**Nazwa przedmiotu:**

Electrochemistry

**Koordynator przedmiotu:**

Leszek Niedzicki, PhD, DSc, Eng.

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Electric and Hybrid Vehicles Engineering

**Grupa przedmiotów:**

Obowiązkowe

**Kod przedmiotu:**

1150-000000-ISA-0217

**Semestr nominalny:**

4 / rok ak. 2022/2023

**Liczba punktów ECTS:**

2

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

1. Contact hours 30h, including: a) lectures – 30h; b) consultations – 1h;
2. Student's own work – 25h, including: a) preparation for the lectures – reading recommended materials – 10h; b) preparation for the exam and exam itself – 15h.
Total student’s effort: 30h+1h+15h+10h=56h.

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

1.2 ECTS points - contact hours - 31h, including: a) presence at lectures – 30h; b) consultations – 1h

**Język prowadzenia zajęć:**

polski

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

-

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

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

**Wymagania wstępne:**

-

**Limit liczby studentów:**

Brak

**Cel przedmiotu:**

After completion of the course student should have acquired:
- electrochemical knowledge for effective communication in the interdisciplinary engineering team;
- knowledge on materials used to build galvanic cells, their basic properties and methods to measure them;
- understanding of basic phenomena taking place inside the cells, their advantages and limitations;
- knowledge on corrosion - what risks it carries for metal constructions and cells, how it occurs and how to prevent it/protect against it;
- ability to predict potential risks for galvanic cell resulting from use of certain materials and way of their assembly;
- ability to formulate adequate cell parameters and operational requirements for the cell choice for the given application;
- awareness of the necessity and be able to cooperate and communicate with specialists from other fields for the sake of the parameters and requirements formulation for the cells for the given application.

**Treści kształcenia:**

The aim of the lecture is to familiarize students with the basics of electrochemistry for vehicle (or other electric appliances) components design and construction. The following phenomena, definitions, parameters and systems will be covered:
theoretical basics of the electrochemical phenomena; chemistry of the aqueous solutions; electrochemical series of metals; chemical potential vs electrochemical potential; half-cells; fundamentals of electrochemical cells operation; types of cells; cells' construction and necessary components; primary cells, secondary cells, batteries; electrodics; electrode types and parameters; electrodic processes kinetics; electrolytes; types of electrolytes; ionics; ions mobility; diffusion and convection; concentration gradient; molar conductivity and ionic conductivity; viscosity of the solutions; Walden's product; activity coefficients of ions; ionic dissociation and association phenomena; relative permittivity; solid electrolyte interface; ionic conductivity and electronic conductivity on the electrode-electrolyte boundary; passivation and corrosion; microcells; possible threats for cells; phenomena in real cells; chemical parameters of cells, cell components and means to measure them; stability and chemical compatibility of cell materials; measurements of electrochemical parameters of half-cells and electroactive materials; physical parameters of cell components' materials; thermal stability; phase transitions; electrolyte and electrode parameters relationship with full cell parameters; supercapacitors - structure and components, fundamentals of operation; electrostatics; corrosion and protection against it.

**Metody oceny:**

written exam

**Egzamin:**

tak

**Literatura:**

A.J. Bard, L.R. Faulkner, “Electrochemical Methods: Fundamentals and Applications, 2nd edition”, 2001, John Wiley and Sons

**Witryna www przedmiotu:**

http://lniedzicki.ch.pw.edu.pl

**Uwagi:**

Brak

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt 1150-000000-ISA-0217\_W1:**

Student can efficiently communicate in the multidisciplinary engineering team by using professional vocabulary for phenomena or material parameters description.

Weryfikacja:

written exam

**Powiązane efekty kierunkowe:** K\_W01, K\_W02, K\_W05, K\_W15, K\_W20

**Powiązane efekty obszarowe:** T1A\_W01, T1A\_W07, T1A\_W03, T1A\_W04, T1A\_W03, T1A\_W07, T1A\_W03, T1A\_W04, T1A\_W07, T1A\_W06

**Efekt 1150-000000-ISA-0217\_W2:**

Student can characterize materials used in cells manufacturing, their basic parameters and methods to measure them; is able to explain basic phenomena taking place in cells and relationships between them.

Weryfikacja:

written exam

**Powiązane efekty kierunkowe:** K\_W01, K\_W02, K\_W17

**Powiązane efekty obszarowe:** T1A\_W01, T1A\_W07, T1A\_W03, T1A\_W04, T1A\_W03, T1A\_W04, T1A\_W07

**Efekt 1150-000000-ISA-0217\_W3:**

Student can recognize corrosion hazards for metal constructions and cells; is able to explain corrosion initiation mechanism and select proper methods to counteract or protect given construction against it.

Weryfikacja:

written exam

**Powiązane efekty kierunkowe:** K\_W01, K\_W02, K\_W05, K\_W20

**Powiązane efekty obszarowe:** T1A\_W01, T1A\_W07, T1A\_W03, T1A\_W04, T1A\_W03, T1A\_W07, T1A\_W06

### Profil ogólnoakademicki - umiejętności

**Efekt 1150-000000-ISA-0217\_U1:**

Student is able to assess potential hazards for galvanic cell resulting from components choice as well as their combination and assembly way.

Weryfikacja:

written exam

**Powiązane efekty kierunkowe:** K\_U12, K\_U16, K\_U22

**Powiązane efekty obszarowe:** T1A\_U07, T1A\_U08, T1A\_U12, T1A\_U16, T1A\_U10

**Efekt 1150-000000-ISA-0217\_U2:**

Student is able to estimate materials requirements and efficiency of basic electrochemical processes as well as cell parameters for the given application.

Weryfikacja:

written exam

**Powiązane efekty kierunkowe:** K\_U07, K\_U09, K\_U11, K\_U14

**Powiązane efekty obszarowe:** T1A\_U08, T1A\_U09, T1A\_U09, T1A\_U12, T1A\_U08, T1A\_U09, T1A\_U14

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt 1150-000000-ISA-0217\_K1:**

Student is aware of the need for cooperation and efficient communication with other specialists in order to establish expected parameters and requirements for cells for the given application.

Weryfikacja:

written exam

**Powiązane efekty kierunkowe:** K\_K04

**Powiązane efekty obszarowe:** T1A\_K03, T1A\_K04