



# BENG3016

## Medical Imaging Systems

Session 1, Weekday attendance, North Ryde 2020

*School of Engineering*

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## General Information

Unit convenor and teaching staff

Senior Lecturer in Biomedical Engineering

Atul Minhas

[atul.minhas@mq.edu.au](mailto:atul.minhas@mq.edu.au)

Contact via +61 (2) 9850 9096

9 Wally's Walk (9WW), Level 3, Room No 318, Macquarie University, NSW 2109, Australia

Monday (16:20 - 17:30 hrs)

Professor

Yves De Deene

[yves.dedeene@mq.edu.au](mailto:yves.dedeene@mq.edu.au)

Contact via (+61) 02 9850 9152

9 Wally's Walk (9WW) / E6A, Level 3, Room 319, Macquarie University, North Ryde, NSW

Appointment by email

Credit points

10

Prerequisites

BENG2015 or ELEC215

Corequisites

Co-badged status

### Unit description

The aim of this unit is to provide a basic understanding of various medical imaging systems such as X-ray, CT, Ultrasound, PET, SPECT and MRI. The unit consists of five modules. Each module covers the basic working principles, underlying physics, system hardware and image reconstruction principles, for each specific imaging modality. In the first module, an overview of X-ray and CT imaging systems will be provided. This will be followed by a second module on nuclear medicine which consists of PET and SPECT systems. Module three will include ultrasound system explaining about systems based on Pulse Echo and Doppler Effect. Module four will explain about MRI where basic MR physics, imaging principles, and image reconstruction algorithms will be explained followed by introduction of system designs at various magnetic fields. In module five, various other imaging systems such as bio-luminescence and MSOT will be introduced. The theory of medical imaging systems will be tested in practice through tutorials and practical sessions which involve the modelling and simulation exercises on multi-physics design aspects of medical imaging systems. These exercises will be done using a commercial software COMSOL Multiphysics 5.3 and MATLAB. Besides, there will be some hands on experimentation exercises for MRI sub-parts, and optical CT.

## 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:

**ULO1:** Describe the differences between various medical imaging systems including X-ray, CT, PET, SPECT, Ultrasound, and MRI in following aspects: underlying physics, working principle, hardware system, software system (including image reconstruction principle).

**ULO2:** Apply image reconstruction algorithms of various medical imaging modalities including X-ray, CT, PET, SPECT, Ultrasound, and MRI in following aspects: mathematical model of raw data from system, mathematical model of reconstructed data, and programming of image reconstruction algorithm in MATLAB.

**ULO3:** Allocate applications and safety aspects of various medical imaging systems including X-ray, CT, PET, SPECT, Ultrasound, and MRI and why their design needs rigorous approvals from government agencies.

**ULO4:** Demonstrate skills in "modeling and simulation" using a commercial software COMSOL Multiphysics 5.4 and understand its capabilities: (a) to perform analysis of sub-parts of medical imaging systems, and (b) to understand the underlying physics of the

imaging system and their interaction with human body.

## Assessment Tasks

### Coronavirus (COVID-19) Update

Assessment details are no longer provided here as a result of changes due to the Coronavirus (COVID-19) pandemic.

Students should consult [iLearn](#) for revised unit information.

[Find out more about the Coronavirus \(COVID-19\) and potential impacts on staff and students](#)

## General Assessment Information

### Grading and passing requirement for unit:

In order to pass this unit, student has to pass the final exam which is a hurdle (pass marks = 50%). Besides this, a student must obtain a total of 50 mark or more for the unit (i.e. obtain a passing grade P/ CR/ D/ HD). Note that the final exam weight = 45% of the total marks. So, rest of the 55% marks are for other assessment tasks (see Assessment Tasks above for details).

For further details about grading, please refer below in the policies and procedures section.

## Delivery and Resources

### Coronavirus (COVID-19) Update

Any references to on-campus delivery below may no longer be relevant due to COVID-19.

Please check here for updated delivery information: [https://ask.mq.edu.au/account/pub/display/unit\\_status](https://ask.mq.edu.au/account/pub/display/unit_status)

**Delivery** - classroom lecture

### Resources in iLearn:

- lectures, journal papers, handouts for assignments, user manuals for COMSOL, practice guidelines for COMSOL

### Text books:

- **Essential Physics of Medical Imaging**, Authors - *Jerrold T. Bushberg PhD, J. Anthony Seibert PhD, Edwin M. Leidholdt PhD, John M. Boone PhD*

- **Magnetic Resonance Imaging: Physical Principles and Sequence Design**, Second Edition. Authors - *Robert W. Brown Ph.D., Yu-Chung N.*

*Cheng Ph.D., E. Mark Haacke Ph.D., Michael R. Thompson Ph.D., Ramesh Venkatesan D.Sc.*

## Unit Schedule

### Coronavirus (COVID-19) Update

The unit schedule/topics and any references to on-campus delivery below may no longer be relevant due to COVID-19. Please consult [iLearn](#) for latest details, and check here for updated delivery information: [https://ask.mq.edu.au/account/pub/display/unit\\_status](https://ask.mq.edu.au/account/pub/display/unit_status)

Refer to iLearn for unit schedule.

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central>). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Students seeking more policy resources can visit the [Student Policy Gateway](https://students.mq.edu.au/support/study/student-policy-gateway) (<https://students.mq.edu.au/support/study/student-policy-gateway>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/student-conduct>

## Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) 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](https://ask.mq.edu.au) or if you are a Global MBA

student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@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](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- [Getting help with your assignment](#)
- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

## 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](http://ask.mq.edu.au)

If you are a Global MBA student contact [globalmba.support@mq.edu.au](mailto:globalmba.support@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/](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.

## Changes from Previous Offering

- Assignments (problems, questions and answers) to be done during lab sessions. Student participation in practicals will be assessed based on the completion of the assignments.
- Handouts on Comsol learning are provided and must be practiced during practicals.

## Changes since First Published

Date	Description
07/02/2020	Details of another lecturer Yves De Deene added, everything else remains same as previous version.