STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Internal Combustion Engines	**1010651251010600244**

Field of study	Profile of study (general academic, practical)	Year /Semester
Mechanical Engineering	**general academic**	**3 / 5**
Elective path/specialty: **Virtual Design Engineering**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **1** Classes: **-** Laboratory: **1** Project/seminars: **-**		No. of credits: **3**
Status of the course in the study program (Basic, major, other): **other**	(university-wide, from another field): **university-wide**	
Education areas and fields of science and art: **technical sciences** **Technical sciences**		ECTS distribution (number and %): **3 100%** **3 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	In the basic scope regarding the operation of internal combustion engines. In the basic scope regarding chemistry and physics from high school. In the area of the main elements of drive systems.
2	**Skills**	Logical thinking, learning with understanding, use of scientific publications (along with the ability to search web bases).
3	**Social competencies**	Awareness of the need to acquire knowledge and its use in various fields of technical and natural sciences.

Assumptions and objectives of the course:

The aim of the course is to familiarize with issues related to internal combustion engines in the following areas: history, theoretical foundations, construction, thermodynamics, research, exhaust emissions, modern solutions and their applications: road and off-road vehicles, aviation, shipbuilding.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has basic knowledge of the basics of machine construction and the theory of machines and mechanisms, including mechanical vibrations - [M1_W05]
2. Has basic knowledge in the field of technical fluid mechanics, ie liquids and perfect gases, Newton and non-Newtonian viscous liquids, theory of thermal-flow machines - [M1_W05]
3. Has an extended basic knowledge necessary for the understanding of specialist subjects and specialist knowledge about the construction, methods of constructing, manufacturing and operation of a selected group of working, transport and thermal and flow machines covered by the WMRT specialization profile - [M1_W19]
4. Has elementary knowledge about the impact of machinery and technology on the natural environment and global energy balance sheets - [M1_W21]

Skills:

1. Is able to obtain information from literature, the internet, databases and other sources. Is able to integrate the obtained information, interpret and draw conclusions from them and create and justify opinions - [M1_U01]
2. Able to competently advise on the selection of a machine for a given application in an industry covered by a selected specialty based on the acquired knowledge of a given machine group - [M1_U11]
3. Is able to perform elementary technical calculations in the field of fluid mechanics and thermodynamics, such as thermal and mass turbidity, pressure losses in pipelines, selection of blowers and fans for ventilation and transport systems, and to calculate thermodynamic waveforms in thermal machines - [M1_U12]
4. Can create a circuit diagram, select elements and perform basic calculations using ready-made computational packages of mechanical, hydrostatic, electric or hybrid machine drive system. - [M1_U16]
5. Is able to use the experience gained in the professional engineering profession related to the maintenance of devices, facilities and systems typical for the field of study - [M1_U20]
6. Can interact with other people as part of team work (also of an interdisciplinary nature) - [M1_U26]

Social competencies:

1. Is ready to critically evaluate your knowledge and content - [M1_K01]]
2. Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in case of problems with solving the problem - [M1_K02]
3. Is ready to fulfill social obligations, co-organize activities for the social environment - [M1_K03]
4. Is ready to responsibly perform professional roles, including: observance of professional ethics and requirements of others, care for profession's achievements and traditions - [M1_K06]

Assessment methods of study outcomes

Assessment based on a written exam carried out during the examination session and passed laboratory classes (reports + tests).

Course description

The program content will include:

-Introduction: presentation of the steam and combustion engine, principle of the two- and four-stroke engine operation, basic elements, types, applications, short historical outline.

-Construction of an internal combustion engine: main components, power systems, supercharging, construction problems.

-The theory of the internal combustion engine: theoretical and comparative circuits, indicator diagrams, definitions of basic work indicators, Sankey's chart.

-Research of combustion engines: construction of engine dynamometer, dynamic dynamometer, engine`s characteristics, RDE tests.

-Emission of pollutants from internal combustion engines: emission sources, characteristic of main harmful compounds, combustion reaction, dependence of work parameters on emissions.

-Modern solutions used in internal combustion engines: directions of development of power systems, EGR, downsizing, rightsizing, downrating, variable valve timing, electric compressors, Atkinson cycle, Miler cycle, presentation of selected modern combustion engines.

-High-power diesel engines and aerial constructions.

-Application of combustion engines on selected examples.

Basic bibliography:

1. Serdecki W. (red.): Badania silników spalinowych ? Laboratorium. WPP, Poznań, 2012 or later issues.
2. Wajand Jan A., Wajand Jan T.: Tłokowe silniki spalinowe średnio- i szybkoobrotowe. WNT, Warszawa, 2005.
3. Niewiarowski K.: Tłokowe silniki spalinowe. WKiŁ, Warszawa, 1983.
4. Merkisz J.: Ekologiczne problemy silników spalinowych (tom I i tom II). WPP, Poznań, 1998.

Additional bibliography:

1. Materials: engine manufacturers, conference and industry: Combustion Engines, MTZ, SAE.

Result of average student's workload

Activity	Time (working hours)

1. Preparation for the lecture	5
2. Participation in the lecture	15
3. Preparation for laboratory classes	8
4. Participation in laboratory classes	15
5. Strengthening the content of the lecture	8
6. Participation in consultations	4
7. Participation in the test	2
8. Preparation for passing	8

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	65	3
Contact hours	36	2
Practical activities	15	1