**Nazwa przedmiotu:**

Structural Materials

**Koordynator przedmiotu:**

Prof. Tadeusz Kulik PhD, DSc

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Electric and Hybrid Vehicles Engineering

**Grupa przedmiotów:**

Materiały konstrukcyjne

**Kod przedmiotu:**

1150-00000-ISA-0104

**Semestr nominalny:**

1 / rok ak. 2022/2023

**Liczba punktów ECTS:**

3

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

[1] - Attendance on the lectures - 45h,
[2] - Literature studies - 15h,
[3] - Preparation to colloquia - 10h.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

brak

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

brak

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład:  | 45h |
| Ćwiczenia:  | 0h |
| Laboratorium:  | 0h |
| Projekt:  | 0h |
| Lekcje komputerowe:  | 0h |

**Wymagania wstępne:**

brak

**Limit liczby studentów:**

zgodnie z zarządzeniem Rektora PW

**Cel przedmiotu:**

The aim of the course is to provide the knowledge and understanding of the relationship between composition, structure, properties (mainly mechanical) and applications of different groups of structural materials, like metals and their alloys, ceramics, polymers and composite materials. The basic knowledge on crystalline structure and its defects, methods of measurements of mechanical properties and their enhancement by plastic deformation, thermal treatment and surface engineering will also be presented.

**Treści kształcenia:**

[L1] - Introduction to materials science. Structure of metals and alloys, crystalline and amorphous materials, introduction to crystallography, polymorphism, anisotropy of crystalline materials, defects of crystalline structure and their influence on alloys properties. Types of solid solutions and intermetallic compounds.
[L2] - Mechanical properties of structural materials, density, stiffness, elasticity, static strength, fatigue strength, hardness, toughness, brittleness, abrasion resistance, creep strength.
[L3] - Phase equilibria, Gibb’s rule, solid state phase transformations during slow heating or cooling of various two-component alloys, mechanism and kinetics of phase transformations.
[L4] - Methods of materials strengthening – by solid solution formation, dispersion strengthening, by grain refinement, by plastic deformation, curing and recrystallization processes.
[L5] - Fe–C alloys. Mechanical properties of iron, allotropy of crystalline iron, phase equilibrium of Fe-C system, eutectoid transformation, structural phase equilibrium of Fe–Fe3C system, phase transformations for Fe – C alloys and their influence on structure and properties of steels.
[L6] - Influence of carbon and alloying elements on structure and properties of Fe-C alloys. Heat treatment of Fe-C alloys.
[L7] - Industrial iron alloys - classification, selection criteria, properties and application examples of industrial steel (structural, machine, tool, spring, corrosion resistant and heat-resistant steels).
[L8] - Test No 1.
[L9] - Aluminium and aluminium-based alloys – properties, methods of strengthening, classification of Al-based alloys, properties and application of Al alloys.
[L10] - Copper and Cu-based alloys. Properties, designation, structure and application of Cu-based alloys (brass, bronze, other).
[L11] - Structure, properties and application of ceramics. Types of engineering ceramics, fabrication, microstructure, relationship between microstructure and properties of ceramics working under stress, rules of used ceramics as constructional materials, ceramics for special applications.
[L12] - Structure, properties and application of polymers – classification of polymers, constitution of macromolecules, structure of polymers and their influence on the properties and strain mechanisms of polymers, characteristic of elastomers and plastomers, application of polymers in automotive industry, types of plastics, marking method.
[L13] - Structure, properties and application of composites - composite's classification, fibre reinforced composites, properties of fibre reinforced composites, composite's constituents and their effect on polymer matrix composites reinforced with fibres, particle reinforced composites.
[L14] - Surface Engineering - Essence of surface engineering, description: coating, layer, surface layer, the surface engineering techniques, an overview of modern methods of surface engineering: glow discharge methods, CVD and PVD processes, ion implantation, laser treatments, structure and properties of the surface layers, examples of applications, multiplex techniques taking into account the thermal and detonation spray processes, and also chemical and electrochemical treatments, formation the properties of structural and functional materials by surface engineering techniques, examples for the automotive industry.
[L15] - Test No 2.

**Metody oceny:**

Two tests: test no 1 at the 8th lecture, checking the knowledge presented during the first seven lectures and test no 2 at the 15th lecture (the last lecture) to check the knowledge presented at lectures L9-L14.

**Egzamin:**

nie

**Literatura:**

[1] M.F. Ashby, D.R. Jones, Engineering materials, vol.1-3.
[2] J. F. Shackelford, Introduction to materials science, Prentice Hall, 1996

**Witryna www przedmiotu:**

brak

**Uwagi:**

brak

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt 1150-00000-ISA-0104\_W01:**

Has knowledge in the field of structural materials applied in the construction of hybrid vehicles and their components.

Weryfikacja:

Two colloquia

**Powiązane efekty kierunkowe:**

**Powiązane efekty obszarowe:**

**Efekt 1150-00000-ISA-0104\_W02:**

Has basic knowledge in materials mechanics, including stress, strain and methods of mechanical properties measurements of ductile and brittle materials necessary to conduct strength analysis.

Weryfikacja:

Two colloquia

**Powiązane efekty kierunkowe:** K\_W04

**Powiązane efekty obszarowe:** T1A\_W03

**Efekt 1150-00000-ISA-0104\_W03:**

Has basic knowledge on the influence of different materials on the lifetime of vehicles and the problem of recycling and also on the impact of different groups of materials on the environment.

Weryfikacja:

Two colloquia

**Powiązane efekty kierunkowe:** K\_W09

**Powiązane efekty obszarowe:** T1A\_W06, T1A\_W08

### Profil ogólnoakademicki - umiejętności

**Efekt 1150-00000-ISA-0104\_U01:**

Can find appropriate information on materials from literature, data bases and other sources; is able to evaluate their usefulness taking into account properties and their stability, price and recycling aspects.

Weryfikacja:

Colloquium

**Powiązane efekty kierunkowe:** K\_U01

**Powiązane efekty obszarowe:** T1A\_U01

**Efekt 1150-00000-ISA-0104\_U02:**

Is able to judge critically different options of materials selected for the design of project elements taking into account utility and economical criteria.

Weryfikacja:

Colloquium

**Powiązane efekty kierunkowe:** K\_U09

**Powiązane efekty obszarowe:** T1A\_U09, T1A\_U12

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt 1150-00000-ISA-0104\_K01:**

Is aware of the importance of materials selection on the non-technical aspects and effects of mechanical engineer activity.

Weryfikacja:

Colloquium

**Powiązane efekty kierunkowe:** K\_K02

**Powiązane efekty obszarowe:** T1A\_K02

**Efekt 1150-00000-ISA-0104\_K02:**

Is able to think critically and to act practically.

Weryfikacja:

Discussions during lectures and colloquium.

**Powiązane efekty kierunkowe:** K\_K05

**Powiązane efekty obszarowe:** T1A\_K06