Course PHOTOBIOPHYSICS

Basic Information

This is a course, which contributes to MSc award in Biology

Course period	From February 15 st till June 1st, 1 semester (15 weeks)
Study credits	4 ECTS credits
Duration	144 hours
Language of instruction	English
Academic requirements	– BSc degree in Biology, Chemistry, Physics, Chemistry, Environmental Sciences or equivalent (transcript of records), – good command of English (certificate or other official document)

Course overview

The important role of light for life on Earth and on life processes is well-known. Photobiophysics investigates the interaction of light with living matter at all levels, from molecular to ecological. Modern biochemical approaches and optical spectroscopic methods are the main tools to study a photobiophysical processes.

This course aims to further develop students' knowledge of basic mechanisms of the chemical and biological effects of light on the living organisms from the atomic and molecular levels to the whole organisms and ecological communities.

Photobiology deals with the local and systemic effects of electromagnetic radiation on living organisms. Biophysics is an interdisciplinary science somewhere between biology and physics – as may be concluded from its name – and it is furthermore connected to other disciplines, such as mathematics, physical chemistry, and biochemistry. We will share with you our knowledge about photobiophysical research in this course.

Special features of the course

Nowadays new fast developments of biological and biomedical sciences are linked the latest innovations in multidisciplinary science and technology. So many of the big scientific and technical challenges of biological and biophysical sciences require knowledge and fluency in a range of disciplines. The multidisciplinary course "Photobiophysica" is to prepare students with physical, life-science and engineering backgrounds to work in the rapidly expanding disciplines of phobiophysics, biophotonics and bioimaging.

The course provides an overview of the main principles of photobiophysics and basic mechanisms of the chemical and biological effects of light on the living organisms from the atomic and molecular levels to the whole organisms and ecological communities.

This unique course introduces the student to classical and modern topics in photobiophysics. The course also focuses on physical imaging methods currently used by researchers.

Course aim

The aim of the course is to familiarize students with the main principles of photobiophysics and basic mechanisms of the chemical and biological effects of light on the living organisms from the atomic and molecular levels to the whole organisms and ecological communities.

Course objectives

To introduce photobiophysics to biologists, physicists and chemists with emphasis on electronic structure of biological chromophores, energy transport in biomolecules and spectroscopical methods.

This course is developed to provide students with thorough understanding of models for qualitative explanations of phenomena related to the interactions between biomolecules and light.

Learning outcomes of the course

Upon successful completion of the course, graduates will be able to:

- identify and classify a main phenomena and basic mechanisms of photobiophysics
- identify and choose appropriate spectroscopic and photochemical methods and tools for investigating photobiophysical processes in research, medicine, and industry
- demonstrate an understanding the physical basis upon which there is the interaction of light with matter
- demonstrate the physical basis of spectroscopy, in its most basic methods
- interpret the results of experimental investigation of photobiophysical processes
- suggest models for qualitative explanations of phenomena related to the interactions between biomolecules and light
- evaluate the effects of light (beneficial or negative) on biological objects
- perform and understand basic experiments preparation to demonstrate the main phenomena of optics and photonics as well as handle the most basic components and devices in this field for future experimental work and practice

- recommend ways to control the effects of light on biological objects or the environment
- develop ways to protect living organisms against negative effects of light on biological systems
- carry out literature search and use the relevant papers or books to write a report
- analyse a scientific problem and present possible solutions in phobiophycs
- have the necessary scientific culture to provide answers in interdisciplinary topics linking physics and biology

Course Outline

Week	Lectures	Seminars/Assignments	Hours[1]
1-2	Introduction to photobiophysics	Primary and secondary photochemical processes Photophysics and photochemistry lows Spectroscopical methods	**10**
3-5	Basic spectroscopy	Characteristics of Fluorescence Emission. Quenching of Fluorescence Fluorescence.	**34**
6	Photoreactions.	Kinetics of photoreactions	**4**
7-8	Mechanisms of transformation and the energy transfer in photobiological processes	Forster resonance energy transfer	**20**
9-11	Photosynthesis: photobiochemistry and photobiophysics	Photosynthetic Pigments Environmental Aspects of Photosynthesis	**20**
12-14	Photobiological phenomena: photoreception and vision, phototropism and phototaxis, photomutagenic and photoreporty DNA		**20**
15	**Final Exam**		**36**

[1] Hours designed for Classroom sessions, Web-sessions, Home Assignments etc.

Lecturer and Tutor

Lecturer: Irina Sukovataya, Ph.D. in Biophysics

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Assessment

The overall course percentage grade will consist of a weighted average (percentage weight is in parentheses) of:

- attendance (10 %);
- Instructor's evaluation of the level of participation in the course work (5 %);
- participation and leading discussions (10 %);
- 3 Individual problem sets/homeworks (20 % each; 60 % total);
- final exam (15 %).

The percentage will be based on the performance of the entire group of students, and the individual values will be standardized using the maximum individual value achieved in the group.

After standardization the overall course percentage grade will be converted to a letter grade as follows:

- 85–100 % = 5;
- 75–84 % = 4;
- 60–74 % = 3;
- less than 60 % – not certified.

Attendance Policy

A student is excused from attending classes or other required activities, including examinations, for the scientific events, including travel for that purpose.

In order to earn all ten of the possible «participation» percentage points, perfect attendance is expected or a student must provide documentation substantiating the reason for

the absence within one week following the last date of the absence. For illness, documentation should include a note from a doctor or clinic. Students can earn additional ten points through engaging actively in all aspects of the course, for example by raising their hand and responding to questions during class time or webinars, contributing noticeably to their team's in-class activities, and generally making their presence in class obvious to the lecturer.