

A COURSE SYLLABUS – DOCTORAL SCHOOL
REGARDING THE QUALIFICATION CYCLE FROM 2023 TO 2027 .

GENERAL INFORMATION ABOUT COURSE				
Course title	Doctoral Laboratory			
Name of the unit running the course	Doctoral School at the University of Rzeszów			
Type of course (<i>obligatory, optional</i>)	Obligatory			
Year and semester of studies	Year I-IV / Semester I-VIII			
Discipline	Mathematics			
Language of Course	Polish			
Name of Course coordinator	Prof. dr hab. Wiesław Śliwa			
Name of Course lecturer	Prof. dr hab. Wiesław Śliwa			
Prerequisites	Knowledge of mathematics at the master's level			
BRIEF DESCRIPTION OF COURSE (100-200 words)				
<p>The doctoral laboratory aims to prepare the doctoral student (under the substantive supervision of the supervisor) to conduct independent research. It should also prepare the doctoral student to formulate research hypotheses, optimize research methodology, perceive and verbalize scientific problems. The specific objective is: to perform research as part of the doctorate, analysis and preparation of the results of these research. The aim of the doctoral studio is also:</p> <ul style="list-style-type: none"> - broadening the knowledge about the methods of obtaining scientific information as well as preparing and writing research papers with respect for copyrights and intellectual property, - drawing the doctoral student's attention to the need for further education and systematic familiarization with the current one, scientific literature. 				
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)			
1	A global achievement, including theoretical foundations and issues general and selected specific issues - appropriate for mathematics	P8S-WG1	laboratory	Project - implementation of the research plan
2	Main development trends in mathematics	P8S-WG2	laboratory	Project - implementation of the research plan
3	Scientific research methodology	P8S-WG3	laboratory	Project - implementation of the research plan
4	Principles of disseminating the	P8S-WG4	laboratory	Project -

	results of scientific activity, also in the mode of open access			implementation of the research plan		
Skills (no.)	(Able to)					
1	Use knowledge from various branches of mathematics for creative identification and solving of complex problems; in particular: - define the purpose and subject of research, formulate a research hypotheses, - develop methods, techniques and research tools and use them creatively, - make conclusions on the basis of scientific research	P8S-UW1	laboratory	Project - implementation of the research plan		
2	Use scientific literature to solve research problems	P8S-UW/2	laboratory	Project - implementation of the research plan		
3	Perform a critical analysis and evaluation of the results of scientific research and their contribution to the development of knowledge	P8S-UW3	laboratory	Project - implementation of the research plan		
4	Communicate on specialist topics to a degree enabling active participation in the international scientific environment	P8S-UK1	laboratory	Project - implementation of the research plan		
5	Initiate a discussion and participate in the scientific discourse	P8S-UK3 P8S-UK4	laboratory	Project - implementation of the research plan		
Social competence (no.)	(Ready to)					
1	Critical evaluation of the achievements within the scientific discipline mathematics	P8S-KK1	laboratory	Project - implementation of the research plan		
2	Critical evaluation of one's own contribution to the development of a given scientific or artistic discipline	P8S-KK2	laboratory	Project - implementation of the research plan		
3	Recognize the importance of knowledge in solving cognitive and practical problems	P8S-KK3	laboratory	Project - implementation of the research plan		
LEARNING FORMAT – NUMBER OF HOURS						
Semester (no.)	Lectures	Seminars	Lab classes	Internships	others	ECTS
I-VIII			240			24

METHODS OF INSTRUCTION

Discussion; critical analysis scientific literature; research; formulating of research problems and hypotheses; analysis of research results; preparation of doctoral dissertation

COURSE CONTENT

The specificity of scientific work, research techniques in the field of mathematics.

Development of a concept and work plan, definition of the purpose and methods of research.

Searching for scientific literature in the field of the research problem presented in the doctoral dissertation

Analysis of available literature on the subject of the doctoral thesis

Editing manuscripts respecting the intellectual property of the authors of the scientific literature used.

Preparation of the doctoral dissertation

COURSE ASSESSMENT CRITERIA

Implementation of scientific research. Presenting the results of own research at seminars and scientific conferences. Preparation of manuscripts of scientific articles. Progress in preparing a doctoral dissertation.

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	$4 \times 60 = 240$
Other contact hours involving the teacher (consultation hours, examinations)	----
Non-contact hours – student's own work (preparation for classes or examinations, project, etc.)	480
Total number of hours	720
Total number of ECTS credits	24

INSTRUCTIONAL MATERIALS

Compulsory literature:	<ol style="list-style-type: none"> 1. Tomkowicz, Grzegorz; Wagon, Stan The Banach-Tarski paradox. Second edition. Encyclopedia of Mathematics and its Applications, 163. Cambridge University Press, New York, 2016. xviii+348 pp. 2. Perez-Garcia, C.; Schikhof, W. H. Locally convex spaces over non-Archimedean valued fields. Cambridge Studies in Advanced Mathematics, 119. Cambridge University Press, Cambridge, 2010. xiv+472 pp. 3. Schikhof, W. H. Ultrametric calculus. An introduction to p-adic analysis. Cambridge Studies in Advanced Mathematics, 4. Cambridge University Press, Cambridge, 2006. xii+306 pp. 4. Schneider, Peter Nonarchimedean functional analysis. Springer Monographs in Mathematics. Springer-Verlag, Berlin, 2002. vi+156 pp. 5. Burillo, Josep Groups and the Banach-Tarski paradox. (Catalan) Butl. Soc. Catalana
------------------------	---

	<p>Mat. 23 (2008), no. 2, 181–199</p> <p>6. Dougherty, Randall; Foreman, Matthew Banach-Tarski decompositions using sets with the property of Baire. <i>J. Amer. Math. Soc.</i> 7 (1994), no. 1, 75–124.</p> <p>7. Dougherty, Randall; Foreman, Matthew Banach-Tarski paradox using pieces with the property of Baire. <i>Proc. Nat. Acad. Sci. U.S.A.</i> 89 (1992), no. 22, 10726–10728.</p> <p>8. Banach, Stefan; Tarski, Alfred: Sur la décomposition des ensembles de points en parties respectivement congruentes, „<i>Fundamenta Mathematicae</i>” 6 (1924), s. 244–277.</p> <p>9. Dekker, Th. J. Decompositions of sets and spaces. I, II. <i>Nederl. Akad. Wetensch. Proc. Ser. A</i> 59. <i>Indag. Math.</i> 18 (1956), 581–589, 590–595.</p> <p>10. Tits, J. Free subgroups in linear groups. <i>J. Algebra</i> 20 (1972), 250–270.</p> <p>11. Traina, Charles R. Trace polynomial for two-generator subgroups of $SL(2, \mathbb{C})$. <i>Proc. Amer. Math. Soc.</i> 79 (1980), no. 3, 369–372.</p> <p>12. Ershov, Mikhail; Golan, Gili; Sapir, Mark The Tarski numbers of groups. <i>Adv. Math.</i> 284 (2015), 21–53.</p>
Complementary literature:	<p>1. Schneider, Peter <i>p</i>-adic Lie groups. <i>Grundlehren der Mathematischen Wissenschaften</i>. Springer, Heidelberg, 2011. xii+254 pp.</p> <p>2. Lyndon, Roger; Schupp, Paul - <i>Combinatorial Group Theory</i>. <i>Classics in Mathematics</i>. Springer-Verlag, Berlin, 2001. xiv+339 pp.</p> <p>3. Lang, Serge - <i>Algebra</i>. <i>Graduate Texts in Mathematics</i>. Springer-Verlag, New York, 2002. xvi+914 pp.</p> <p>4. Engelking, Ryszard - <i>General Topology</i>. Second Edition. <i>Sigma Series in Pure Mathematics</i>, Heldermann Verlag, Berlin, 1989. viii+529 pp.</p> <p>5. Databases of scientific publications</p> <p>6. Kolman R., <i>Poradnik dla doktorantów i habilitantów</i>. Oficyna Wydawnicza Ośrodka Postępu Organizacyjnego, Bydgoszcz, 2000</p> <p>7. Apanowicz J. - <i>Metodologiczne uwarunkowania pracy naukowej : prace doktorskie, prace habilitacyjne</i>. warszawa : "Difin". 2005.</p> <p>8. Stępień B. - <i>Zasady pisania tekstów naukowych : prace doktorskie i artykuły</i>. Wydawnictwo Naukowe PWN. Warszawa. 2022.</p>