the technical and safety aspects of medical imaging technologies
- CLO5 : Communicate effectively with medical professions working in the field of medical imaging

Detailed Assessment Description

The final exam will be conducted online through Moodle. You will be allotted 2.5 hours for the exam, with an additional 15 minutes for reading. The image analysis section will consist of two short-answer questions involving numerical calculations. Questions on ultrasound and magnetic resonance imaging will be in multiple-choice format. All three imaging modalities will carry equal weight in terms of the marks allocated.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Assignments

Assessment Overview

There will be up to 4 assignments due throughout the course.

Assignments will be marked using marking guidelines.

Assignment answers will be provided before the final exam to assist with revision.

Course Learning Outcomes

- CLO1 : Explain the physical basis of medical imaging
- CLO2 : Apply mathematical and computational tools for image formation
- CLO3 : Provide technical explanations for imaging artifacts
- CLO4 : Critically evaluate the technical and safety aspects of medical imaging technologies

Detailed Assessment Description

The coursework will include assignments in X-ray imaging (15%), Magnetic Resonance Imaging (15%), and a health technology assessment for a new ultrasound imaging technology (10%). All assignments are to be submitted via Moodle.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Group presentation

Assessment Overview

The group presentation will be assessed by a panel of experts and the class. The assessment

criteria will be provided to students via Moodle in week 1 of the course.

Course Learning Outcomes

- CLO1 : Explain the physical basis of medical imaging
- CLO4 : Critically evaluate the technical and safety aspects of medical imaging technologies
- CLO5 : Communicate effectively with medical professions working in the field of medical imaging

Detailed Assessment Description

Teams of four will evaluate a novel ultrasound imaging application created by Professors Tracie Barber and Alec Welsh, as discussed in the lectures from weeks 7 and 8. The presentation of your report to the class is planned for week 10. The report should cover the following points:

1. The unaddressed medical need.
2. How the new technology will meet this need.
3. The present stage of research and the level of technology readiness.
4. The demographics of patients who will benefit from this innovation.
5. The innovation's value proposition for patients, clinicians, and healthcare providers.

Additionally, a separate written report is required to be submitted.

Assessment information

Rubrics will be provided for marking of the health technology assessment and written report

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Assistance with Attribution

This assessment requires you to write/create a first iteration of your submission yourself. You are then permitted to use generative AI tools, software or services to improve your submission in the ways set out below.
Any output of generative AI tools, software or services that is used within your assessment must be attributed with full referencing.
If outputs of generative AI tools, software or services form part of your submission and are not appropriately attributed, your Convenor will determine whether the omission is significant. If so, you may be asked to explain your submission. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.

For more information on Generative AI and permitted use please see here.

General Assessment Information

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Blended	Associate Professor Robert Nordon (X-ray imaging) Introduction medical imaging, X-ray production and interaction with tissues, Radon transform
Week 2 : 16 September - 22 September	Blended	Associate Professor Claudia Hillenbrand (MRI) Principles of magnetic resonance imaging 1
Week 3 : 23 September - 29 September	Blended	Associate Professor Claudia Hillenbrand (MRI) Principles of magnetic resonance imaging 2
Week 4 : 30 September - 6 October	Blended	Associate Professor Claudia Hillenbrand (MRI) MRI Hardware and special imaging methods
Week 5 : 7 October - 13 October	Online Activity	Associate Professor Robert Nordon (X-ray imaging): Fourier transform, Line integrals and Central Slice Theorem (Labour day holiday, Online lecture)
Week 6 : 14 October - 20 October	Fieldwork	Associate Professor Claudia Hillenbrand (MRI) Tour of Research Imaging (NSW) Randwick Precinct.
	Assessment	Submission of MRI assignment
Week 7 : 21 October - 27 October	Blended	Professor Tracie Barber (U/S). Presentation of U/S imaging technology R&D.
Week 8 : 28 October - 3 November	Blended	Professor Alec Welsh (U/S): Introduction to U/S imaging including physics and clinical application.
Week 9 : 4 November - 10 November	Blended	Associate Professor Robert Nordon (X ray imaging): CT image reconstruction, inverse radon transforms, sampling errors
Week 10 : 11 November - 17 November	Presentation	Assocated Professor Robert Nordon, Professor Alec Welsh and Professor Tracie Barber: Student group presentations with peer review of health technology report.
Week 11 : 18 November - 24 November	Assessment	Submission of X-ray imaging assignment
	Assessment	Submission of group report (U/S technology assessment)

Attendance Requirements

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

General Schedule Information

Lecture and Tutorial will be held on Monday 10 am - 1 pm at Bioscience G07.

Course Resources

Prescribed Resources

All material will be provided via Moodle. Lectures and tutorials will be recorded using Echo 360. Contact course lecturers via email. TEAMS can by used for meetings with Lecturers or group work.

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 Course and Teaching Evaluation and Improvement process (MyExperience).

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Robert Nordon		Room 508	+61 2 9385 0559	During class time or by teams.	Yes	Yes
Lecturer	Claudia Hillenbrand		Level 1, Building 3, Prince of Wales Hospital, Randwick, NSW, 2031			No	No
	Tracie Barber		Ainsworth Building (J17) Level 4, Room 401A Kensington Campus	+61 2 9385 4081	By appointment	No	No
	Alec Welsh		Perinatal Imaging Research Group Level 0 Royal Hospital for Women Barker Street Randwick NSW 2031	(02) 9382 6214		No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance

- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the 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 or your primary learning management system (LMS) 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/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit:

student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,

- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School Contact Information

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