DESCRIPTION OF THE COURSE OF STUDY

Course code	***23.3-2CHM-C07-SM***	
Name of the course in	Polish	Spektroskopia molekularna
	English	Molecular spectroscopy

1. LOCATION OF THE COURSE OF STUDY WITHIN THE SYSTEM OF STUDIES

1.1. Field of study	**Chemistry**
1.2. Mode of study	**Full-time studies**
1.3. Level of study	**Second-cycle studies**
1.4. Profile of study*	**General academic**
1.5. Person/s preparing the course description	**prof. dr hab. Piotr Słomkiewicz, dr. hab. Beata Szczepanik, prof. UJK dr Anna Kołbus**
1.6. Contact	**piotr.słomkiewicz@ujk.edu.pl**

2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

2.1. Language of instruction	**English**
2.2. Prerequisites*	**mathematics, physics, basics of chemistry**

3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

3.1. Form of classes		**Lectures, laboratory**
3.2. Place of classes		**Classes in the teaching room of the UJK**
3.3. Form of assessment		**Lecture - exam, laboratory – pas w/ grade**
3.4. Teaching methods		**Lecture, discussion, demonstration, experiments, project**
3.5. Bibliography	**Required reading**	Molecular Spectroscopy, Mchale Jeanne L. Taylor&Francis Inc. 2nd Edition 2017 Handbook of Spectroscopy: Second, Enlarged Edition Editor(s): Günter Gauglitz, David S. Moore, 2014 Wiley-VCH Verlag GmbH & Co. KGaA Physical Chemistry, P. Atkins, J. De Paula, Oxford University Press, 2006
	Further reading	Encyclopedia of Spectroscopy and Spectrometry, Editor-in-Chief John C. Lindon, 2010 Elsevier Ltd.

4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES

4.1. Course objectives ***(including form of classes)***

LECTURE

C1 – Making the student acquainted with different types of spectroscopy and the use of spectroscopic methods in chemical research

C2 – Making the student acquainted with the physical basis of microwave, infrared, ultraviolet and visible light spectroscopy, nuclear magnetic resonance spectroscopy, electron paramagnetic resonance, mass spectrometry and their applications.

SEMINAR

C3 – Introduction of methods for solving spectroscopic problems and interpreting the spectra of various types of spectroscopy

LAB

C4 – Acquiring skills in using equipment in the molecular spectroscopy laboratory

4.2. Detailed syllabus ***(including form of classes)***

Interaction of electromagnetic radiation with matter. The nature of radiation and its spectrum. Absorption and emission of radiation, probability of transitions. Forms of molecular energy. Energy quantization. Energy distribution in a state of thermal equilibrium.

Rotation and vibrational spectra - models, selection rules, examination of molecular structure based on spectra, equipment for recording rotational spectra. Scattering of electromagnetic radiation. Raman spectrum. Selection rules.

UV-VIS spectroscopy. Electronic absorption and emission spectra. Molecular orbitals and electronic states of molecules. Electronic transitions; selection rules. Deactivation of excited states. Fluorescence and phosphorescence. Qualitative and quantitative parameters of luminescence. Fluorescence quenching.

Properties of molecules in excited states and their reactivity. NMR spectroscopy - physical basics, chemical shift, spin-spin coupling and its use to determine the structure of compounds. EPR spectroscopy. Types of paramagnetic centers.

Equipment for recording EPR spectra and research methodology. Spin-spin couplings, fine and hyperfine structure of EPR signals. Relaxation processes. Application of EPR in chemistry.

4.3 Intended learning outcomes

Code	A student, who passed the course	Relation to learning outcomes
within the scope of **KNOWLEDGE:**		
W01	has extended knowledge on the role of molecular spectroscopy in science and its significance for the development of humanity, explains the processes accompanying the interaction of radiation with matter	CHEM2A_W04
within the scope of **ABILITIES:**		
U01	interprets spectra obtained in various types of spectroscopy	CHEM2A_U01
U02	is able to select appropriate spectroscopic techniques to solve a given scientific problem, solves tasks and problems related to the content introduced during the lecture	CHEM2A_U09
within the scope of **SOCIAL COMPETENCE:**		
K01	is ready to recognize the importance of knowledge in solving cognitive and practical problems	CHEM2A_K01

4.4. Methods to verify the achievement of the learning outcomes

Teaching outcomes *(code)*	Method of verification (+/-)											
	Exam oral/written*			Test*			Project*			Group work*		
	Form of classes			*Form of classes*			*Form of classes*			*Form of classes*		
	W	*C*	*...*	*W*	*K*	*L.*	*W*	*K*	*L*	*W*	*K*	*L*
W01	+				+	+						
W02	+				+	+						
W03	+				+	+						
U01												+
U02					+							+
U03					+	+			+			+
U04					+	+			+			+
U05					+				+			
K01	+											

delete as appropriate

4.5. Criteria of assessment of the intended learning outcomes

Form of classes	Grade	Criterion of assessment
lecture (L) (including e-learning)	**3**	Exam - test, 51-60% correct answers
	3,5	Exam - test, 61-70% correct answers
	4	Exam - test, 71-80%correct answers
	4,5	Exam - test, 81-90%correct answers
	5	Exam - test, 91-100% correct answers
Seminar including e-learning)	**3**	Pass w/grade - test, 51-60% correct answers
	3,5	Pass w/grade - test, 61-70% correct answers
	4	Pass w/grade - test, 71-80% correct answers
	4,5	Pass w/grade - test ,81-90% correct answers
	5	Pass w/grade - test, 91-100% correct answers
Laboratory exercises (including e-learning)	**3**	Pass w/grade - test, 51-60% correct answers
	3,5	Pass w/grade - test, 61-70% correct answers
	4	Pass w/grade - test, 71-80% correct answers
	4,5	Pass w/grade - test, 81-90% correct answers
	5	Pass w/grade - test, 91-100% correct answers

5. BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT

Category	Student's workload	
	Full-time studies	Extramural studies
NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/	***105***	**105**
*Participation in lectures**	***45***	**45**
*Participation in seminars, laboratories**	***60***	**60**
INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/	***95***	**95**
*Preparation for the classes, seminars, laboratories**	***60***	**60**
*Preparation for the exam/test**	***35***	**35**
TOTAL NUMBER OF HOURS	**200**	**200**
ECTS credits for the course of study	**8**	**8**

****delete as appropriate***

Accepted for execution *(date and legible signatures of the teachers running the course in the given academic year)*

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