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 *(obligatory, optional)*	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)

The doctoral thesis is aimed at preparing the doctoral student (under the substantive supervision of the supervisor) to independently conduct scientific research. It should also prepare the doctoral student to formulate research hypotheses, optimize research methodology, perceive and verbalize scientific problems scientific problems. The specific goal is: to perform research as part of the implementation of the doctorate, to analyze and develop the results of this research. The goal of the doctoral laboratory is also:
- expanding knowledge of methods of acquiring scientific information and preparing and writing scientific papers scientific work with respect for copyright and intellectual property,
- to draw the attention of the doctoral student to the need for further education and systematic familiarization with current 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	World scientific achievements, including fundamentals, as well as general issues and selected specific issues - specific to the scientific discipline of mathematics.	P8S-WG1	laboratory	Project - implementation of the research plan
2	The main development trends of mathematics.	P8S-WG2	laboratory	Project - implementation of the research plan
3	Conceptual terminology resulting from scientific research in the discipline of mathematics and related disciplines in Polish and foreign languages recognized as leading for the discipline and related disciplines.	P8S-WG3	laboratory	Project - implementation of the research plan
4	The methodology of scientific research	P8S-WG4	laboratory	Project - implementation

	and principles of dissemination The results of scientific activity, also in the mode of open access.			of the research plan
Skills (no.)	**(Able to)**			
1	Use knowledge of various branches of mathematics to creatively identify and solve complex problems; in particular: - define the purpose and object of scientific research, formulate research hypotheses, - develop research methods, techniques research tools and creatively apply them, - make conclusions based on scientific research.	P8S-UW1	laboratory	Project - implementation of the research plan
2	Use scientific literature to identify and solve research problems.	P8S-UW/2	laboratory	Project - implementation of the research plan
3	Perform critical analysis and evaluate the results of research scientific research and their contribution to the advancement of knowledge.	P8S-UW3	laboratory	Project - implementation of the research plan
Social competence (no.)	**(Ready to)**			
1	Critically evaluate the achievements within the discipline of scientific mathematics	P8S-KK1	laboratory	Project - implementation of the research plan

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

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

COURSE CONTENT

The specifics of the research work, research techniques in mathematics are carried out in the period from semester I to semester VIII. Developing the concept and plan of the work, determining the purpose and methods of research.
Search for scientific literature on the research problem presented.
As part of the dissertation.
Analysis of the available literature on the subject matter of the dissertation.
Editing manuscripts with respect for the intellectual property of the authors.
The scientific literature used.
Preparation of the dissertation

COURSE ASSESSMENT CRITERIA

Credit for the course with a grade after each semester.

Implementation of scientific research. Presentation of own research results at seminars and scientific conferences. Preparation of manuscripts of scientific articles. Progress in the preparation of the dissertation. Possible semester grades are: 2.0, 3.0, 3.5, 4.0, 4.5, 5.0.

To obtain a passing grade, a conversion factor is applied for the corresponding percentage of points obtained:

- up to 50% - insufficient, (the doctoral student does not make progress in scientific research, does not expand knowledge, does not study the readings, does not participate in substantive discussion, does not fulfill his/her academic obligations);

- 51% - 60% - sufficient, (the doctoral student makes negligible progress in scientific research, expands knowledge, studies primary literature, the discussion held is limited to a narrow range of substantive knowledge, fulfills basic scientific duties);

- 61% - 70% - sufficient plus, (the doctoral student makes progress in scientific research, expands knowledge, studies basic literature, substantively participates in the discussion , fulfills scientific duties);

- 71% - 80% - good, (doctoral student makes significant progress in scientific research, expands knowledge, studies primary and secondary literature, substantively participates in discussion, fulfills all scientific duties);

- 81% - 90% - good plus, (doctoral student makes significant progress in scientific research, systematically expands knowledge, studies primary and supplementary literature, substantively participates in discussions, fulfills of all scientific duties);

- 91% - 100% - very good (a doctoral student makes significant progress in scientific research, systematically expands knowledge, studies basic, complementary and beyond obligatory literature, substantively participates in discussion, fulfills all scientific duties)

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 x 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.)	4 x 120 - 480
Total number of hours	720
Total number of ECTS credits	24

INSTRUCTIONAL MATERIALS

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

*(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