

BIOM9027

Medical Imaging

Term 3, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Robert Nordon	r.nordon@unsw.edu.au			+6193850558

Lecturers

Name	Email	Availability	Location	Phone
Mitra Safavi-Naeini	m.safavi-naeini@unsw.edu.au		ANSTO	+61 2 9717 3143
Claudia Hillenbrand	claudia.hillenbrand@unsw.edu.au		Level 1, Building 3, Prince of Wales Hospital, Randwick, NSW, 2031	

School Contact Information

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

Course Details

Units of Credit 6

Summary of the Course

Fundamentals of producing a medical image, image collection techniques, image reconstruction algorithms. Detailed examination of the four main areas of medical imaging: Nuclear Medicine and Positron Emission Tomography, X-ray imaging, Magnetic Resonance and image analysis methods.

Medical Imaging is for engineers rather than life science graduates and requires some knowledge in physics, mathematics and computer science. Whilst it is not necessary to have taken an undergraduate course with physics, advanced mathematics and computer science, a background in signal analysis (BIOM9621) or related subject is highly desirable. Please contact us to determine if your educational background is appropriate for this course.

Course Aims

To develop an understanding of the principles of medical imaging technologies from an engineering perspective.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Explain the physical basis of medical imaging	
2. Apply mathematical and computational tools for image formation	PE1.2
3. Provide technical explanations for imaging artifacts	PE1.3
4. Critically evaluate the technical and safety aspects of medical imaging technologies	
5. Communicate effectively with medical professions working in the field of medical imaging	PE3.2, PE3.4

Teaching Strategies

The course caters to both under- and post-graduate engineers, and is delivered using a blended format (online and face-to-face content). Moodle will be used for delivery of content with face-to-face blended learning.

X-ray, magnetic resonance and nuclear medical imaging are taught in 3 week blocks. Each week there will be a one hour lecture followed by a 2 hour tutorial where lecture content is revised with worked problems. The tutorials will include worked problems and Matlab programming tasks. The computer vision component of the course will be delivered online. Magnetic resonance imaging and nuclear medical imaging are taught by external lecturers who have specialised in these fields.

The course will be assessed by four assignments, one for each modality, comprising 52% of the assessment. The final exam will comprise the remainder of the assessment (48%). The exam will include multiple choice questions, short answer questions and calculations.

Additional Course Information

This course is an introduction to medical imaging by x-ray, nuclear isotope and magnetic resonance imaging as well as image processing. The course is interdisciplinary drawing from physics, mathematics and computer science. Whilst it is not necessary to have taken an undergraduate course in physics and computer science, a background in signal analysis (BIOM9621) or related subject is highly desirable. Please contact us to determine if your educational background is appropriate for this course.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment 3	13%	08/11/2022 11:59 PM	1, 2
2. Assignment 2	13%	25/10/2022 11:59 PM	1, 2
3. Assignment 1	13%	04/10/2022 11:59 PM	1, 2
4. Assignment 4	13%	25/11/2022 11:59 PM	1, 2
5. Final examination	48%	Not Applicable	3, 4, 5

Assessment 1: Assignment 3

Due date: 08/11/2022 11:59 PM

Magnetic resonance imaging assignment

Assessment 2: Assignment 2

Due date: 25/10/2022 11:59 PM

Image analysis assignment

Assessment 3: Assignment 1

Due date: 04/10/2022 11:59 PM

X-ray imaging assignment

Assessment 4: Assignment 4

Due date: 25/11/2022 11:59 PM

Nuclear medical imaging assignment

Assessment 5: Final examination

Final exam

Attendance Requirements

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

Course Schedule

Lecture Wednesday, 3:00 – 4:00 pm [Bioscience G07](#)

(face-to-face or recorded lecture)

Tutorial/Laboratory

Face-to-face Wednesday, 4:00 – 6:00 pm [Bioscience G07](#)

or (face-to-face or recorded lecture)

Web based Computer vision lectures and tutorials

[View class timetable](#)

Timetable

Date	Type	Content
Week 1: 12 September - 16 September	Lecture	Introduction medical imaging, X-ray production and interaction with tissues, Radon transform. Lecturer: Robert Nordon
	Online Activity	Image Enhancement and Registration (online lecture and tutorial). Lecturer: Robert Nordon
Week 2: 19 September - 23 September	Lecture	X-ray imaging, Fourier transform, Line integrals and Central Slice Theorem. Lecturer: Robert Nordon
	Online Activity	Image Segmentation (online lecture and tutorial). Lecturer: Robert Nordon
Week 3: 26 September - 30 September	Online Activity	Feature Classification (online lecture and tutorial). Lecturer: Robert Nordon
	Lecture	CT image reconstruction, inverse radon transforms, sampling errors. Lecturer: Robert Nordon
Week 4: 3 October - 7 October	Lecture	Principles of magnetic resonance imaging 1. Lecturer: Dr Claudia Hillenbrand
	Assessment	Assignment 1
Week 5: 10 October - 14 October	Lecture	Principles of magnetic resonance imaging 2. Lecturer: Dr Claudia Hillenbrand
Week 6: 17 October - 21 October	Fieldwork	Tour of Research Imaging (NSW) Randwick Precinct
Week 7: 24 October -	Lecture	MRI Hardware and special imaging methods.

28 October		Lecturer: Dr Claudia Hillenbrand
	Assessment	Assignment 2
Week 8: 31 October - 4 November	Blended	Nuclear medicine: physics, radiopharmaceuticals, detectors. Lecturer: Dr Mitra Safavi-Naeini
Week 9: 7 November - 11 November	Blended	Nuclear medicine: digital imaging and data processing. Lecturer: Dr Mitra Safavi-Naeini
	Assessment	Assignment 3
Week 10: 14 November - 18 November	Blended	Nuclear medicine: SPECT and PET / Revision. Lecturer: Mitra Safavi-Naeini

Resources

Prescribed Resources

All material will be provided via Moodle and Teams. Online activities including lectures and tutorials will utilise the Teams platform.

Recommended Resources

DATES TO NOTE

Refer to MyUNSW for [Important Dates](#).

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 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.

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 ADVICE

- Contract cheating and 'sharing' of assignment answers are very serious breaches of academic conduct. Please read the [student conduct policy](#) and the [academic misconduct procedure](#). It is expected that students attend all lectures and tutorial sessions.
- Assignments submitted after the due date without prior notification and permission will be subject to a deduction in marks.
- UNSW has a wide range of student support services. The resources listed below should be used by students needing assistance related to aspects of their overall University experience. Specific help regarding this course can be sought from the course coordinator.

<http://www.student.unsw.edu.au/>

https://my.unsw.edu.au/student/howdoi/HowDoI_MainPage.html

<http://www.counselling.unsw.edu.au/>

- Students with a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator before, or at the commencement of, their course, and should contact the [Equitable Learning Service](#). Issues to

be discussed may include access to materials, signers or note-takers, the provision of services and additional exam or assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

- If you believe that your performance in an assessable component of the course has been affected by illness or another unexpected circumstance, you should make an application for special consideration as soon as possible after the event by visiting UNSW Student Central. Please talk to the course coordinator as well and note that considerations are not granted automatically.
- UNSW has strict policies and expectations relating to Occupational Health and Safety (OHS) accessed at <http://www.ohs.unsw.edu.au/>

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](#)).

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 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 2022 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

Wilhelm Conrad Roentgen, discovered x-rays in 1895. This is the first x-ray of a human (Roentgen's wife's hand).

Online Radiography Continuing Education for Radiologic X ray Technologist. [Biological Effects of Irradiation \(ceessentials.net\)](https://www.ceessentials.net/)

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	