COURSE UNIT DESCRIPTION

Course unit title	Code
Photobiology	

Annotation
After completing the course, the student would acquire interdisciplinary knowledge about the role of photophysical processes in biological systems, their research methods and areas of practical application - from the development of new optical technologies to biomedicine.

Lecturer(s)	Department, Faculty
Coordinating: prof. dr. Saulius Bagdonas **Other:**	Faculty of Physics

Study cycle	Type of the course unit
Full-time studies (2nd stage)	Optional

Mode of delivery	Semester or period when it is delivered	Language of instruction
Lectures, seminars	I semester	Lithuanian, English

Requisites	
Prerequisites: Basic knowledge in biology, chemistry, and optical spectroscopy	**Co-requisites (if relevant):**

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	140	48	92

Purpose of the course unit: programme competences to be developed

The course unit aims to develop:
Specific competences:
- Understanding and ability to explain the light-induced effects and their importance for living systems;
- Ability to assess the opportunities and limitations of modern optical methods applied in studies of biological systems.
General competences:
- Ability to present and critically evaluate interdisciplinary scientific information to an audience, to make arguments and participate in scientific discussion;

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
Will understand photoinduced responses of organisms and will be able to explain their mechanisms on the molecular level.	Lectures with problem-based content, research elements (information retrieval, reading literature)	Open written tests
Will be able to comprehensively convey interdisciplinary information and systematize it at the level of molecules, cells and organisms.	Discussion during seminars, research elements (information retrieval, reading literature)	Assessment of activity during seminars, test results, oral presentation
Will know the principles and limitations of optical methods used in studies of living systems.	Lectures, reading of relevant literature	Written tests, oral presentation

Course content: breakdown of the topics	Contact hours							Individual work: time and assignments	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship/work placement	**Contact hours, total**	**Individual work**	**Assignments**
1. *Introduction.* The time scale of photoprocesses. Overview of photochemical reactions. Primary photochemical reactions, their types and kinetics. Photoactivated proteins.	2						**2**	**10**	Reading lecture and textbook materials,
2. *Photosensitization.* Photosensitizers, their physical and chemical properties. Photosensitizing effect on viruses, unicellular and multicellular organisms. Role of photosensitizers in ecology and evolution of living organisms. Photochemical internalization.	3		2				**5**	**10**	Reading lecture and textbook materials, relevant scientific publications,
3. *The action spectrum of the photoinduced response of an organism*. General principles of the photoresponse mechanism, its registration and application in the biosystems research.	2						**2**	**5**	Reading lecture and textbook materials
4. *Environmental photobiology.* The Sun's spectrum. UV-induced biomolecular damage and its detection. UV-induced mutagenesis. Optical properties of skin. Biosynthesis of Vitamin D.	3		1				**4**	**16**	Reading lecture and textbook materials, relevant scientific publications
5. *Photomorphogenesis.* Light as an information source. Diversity of photomorphogenesis. Morphogenesis regulated by phytochromes. Photochromic adaptation.	3		1				**3**	**5**	Reading lecture and textbook materials
6. *Circadian rhythms.* Origin of circadian rhythms, their formation mechanisms, regulation, significance and spread in nature as well as methods of study. Photoperiodism.	2		1				**3**	**5**	Reading lecture and textbook materials, relevant scientific literature
7. *Photomovement.* Photoreceptors, their types and localization in living systems. Types of photomovement and their mechanisms. Methods of study. Ecological importance.	3		1				**4**	**5**	Reading lecture and textbook materials
8. *Vision.* Structure and spectra of chromophores. Primary photoprocesses in vision. Diversity of vision systems. The origin of colours. Technologies for creating colours.	3		2				**5**	**5**	Reading lecture and textbook materials, relevant scientific literature
9. *Biological fluorophores.* Coloured fluorescence of proteins in living organisms. Fluorescent biomarkers, their biotechnological applications.	3		2				**5**	**5**	Reading lecture and textbook materials, relevant scientific literature
10. *Bioluminescence.* Reactions of chemiluminescence. Main principles of bioluminescence reactions. Spread of bioluminescence and its importance for living organisms. Biomedical applications.	3		2				**5**	**5**	Reading lecture and textbook materials, relevant scientific literature
11. *Photosynthesis.* Photosynthetically active pigments. Structural organization of photosynthesis. Reaction centre. Artificial photosynthesis as a source of energy.	3		2				**5**	**16**	Reading lecture and textbook materials, relevant scientific literature
12. *Photomedicine.* Physical background of photomedicine. Photoprotection. Photoimmunology.	2		2				**4**	**5**	Reading lecture and textbook materials, relevant scientific literature
Total	**32**		**16**				**48**	**92**	

Assessment strategy	Weight %	Deadline	Assessment criteria
Oral presentation	20	During semester	50% - for a comprehensive interpretation of the topic, 25% - for the quality of topic analysis, 25% - for the quality of topic presentation
Written test	20	After topics 1 to 4	10 open questions, full answer – 2 pts., partial answer – 1 pt., incorrect answer – 0 pt.
Written test	20	After topics 5 to 8	10 open questions, full answer – 2 pts., partial answer – 1 pt., incorrect answer – 0 pt.
Written test	20	After topics 9 to 12	10 open questions, full answer – 2 pts., partial answer – 1 pt., incorrect answer – 0 pt.
Final exam	20	After the course	15 open questions and problem-oriented tasks, full answer – 2 pts., partial answer – 1 pt., incorrect answer – 0 pt.
Total	100		Final mark is based on the cummulative score. <50 % of posible points – failed (insufficient) 50-55 % – 5 (weak) 56-60 % – 6 (satisfactory) 61-70 % – 7 (average) 71-80 % – 8 (good) 81-90 % – 9 (very good) >90 % – 10 (excellent)

Author	Publishing year	Title	Issue of a periodical or volume of a publication; pages	Publishing house or internet site
Required reading				
S.Bagdonas, R.Rotomskis, M.Vengris	2007	Fotobiologija		VU publishing, Vilnius, p. 244.
American Society for Photobiology		Photobiological Sciences online		http://www.photobiology.info
Recommended reading				
Lars Olof Björn (Ed.)	2015	Photobiology The Science of Light and Life	3rd. edition	Springer Science + Business Media New York, p. 455
E.Kohen, R.Santus, J.G.Hirschberg	1995	Photobiology		Academic Press, San Diego, p.506
W.Horspool, F.Lenci, eds.,	2004	CRC Handbook of Organic Photochemistry and Photobiology	2nd edition, Vol. 2	CRC Press