A COURSE SYLLABUS – DOCTORAL SCHOOL

REGARDING THE QUALIFICATION CYCLE FROM 2021 TO 2025

GENERAL INFORMATION ABOUT COURSE	
Course title	**PhD seminar**
Name of the unit running the course	Doctoral School at University of Rzeszów
Type of course *(obligatory, optional)*	obligatory
Year and semester of studies	I-IV/ semestr I-VIII
Discipline	Biological sciences
Language of Course	Polish
Name of Course coordinator	dr hab. Grzegorz Chrzanowski, prof. UR
Name of Course lecturer	dr hab. Grzegorz Chrzanowski, prof. UR
Prerequisites	

BRIEF DESCRIPTION OF COURSE
(100-200 words)

The aim of the course is to acquaint students with development trends in the field of biological sciences, including the influence of biotic and abiotic stressors on plants, the generation of oxidative stress in cells, and their responses at the metabolomic level.
Participation in the seminar will show the necessary research methods and tools to provide the extraction and determination of (1) reactive oxygen species, (2) markers of oxidative stress, (3) analysis of secondary phenolic metabolites and carotenoids, and (4) determination of the activity of selected enzymes involved in the biosynthesis of carotenoids and phenolic compounds will be presented.
The implementation of the seminar will enable the doctoral student to acquire the ability to make an advanced query of scientific literature, formulate research hypotheses, develop the results independently and present them. Particularly, all students will acquire the skills to solve research problems and learn about the possibilities of obtaining funds for the implementation of scientific research.

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.)				
1	The student understands terminology and methodology appropriate to the research discipline	P8S-WG/1, P8S-WG/3	Seminar	presentation/ project
2	The student understands the basic phenomena and processes in cells, explains the biochemical changes in them	P8S-WG/2	Seminar	presentation/ project

3	The student knows the principles of presenting and sharing the results and transfer of knowledge to the economic area	P8S-WG/4, P8S-WK/3	Seminar	presentation/ project
Skills (no.)				
1	Defines the purpose and subject of research and express research hypotheses using the knowledge of chemistry, biochemistry, and plant physiology	P8S-UW/1	Seminar	presentation/ project
2	The student can use and develop research methods and elicit conclusions based on the obtained results	P8S-UW/1	Seminar	presentation/ project
3	Performs an analysis of the obtained results of own research and other works based on expert activity	P8S-UW/2,	Seminar	presentation/ project
4	The student can present the results, communicates with specialists in the scientific discussion	P8S-UW/3, P8S-UK/1, P8S-UK/3, P8S-UK/4	Seminar	presentation/ project
5	On the basis of the conducted research and review of the literature, he plans research projects for his development.	P8S-UO, P8S-UU/1	Seminar	presentation/ project
6	Participates in planning research for students performing engineering and master's theses	P8S-UK/2, P8S-UU/1	Seminar	project
7	The student conducts research and presents the results on the international conferences	P8S-UO	Seminar	project
Social competence (no.)				
1	The student is aware of the progress in science and critically evaluates the achievements and his contribution to the development of the scientific discipline	P8S-KK/1, P8S-KK/2	Seminar	project
2	The student is aware of the need to raise knowledge to solve research problems	P8S-KK/3	Seminar	project
3	The student is aware of independence in the research process and respect for intellectual property.	P8S-KK/3, P8S-KR	Seminar	project

LEARNING FORMAT – NUMBER OF HOURS

Semester (no.)	Lectures	Seminars	Lab classes	Internships	others	ECTS
I	——	——	——	——	30	——
II	——	——	——	——	30	——
III	——	——	——	——	30	——
IV	——	——	——	——	30	——
V	——	——	——	——	30	——
VI	——	——	——	——	30	——
VII	——	——	——	——	30	——
VIII	——	——	——	——	30	——

METHODS OF INSTRUCTION

E.G, LECTURE: A PROBLEM-SOLVING LECTURE/A LECTURE SUPPORTED BY A MULTIMEDIA PRESENTATION/ DISTANCE LEARNING CLASSES: TEXT ANALYSIS AND DISCUSSION/PROJECT WORK (RESEARCH PROJECT, IMPLEMENTATION PROJECT, PRACTICAL PROJECT)/ GROUP WORK (PROBLEM SOLVING, CASE STUDY, DISCUSSION)/DIDACTIC GAMES/ DISTANCE LEARNING LABORATORY CLASSES: DESIGNING AND CONDUCTING EXPERIMENTS)

Discussion connected with a presentation

COURSE CONTENT

Seminars:

Planning research, defining research goals and hypotheses, methods of hypothesis verification.
Cultivation of the microalgae; conditions and methods for measuring algal colony growth; Biotic and abiotic stressors. Generation of stressful conditions; Reactive oxygen and nitrogen species; Methods of determination of ROS; Markers of oxidative stress; Statistical analysis in population studies.
Biomass determination of algal cultivation and preparation of raw material for biochemical analyzes - enzymatic, free radicals, and metabolites. Presentation of the results.
Carotenoids, their biosynthesis, and assay methods. Solid-phase extraction, liquid chromatography, spectrophotometry, and mass spectrometry in carotenoid analysis.
Statistical analysis in biochemical determinations - variance, one-way, and multi comparison post hoc analysis. Correlation and regression.
Phenolic compounds, biosynthetic pathways in plants. Extraction, fractionation, and determination of phenolic substances. The use of separation and spectroscopic methods in the analysis of phenolic compounds.
Antioxidant enzymes and molecular (non-enzymatic) antioxidants. Methods of enzyme analysis, units of activity.

COURSE ASSESSMENT CRITERIA

semester I: (1) preparation of a research plan, (2) presentation of research assumptions and methods necessary for goals achieving;
semester II: preparation of an article manuscript;
semester III: presentation of results, connected with discussion;
semester IV: presentation of results, connected with discussion;
semester V: preparation of an article manuscript;
semester VI: presentation of results, connected with discussion;
semester VII: presentation of results, connected with discussion;
semester VIII: preparation of an article manuscript;

The assessment will depend on the scientific level of the presentations and the progress in the scientific research necessary to prepare the 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	240
Other contact hours involving the teacher (consultation hours, examinations)	120
Non-contact hours – student`s own work (preparation for classes or examinations, project, etc.)	240
Total number of hours	600
Total number of ECTS credits	———

INSTRUCTIONAL MATERIALS	
Compulsory literature:	1. Artykuły naukowe – Czasopisma: Elsevier (ScienceDirect); MDPI; Taylor and Francis Group; Royal Society of Chemistry 2. Zieliński J. Metodologia pracy naukowej. Oficyna Wydawnicza ASPRA-JR, Warszawa 2012. 3. Stanisz A. Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Kraków: "StatSoft", 2006.
Complementary literature:	1. Łomnicki A. Wprowadzenie do statystyki dla przyrodników. Wyd. Naukowe PWN, Warszawa 2014. **2.** Weiner J., Weiner 3 J. Technika pisania i prezentowania przyrodniczych prac naukowych. Wyd. Naukowe PWN, Warszawa 2018.