BIOENG-445 **Biomedical optics**

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Cursus	Sem.	Type
Biomedical technologies minor	H	Opt.
Life Sciences Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Photonics minor	H	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course addresses the principles governing the interactions between light and biological tissue, their optical properties and basic concepts of radiometry. Illustrative diagnostic and therapeutic applications of light in medicine and photobiology will also be described.

Content

Introduction
Brief history
Introduction to general optics and tissue optics
Radiometry and Photometry
Light dosimetry
Light-tissues interactions
Introduction to molecular spectroscopy
Photosensitizers
Principles and techniques
Absorption, fluorescence and vibrational spectroscopies and imaging.
Time-resolved spectroscopy and imaging.
Light sources, detectors and optical systems.
Applications
Analytical techniques, oxymetry, optical biosensors, Photodetection of early cancers with exogenous and endogenous dyes, Angiography, Phototherapy and Photodynamic therapy, optical coherence tomography.

Keywords

Biomedical photonics, tissue optics, light-tissue interactions, photodiagnosis, phototherapy, light dosimetry, dyes, photosensitizers.

Learning Prerequisites

Important concepts to start the course

Basic background in biology, chemistry and optics.

Learning Outcomes

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

- Design simple systems used for phototherapy and photodiagnosis.
- Characterize the spectral design of apparatus used in biomedical optics.
- Compute the light dose in biological tissues.

- Identify the optical components to develop an apparatus used in phototherapy.
- Explain the working principles of apparatus used in biomedical optics.
- Model the propagation of light in biological tissues.
- Quantify the light dose in phototherapy.
- Interpret data obtained or published in photomedicine.

Transversal skills

- Access and evaluate appropriate sources of information.
- Collect data.
- Make an oral presentation.
- Summarize an article or a technical report.
- Communicate effectively with professionals from other disciplines.

Teaching methods

Lectures, Exercises, recent literature review papers, classroom discussion + oral presentation.

Expected student activities

Exercises, lecture of review papers, classroom discussion + oral presentation.

Assessment methods

Oral exam (1/2) + presentation (1/4) + exercices (1/4).

Resources

Bibliography

- Optical-Thermal Response of Laser Irradiated Tissue, A.J. Welch & M.J.C. van Gemert (Plenum, 1995).
- Principles of Fluorescence Spectroscopy, J.R. Lakowicz (Kluwer, 1999).
- Optics, E. Hecht (Addison Wesley, 2000).
- Handbook of Photomedicine, M. Hamblin & Y.-Y. Huang (CRC Press, 2013).
- Handbook of Biomedical Fluorescence, M.-A. Mycek & B. W. Pogue (Dekker, 2003).
- Photosensitisers in Biomedicine, M. Wainwright (Wiley-Blackwell, 2009).
- Quantitative Biomedical Optics, I. Bigio & S. Fantini (Cambridge Univ. Press, 2016)

Ressources en bibliothèque

- Optics / Hecht
- Optics / Hecht
- Optical-Thermal Response of Laser Irradiated Tissue / Welch
- Photosensitisers in Biomedicine / Wainwright
- Principles of Fluorescence Spectroscopy / Lakowicz
- Handbook of Photomedicine / Hamblin
- Quantitative Biomedical Optics / Bigio
- Handbook of Biomedical Fluorescence / Mycek
- Optics / Hecht

Notes/Handbook

Slides available on Moodle.

Prerequisite for

Master. Academic research and R/D activities in the industry of this field