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| **Course code** | CC2 |
| **Type and description** |  |
| **ECTS credit** | 1 |
| **Course name** | **Research Methods of Materials Science** |
| **Course name in Polish** | **Metody badań materiałów** |
| **Language of instruction** | English |
| **Course level** | 8 PRK |
| **Course coordinator**  | Dr hab. Michał Puchalski |
| **Course instructors** |  |
| **Delivery methods and course duration** |

|  | **Lecture** | **Tutorials** | **Laboratory** | **Project** | **Seminar** | **Other** | **Total of teaching hours during semester** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Contact hours | 0 |  |  |  |  | 0 | 15 |
| E-learning | No | No | No | No | No | No |  |
| Assessment criteria (weightage) | 0,00 |  |  |  |  | 0,00 |  |

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| **Course objective** | Objective of the courseThe objective of the course is to enable the acquisition of knowledge including the principle of work and application of selected measurement methods applied in material engineering. |
| **Learning outcomes** | Doctoral student on completion of the course:1. knows and understands the principle of functioning and the area of application of research methods applied in materials engineering ***W1\_P8S\_EG*** 2. is able to develop methods, techniques and research tools for assessing the physical structure of materials and creatively plan their application ***U1\_P8S\_UW***3. is able to critically analyze and evaluate the results of tests on the properties of engineering materials ***U1\_P8S\_UW*** |
| **Assessment methods** | Methods of verifying of learning outcomes Learning outcome 1- written colloquiumLearning outcomes 2, 3 – laboratory reportFinal mark consist of:Written colloquium score - 80%.Laboratory report - 60%. |
| **Prerequisites** |  |
| **Course content with delivery methods** | Laboratory1. Determination of crystalline structure of materials and nanomaterials by using of X-ray diffractometer.2. Analysis of topography of materials by using of atomic force microscope.3. Investigation of the morphology of materials by using of a high resolution scanning electron microscope.4. Evaluation of thermal phase transition of polymeric materials by using of differential scanning calorimetry5. Analysis of the chemical composition of materials surface by the using of X-ray microanalysis. |
| **Basic reference materials** | 1. A. Foster, W. Hofer, Scanning Probe Microscopy: Atomic Scale Engineering by Forces and Currents, Springer, 2006
2. A.R. Clarke, C.N. Eberhardt, Microscopy techniques for materials science, CRC Press LLC, 2000
3. K. Sikorski, Quantitative X-ray Microanalysis Beyond the Resolution of the Method, OWPW, 2009
4. W.M. Groenewoud Characterisation of Polymers by Thermal Analysis, Elsevier, 2001
5. M. Birkholz, Thin Film Analysis by X-Ray Scattering, WILEY-VCH Verlag GmbH & Co. 2006
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| **Other reference materials** | 1. Scanning Probe Microscopy: Training Notebook, Digital Instruments Veeco Metrology Group, 1999
2. N. Yao, Z. L. Wang, HANDBOOK OF MICROSCOPY FOR NANOTECHNOLOGY, Kluwer Academic Publishers, 2005
3. M. Puchalski, P.J. Kowalczyk, Z. Klusek, W. Olejniczak. „The applicability of global and surface sensitive techniques to characterization of silver nanopartilces for Ink-Jet printing technology” in „Silver nanoparticles” David Pozo Perez Ed., In-Tech, 2010
4. M. Puchalski, P. Dabrowski, W. Olejniczak, P. Krukowski, P. Kowalczyk, K. Polański. „The study of nanoparticles of silver by means of SEM, EDX, STM” Materials Science – Poland, Vol. 25, 2007, 473 – 478.
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| **Average student workload outside classroom** | 10 hour |
| **Comments** |  |
| **Last update** |  |