COURSE DESCRIPTION CARD - SYLLABUS

Course name
CARBON NANOTUBES IN MECHANICAL ENGINEERING, THE ROUTE TOWARDS APPLICATIONS [S5ILIT>NWKM]

Course

Proposed by Discipline
–

Year/Semester
2/4

Level of study
Doctoral School

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
4

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

dr hab. inż. Jarosław Kałużny prof. PP
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Lecturers

Prerequisites

Basic knowledge in physics and chemistry.

Course objective

The primary and direct goal of this course is introduction into nanotechnology The secondary aim is to present an emerging science and its background. In particular the application-driven approach to the science will be presented. The students innovative power will be gained, whereby critical thinking and risk analysis will be implemented.

Course-related learning outcomes

understanding of the basics of nanotechnology and:
Knowledge:
P8S_WG/SzD_W01

Skills:
P8S_UW/SzD_U01

Social Competences

P8S_KK/SzD_K01

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Student's activity during the meetings,
Student's individual report in written, describing original, individually chosen application of carbon nanomaterials.

The following criteria will be applied for student's report assessment:
over 50% up to 60%: note 3.0
over 60% up to 70%: note 3.5
over 70% up to 80%: note 4.0
over 80% up to 90%: note 4.5
over 90% up to 100%: note 5.0

Programme content

Nanotechnology for mechanical engineering,
basics of nanotechnology and the way towards industrial applications.

Students will explore both prospective applications of nanomaterials basing on their unique physical properties. At the same time the risk of scientific project failure will be discussed, taking into account nanomaterials environmental impact and toxicity, risk related to limited scaleability of the manufacturing and others. The good practice in scientific project management will be discussed, including innovative power vs short-living research trends with limited options for industrial application.

Course topics

- nanotechnology, definition
- types of nanomaterials
- current research highlights
- carbon nanomaterials, superlubricity
- carbon nanomaterials - review of their applications in mechanical engineering
- future applications, student's concepts, brainstorm

Teaching methods

lecture
presentation
discussion
brainstorm
individual consultation

Bibliography

some suggestions can be found there:
https://nanocarbon.put.poznan.pl

[1] Kałużny J, Merkisz-Guranowska A, Giersig M, Kempa K. Lubricating performance of carbon nanotubes in internal combustion engines – engine test results for cnt enriched oil. Int J Auto Tech 2017; 18:1047-1059.
[2] Kałużny J. et al., Reducing friction and engine vibrations with trace amounts of carbon nanotubes in the lubricating oil Tribology International, Volume 151, November 2020, https://doi.org/10.1016/j.triboint.2020.106484
[3] Kałużny J. et al., The Indirect Tribological Role of Carbon Nanotubes Stimulating Zinc Dithiophosphate Anti-Wear Film Formation, Nanomaterials 2020, 10(7), 1330; https://doi.org/10.3390/nano10071330
[4] Kałużny J, Merkisz J, Kempa K, Gapiński B, Wróblewski E, Stepanenko A, Al-Karawi M. Friction reducing performance of carbon nanotubes covered pistons in internal combustion engines – engine test results. Combustion Engines 2018; 172:14-24.
[5] Kałużny J, Experimental applications of carbon nanotubes in the construction of internal combustion

engines. PhD Thesis, Poznan University of Technology; 2013.
[6] J. Kałużny, A. Świetlicka, Ł. Wojciechowski, S. Boncel, G. Kinal, T. Runka, M. Nowicki, O. Stepanenko, B. Gapiński, J. Leśniewicz, P. Błaszkiewicz, K. Kempa, Machine Learning Approach for Application-Tailored Nanolubricants' Design, Nanomaterials, 12 (2022) 1765. https://doi.org/10.3390/nano12101765.
[7] J. Kałużny, I. Pielecha, P. Błaszkiewicz, S. Boncel, A.A. Marek, A.P. Terzyk, E. Korczeniewski, T. Runka, M. Nowicki, Carbon nanotubes as biofuel additives enabling advanced combustion modulation strategies, Carbon, Volume 244, 2025, https://doi.org/10.1016/j.carbon.2025.120686

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,00
Classes requiring direct contact with the teacher	4	0,00
Doctoral student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation)	21	1,00