GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2015-2016

Nuclear Magnetic Resonance Imaging Technology (E027761)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)

Credits	Study time	Contact hrs
3.0	90 h	30.5 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 2)	English	Gent	practicum	7.5 h
			lecture	22.5 h

Lecturers in academic year 2020-2021

Van Holen, Roel	TW06	lecturer-in-charge
Buls, Nico	VUB	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Biomedical Engineering	3	A
International Master of Science in Biomedical Engineering	3	A
Master of Science in Biomedical Engineering	3	A

Teaching languages

English

Keywords

Magnetic resonance imaging (MRI), nuclear magnetic resonance (NMR).

Position of the course

The aim of this course is to provide the student with more knowledge and insight into several techniques and methodologies in nuclear magnetic resonance imaging (NMR/MRI). While the basic principles of MRI are discussed in the course “medical physics” and “biomedical signals and images”, this course gives an overview of more advanced MRI techniques.
In this course, the student becomes also acquainted with the arsenal of innovative techniques and experimental methods of MRI that are the basis of current research. The student also comes in contact with the versatile MRI research domain through ‘hands on’ laboratory and practical exercises.

Contents

- Nuclear magnetism and nuclear magnetic resonance: Description on the basis of a classic electro-dynamic and quantum mechanical model
- Principles of MR imaging: spatial encoding, spin-lattice and spin-spin relaxation, T1, T2 and T2 * contrast
- Quantitative physical description of NMR mechanisms: the rotating reference frame, RF-pulses, signal acquisition
- Basic imaging sequences: gradient echo (GE), spin echo (SE) and inversion recovery (IR)
- Fast imaging techniques: echo planar imaging, RARE, GRASE and PRESTO
- Image reconstruction in MRI: Fourier reconstruction, parallel acquisition
- Diffusion-weighted MR imaging: DWI, DTI, and applications
- Perfusion-weighted MR imaging: Effects of flow, angiography and applications
- In vivo NMR spectroscopy: spectroscopy imaging (SVS and CSI) and applications
- Artifacts in MRI
- interventional MRI
- Clinical applications of MRI
- Pre-clinical applications of MRI

Initial competences

Basic knowledge of general and medical physics and mathematical analysis.

Final competences

1 Understanding and being able to apply the underlying principles of NMR.
2 To understand the physical basis of MR contrast mechanisms (e.g. spin-lattice and spin-spin relaxation, molecular self-diffusion, magnetization transfer and chemical shift).
3 To understand the operation of a clinical MR scanner both in terms of the hardware and the software.
4 Being able to describe NMR imaging sequences analytically.
5 Knowledge and understanding recent methods in NMR imaging.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, practicum

Extra information on the teaching methods

- Classroom lectures
- Guided workshops and laboratory 'hands-on' sessions

Learning materials and price

Handouts of powerpoint presentations.

References

- Handbook of MRI pulse sequences; Bernstein M.A., King K.F. and Zhou X.J., ed. Elsevier academic press
- Spin dynamics: Basics of nuclear magnetic resonance; Levitt M.H., ed. John Wiley & Sons

Course content-related study coaching

In consultation with lecturer.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Oral examination

Examination methods in case of periodic evaluation during the second examination period

Oral examination

Examination methods in case of permanent evaluation

Report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible

Extra information on the examination methods

During examination period: oral exam with written preparation. During semester: evaluation of report practical sessions.

Calculation of the examination mark

Special conditions: During examination period: oral exam with written preparation. During semester: report practicum.