**A COURSE SYLLABUS – DOCTORAL SCHOOL**
**regarding the qualification cycle from 2024/2025 to 2027/2028**

| GENERAL INFORMATION ABOUT COURSE | |
|---|---|
| Course title | ***OPTIONAL SPECIALISED SUBJECT: Nanomaterials: properties, production and applications.*** |
| Name of the unit running the course | Doctoral School at the University of Rzeszów |
| Type of course *(obligatory, optional)* | compulsory - optional specialist |
| Year and semester of studies | year II, semester: IV |
| Discipline | Materials engineering |
| Language of Course | Polish/English |
| Name of Course coordinator | Dr Ireneusz Stefaniuk, Professor at the University of Rzeszów |
| Name of Course lecturer | Dr Ireneusz Stefanium, Professor at the University of Rzeszów |
| Prerequisites | In-depth knowledge of engineering materials. Knowledge of English at B2 CEFR level, |

**BRIEF DESCRIPTION OF COURSE**
**(100-200 words)**

The aim of the OPTIONAL SPECIALISED SUBJECT is to organise doctoral students' knowledge about nanomaterials. Examples of innovative technologies for the production of nanomaterials will be presented. The effects of previous research work related to the production and testing of nanomaterials with various properties will be analysed, as well as the opportunities and barriers to the development of new nanomaterials. The course also aims to consolidate knowledge, skills and social competences on the impact of nanomaterials on the environment in a broad sense.

**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** | He has extensive theoretical knowledge backed by research experience and is familiar with the current state of the art in nanomaterials, which he uses to objectively address existing perceptions of nanomaterials. | **P8S_WG1** | Seminar | oral exam, written exam, project, test; |
| **P8S_WG2** | He has extensive knowledge and is familiar with the latest global scientific achievements and global development trends in the field of nanomaterials. | **P8S_WG2** | Seminar | oral exam, written exam, project, test; |
| **P8S_WG3** | He knows, understands and uses terminology appropriate for the discipline of materials engineering and related disciplines in Polish and a | **P8S_WG3** | Seminar | oral exam, written exam, project, test; |

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|---|---|---|---|---|
| | foreign language leading in the discipline. | | | |
| **P8S_WK1** | Possesses knowledge of the impact of technical and technological progress on the advancement of civilisation, including the discovery of new possibilities related to nanomaterials. | **P8S_WK1** | Seminar | oral exam, written exam, project, test; |
| **Skills (no.)** | can | | | |
| **P8S_UW1** | Based on interdisciplinary knowledge in the field of engineering and technical sciences, they are able to formulate and set ambitious research goals related to nanomaterials research. They are able to identify and improve research methods, techniques and tools, as well as draw constructive conclusions based on the results of their research work. | **P8S_UW1** | Seminar | oral exam, written exam, project, test; |
| **P8S_UW2** | Based on available interdisciplinary scientific publications, they are able to identify and solve a research problem that can be used to create a new element of their work. | **P8S_UW2** | Seminar | oral exam, written exam, project, test; |
| **P8S_UW3** | They are able to use their interdisciplinary knowledge and research experience to analyse and evaluate scientific achievements, expert opinions and other studies, formulating opinions on this basis, including critical judgements. | **P8S_UW3** | Seminar | oral exam, written exam, project, test; |
| **P8S_UK6** | They are able to carry out and present scientific work, actively participate in the national and international scientific and professional community, communicating in a foreign language at level B2 of the Common European Framework of Reference for Languages. | **P8S_UK6** | Seminar | oral exam, written exam, project, test; |
| **Social competence (no.)** | is ready to | | | |
| **P8S_KK3** | He is ready to exchange ideas, conduct substantive scientific discussions, and solve cognitive and practical problems using his knowledge in the field of materials engineering. | **P8S_KK3** | Seminar | oral exam, written exam, project, test; |

| Semester | Lectures | Seminar | Conversatory/ Lab classes | Internships | others | ECTS |
|---|---|---|---|---|---|---|
| **IV** | **-** | **15 hrs.** | **-** | **-** | **-** | **2** |

## METHODS OF INSTRUCTION

***- SEMINAR***

***- DISCUSSION.***

## COURSE CONTENT

**Seminar:**

Substantive description of the course content:
Topic 1 – Nanomaterials, basic properties
Topic 2 – Nanomaterials and their types
Topic 3 – Nanotechnologies, basic methods of nanomaterial synthesis
Topic 4 – Characteristics of synthesised nanomaterials
Topic 5 – Challenges and future directions in the development of nanomaterial synthesis
Topic 6 – Properties of nanomaterials, testing methods
Topic 7 – Applications of nanomaterials in industry, medicine and electronics
Topic 8 – Safety aspects of nanomaterials

## COURSE ASSESSMENT CRITERIA

**The examination takes place after each semester of the course.**

**Examination requirements:**
**- active and consistent work by the doctoral student;**
**- active participation in classes**

**The doctoral student prepares a presentation on selected topics discussed in class. The presentations should be original and reflect the essential content of the course.**

**Very good grade:**
- very high activity and involvement during classes,
- visible ability to lead discussions and draw constructive conclusions,
- very high substantive value of the paper;
- attendance at least 4/5 of the total number of classes;
- active use of the suggested literature, expanded and deepened on one's own.

**Good plus grade:**
- high activity during classes;
- high substantive value of the paper;
- attendance at least 4/5 of the total number of classes;
- visible satisfactory ability to lead discussions and draw conclusions;
- active use of the recommended literature.

**Good grade:**
- satisfactory activity during classes;
- satisfactory substantive value of the paper;
- attendance at least 4/5 of the total number of classes;
- moderate ability to lead discussions and draw conclusions;
- satisfactory use of the suggested literature.

**Pass with distinction:**
- moderate level of activity during classes
- relatively poor content of the paper;
- attendance at least 3/5 of the total number of classes;
- moderately poor ability to lead discussions and draw conclusions;
- moderate use of the recommended literature.

**Satisfactory grade:**
- low level of activity during classes
- poor substantive value of the paper;
- attendance at least 3/5 of the total number of classes;
- poor ability to lead discussions and draw conclusions;
- sporadic use of the recommended literature.

**Fail:**
- lack of activity during classes;
- unacceptable substantive value of the paper;
- lack of ability to lead discussions and draw conclusions;
- absence from more than 3/5 of the total number of classes;
- lack of use of the recommended literature.

| **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 | **15 hrs.** |
| Other contact hours involving the teacher (consultation hours, examinations) | **1 hrs.** |
| Non-contact hours – student`s own work (preparation for classes or examinations, project, etc.) | **44 hrs.** |
| **Total number of hours** | **60 hrs.** |
| **Total number of ECTS credits** | **2 ECTS** |

| **INSTRUCTIONAL MATERIALS** | |
|---|---|
| Basic literature: | 1. Dobrzański L.A.: Podstawy nauki o materiałach i metaloznawstwo. Materiały inżynierskie z podstawami projektowania materiałowego. WNT, Gliwice - Warszawa 2002<br>2. Nanotechnologie, Red. nauk. R.W.Kelsall, I.W. Hamley, M. Geogehegan, tlm.pol. pod red. K, Kurzydłowskiego, PWN, 2008.<br>3. Mike Ashby, Paulo Ferreira, Daniel Schodek, Nanomaterials nanotechnologies and Design, Copyright © 2009, Elsevier Ltd. ISBN: 978-0-7506-8149-0<br>4. C. Br´echignac P. Houdy M. Lahmani, (Eds.), Nanomaterials and Nanochemistry, ISBN 978-3-540-72992-1 Springer Berlin Heidelberg New York |
| Supplementary literature: | 1. Mateusz Pawlaczyk, Grzegorz Schroeder Hybrydowe nanomateriały magnetyczne, 2017, ISBN 978-83-62108-39-8<br>2. Nanomaterials_ Introduction and Applications, Published by Career Point Ltd,<br>3. T. Grausz Nanomateriały bezpiecznie w pracy Warszawa 2013 |

*(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