Light Matter Interaction for Biology

SCHOOL
Faculty of Science

CAMPUS
Belle-Beille

LEVEL
2nd year Master's degree

OPEN TO EXCHANGE STUDENTS
Yes

SEMESTER
Fall (S1)

- **Degree course:** Light, Molecules, Matter
- **Teaching unit:** UE4
- **Course language:** English
- **Duration (hours):** 13
- **ECTS:** 1
- **Teacher(s):** Elena ISHOW

Assessment:

- [x] Continuous assessment
- [ ] Final exam

Teaching methods:

[x] Lecture course	13 hours	[ ] Case study
[ ] Tutorial course	hours	[ ] Project
[ ] Practical work	hours	

COURSE DESCRİPTİON

Optical bioimaging
1. Stakes
2. Design of luminescent labels and probes
- molecular agents,
- photoactive nanoparticles,
- probing the biological surroundings.
3. Two-photon microscopy for improved sensitivity
- fundamentals,
- optical setup,
- nonlinear optical labels.
4. Photoacoustic microscopy for improved depth detection
- principles,
- main endogenous and exogenous tracers.

Photobiology
1. Photodynamic therapy
- principles,
- structural evolution of photosensitizers,
- in the clinics.
2. Photopharmacology
- structural requirements,
- drug photo-uncaging,
- photoswitches for structural and functional photoregulation.

OBJECTİVES

Light has become a key tool in biology to image and study living matter, probe specific locations in tissues and cells, and very recently trigger biological events. In a broader sense, biophotonics, coupling light and life, can be regarded as a strongly interdisciplinary topic at the interface of chemistry, biology and physics. Chemistry, therefore, plays a major role to provide specifically designed chemicals as a function of the biological issues to be addressed and the resorted detection optical setups, especially optical microscopes. In this course, two main aspects will be interrogated.

The first part will be devoted to the stakes of optical bioimaging with respect to the current diagnostic technologies and tackle the in vitro-in vivo continuum through the presentation of appropriate luminescent molecules and nanomaterials. The challenge for deep light penetration and high sensitivity in tissues will be addressed through the introduction of more established (two-photon microscopy) or emerging (photoacoustics) techniques and the targeted labels or probes thereof. The second part will rely on the photoactivation of photophysical and chemical processes in a controlled and remote manner to either induce damaged cell apoptosis (photodynamic therapy), or photoswitch the activity of drugs, enzymes, cell attachment or ion transporters (photopharmacology).