**Nazwa przedmiotu:**

Vehicle Recycling

**Koordynator przedmiotu:**

Paweł Krawczyk, MsC

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Electric and Hybrid Vehicles Engineering

**Grupa przedmiotów:**

Obowiązkowe

**Kod przedmiotu:**

403

**Semestr nominalny:**

7 / rok ak. 2022/2023

**Liczba punktów ECTS:**

2

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

1) Number of contact hours - 31 h., including: lecture - 30 godz., consultations – 1 h.
2) Student's own work – 20 h., including: preparation for lecures: 5 h., literature studies: 5 h., preparation for colloquia: 10 h.
3) TOTAL – 51 h.

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

1.2 ECTS points: number of contact hours – 31 h., including: lecture - 30 h., consultations – 1 h.

**Język prowadzenia zajęć:**

polski

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

0 ECTS points

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

|  |  |
| --- | --- |
| Wykład: | 30h |
| Ćwiczenia: | 0h |
| Laboratorium: | 0h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

Essential knowledge of construction materials from subject Structural Materials. Knowledge of construction from the scope of subject Introduction to Machine Design I, manufacturing technologies from subject Manufacturing Technology. Knowledge of metrology and measurements from subject Metrology and Interchangeability, and knowledge of vehicles from subjects Vehicles, Construction of Autonomous Vehicles, and Electric and Hybrid Vehicles Engineering.

**Limit liczby studentów:**

Brak

**Cel przedmiotu:**

Student gains knowledge of operating principles of end-of-life vehicle recycling system, knowledge of methods of processing materials like steel and iron alloys, other metals, rubber, glass, plastics, and composites, as well as knowledge of ways of dismantling the end-of-life vehicles. Students know particularities of recycling hybrid and electric vehicles.

**Treści kształcenia:**

Specific problems of electric and hybrid electric vehicles construction that increase the need for recycling, in particular, electric powertrains and batteries. Impact of recycling of cars and their components on the environment. Issues of operation of end-of-life vehicles recycling system in Poland, technical, legal and economic conditions. Recycling targets. Vehicle recycling systems in Europe, United States of America and Japan. Features of end-of-life recycling system. Recycling of energy sources: lead-acid, nickel-metal-hydride and lithium-ion batteries. Recycling of electric motors, including motors with permanent magnets. Processing of EV and HEV vehicle materials on examples. End-of-life vehicle dismantling and material selection, with used tools and processes. Possibilities of recycling of various kinds of materials used in electric and hybrid electric vehicles construction. Pro-recycling construction of vehicles, facilitation of dismantling and material selection. The role of computer-assisted car recycling systems.

**Metody oceny:**

Two written tests.

**Egzamin:**

nie

**Literatura:**

1. “End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue” B.J. Jody, E.J. Daniels, Argonne National Laboratory report, 2010.
2. Directive 2000/53/EC of The European Parliament and of The Council of 18 September 2000 on end-of life vehicles.
3. „Environmental Impacts of Road Vehicles: Past, Present and Future”, R. M. Harrison, R. E. Hester, Royal Society of Chemistry, 2017.
4. S. Sakai, et al. "An international comparative study of end-of-life vehicle (ELV) recycling systems" Journal of Material Cycles and Waste Management 16.1, pp. 1-20, 2014.
5. "Automotive Scrap Recycling: Processes, Prices and Prospects", J. W. Sawyer, Routledge, 2016.
6. "Automotive Recycling, Plastics, and Sustainability: The Recycling Renaissance", D. Schönmayr, Springer, 2017.
7. "Advances in Plastics: Automotive Polyurethanes, Vol. 2", W. Rasshofer, E. Weigand, CRC Press, 2001.
8. "Electronic Waste: Recycling Techniques", H. M. Veit, A. M. Bernardes, Springer, 2015.
9. "Reuse and Recycling of Lithium-Ion Power Batteries", G. Zhao, John Wiley & Sons, 2017.
10. "Used Battery Collection and Recycling",G. Pistoia, J.-P. Wiaux, S.P. Wolsky, Elsevier, 8 lis 2001.
11. "Wybrane zagadnienia recyklingu samochodów", J. Osiński, P. Żach, Wydawnictwa Komunikacji i Łączności WKŁ, 2009.

**Witryna www przedmiotu:**

Brak

**Uwagi:**

Brak

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt 1150-000000-ISP-0406\_W1:**

The student knows specific problems of electric and hybrid electric vehicles construction that increase the need for recycling, in particular, electric power trains and batteries.

Weryfikacja:

Written tests

**Powiązane efekty kierunkowe:** K\_W09, K\_W11

**Powiązane efekty obszarowe:** T1A\_W06, T1A\_W08, T1A\_W02, T1A\_W03

**Efekt 1150-000000-ISP-0406\_W2:**

The student knows ways of dismantling the end-of-life vehicles and the role of computer-assisted car recycling systems.

Weryfikacja:

Written tests

**Powiązane efekty kierunkowe:** K\_W15

**Powiązane efekty obszarowe:** T1A\_W03, T1A\_W04, T1A\_W07

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt 1150-000000-ISP-0406\_K1:**

The student knows and can explain the positive impact of recycling of cars and their components on the environment.

Weryfikacja:

Written tests

**Powiązane efekty kierunkowe:** K\_K02

**Powiązane efekty obszarowe:** T1A\_K02