Course description

Department/Unit /	KFY / OSPP2			**Academic Year**	2016/2017
Title	Optical Spectroscopy II			**Type of completion**	Exam
Accredited/Credits	Yes, 5 Cred.			**Type of completion**	Oral
Number of hours	Přednáška 2 [Hours/Week] Seminář 1 [Hours/Week]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	YES
Winter semester	21 / -	0 / -	0 / 3	**Min. (B+C) students**	not determined
Timetable	Yes			**Repeated registration**	NO
Language of instruction	Czech			**Semester taught**	Winter semester
Substituted course	None				
Preclusive courses	N/A				
Prerequisite	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

The completion course to KFY/OSPP1 focused on special spectroscopic methods. The main purpose is to explain physical principles of below mentioned methods on the basis of interaction of optical radiation with the sample. Students will be acquainted with experimental equipment and use of these methods in the research and laboratory practice.
Fluorescence of biological and biochemical systems, involvement of intermolecular interactions and their application. Phosphorescence and delayed fluorescence, thermoluminiscence. Time-resolved fluorescence. Chiroptical methods, linear and circular dichroism, optical rotational dispersion. Infrared absorption spectroscopy. Raman scattering.

Requirements on student

The basic knowledge of optics, quantum physics, atomic and nuclear physics and basic methods of optical spectroscopy within the range of KFY/OSPP1 course. Elaboration and presentation of a seminar paper during the semester is requirement for the possibility to perform an oral examination. The examination will be rated according to the knowledge within the range of presented issues

Classification is in accordance with the Study and examination regulations of OU (1.9. 2015).

Content

A) Lectures
1. Fluorescence quenching.
Stern-Volmer equation. Collisional theory of fluorescence quenching, dynamic quenching.
2. Static quenching, the combination of static and dynamic quenching. Application of quenching in biophysics.
3. Polarized fluorescence, anisotropy of steady state fluorescence, theory of fluorescence depolarization, effect of anisotropy on fluorescence quantum yield. Application of polarized fluorescence measurements in biophysics.
4. Excitation energy transfer, radiative and nonradiative transfer of excitation energy. Resonant and inductive-exchange theory of nonradiative transfer of excitation energy. Application of fluorescence measurements of excitation energy efficiency in biophysics.
5. Measurements of time-resolved fluorescence - measurement of fluorescence lifetime. Pulse measurements of lifetime. Phase-modulated measurement of fluorescence lifetime. Experimental equipment for pulse method of lifetime measurement (stroboscopic method, photon counting method).
6. Phorsphorescence and delayed luminiscence - principle, experimental equipment, application. Thermoluminiscence (TL) - principle, mechanisms of TL in anorganic crystals and photosynthetically active samples. Experimental equipment and system of measurement. Description of thermoluminiscence curve, properties of thermoluminiscence bands and application of TL in

photosynthesis.
7. Methods using polarization of radiation - Chiroptical methods I.
Circular dichroism (CD), optical rotary dispersion (ORD). The basic definitions and principles - polarized radiation, absorption of radiation (+ demonstration using animation models), optical activity and chirality, classification of chiroptical methods.
Theoretical description ORD and CD (+ animation models), definitions and units in ORD and CD, experimental equipment for ORD and CD, description of ORD and CD spectra, problems with CD spectra measurements, interpretation of CD spectra.
8. Methods using polarization of radiation - Chiroptical methods II.
Linear dichroism (LD), preparation of samples. Application and use of LD, CD. Additional chiroptical methods (IRCD, FDCD, MCD, CPE).
9. Infrared spectroscopy (IR) - vibrational, rotational and vibrational-rotational spectra of molecules, description of molecule vibrations, selection rules, construction and the principle of operation of infrared spectrometers. Samples for IR spectroscopy. Interpretation and application of infrared spectra. Disperse and FT infrared spectrometers.
10. Raman spectroscopy (RS) - the principle, experimental equipment for measurement of Raman spectra, application of RS. Resonance RS and its application.
11. Selected special methods - method of hole burning into the spectrum ("hole-burning" spectroscopy), photoacoustic spectroscopy.

B) Seminars: (Topics of seminars are identical with topics of lectures).
Seminars comprise the preparation and presentation of seminar papers on assigned topics. Seminars will be held in blocks after arrangement with the guarantee.

Prerequisites - other information about course preconditions

The basic knowledge of optics, quantum physics, atomic and nuclear physics and basic methods of optical spectroscopy within the range of KFY/OSPP1 course.

Competences acquired

The student:
- applies and develops knowledge obtained within the range of KFY/OSPP1 course and masters special spectroscopic methods.
- has knowledge of fluorescence of biological and biochemical systems, understands intermolecular interactions and their application.
- understand problematics of phosphorescence, delayed fluorescence, thermoluminiscence and time-resolved fluorescence.
- knows chiroptical methods, linear and circular dichroism, optical rotary dispersion.
- acquires knowledge in infrared absorption spectroscopy and understands Raman scattering.

Studijní opory

Guarantors and lecturers

- **Guarantors:** doc. RNDr. Vladimír Špunda, CSc.
- **Lecturer:** Mgr. Václav Karlický, Mgr. Martin Navrátil, Ph.D.
- **Seminar lecturer:** Mgr. Václav Karlický, Mgr. Martin Navrátil, Ph.D.

Literature

- **Basic:** AMESZ A., HOFF, A.J. *Biophysical Techniques in Photosynthesis*. Dodrecht, 1996. ISBN 0-7923-3642-9.
- **Basic:** *Další aktuální knižní a časopisecká literatura*.
- **Basic:** PROSSER V. aj. *Experimentální metody biofyziky*. Praha, 1989. ISBN 80-200-0059.
- **Basic:** ŽALOUDEK F. *Experimentální metody biofyziky III. (experimentální metody infračervené a Ramanovy spektroskopie)*. Olomouc, 1986.
- **Basic:** VALEUR B., BROCHON J.-C. *New trends in fluorescence spectroscopy. Application to chemical and life sicences*. Berlin, 2001. ISBN 3-540-67779-8.
- **Basic:** LAKOWICZ, R.J. *Principles of fluorescence spectroscopy. 2nd edition*. New York, 1999. ISBN 0-306-46093-9.

Time requirements

Activities	Time requirements for activity [h]
Being present in classes	39

Activities	Time requirements for activity [h]
Continuous tasks completion (incl. correspondence tasks)	25
Scientific text studying in a foreign language	20
Scientific text studying in the Czech language	15
Preparation for an exam	25
Consultation of work with the teacher/tutor (incl. electronic)	10
Self-tutoring	10
Total:	**144**

assessment methods

professional knowledge

Oral examination

Written examination

prerequisite

professional knowledge

The basic knowledge of optics, quantum physics, atomic and nuclear physics and basic methods of optical spectroscopy within the range of KFY/OSPP1 course.

teaching methods

professional knowledge

Dialogic (discussion, dialogue, brainstorming)

Monologic (explanation, lecture, briefing)

Projection (static, dynamic)

Working with text (coursebook, book)

learning outcomes

professional knowledge

The student:
- applies and develops knowledge obtained within the range of KFY/OSPP1 course and masters special spectroscopic methods.
- has knowledge of fluorescence of biological and biochemical systems, understands intermolecular interactions and their application.
- understand problematics of phosphorescence, delayed fluorescence, thermoluminiscence and time-resolved fluorescence.
- knows chiroptical methods, linear and circular dichroism, optical rotary dispersion.
- acquires knowledge in infrared absorption spectroscopy and understands Raman scattering.

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Applied Physics	Postgraduate Master	Full-time	Biophysics	1	2014	2016	Povinné předměty	A	1	ZS
Biology	Postgraduate Master	Full-time	Experimental Biology	1	2	2016	Povinné předměty	A	1	ZS
Chemistry	Postgraduate Master	Full-time	Analytical Chemistry of Solid Phase	1	2013	2016	Povinně volitelné předměty	B	2	ZS