

A COURSE SYLLABUS – DOCTORAL SCHOOL
REGARDING THE QUALIFICATION CYCLE FROM 2024/2025 TO 2027/2028

GENERAL INFORMATION ABOUT COURSE				
Course title	DOCTORAL LABORATORY			
Name of the unit running the course	Doctoral School at University of Rzeszów			
Type of course (<i>obligatory, optional</i>)	obligatory subject			
Year and semester of studies	year I -IV, semester: I - VIII			
Discipline	Materials Engineering			
Language of Course	Polish/English language			
Name of Course coordinator	dr hab. Ireneusz Stefaniuk, prof. UR			
Name of Course lecturer	dr hab. Ireneusz Stefaniuk, prof. UR			
Prerequisites	The scope of knowledge resulting from the curriculum of the Master of Science degree in Materials Engineering. Knowledge of the English language at the level allowing to use foreign language sources of scientific information,			
BRIEF DESCRIPTION OF COURSE (100-200 words)				
The main objective carried out during the course of the course in the doctoral laboratory is to perform experiments, analyse them and relate the obtained results to the state of knowledge in the studied area in order to collect material for the doctoral thesis. The scope of the material for this subject includes research using electron paramagnetic resonance. Knowledge of the electron structure, properties of excited states and types of their quenching, i.e. electron transitions, is necessary to perform correct analysis of experimental results. One of the objectives is to: gain the ability to conduct a scientific discussion, increase the level of inference in the chosen scientific field, develop the ability to communicate with scientists outside their discipline, gain the knowledge and skills necessary for the proper development of a doctoral dissertation.				
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, has knowledge			
P8S_WG1	theoretical background in EPR spectroscopy and general issues in materials engineering and related disciplines, the current scientific output, including worldwide;	P8S_WG	conversation	report
P8S_WG2	direction of development and the latest discoveries of scientific research in materials engineering with the consideration of EPR spectroscopy, including of worldwide range;	P8S_WG	conversation	report
P8S_WG3	used specialist terminology in materials engineering and related disciplines, also in a foreign language;	P8S_WG	conversation	report

P8S_WG₄	issues in the field of methodology of scientific research in the chosen scientific discipline of materials engineering, principles of planning and carrying out scientific research, using interdisciplinary techniques and research tools;			P8S_WG	conversation	report
Skills (no.)	can					
P8S_UW₁	on the basis of his/her knowledge in the field of materials engineering, is able to identify and solve a research problem, define the aim of research, formulate a hypothesis and the subject of research, develop techniques, methods and research tools and make conclusions on the basis of research results;			P8S_UW	conversation	report
P8S_UW₂	select and use the scientific literature to properly diagnose and solve research problems of the EPR spectroscopy field, as well as to apply the appropriate workshop to create new elements of the scientific output;			P8S_UW	conversation	report
P8S_UW₃	independently acquire knowledge, expand analytical skills, and stimulate critical sensitivity to recognize dilemmas when conducting scientific research and fulfilling the role of an academic teacher;			P8S_UW	conversation	report
Social competence (no.)	is ready to					
P8S_KK₁	critically appraise the achievements within the scientific discipline of materials engineering, and critically evaluate the contribution of the results of his/her own research activity to the development of the discipline;			P8S_KK	conversation	report
LEARNING FORMAT – NUMBER OF HOURS						
Semester (no.)	Lectures	Seminars	Lab classes	Internships	others	ECTS
I - VIII	-	-	8 x 30 hrs. – 240 hrs.	-	-	24

METHODS OF INSTRUCTION	
- performing experiments and experiments; - conducting research;	
COURSE CONTENT	
laboratory /classes Year I:, sem. I and II Construction and operation of EPR spectrometer Influence of registration parameters on obtained EPR spectra Temperature dependence of EPR spectra Physical basis of EPR spectroscopy Year II:, sem. III and IV Construction and operation of EPR spectrometer including pulse technique Electron structure of molecules and paramagnetic ions Properties of excited states of molecules Spin Hamiltonian, types of electron transitions Determination and interpretation of EPR spectra Year III:, sem. V and VI Quantitative methods in EPR measurements Analysis and interpretation of EPR spectra Determination of parameters of spin Hamiltonian using specialised software, Preparation of doctoral thesis Year IV: sem. VII and VIII Determination of parameters of experimental spectra and simulation of theoretical spectra with the EasySpin and VisualEPR software Preparation of doctoral thesis	
COURSE ASSESSMENT CRITERIA	
The continuous work of the doctoral student in each semester and academic year is assessed in terms of: the implementation of research, the expansion of knowledge, the study of literature, engagement and progress in the preparation of the dissertation. Possible semester grades are: 2.0, 3.0, 3.5, 4.0, 4.5, 5.0.	
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 hrs - 240 hrs.
Other contact hours involving the teacher (consultation hours, examinations)	10
Non-contact hours – student`s own work (preparation for classes or examinations, project, etc.)	470
Total number of hours	720
Total number of ECTS credits	24
INSTRUCTIONAL MATERIALS	
Compulsory	1. A. Abragam, B. Bleaney, Electron Paramagnetic Resonance of Transition Ions 1986.

literature:	<ol style="list-style-type: none"> 2. John Ashley Weil, James R. Bolton, Electron paramagnetic resonance: elementary theory and practical applications, John Wiley and Sons, 2007. 3. F. Gerson, W. Huber Electron Spin Resonance Spectroscopy of Organic Radicals, 2003. 4. A. Schweiger, G. Jeschke Principles of Pulse Electron Paramagnetic Resonance, 2001.
Complementary literature:	<ol style="list-style-type: none"> 1. Z. Kęcki, Fundamentals of molecular spectroscopy, PWN 2013. 2. P. Atkins, de P. Julio, J. Keeler, Physical Chemistry, PWN 2022. 3. scientific journals in Polish and foreign languages in the field of EPR spectroscopy and the material studied.

*(1 ECTS CREDIT CORRESPONDS TO 25 - 30 HOURS OF THE TOTAL WORKLOAD OF A DOCTORAL STUDENT, NEEDED TO ACHIEVE THE ESTABLISHED EFFECTS).

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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