A COURSE SYLLABUS – DOCTORAL SCHOOL

REGARDING THE QUALIFICATION CYCLE FROM 2022TO 2026

GENERAL INFORMATION ABOUT COURSE	
Course title	**Seminar**
Name of the unit running the course	**Doctoral School at the University of Rzeszow**
Type of course *(obligatory, optional)*	Obligatory
Year and semester of studies	Year I: 2022/2023, semesters I and II Year II: 2023/2024, semester III and IV
Discipline	physics
Language of Course	polish
Name of Course coordinator	dr. hab. prof. UR Andrzej Wal
Name of Course lecturer	dr. hab. prof. UR Andrzej Wal
Prerequisites	Master's degree in physics

BRIEF DESCRIPTION OF COURSE
(100-200 words)

The substantive content of the course is in direct relation to the physical aspects of the doctoral dissertation and covers research methodology in the discipline of physical sciences and issues related to the research undertaken by the doctoral student. This course presents the physical basis of spectroscopic methods. The phenomena of absorption, fluorescence, and phosphorescence, and their relationship with the electronic structure of molecules, will be discussed. Models of singlet oxygen generation, which is the main factor in photodynamic therapy, will be presented and analysed. The content of the course also includes the issue of measurement errors as a necessary supplement in the analysis of experimental data. These topics will allow the achievement of the main goal, which is the description of the physical phenomena that are the basis of photodynamic therapy for the selected photosensitizer. An equally important goal of the course will be to prepare the concept of a doctoral dissertation, which will be preceded by a review of the literature to determine the current state of knowledge in the research area.

COURSE LEARNING OUTCOMES AND METHODS OF EVALUATING LEARNING OUTCOMES

Learning outcome	The description of the learning outcome defined for the course	Relation to the degree programme outcomes (symbol)	Learning Format (Lectures, classes,...)	Method of assessment of learning outcomes (e.g. test, oral exam, written exam, project,...)
Knowledge (no.)	**(Knows and understands)**			
K1	World achievements and theoretical foundations of issues (also in a foreign language) related to the interaction of electromagnetic radiation with fluorescent materials	P8S_WG1 P8S_WG3	seminar	observation
K2	Directions of the latest research in the field of physical phenomena related to photodynamic therapy	P8S_WG2	seminar	observation
Skills (no.)	**(Able to)**			
S1	Use knowledge in the field of physics, chemistry and medicine to describe the phenomena and design research methods	P8S_UW1	seminar	observation

	regarding the interaction of electromagnetic radiation with the photosensitizer and the tissue being tested			
S2	Use the research literature in the field of her research, make a critical assessment of it, and make her own contribution to this literature as a result of the research	P8S_UW2 P8S_UW3	seminar	observation
S3	Use English at the B2 level to the extent that allows one to use the scientific achievements of other researchers and conduct discussions with them	P8S_UK6	seminar	observation
Social competence (no.)	**(Ready to)**			
SC1	Critical evaluation of scientific achievements in the discipline of physical sciences in the area of their research	P8S_KK1	seminar	observation
SC2	Recognition of knowledge as a decisive criterion in solving the encountered research problems	P8S_KK3	seminar	observation

LEARNING FORMAT – NUMBER OF HOURS

Semester (no.)	Lectures	Seminars	Lab classes	Internships	others	ECTS
I-IV		30				4

METHODS OF INSTRUCTION

Discussions, short seminars, computer work, calculations

COURSE CONTENT

Year I: 2022/2023, semesters I and II
1. Research methodology in the physical sciences
2. Review of the literature and determination of the current state of knowledge in the field of photodynamic therapy
3. Spectroscopic methods in physical research
4. Physical basis of fluorescence and phosphorescence
5. Analysis of measurement data and measurement errors
6. Preparation of an article presenting the obtained results

Year II: 2023/2024, Semesters III and IV
1. Quantum efficiency of fluorescence and phosphorescence
2. Analysis of the physical basis of the singlet oxygen generation model in photodynamic therapy
3. Physical properties of indocyanine green photosensitizer
4. Preparation of articles presenting research results

COURSE ASSESSMENT CRITERIA

The pass mark is an active participation in the seminar consisting in asking questions and conducting a substantive discussion on the presentation of the research results presented during the seminar

TOTAL PhD STUDENT WORKLOAD REQUIRED TO ACHIEVE THE INTENDED LEARNING OUTCOMES – NUMBER OF HOURS AND ECTS CREDITS

Activity	Number of hours
Scheduled course contact hours	7,5 x 4 = 30
Other contact hours involving the teacher (consultation hours, examinations)	2 x 4 = 8
Non-contact hours – student`s own work (preparation for classes or examinations, project, etc.)	16 x 4 = 64
Total number of hours	102
Total number of ECTS credits	4

INSTRUCTIONAL MATERIALS	
Compulsory literature:	1. J. Lakowicz, Principles of Fluorescence Spectroscopy, Springer 2010 2. Z. Kęcki, Podstawy spektroskopii molekularnej, PWN 2013 3. P. Atkins, de P. Julio, J. Keeler, Chemia fizyczna, PWN 2022 4. P. Kapusta, M. Wahl, R. Erdmann, Advanced Photon Counting, Springer 2015 5. M. H. Abdel-Kader (Ed.), Photodynamic Therapy, From Theory to Application, Springer 2014 6. I. Fleming, D. Williams, Spectroscopic Methods in Organic Chemistry, Springer 2019 7. S. Hackbarth, M. Pfitzner, J. Pohl, B. Röder, Singlet Oxygen Detection and Imaging, Springer 2021
Complementary literature:	1. G. Drake (ed.) Springer Handbook of Atomic, Molecular, and Optical Physics, Springer 2006 2. C. Fritsch, T. Ruzicka, Fluorescence Diagnosis and Photodynamic Therapy of Skin Disease, Springer 2003 3. B. Oeseburg , Tissue oxygenation-monitoring using Near Infra Red Spectroscopy. In: Dahan, A., Teppema, L., van Beek, J.H.G.M. (eds) Physiology and Pharmacology of Cardio-Respiratory Control. Springer, 1998 4. J. R. Taylor, Wstęp do analizy błędu pomiarowego, PWN 2022

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Date and signature of the Course lecturer

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Approved by the Head of the Department or an authorised person