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| **Course code** |  |
| **Type and description** | EC – Elective Course |
| **ECTS credit** | 1 |
| **Course name** | Tribology: from macro to nanoscale |
| **Course name in Polish** | Tribologia: od makro do nanoskali |
| **Language of instruction** | English |
| **Course level** | 8 PRK |
| **Course coordinator** | dr hab. inż. Łukasz Kołodziejczyk |
| **Course instructors** | dr hab. inż. Łukasz Kołodziejczyk |
| **Delivery methods and course duration** | |  | **Lecture** | **Tutorials** | **Laboratory** | **Project** | **Seminar** | **Other** | **Total of teaching hours during semester** | | --- | --- | --- | --- | --- | --- | --- | --- | | Contact hours | 0 | 0 | 0 | 15 | 0 | 0 | 15 | | E-learning | No | No | No | No | No | No |  | | Assessment criteria (weightage) |  |  |  | 100% |  | 0,00 |  | |
| **Course objective** | The aim of the course is to enable students to acquire knowledge in tribology, including experimental and theoretical studies of adhesion, wear, friction and lubrication from the macroscopic to the atomic level. |
| **Learning outcomes** | After completing the course PhD student will be able to:  1. list and describe the basic differences concerning selected tribological aspects taking into account the different phenomenon scales (macro, micro, nano).  2. list and describe the methods and research techniques used to determine the tribological properties of materials at the macro- and nanoscale.  3 describe selected methods of surface modification of materials to provide specific tribological properties at the nanoscale.  W4, U4, K1 |
| **Assessment methods** | Outcomes 1-3 – presentation (with discussion)  The final grade for the course consists of 100% of the presentation grade. |
| **Prerequisites** | Basic knowledge of physics and chemistry. |
| **Course content with delivery methods** | Project:  Macroscale to microscale tribology: scale effect. Surface energy and surface forces. Mechanical properties of solids and real area of contact. Friction and wear on the nano- and atomic scale: measurement and analysis. Surface roughness. Effects of micro- and nanoscale texturing on surface adhesion and friction. Nanotribology of ultrathin and hard amorphous carbon films. Tribology of low-dimensional nanomaterial systems. Nanoscale boundary lubrication studies. Environmental effects in tribology. Modeling and simulation in tribology across scales. |
| **Basic reference materials** | Documents available on websites and scientific articles related to the course content. |
| **Other reference materials** | 1. Mate C.M. (2008). Tribology on the Small Scale. Oxford University Press. ISBN: 978-0-19-852678-0  2. Chung Y-W. (Ed). (2012). Micro- and Nanoscale Phenomena in Tribology. CRC Press. ISBN: 978-1-4398-3922-5  3. Bhushan B. (Ed). (2011) Nanotribology and Nanomechanics I: Measurement Techniques and Na-nomechanics. Springer. ISBN 978-3-642-15282-5. doi: 10.1007/978-3-642-15283-2  4. Bhushan B. (Ed). (2011) Nanotribology and Nanomechanics II: Nanotribology, Biomimetics and Industrial Applications. Springer. ISBN 978-3-642-15262-7. doi: 10.1007/978-3-642-15263-4  5. Gnecco E, Meyer E. (2015) Elements of Friction Theory and Nanotribology. Cambridge Universi-ty Press. doi:.10.1017/CBO97805117950394. Avouris P., Heinz T.F. & Low T. (Eds.). (2017). 2D Materials: Properties and Devices. Cam-bridge University Press. ISBN: 978-1316681619. doi: 10.1017/9781316681619 |
| **Average student workload outside classroom** | 15h |
| **Comments** |  |
| **Last update** | May 2023 |