**Nazwa przedmiotu:**

Combustion Engines Theory

**Koordynator przedmiotu:**

Dmytro Samoilenko, PhD

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Electric and Hybrid Vehicles Engineering

**Grupa przedmiotów:**

Obowiązkowe

**Kod przedmiotu:**

1150-00000-ISA-0302

**Semestr nominalny:**

5 / rok ak. 2022/2023

**Liczba punktów ECTS:**

4

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

1) Total amount of contact hours / - 62,
a) lectures - 30 hours;
b) practical classes - 15 hours;
c) laboratory classes - 15 hours;
d) consultations - 2 hours;

2) Student's independent work - 55
a) Literature studies, lectures - 15 hours;
b) Literature studies, practical classes - 15 hours;
c) Preparation for classes, laboratory classes - 5 hours;
d) Reports, laboratory classes - 10 hours;
e) Preparing for colloquium - 10 hours.

3) TOTAL – 117 hours.

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

2,5 ECTS credits – amount of contact hours - 62, including:
a) lectures - 30 hours ;
b) practical classes - 15 hours;
c) laboratory classes - 15 hours;
d) consultations - 2 hours;

**Język prowadzenia zajęć:**

polski

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

2 ECTS credits – 50 hours including:
1) practical classes - 15 hours;
2) laboratory classes - 15 hours;
3) literature studies, practical classes - 15 hours;
4) preparation for classes, laboratory classes - 5 hours.

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

|  |  |
| --- | --- |
| Wykład:  | 30h |
| Ćwiczenia:  | 15h |
| Laboratorium:  | 15h |
| Projekt:  | 0h |
| Lekcje komputerowe:  | 0h |

**Wymagania wstępne:**

Basic knowledge in the field of physics related to energy effects for different physical and chemical processes that are accompanied by changing the amount of internal energy inside analyzed systems (secondary school program).

**Limit liczby studentów:**

According to relevant Rector’s directives.

**Cel przedmiotu:**

Ability to solve the technical problems related to design of combustion engines with the focus on the laws of thermodynamics. Ability to use thermodynamics for describing physical phenomena and mathematical simulations of heat exchange processes in the combustion engines. Understanding demands and restrictions in engineering practice.

**Treści kształcenia:**

Lectures: Gas as working substance in thermodynamic system, gas laws, Boyle–Mariotte law, Gay-Lussac's law, Avogadro’s law, equation of state for ideal and semi-perfect gas, heat capacity, gas constant, energy balance, the first law of thermodynamics, thermodynamic processes, internal energy of thermodynamic system, work done in thermodynamic process, absolute work, useful work, technical work, heat transferring in thermodynamic process, enthalpy and entropy, first law of thermodynamics, energy balance in thermodynamic process, energy balance in flow-type machines, types of thermodynamic process for an ideal and semi-perfect gases, isobar, isochore, isotherm, isentrope (adiabat), absolute work, polytrope. Thermodynamic cycles, the second law of thermodynamics, clockwise and counter-clockwise cycles, work and heat in the thermodynamic cycle, efficiency and performance of the cycle, typical comparative gas cycles. Heat transfer fundamentals, main conceptions, the fundamental modes (ways) of heat transfer, conduction, convection, radiation. operation principles of spark ignition and compression ignition engines, real cycles of combustion engines and parameters that characterize their work, gas exchange and valve timing mechanism in the combustion engine, fuels for engines and fuel delivery systems, fuel combustion process, engine emissions and turbocharging systems for internal combustion engines, characteristics of piston combustion engines.
Practical classes: Ideal gases laws. Mixtures of ideal gases, specific heats of gases. The first law of thermodynamics, thermodynamic processes. Thermodynamic cycles.
Laboratory classes:
Study of unsteady heat exchange. Study of the piston compressor. Study of automotive climate control system. Indicated diagram. Internal Combustion engine characteristics: speed curves and load curves. Study on exhaust gases emissions and concentrations of individual harmful components.

**Metody oceny:**

The auditorium exercises (practical classes) will be passed after positive marks obtainment from two written tests. The final grade on the auditorium exercises is the arithmetic mean of the written test scores. Prerequisite for passing the lecture course is to obtain a positive grade during the examination. The condition of passing the laboratory classes is to obtain positive marks for all practical classes placed in the schedule. The final grade for the laboratory is the arithmetic mean of the grades from the individual exercises. The Head of the Combustion Engines Theory Laboratory is responsible for final students grading during the laboratory classes. The grades for examination, auditorium exercises as well as final grade for laboratory classes will be considered during the final grade calculations.

**Egzamin:**

tak

**Literatura:**

1) Michael J. Moran, Howard N. Shapiro: Fundamentals of engineering thermodynamics, John Wiley & Sons Ltd, England 2006,
2) Heywood John B.: Internal combustion engine fundamentals, McGraw-Hili,Inc.1988.
3) Luft S.: Podstawy budowy silników. WKŁ Warszawa 2011,
4) Serdecki W.: Badania silników spalinowych. Laboratorium. Wyd. Politechniki Poznańskiej, Poznań 2001,

**Witryna www przedmiotu:**

Brak

**Uwagi:**

Brak

## Efekty przedmiotowe

### Profil ogólnoakademicki - wiedza

**Efekt 1150-00000-ISA-0302\_W1:**

Able to identify processes related to the combustion engines theory that could be successfully described by appropriate thermodynamic models.

Weryfikacja:

Exam, written test

**Powiązane efekty kierunkowe:** K\_W02

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

**Efekt 1150-00000-ISA-0302\_W2:**

Able to formulate equations describing processes related to the theory of combustion engines

Weryfikacja:

 Exam, written test

**Powiązane efekty kierunkowe:** K\_W02

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

### Profil ogólnoakademicki - umiejętności

**Efekt 1150-00000-ISA-0302\_U1:**

Able to perform the basic calculations necessary for proper selection of parameters in the processes related to the combustion engines theory

Weryfikacja:

Examination, reports grading

**Powiązane efekty kierunkowe:** K\_U24

**Powiązane efekty obszarowe:** T1A\_U15

**Efekt 1150-00000-ISA-0302\_U2:**

Able to perform simple measurements in terms of basic parameters related to combustion engines

Weryfikacja:

Reports grading

**Powiązane efekty kierunkowe:** K\_U24

**Powiązane efekty obszarowe:** T1A\_U15

### Profil ogólnoakademicki - kompetencje społeczne

**Efekt 1150-00000-ISA-0302\_K1:**

Ability to work individually and in teams

Weryfikacja:

Reports grading

**Powiązane efekty kierunkowe:** K\_K04

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