

CH-401 **Advanced NMR and imaging**

Emsley Lyndon

Cursus	Sem.	Type
Chimiste	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	2 weekly
Courses	2 weekly
Number of positions	

Summary

Principles of Magnetic Resonance Imaging (MRI) and main applications to medical imaging. Principles of modern multi-dimensional NMR in liquids and solids and application to biomolecules and materials. Principles of Hyperpolarization.

Content

- Projections of objects using magnetic field gradients.
- Image reconstruction by back-projection and by Fourier transformation.
- Contrast based on relaxation, diffusion, and contrast agents.
- Functional imaging.
- Imaging of flow and angiography.
- Advanced multi-dimensional correlation methods in magnetic resonance. Applications to protein structure determination and to determination of metabolism.
- Principles of multiple-pulse solid-state NMR. Applications to materials science.
- Principles of Nuclear Hyperpolarization and applications to imaging and spectroscopy.

Learning Prerequisites**Required courses**

Nuclear Magnetic Resonance (by L. Emsley)

Recommended courses

Basic physical, organic, inorganic and biological chemistry

Important concepts to start the course

Spectroscopy, data analysis, analytical chemistry

Learning Outcomes

By the end of the course, the student must be able to:

- Assess / Evaluate the meaning and limitations of MRI pictures
- Assess / Evaluate an approach to structure determination of molecules by NMR
- Design an NMR based approach to characterising materials
- Hypothesize how to produce hyperpolarized nuclear spins

Teaching methods

Lectures based on popular textbooks with ample addition of illustrations through recent applications and case studies.
Regular exercise classes.

Assessment methods

Written examination

Supervision

Assistants Yes

Resources

Bibliography

"NMR: the Toolkit", P.J. Hore, J.A. Jones and S.Wimperis, Oxford, 2003
"Understanding NMR Spectroscopy," 2nd Edition, J. Keeler, Wiley, 2010
"Spin Dynamics," 2nd Edition, M.H. Levitt, Wiley, 2008

Ressources en bibliothèque

- [NMR: the Toolkit / Hore](#)
- [Spin dynamics / Levitt](#)
- [Understanding NMR spectroscopy / Keeler](#)

Websites

- http://scgc.epfl.ch/telechargement_cours_chimie