PHYS-438

Fundamentals of biomedical imaging

Gruetter Rolf

Cursus	Sem.	Type
Auditeurs en ligne	E	Opt.
Biomedical technologies minor	E	Opt.
Computational Neurosciences minor	E	Opt.
Electrical Engineering		Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Ing.-phys	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Minor in Imaging	E	Opt.
Neuro-X minor	E	Opt.
Neuro-X	MA2, MA4	Opt.
Neuroprosthetics minor	E	Opt.
Photonics		Opt.
Physicien	MA2, MA4	Opt.
Physics of living systems minor	E	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The goal of this course is to illustrate how modern principles of basic science approaches are integrated into the major biomedical imaging modalities of importance to biology and medicine, with an emphasis on those of interest to in vivo.

Content

1. Introduction to the course, importance and essential elements of bioimaging - lab visit of CIBM
2. Ultrasound imaging; ionizing radiation and its generation
3. X-ray imaging - when the photon bumps into living tissue, radioprotection primer
4. Computed tomography - From projection to image
5. Emission tomography - what are tracers and how to "trace" them in your body, x-ray detection, scintillation principle
6. Positron emission tomography (PET) - imaging anti-matter annihilation
7. Tracer kinetics - modeling of imaging data
8. Introduction to biological magnetic resonance (MR) - Boltzmann distribution, from spins to magnetization
9. Excitation of spins, Relaxation, the Basis of MR contrast (The Bloch Equations)
10. MR spectroscopy: In vivo Biochemistry, without chemistry ...
11. From Fourier to image: Principles of MR image formation, k-space - echo formation
12. Basic MRI contrast mechanisms, BOLD fMRI, contrast agents
13. Spin gymnastics: Imaging Einstein's random walk - fiber tracking. Overview of imaging modalities treated in this course

Keywords

Ultrasound
MRI
PET
SPECT
CT
Radioprotection

Learning Prerequisites

Recommended courses

General Physics I-III

Important concepts to start the course
Fourier transformation

Learning Outcomes
By the end of the course, the student must be able to:
- Deduce which imaging technique is appropriate for a given situation
- Describe their fundamental promises and limitations
- Differentiate the imaging modalities covered in the course

Transversal skills
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Manage priorities.

Teaching methods
Ex cathedra with experimental demos

Expected student activities
strong participation in course and exercices

Assessment methods
a written exam

Supervision
Office hours	Yes
Assistants	Yes

Resources
Bibliography
"Introduction to biomedical imaging / Andrew Webb". Année:2003. ISBN:0-471-23766-3
Also available as e-book at EPFL library

Ressources en bibliothèque
- Introduction to biomedical imaging / Webb

Websites
- http://lifmet.epfl.ch/

Moodle Link
- https://go.epfl.ch/PHYS-438

Videos
- http://provided on moodle