A COURSE SYLLABUS – DOCTORAL SCHOOL

REGARDING THE QUALIFICATION CYCLE FROM 2022 TO 2026

GENERAL INFORMATION ABOUT COURSE	
Course title	**Laboratory**
Name of the unit running the course	Doctoral School at the University of Rzeszow
Type of course *(obligatory, optional)*	Obowiązkowy
Year and semester of studies	Year I: semester I and II Year II: semester III and IV Year III: semester V and VI Year IV: semester VII and VIII
Discipline	physics/medicine
Language of Course	Polish/English
Name of Course coordinator	Dr hab. n. med. David Aebisher, Prof UR Dr hab Andrzej Wal, Prof UR
Name of Course lecturer	Dr hab. n. med. David Aebisher, Prof UR Dr hab Andrzej Wal, Prof UR
Prerequisites	Fundamentals of physics and chemistry

BRIEF DESCRIPTION OF COURSE
(100-200 words)

The main goal pursued during the classes at the doctoral laboratory is to perform experiments, analyze them, and refer the obtained results to the state of knowledge in the researched area in order to collect materials for the doctoral dissertation. The scope of the material for this subject includes spectroscopic studies: determination of absorption, fluorescence, phosphorescence of samples, and the interaction of electromagnetic radiation with both photosensitizers and selected tissues. The characteristics of the radiation sources will be discussed. To perform a correct analysis of experimental results, it is necessary to know the electronic structure, properties of excited states, and types of their quenching, i.e. electronic transitions. The main emphasis of the planned research will be the assessment of the efficiency of singlet oxygen generation in the tested samples and its impact on the efficiency of photodynamic therapy. To understand the discussed processes and analyse the models describing them, it will be necessary to introduce elements of biochemistry to discuss the chemical structure of the compounds used, chemical reactions occurring during photodynamic therapy, and their impact on the cells/tissues of the tested samples.

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 and tissues	P8S_WG1 P8S_WG3	exercises, laboratory	observation, project
K2	Directions of the latest research in the field of photodynamic therapy	P8S_WG2	discussion	project
K3	Research methodology applied in physical, chemical, and medical sciences, including applied research techniques and	P8S_WG4	laboratory	observation, project

	tools			
Skills (no.)	**(Able to)**			
S1	Use knowledge in the field of physics, chemistry, and medicine to describe the phenomena and design research methods regarding the interaction of electromagnetic radiation with the photosensitizer and the tested tissue; conduct research to determine the efficiency of singlet oxygen generation	P8S_UW1	laboratory	observation, project
S2	Use the research literature in the field of photodynamic therapy, make a critical assessment of it, and make your own contribution as a result of the conducted research	P8S_UW2 P8S_UW3	discussion	observation, project
Social competence (no.)	**(Ready to)**			
SC1	Critical evaluation of scientific achievements in the field of research related to photodynamic therapy	P8S_KK1	discussion	observation

LEARNING FORMAT – NUMBER OF HOURS

Semester (no.)	Lectures	Seminars	Lab classes	Internships	others	ECTS
I-VIII			240			24

METHODS OF INSTRUCTION

Laboratory exercises

COURSE CONTENT

Year I: 2022/2023, semester I and II
Ability to use the UV-VIS spectrophotometers
Light sources used in spectroscopic measurements.
Determination of the absorption spectrum of samples.
Spectroscopic methods of identification of organic compounds
Physical/chemical basis of photodynamic therapy

Year II: 2023/2024, semester III and IV
Ability to use the spectrofluorometers
Electronic structure of molecules
Properties of excited states of molecules
Types of electronic transitions and their identification
Determination of fluorescence and phosphorescence spectra

Year III: 2024/2025, semester V and VI
Quantitative methods in fluorescence measurements
Quantum efficiency and lifetimes of excited states
Methods of measuring the efficiency of singlet oxygen generation
Physical methods for determining the efficiency of the photodynamic process
Preparation of a doctoral dissertation

Year IV: 2025/2026, semester VII and VIII

Measurement methods of light propagation in anisotropic materials Physical methods to determine the concentration of photosensitizers in the tested material Optimization of the effectiveness of photodynamic therapy for selected tissues Preparation of a doctoral dissertation
COURSE ASSESSMENT CRITERIA
Due to the individual nature of the classes (work with one student), the learning outcomes are checked and assessed on an ongoing basis

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	8 x 30 = 240
Other contact hours involving the teacher (consultation hours, examinations)	8 x 10 = 80
Non-contact hours – student`s own work (preparation for classes or examinations, project, etc.)	8 x 40 = 320
Total number of hours	640
Total number of ECTS credits	24

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 8. K. Danzer, Analytical Chemistry, Springer 2007 9. T. W. G. Salomons, C. B. Fryhle, S. A. Snyder, Organic Chemistry, Wiley 2016
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. Ch. J. Gomer, Photodynamic Therapy, Methods and Protocols, Springer 2010. 4. M. Schwab (Ed.), Encyclopedia of Cancer, Springer 2017 5. V. Rapozzi, G. Jori, Resistance to Photodynamic Therapy in Cancer, Springer 2015