# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Nanomaterials in engine design [N2MiBP1-HSN>NwBSSp]

## Course

Field of study
Mechanical and Automotive Engineering

Year/Semester
2/3

Area of study (specialization)
Hybrid Powertrain Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

## Number of hours

Lecture
9

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

## Number of credit points

1,00

## Coordinators

dr hab. inż. Jarosław Kałużny prof. PP
jaroslaw.kaluzny@put.poznan.pl

## Lecturers

## Prerequisites

Knowledge: Base knowledge in physics, according to the course for the faculty of mechanics; base knowledge in chemistry, according to the course for the faculty of mechanics Competences: Ability to conduct self studies in literature; ability for creative usage of knowledge in various fields of physics, chemistry and engimeering scieces Social competences: Understanding of continuous personal developement; understanding of the impact of engineering products on the human environment.

## Course objective

Analysis of the process of piston-cylinder friction. Hydrodynamic theory of lubrication.

## Course-related learning outcomes

Knowledge:
Has extended knowledge of physics in the field of contemporary physical problems conditioning the progress in technical sciences: solid state physics nonlinear optics, nuclear physics and new research methods used in physics.
Has extended knowledge of modern construction materials such as carbon plastics, composites, ceramics, in terms of their construction, processing technology and applications.

Has extended knowledge of material strength in the field of nonlinear models, fracture and fatigue strength, calculations of statically indeterminate structures, structure stability.

Skills:
Can formulate and test hypotheses related to simple research problems.
Can plan and carry out experimental research of specific processes taking place in machines and routine tests of a working machine or a vehicle from a selected group of machines.
He can design the technology of exploitation of a selected machine with a high degree of complexity.

Social competences:
TIt is ready to fulfill social obligations, inspire and organize activities for the benefit of the social environment.
It is ready to initiate actions for the public interest.
Is willing to think and act in an entrepreneurial manner.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Discussion during the lesson
Mutual or written exam

## Programme content

Carbon nanomaterials in combustion engines design.
Carbon allotropes and nanocarbon structures.
Review of recent scientific reports focused on applications of nanocarbons in mechanical design.
Nanocarbons in friction.
Bionics.

## Course topics

- Definition of nanomaterials, types of nanomaterials
- Application of nanomaterials in mechanical and electronics design
- Carbon allotropes
- Growth of carbon nanomaterials
- Carbon nanomaterials for friction reduction
- Results of the tests targeting application of carbon nanotubes in combustion engines, discussion
- Electron microscopy, types of microscopes, principles of imaging process
- EDX spectroscopy
- Raman Spectroscopy

## Teaching methods

various

## Bibliography

Basic
1. ACS Nano
2. Nano Today
Additional
1. Nature
2. Science

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 15 | 1,00 |
| Classes requiring direct contact with the teacher | 9 | 0,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 6 | 0,50 |