Programme		
Aerospace Engineering		
Degree	Type	Academic year
Bsc	full-time	2019/2020

Purposes

The objectives of the study is to create the solid fundamental engineering knowledge during the first year of the study, then learn deeply the problems devoted to the subject of the study. The graduates are prepared to work in industry and to solve engineering problems. At first the aforementioned abilities should be proved in the diploma thesis where a given problem must be solved and the work must be documented and explained. Each diploma thesis is reviewed by 2 reviewers and is defended in the presence of commission consisting of professors and assistant professors.

Effects of education

Code of effect:	**Aero1_W01**
Description:	Student has basic mathematical knowledge necessary for understanding and usage of the mathematical formalism and methods applied to fundamental termomechanical and electrical phenomena, as well as for conducting basic computations related to engineering design and modeling.
Area of study related learning outcomes	
Code of effect:	**Aero1_W02**
Description:	Student has knowledge on structure and mechanical, electromagnetic and optical properties of matter, sufficient for understanding basic physical phenomena in engineering as well as principles of operation of typical measurement and diagnostic devices; student knows general principles of measurement of physical quantities, validation and error estimation methods.
Area of study related learning outcomes	
Code of effect:	**Aero1_W03**
Description:	Student knows basic computer programing, has basic knowledge on conducting and validation of engineering computer calculations, knows basic numerical algorithms of applied mathematics.
Area of study related learning outcomes	
Code of effect:	**Aero1_W04**
Description:	Student has knowledge on aerospace materials and their manufacturing technology, corrosion and anticorrosion protection.
Area of study related learning outcomes	
Code of effect:	**Aero1_W05**
Description:	Student has systematic and theoretically grounded knowledge in the area of general and solid body mechanics, including strength of materials and structures.
Area of study related learning outcomes	
Code of effect:	**Aero1_W06**
Description:	Student has systematic knowledge on design of typical mechanical elements and their links, as well as on deterministic and probabilistic methods of their modeling. Student has a basic knowledge on the drive transmission systems.

Effects of education	
Area of study related learning outcomes	
Code of effect:	**Aero1_W07**
Description:	Student has knowledge on fundamentals of thermodynamics and fluid mechanics, in the extent sufficient for understanding and conducting a quantitative analysis of basic thermal and flow phenomena and processes.
Area of study related learning outcomes	
Code of effect:	**Aero1_W08**
Description:	Student has basic knowledge in the area of electric circuits and electric machines; student knows principles of operation and basic applications of semiconductor electronic elements.
Area of study related learning outcomes	
Code of effect:	**Aero1_W09**
Description:	Student has systematic and theoretically grounded knowledge on the foundations of automation and control, including different kinds and structures of the control systems, regulatory elements, basics of the dynamical system modeling, design and analysis of the linear control systems.
Area of study related learning outcomes	
Code of effect:	**Aero1_W10**
Description:	Student knows basics of metalworking: forging, casting, cutting, surface machining, electric discharge machining.
Area of study related learning outcomes	
Code of effect:	**Aero1_W11**
Description:	Student has systematic knowledge in the area of aircraft aerodynamics and flight dynamics including basics of stability and flight control.
Area of study related learning outcomes	
Code of effect:	**Aero1_W12**
Description:	Student has knowledge on the aircraft design process and functions, characteristics, loads and typical design solutions of aircraft elements. Student knows selected rules and regulations concerning aircraft construction and design.
Area of study related learning outcomes	
Code of effect:	**Aero1_W13**
Description:	Student knows basic kinds of aerospace propulsion systems, their theoretical and real thermodynamic cycles, basic structural design, characteristics and ranges of application.
Area of study related learning outcomes	
Code of effect:	**Aero1_W14**
Description:	Student knows principles of operation of various aircraft systems: flight control, landing assistance, collision avoidance, inertial navigation sensors, flight recording, communication. Student has knowledge on basic on-board installations used in flying vehicles.

Effects of education	
Area of study related learning outcomes	
Code of effect:	**Aero1_W15**
Description:	Student has systematic knowledge on vibrations in physics and technology. Student knows aerospace related aeroelastic phenomena, their characteristics and mathematical models, investigation methods and avoidance techniques.
Area of study related learning outcomes	
Code of effect:	**Aero1_W16**
Description:	Student has detailed knowledge in the selected areas of aerospace engineering: aircraft structural design or aircraft engines, power systems and combustion or design, integration and simulation of aircraft systems or astronautics.
Area of study related learning outcomes	
Code of effect:	**Aero1_W17**
Description:	Student has basic knowledge on the development trends in aerospace engineering.
Area of study related learning outcomes	
Code of effect:	**Aero1_W18**
Description:	Student has basic knowledge concerning life cycle of the technical devices, objects and systems, in particular – exploitation of aerial vehicles.
Area of study related learning outcomes	
Code of effect:	**Aero1_W19**
Description:	Student is acquainted with basic methods, techniques, tools and materials used in solving simple engineering tasks, in the extent appropriate for aerospace engineering.
Area of study related learning outcomes	
Code of effect:	**Aero1_W20**
Description:	Student has basic knowledge needed for understanding social, economic, legal and other conditions of engineering activity.
Area of study related learning outcomes	
Code of effect:	**Aero1_W21**
Description:	Student has elementary knowledge in the area of management, including quality management and economic activity.
Area of study related learning outcomes	
Code of effect:	**Aero1_W22**
Description:	Student knows and understands concepts and principles related to protection of industrial and intellectual property, copyrights and patents; student know how to use patent information resources.
Area of study related learning outcomes	
Code of effect:	**Aero1_W23**
Description:	Student is familiar with general principles of setting up and development of different form of an individual enterprising, using expertise in the

Effects of education	
	area of the aerospace engineering.
Area of study related learning outcomes	
Code of effect:	**Aero1_U01**
Description:	Student can collect information from literature, data basis and other sources, also in English; student can integrate acquired information, interpret, draw conclusions, formulate and justify opinions.
Area of study related learning outcomes	
Code of effect:	**Aero1_U02**
Description:	Student can communicate – using different techniques – in her/his professional and other communities.
Area of study related learning outcomes	
Code of effect:	**Aero1_U03**
Description:	Student can prepare – both in Polish and a foreign language – well designed and documented elaboration/report on a topic related to aerospace engineering.
Area of study related learning outcomes	
Code of effect:	**Aero1_U04**
Description:	Student can prepare and deliver a short presentation of results of a task in the area of aerospace engineering.
Area of study related learning outcomes	
Code of effect:	**Aero1_U05**
Description:	Student is able to acquire knowledge and develop personal and professional skills using different sources and modern technologies.
Area of study related learning outcomes	
Code of effect:	**Aero1_U06**
Description:	Student understands the meaning of main ideas contained in clear, standard English statements, concerning known and/or typical topics/issues. Student can cope in most of the communication situations. Student can construct simple and consistent oral and written statements, shortly justifying/explaining her/his opinions and plans.
Area of study related learning outcomes	
Code of effect:	**Aero1_U07**
Description:	Student understands the meaning of main ideas in complex English texts on specific and abstract topics, also in a discussion on subjects from his/her specialisation; can have a conversation with a native speaker fluently and spontaneously enough so that none of the speakers feels unease; can formulate clear oral and written texts on a wide range of topics, present his/her opinions, discuss advantages and disadvantages of different solutions
Area of study related learning outcomes	
Code of effect:	**Aero1_U08**
Description:	Student is able to prepare/read technical

Effects of education	
	documentation containing technical drawings/schemes and describe geometry of a designed device or its parts using 3D CAD software.
Area of study related learning outcomes	
Code of effect:	**Aero1_U09**
Description:	Student can plan and conduct experiments, including measurements and computer simulations, interpret obtained results, assess measurement error, verify computational outcomes and draw conclusions.
Area of study related learning outcomes	
Code of effect:	**Aero1_U10**
Description:	Student can use learned mathematical methods, physical models and computer simulations in design, modeling and assessment of mechanical and exploitation properties of typical mechanical devices and systems.
Area of study related learning outcomes	
Code of effect:	**Aero1_U11**
Description:	Student can write simple computational/simulation programs using learned numerical algorithms and programming languages; student can use basic tools for post-processing and visualization of obtained results; student can perform critical assessment of obtained results.
Area of study related learning outcomes	
Code of effect:	**Aero1_U12**
Description:	Student can use known principles and laws of classical mechanics to build quantitative description of basic mechanical phenomena in technical systems. Student can conduct an analysis of strength/stability of selected types of engineering structures and design simple mechanical devices.
Area of study related learning outcomes	
Code of effect:	**Aero1_U13**
Description:	Student can calculate characteristics of simple thermodynamic processes, solve simple problems in statics, kinematics and dynamics of fluids. Student can explain principles of operations of selected measuring devices and use them in laboratory experiments.
Area of study related learning outcomes	
Code of effect:	**Aero1_U14**
Description:	While formulating and solving engineering tasks, Student is able to notice their systemic and nontechnical aspects.
Area of study related learning outcomes	
Code of effect:	**Aero1_U15**
Description:	Student is sufficiently prepared for work in industrial environment and knows rules of safety related to such work.

Effects of education	
Area of study related learning outcomes	
Code of effect:	**Aero1_U16**
Description:	Student can perform preliminary economic analysis of the engineering task.
Area of study related learning outcomes	
Code of effect:	**Aero1_U17**
Description:	Student is able for critical assessment of various technical solutions (devices, objects, systems, processes, services) in aerospace engineering and industry.
Area of study related learning outcomes	
Code of effect:	**Aero1_U18**
Description:	Student can analyze flying properties, loads and structural strength of selected flying vehicles. Student can choose and analyze properties of their propulsion and equipment.
Area of study related learning outcomes	
Code of effect:	**Aero1_U19**
Description:	Student can identify and formulate simple engineering tasks, having practical valor and specific for aerospace engineering.
Area of study related learning outcomes	
Code of effect:	**Aero1_U20**
Description:	Student can assess usefulness of routine methods and tools for a practical engineering task specific for aerospace engineering, choose and apply an appropriate method and tools.
Area of study related learning outcomes	
Code of effect:	**Aero1_U21**
Description:	Student can design – following a given specification – simple flying vehicle and construct its selected parts by means of appropriately chosen methods and tools.
Area of study related learning outcomes	
Code of effect:	**Aero1_K01**
Description:	Student understands the need for life-long learning – increasing professional and personal competences.
Area of study related learning outcomes	
Code of effect:	**Aero1_K02**
Description:	Student is aware of the importance of non-technical aspects and consequences of engineering activity, including its impact on the environment and the responsibility for ensuing decisions.
Area of study related learning outcomes	
Code of effect:	**Aero1_K03**
Description:	Student is aware of the need to act professionally and observe the rules of professional ethics.
Area of study related learning outcomes	
Code of effect:	**Aero1_K04**
Description:	Student is aware of the responsibility for jointly

Effects of education	
	realised tasks, connected with team work.
Area of study related learning outcomes	
Code of effect:	**Aero1_K05**
Description:	Student can think and act in an entrepreneurial way.
Area of study related learning outcomes	
Code of effect:	**Aero1_K06**
Description:	Student is aware of the need to formulate and deliver, especially via mass media, information and opinions on technical achievements and other aspects of engineering activity; can make the information and opinions widely understandable.
Area of study related learning outcomes	

Courses by semester

Semester 1

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	HES Courses	HES 11	2	30	0	0	0
Aerospace Engineering	HES Courses	Wittgenstein's Philosophy and Ethics	2	30	0	0	0
Aerospace Engineering	Physical Education and Sports	Physical Education and Sport 1	0	0	30	0	0
Aerospace Engineering	Specialization	Engineering Graphics	2	15	15	0	0
Aerospace Engineering	Specialization	Algebra and Geometry	4	0	45	0	0
Aerospace Engineering	Specialization	Calculus I	7	30	45	0	0
Aerospace Engineering	Specialization	Computer Science I	5	30	0	30	0
Aerospace Engineering	Specialization	Engineering Physics	3	15	30	0	0
Aerospace Engineering	Specialization	Environment Protection	2	30	0	0	0
Aerospace Engineering	Specialization	Materials I	2	0	0	0	0
Aerospace Engineering	Specialization	Mechanics I	3	15	15	0	0

Semester 2

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	HES Courses	Economics	2	30	0	0	0
Aerospace Engineering	HES Courses	HES 12	2	450	0	0	0
Aerospace Engineering	Languages	Foreign/Polish Language 1	2	0	30	0	0
Aerospace Engineering	Physical Education and Sports	Physical Education and Sport 2	0	0	30	0	0
Aerospace Engineering	Specialization	Calculus II	5	30	30	0	0
Aerospace Engineering	Specialization	Computer Science II	2	15	0	15	0
Aerospace Engineering	Specialization	Electric Circuits I	3	30	15	0	0
Aerospace Engineering	Specialization	Engineering Graphics – CAD1	2	15	15	0	0
Aerospace Engineering	Specialization	Mechanics II	5	30	30	0	0

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	Specialization	Mechanics of Structures I	4	30	15	0	0
Aerospace Engineering	Specialization	Thermodynamics I	5	30	30	0	0

Semester 3

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	Languages	Foreign/Polish Language 2	2	0	30	0	0
Aerospace Engineering	Physical Education and Sports	Physical Education and Sport 3	0	0	30	0	0
Aerospace Engineering	Specialization	Aeronautical Systems I	3	30	0	0	0
Aerospace Engineering	Specialization	Basics of Automation and Control 1	4	30	15	0	0
Aerospace Engineering	Specialization	Calculus III	3	15	30	0	0
Aerospace Engineering	Specialization	Engineering Graphics – CAD2	2	0	30	0	0
Aerospace Engineering	Specialization	Fluid Mechanics I	4	30	15	0	0
Aerospace Engineering	Specialization	Introduction to Aerospace	2	15	0	0	15
Aerospace Engineering	Specialization	Machine Design I	3	15	15	0	0
Aerospace Engineering	Specialization	Manufacturing Technology	2	30	0	0	0
Aerospace Engineering	Specialization	Materials in Aerospace Technology	3	15	15	0	0
Aerospace Engineering	Specialization	Mechanics of Structures II	2	15	15	0	0

Semester 4

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	Languages	Foreign Language 3	2	0	30	0	0
Aerospace Engineering	Physical Education and Sports	Physical Education and Sport 4	0	0	30	0	0
Aerospace Engineering	Specialization	Aerodynamics I	2	30	0	0	0
Aerospace Engineering	Specialization	Astronautics	4	30	0	0	0
Aerospace Engineering	Specialization	Electronics 1	2	15	15	0	0
Aerospace Engineering	Specialization	Electronics 2	1	0	0	15	0
Aerospace Engineering	Specialization	Integrated CAD/CAM/CAE Systems	2	0	0	30	0
Aerospace Engineering	Specialization	INTEGRATED LABORATORY	3	0	0	30	0
Aerospace Engineering	Specialization	Machine Design II	3	15	15	0	0
Aerospace Engineering	Specialization	Manufacturing Technology II LAB	2	0	0	30	0
Aerospace Engineering	Specialization	MECHANICS OF FLIGHT 1	4	15	0	0	15
Aerospace Engineering	Specialization	Propulsion Systems	5	30	15	0	0

Semester 5

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	Languages	Foreign Language 4	2	0	30	0	0
Aerospace Engineering	Physical Education and Sports	Physical Education and Sport 5	0	0	30	0	0
Aerospace	Specialization	Aeronautical Systems II	3	15	0	15	0

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Engineering							
Aerospace Engineering	Specialization	Aircraft design I	4	30	0	0	15
Aerospace Engineering	Specialization	Aircraft Engine Design I	3	30	0	0	0
Aerospace Engineering	Specialization	Chemistry of Combustion	3	15	15	0	0
Aerospace Engineering	Specialization	Machine Design III	3	15	15	0	0
Aerospace Engineering	Specialization	MECHANICS OF FLIGHT 2	3	15	0	0	15
Aerospace Engineering	Specialization	Risk and Reliability in Aviation	3	15	15	0	0
Aerospace Engineering	Specialization	Rotorcraft aeromechanics	5	30	15	0	0
Aerospace Engineering	Specialization	Spacecraft Design	1	15	0	0	0

Semester 6

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	Physical Education and Sports	Physical Education and Sport 6	0	0	30	0	0
Aerospace Engineering	Specialization	Aircraft design II	4	15	0	0	30
Aerospace Engineering	Specialization	Aircraft Engine Design II	2	0	0	0	30
Aerospace Engineering	Specialization	Aircraft Maintenance	3	30	0	0	0
Aerospace Engineering	Specialization	Finite Element Method I	4	30	0	0	0
Aerospace Engineering	Specialization	Intermediate Engineering Project	6	0	0	0	60
Aerospace Engineering	Specialization	Machine Design VI	3	0	0	0	30
Aerospace Engineering	Specialization	Physics I	3	30	0	0	0
Aerospace Engineering	Specialization	Simulation of Aeronautical Systems	3	15	0	0	15
Aerospace Engineering	Specialization	Structure and assembling of airframes	2	15	0	0	15

Semester 7

Block	Group	Course	ECTS	Lect.	Exrc.	Lab.	Proj.
Aerospace Engineering	Specialization	Aeronautical Regulations	1	15	15	0	0
Aerospace Engineering	Specialization	Aircraft engines maintenance	2	30	0	0	0
Aerospace Engineering	Specialization	Computational Fluid Dynamics	3	30	0	15	0
Aerospace Engineering	Specialization	Engineering Diploma Seminar	2	0	0	0	30
Aerospace Engineering	Specialization	Engineering Diploma Thesis	15	0	0	0	180
Aerospace Engineering	Specialization	FINITE ELEMENT METHOD II	2	15	0	15	0
Aerospace Engineering	Specialization	Simulators	2	15	15	0	0
Aerospace Engineering	Specialization	VIBRATIONS AND AEROELASTICITY	3	15	15	0	0

Description of course

Code of course	ANHES_1	
Name of course	HES 11	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Administration and Social Sciences.	
Coordinator of course	Academic teachers of the Faculty of Administration and Social Sciences. Detailed data contains syllabus of specific course.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	HES Courses	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Detailed data contains syllabus of specific course.	
Limit of students	Detailed data contains syllabus of specific course.	
C. Effects of education and manner of teaching		
Purpose of course	Detailed data contains syllabus of specific course.	
Effects of education	See Table 1.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Detailed data contains syllabus of specific course.	
Methods of evaluation	Detailed data contains syllabus of specific course.	
Methods of verification of effects of education	See Table 1.	
Exam	no	
Literature	Detailed data contains syllabus of specific course.	
Website of the course	Detailed data contains syllabus of specific course.	
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	Number of hours that require the presence of a teacher ~30 lectures. The number of hours of independent work of student ~30.	
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit - number of hours that require the presence of a teacher ~30 lectures.	
Number of ECTS credits on practical activities on the course	Detailed data contains syllabus of specific course.	
E. Additional information		
Notes	Specific learning outcomes are defined for the chosen course.	
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Table 1. Learning outcomes

General academic profile - social competences

Table 1. Learning outcomes	
Code of effect:	**Detailed data contains syllabus of specific course.**
Description:	Detailed data contains syllabus of specific course.
Verification:	Detailed data contains syllabus of specific course.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**Detailed data contains syllabus of specific course.**
Description:	Detailed data contains syllabus of specific course.
Verification:	Detailed data contains syllabus of specific course.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	
Code of effect:	**Detailed data contains syllabus of specific course.**
Description:	Detailed data contains syllabus of specific course.
Verification:	Detailed data contains syllabus of specific course.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW103	
Name of course	Wittgenstein's Philosophy and Ethics	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Administration and Social Sciences	
Coordinator of course	prof. dr hab. Marek Maciejczak	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	HES Courses	
Type of course	Elective	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	General knowledge in the secondary school.	
Limit of students	150	
C. Effects of education and manner of teaching		
Purpose of course	C1. Gain knowledge and comprehension of philosophical ideas and especially of ethics and analytical style of thinking. C2. Gain knowledge of philosophical and social conditions of engineer's activities. C3. Gain knowledge how to interpret engineer's profesy from philosophical and social point of view. C 4. The course introduces students to main books of the of Western Philosophy, which had a decisive impact upon contemporary ideas in ethics, esthetics, psychology, religion, semantics: Tractatus logico-philosophicus and Philosophical Investigations of Ludwig Wittgenstein. Their scope is a critique of language. The understand of how language works means to know better the nature of thoughts, i.e. mind. Besides of language, Wittgenstein’s ideas on Mathematics, Ethics, Religion, Society, Culture and Science, are taken into account.	
Effects of education	See Table 2.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. What is philosophy? Different concepts of philosophy, its main trends, periods, books and thinkers. 2. Example of philosophical ideas in the present dispute of moral situation of the individual in a consumerist society. There is a strong tendency to erasure of the ethical aspect of man’s deeds. May the need of moral sensitivity be seen	

Description of course

	as a condition of happy life? 3. Analytical current in the XX philosophy. Ludwig Wittgenstein – person and life. Wittgenstein tried to understand himself as a genius, endowed with w guiding sense of ethical imperative. His letters, conversations, diaries, philosophical texts are documents of determination to know himself better and better. 4. Wittgenstein's first and only one book published during his lifetime – Tractatus logico-philosophicus (1921). The tractarian theory of language and meaning. Language of sciences and definition of truth. The difference between what can be said and what can be only shown. 5. Ethics in the Tractatus. The tractarian theory of linguistic meaning provides the answer to the questions, why there are no ethical propositions and why ethics is not merely senseless but ineffable. 6. The lecture on Ethics (1930). The only one public lecture delivered by Wittgenstein to the Heretic Club in Cambridge. Ethics is running up against the limits of language. It is an attempt to say something that cannot be said. Examples of ethical problems – discussion. 7. Wittgenstein later philosophy. Anthropological method in philosophy. Philosophical Investigations (1953). Philosophy as a battle against the bewitchment of our intelligence by means of language. Philosophy as seeing differences and similarities. Seeing connection as condition of understanding ethics, aesthetics, religion, mathematics. 8. Grammar of religious beliefs. Language in religion. The nature of religious beliefs. 9. Culture. The dominance of science in modern culture. The modern mentality. Value of culture and tradition. 10. Summary: Wittgenstein's legacy.
Methods of evaluation	Two class-tests. A brief critical essay (presentation) on topics to be advised.
Methods of verification of effects of education	See Table 2.
Exam	no
Literature	Compulsory readings: • Ray M., Wittgenstein: The Duty of Genius, London: Vintage, 1990. • Wittgenstein's Lectures, 1932-35, ed. by A. Ambrose, Blackwell 1979. • Wittgenstein, Lectures and Conversations on Aethetics, Psychology & Religious Beliefs. Edited by C. Barrett, Blackwell, Oxford, 1966. Recommended readings: • J.C. Kelly, Wittgenstein, the self, and ethics. The Review of Metaphysics; 3/1/1995; • P. C. John., Wittgenstein's "Wonderful Life", Journal of the History of Ideas, Vol.49, No.3 (Jul.-Sep., 1988), 495-510. • C. Radford, Wittgenstein on Ethics, Grazer Philosophische Studien, her. Von R. Haller, Vol 33/34-1989, 84-114. • R. Monk, Ludwig

Description of course	
	Wittgenstein, The Duty of Genius, London 1990. • F. Cioffi, Wittgenstein on Freud and Frazer, Cambridge 1998. • D. Pears, Wittgensten, 1979. • A.J.P. Kenny, Wittgenstein, 1973.
Website of the course	-
D. Student's activity	
Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 2 hours. 2) 2) The number of hours of independent work of student : • systematic preparation for classes - 10 hours; • preparing presentation of selected topic - 5 hours; • preparing to colloque - 5 hours. Total: 52 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,2 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures-15 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-
E. Additional information	
Notes	-
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Table 2. Learning outcomes	
General academic profile - knowledge	
Code of effect:	**ML.ANW103_W01**
Description:	He has a basic knowledge essential to understand philosophical-social conditions of engineering activity.
Verification:	Tests.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW103_U01**
Description:	He can interpret information in the field of philosophical and social conditions engineering business.
Verification:	Tests.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW103_K01**
Description:	He understands the need for the constant learning.
Verification:	Tests
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ML.ANW103_K02**
Description:	He is aware of a social role of the graduate of a technical univertsity.

Table 2. Learning outcomes	
Verification:	Tests.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANW103_K03**
Description:	Is aware of compliance with the principles professional ethics.
Verification:	Tests.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	
Code of effect:	**ML.ANW103_K04**
Description:	He is aware of a social role of media, is able to notice their positive and negative functions.
Verification:	Tests.
Field of study related learning outcomes	Aero1_K06
Area of study related learning outcomes	

Description of course

Code of course	ANWF1	
Name of course	Physical Education and Sport 1	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	College of Physical Education and Sport.	
Coordinator of course	Teacher at College of Physical Education and Sport.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Physical Education and Sports	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	The development of physical activity of students. Detailed data contains syllabus of specific course.	
Effects of education	See Table 3.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The exercise program offer by College of Physical Education and Sport.	
Methods of evaluation	According to the rules of classes developed by College of Physical Education and Sport.	
Methods of verification of effects of education	See Table 3.	
Exam	no	
Literature		
Website of the course		
D. Student’s activity		
Number of ECTS credits	0	
Number of hours of student’s work to achieve effects of education	Participation in classes - 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0.0 ECTS credit (30 hours of classes, without ECTS).	
Number of ECTS credits on practical activities on the course	-	
E. Additional information		
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Table 3. Learning outcomes

Description of course

Code of course	ANW105	
Name of course	Engineering Graphics	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering	
Coordinator of course	Dr inż. Witold M. MIRSKI	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Base information from high school.	
Limit of students	70 students on the lecture and 12 students for one teacher on practise.	
C. Effects of education and manner of teaching		
Purpose of course	Create the orthogonal projection of spatial geometrical forms onto adequate projection plane. Teaching spatial imagination. The skill of rational use of space.	
Effects of education	See Table 4.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Basic information about the axonometric projection. Introduction to the descriptive geometry using the Monges method. Projection of such simply geometric elements, like; points, straight lines, planes and spatial relationships between them. Common elements of them. Auxiliary-view method. Projection of revolution. Projection of surfaces of basic geometric shapes: rectangular prisms, cylinders, cones and spheres. Cross-sections and points of intersections. Intersection lines of such shapes. Creating of components of complex objects on the base of two-dimensional sketch using a Computer Aided Design three-dimensional system (CAD-3D).	
Methods of evaluation	Positive results of tests as well as home and class work.	
Methods of verification of effects of education	See Table 4.	
Exam	no	
Literature	1. George C. Beakley, Ernst G. Chilton Introduction to Engineering Design and Graphics.	

Description of course

Website of the course	http://www.meil.pw.edu.pl/zpk/ZPK/Dydaktyka/

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures -15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 2 hours. 2) The number of hours of independent work of student : • systematic preparation for classes - 10 hours; • work on homework – 10 hours; • preparation for class tests – 5 hours. TOTAL – 57 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures-15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	1,5 ECTS credits – 37 hours, including: a) systematic preparation for classes - 10 hours; b) work on homework – 10 hours; c) attendance at the exercises -15 hours; d) consultancy meetings - 2 hours.

E. Additional information

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Table 4. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW105 _W1**
Description:	Student knows the basics of creating a drawing axonometric
Verification:	Controlled own work - axonometric drawing.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW105_W2**
Description:	Student knows the rules of mapping geometric elements on several viewports.
Verification:	Tests.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW105_W3**
Description:	Student knows the rules of creation and mapping of solids and second degree surfaces
Verification:	Short tests.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW105_W4**
Description:	It has a basic knowledge of drawing the lines penetrate.
Verification:	Test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	

Table 4. Learning outcomes	
General academic profile - skils	
Code of effect:	**ANW105_U1**
Description:	Student is able to do an isometric drawing.
Verification:	Controlled own work - axonometric drawing.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ANW105_U2**
Description:	Student can reproduce the geometric elements and geometric relationships that occur between them.
Verification:	Short tests.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ANW105_U3**
Description:	Student can reproduce and analyze the rotation.
Verification:	Short tests.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ANW105_U4**
Description:	Can create and map second degree surfaces.
Verification:	Short tests.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ANW105_U5**
Description:	Can draw lines penetrate the surface.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	

Description of course

Code of course	ANW 101	
Name of course	Algebra and Geometry	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Mathematics and Information Science	
Coordinator of course	dr Ewa Lewińska	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	-	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	To get students familiar with basic concepts of linear algebra and with some elements of 3-d analytic geometry. To introduce fundamental abstract definitions of linear spaces, algebraic bases, linear mappings and to reinterpret earlier material from this abstract point of view.	
Effects of education	See Table 5.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	45h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Complex numbers. Polynomials. Matrices and matrix operations. Determinants, invertible matrices and Cramers Rule. Systems of linear equations and Gauss Elimination Method. Rank of a matrix and Kronecker-Capelli Theorem. Homogeneous systems. Eigenvalues and eigenvectors. Vectors in the 3-d Cartesian coordinate system. Scalar, vector and box products. Equations of planes and lines and orthogonal projections onto them. Definition of a linear space. Linear subspaces. Algebraic basis and dimension of a linear space. Linear mappings. Inner product spaces. Orthogonality of vectors. Diagonalization of matrices. Diagonalization of real symmetric matrices.	
Methods of evaluation	50% at a mid-semester class test, 50% at an exam, if the class test is failed, then 100% at an exam.	
Methods of verification of effects of education	See Table 5.	

Description of course

Exam	yes
Literature	Recommended texts (reading): 1. Anton H., Rorres Ch.-Elementary linear algebra. 2. Lay D.C.- Linear algebra and its applications. 3. Kolman B., Hill D.R.- Elementary linear algebra.
Website of the course	-

D. Student's activity

Number of ECTS credits	4
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 47, including: a) attendance at the exercises - 45 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: a) homework and preparation for the exercises-15 hours, b) preparation for a class test -10 hours, c) presence at the exam - 5 hours. TOTAL: 77 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 47, including: a) attendance at the exercises - 45 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 5. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW101_W1**
Description:	Student knows arithmetics of complex numbers. Student has acquired basic knowledge about polynomials of a complex variable.
Verification:	Tests and exam
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW101_W2**
Description:	Student knows fundamentals of matrix algebra, theory of determinants as well as basic solution mathod for linear algebraic systems od equations. Student comprehends the concepts of matrix eigenvalues and eigenvectors.
Verification:	Tests and exam
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW101_W3**
Description:	Students knoes basic concepts and definitions in the theory of linear spaces and linear transformations .
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW101_W4**

Table 5. Learning outcomes	
Description:	Student has a basic knowledge in the area of analytical geometry. Student knows basic theoretical facts about second-order surfaces and lines in space.
Verification:	Exam
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ANW101_U1**
Description:	Student can carry out elementary calculations with complex numbers, including evaluation of powers and roots. Student can factorize the complex polynomials and determine their roots.
Verification:	Tests and exam
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW101_U2**
Description:	Student is able to carry out algebraic calculations with matrices. Student can determine the matrix rank and solve the linear algebraic systems. Student can calculate eigenvalues and eigenvectors.
Verification:	Tests and exam
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW101_U4**
Description:	Student can describe mathematically lines and planes in space and investigate geometric relations bewteen them.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW101_U5**
Description:	Student can draw the second-surface using its canonic equation. Student can determine parameters of curves and the Frenet trihedron.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW101_U5**
Description:	Student can draw the second-surface using its canonic equation. Student can determine parameters of curves and the Frenet trihedron.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ANW1013_U3**
Description:	Student is able to verify linear independence of vectors and check whether a set of vectors forms a linear space basis.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	

Description of course

Code of course	ANW102
Name of course	Calculus I
Version of course	2013

A. Place of the course in system of studies

Level of education	First cycle studies
Form and mode of studies	full-time
Profile of studies	General academic profile
Specialisation	-
Place of teaching of course	Faculty of Power and Aeronautical Engineering
Place of realization of course	Faculty of Mathematics and Information Science
Coordinator of course	Andrzej Fryszkowski, Professor

B. General characteristic of the course

Block of courses	Aerospace Engineering
Group of courses	Specialization
Type of course	Compulsory
Language of course	angielski
Nominal semester	1 (r.a. 2019/2020)
Time of completion in the academic year	summer semester
Preliminary requirements	High school mathematics.
Limit of students	150

C. Effects of education and manner of teaching

Purpose of course	To convey and reinforce the knowledge on real number sequences, functions of one variable, the constant e, one-variable differential and integral calculus, definite and improper integrals, and their application, to acquire thorough understanding of basic concepts and computational processes, and to master skills of using them, to acquire the skill of correct mathematical reasoning and inference.	
Effects of education	See Table 6.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	45h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Real sequences . Definition of sequence limit - convergent and divergent sequences. Indeterminate forms. Squeezing theorem. The constant e. 2. Function domain and counterdomain. Inversion and composition of functions. Elementary functions - linear, quadratic and rational functions. Properties of the exponential and logarithmic functions. Even and odd functions. Periodic functions. Trigonometric and cyclometric functions and their properties. 3. Function limit at a given point and at infinity. Horizontal, vertical and oblique asymptotes. Function continuity at a point and in the interval. One-sided continuity. Properties of continuous functions. 4. Function increment. Definition of the derivative of a function at a given point and its geometric interpretation. Derivatives of some	

Description of course

	common functions. The derivative of a sum, a product and a quotient of functions. The derivative of a composition. Tangent and normal lines at a point to a curve f(x). 5. De l'Hospital's rule. Function differential. Higher order derivatives and differentials. Taylor and MacLaurin formulas - approximate values of expressions. 6. Function extrema, necessary and sufficient condition. Rolle's theorem. The Lagrange Mean Value theorem. And its implications. 7. Derivatives of higher order with the use to identify extrema. Inflection points. Concave and convex functions. Necessary and sufficient conditions for inflection points. Examining the function and plotting its graph. 8. Indefinite integral - definition; antiderivative; integral of some common functions; properties. Techniques of integration. 9. Properties of definite integrals. The Fundamental Theorem of Calculus. Integration by parts and by substitution for definite integrals. 10. Definite integrals: definition and geometrical interpretation. Improper integrals of the first and the second kind. Applications of integrals; computing areas of planar figures, arc length of the curves, surface areas, volumes of revolved solids. 11. Convergence of an R2 sequences. Functions of two variables. Heines definition for function limit. 12. Gradient of a function at a point. Higher order partial derivatives. Taylor formula with the second and higher order. 13. Differential. Computing approximate values of expressions. Local extrema and necessary condition for them. Sufficient condition for an extremum. Functions of three variables: partial and directional derivatives and differentials. Taylor formula with the second order differential. 14. Implicit functions of one variable. Implicit function derivatives of first and second order. Extrema of implicit functions. Conditional extrema of the functions of two and three variables. Parametric representation of the two and three dimensional curves. Some common surfaces: sphere, cylinder, cone, paraboloid, hyperboloid. Planar regions in polar coordinates. Frenet trihedron.
Methods of evaluation	50% continuous assesment based on laboratory work and tests, 50% written final exam.
Methods of verification of effects of education	See Table 6.
Exam	yes
Literature	Recommended texts (reading): 1. Thomas “Calculus” . 2. Robert A. Adams, Calculus. A complete course. 3. Thomas G. Finney: Calculus, ed. Addison-Wesley.

Description of course

Website of the course	-
D. Student's activity	
Number of ECTS credits	7
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 80, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 45 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 45 hours; • work on homework (solving tasks) – 20 hours; • preparation for class tests – 15 hours; • preparation for the final examination – 15 hours. TOTAL = 175 hours
Number of ECTS credits on the course with direct participation of academic teacher	3,5 ECTS credits – number of hours that require the presence of a teacher - 80, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 45 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	-
E. Additional information	
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Table 6. Learning outcomes

General academic profile - knowledge	
Code of effect:	**ANW102_W1**
Description:	Student knows basic concepts of the analysis such that a metric space, convergence in a metric space, metric space transformations and their properties.
Verification:	Class tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW102_W2**
Description:	Student knows fundamentals of the differential calculus of single-variable functions.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW102_W3**
Description:	Student knows fundamentals of the integral calculus of single-variable functions, including the first and the second theorems of the integral calculus.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW102_W4**
Description:	Student knows fundamentals of the multi-variable differential calculus, including the concept of a partial derivative, a directional

Table 6. Learning outcomes	
	derivative and a gradient.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ANW102_U1**
Description:	Student can work with the elementary functions of a single variable, determine proper and improper limits of functions, investigate continuity properties of functions.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW102_U2**
Description:	Student can calculate derivatives of single-variable function (also derivatives of composite functions), determine monotonicuty and extremal points, determine an equation of a line tangent to a function's graph, use the de l'Hospital rule to evaluate function limits.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW102_U3**
Description:	Student can evaluate indetermined integrals (antiderivatives) using the integration by part and integration by substitution methods. Student knows hot to evaluate integrals of rational functions.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW102_U4**
Description:	Student can calculate determined integrals and use them in physics and geometry. Student is able to evaluate simple improper integrals.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW102_U5**
Description:	Student can calculate derivatives of multiply-variable functions, including partial derivatives of composite functions. Student can determine the directional derivative.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW102_U6**
Description:	Student is able to find extrema of functions of

Table 6. Learning outcomes	
	two variables and the plane tangent to the surface plot of such function. Student knows how to use the implicit function theorem.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ANW102_K1**
Description:	Student is aware of necessity of self-study and thoroughness and exactitude.
Verification:	Homework, exam.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	

Description of course

Code of course	ANW106	
Name of course	Computer Science I	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering	
Coordinator of course	Prof. J. Rokicki	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Basic knowledge in math at the highschool level.	
Limit of students	80 - lecture, 12- lab group	
C. Effects of education and manner of teaching		
Purpose of course	To familiarize the students with computer science and in particular with programming in computer language C.	
Effects of education	See Table 7.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	30h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Basic information related to operating systems and computer networks. Word-processing and spreadsheets used in typical engineering applications. Programming language C - variables and their types, arithmetical and logical operations, control statements, functions, tables and pointers, structures. Input and Output. Code examples. Basic algorithms (sorting), simple numerical methods. Practical programming skills.	
Methods of evaluation	2 tests (60 points), lab. continuous assignement (20 points), lab. project (20 points), resulting mark: (30-49 N, 50-59 3.0, 60-69 3.5, 70-79 4.0, 80-89 4.5, 90-100 5.0).	
Methods of verification of effects of education	See Table 7.	
Exam	no	
Literature	Recommended texts (reading): Oualline, Steve, Practical C Programming, O Reilly, 1991, http://publications.gbdirect.co.uk/c_book/.	
Website of the course	http://c-cfd.meil.pw.edu.pl/ccfd/index.php?item=6	
D. Student’s activity		
Number of ECTS credits	5	
Number of hours of student’s work to achieve	Number of hours that require the presence of a	

Description of course

effects of education	teacher : 70 hours, including: a) lecture – 30 hours, b) labs – 30 hours, c) consulatations – 10 hours. The number of hours of independent work of student: 55 hours, including: a) 20 hours. – preparation for labs and lectures, b) 10 hours - homework, c) 20 hours – preparation for 2 colloquia. Total: 125 hours.
Number of ECTS credits on the course with direct participation of academic teacher	3 ECTS credits - 70 hours, including: a) lecture – 30 hours, b) labs – 30 hours, c) consultations – 10 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credits – 55 hours including: a) 30 hours - labs, b) 15 hours – preparation for the labs, c) 10 hours – homework.

E. Additional information

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Table 7. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW106_W1**
Description:	Student has basic knowledge in the C language programming.
Verification:	2 tests and assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW106_W1**
Description:	Student has basic knowledge in the C language programming.
Verification:	2 tests and assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ANW106_W2**
Description:	Student has a basic knowledge about the usage of an operational system.
Verification:	2 tests and assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ANW106_U1**
Description:	Student has skills to write a simple computer program in C language.
Verification:	2 tests, assesment of the progress/activity in lab tutorilas, evaluation of a home project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ANW106_U2**
Description:	Student is able to solve a simple mathematical problem using his own computer program written in C language.

Table 7. Learning outcomes	
Verification:	2 tests, assesment of the progress/activity in lab tutorilas, evaluation of a home project.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ANW106_U2**
Description:	Student is able to solve a simple mathematical problem using his own computer program written in C language.
Verification:	2 tests, assesment of the progress/activity in lab tutorilas, evaluation of a home project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ANW106_U3**
Description:	Student can use basic and advanced functions of at editing program and a calculation spreadsheet.
Verification:	Assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ANW106_U4**
Description:	Using computers tools and methods, a student is able to solve a simple mathematical or technical problem
Verification:	Home project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	

Description of course

Code of course	ANW104	
Name of course	Engineering Physics	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering	
Coordinator of course	Hanna Jędrzejuk, PhD, Eng.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students	Lecture max: 150; Exercise max 30	
C. Effects of education and manner of teaching		
Purpose of course	Recollection of the basic laws and principles of the fields of physics being most important in the programme of our Faculty.	
Effects of education	See Table 8.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Mechanics: mass, momentum, moment of momentum, and energy conservation laws in translatory and rotary motion. Field theory: gravity field; electrostatic field; magnetic field. Thermodynamics: intensive quantities, perfect gas, gas processes; extensive quantities, first law of thermodynamics; thermodynamic cycles, second law of thermodynamics. Hydrodynamics: continuity law; Bernoulli equation.	
Methods of evaluation	Class attendance (exercises) and two tests in the middle and at the end of the semester, both tests have to be passed.	
Methods of verification of effects of education	See Table 8.	
Exam	no	
Literature	1. Halliday, D., Resnick, R., and Walker, J.: Fundamentals of Physics, John Wiley & Sons, Inc., 2001. 2. Young, H. D., and Freedman, R. A.: University Physics, Pearson Addison-Wesley, 2008.	
Website of the course	http://estudia.meil.pw.edu.pl/ (dostęp chroniony)	
D. Student's activity		
Number of ECTS credits	3	
Number of hours of student's work to achieve	1) Number of hours that require the presence of a	

Description of course

effects of education	teacher - 48, including: a) attendance at the lectures -15 hours; b) attendance at the exercises -30 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 20 hours; • preparing for tests - 10 hours; • preparing for final test - 10 hours. TOTAL – 88 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 48, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -30 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	

E. Additional information

Notes	Topics help in understanding the fundamentals of physics, and are the minimum in the course of further study.
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Table 8. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW104_W01**
Description:	The student knows the basic physical quantities, he/she is able to convert units, he/she can distinguish scalar and vector and can perform basic operations on them. The student understands the concept of a physical system can determine the fundamental interactions. The student knows and understands the basic principles and issues of the kinematics and dynamics of the motion (including simlified particle and a rigid body).
Verification:	Test 01
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW104_W01**
Description:	The student knows the basic physical quantities, he/she is able to convert units, he/she can distinguish scalar and vector and can perform basic operations on them. The student understands the concept of a physical system can determine the fundamental interactions. The student knows and understands the basic principles and issues of the kinematics and dynamics of the motion (including simlified particle and a rigid body).
Verification:	Test 01
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ANW104_W01**

Table 8. Learning outcomes	
Description:	The student knows the basic physical quantities, he/she is able to convert units, he/she can distinguish scalar and vector and can perform basic operations on them. The student understands the concept of a physical system can determine the fundamental interactions. The student knows and understands the basic principles and issues of the kinematics and dynamics of the motion (including simlified particle and a rigid body).
Verification:	Test 01
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW104_W02**
Description:	The student knows and understands the basic concept of the gravitational field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW104_W02**
Description:	The student knows and understands the basic concept of the gravitational field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ANW104_W02**
Description:	The student knows and understands the basic concept of the gravitational field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW104_W03**
Description:	The student knows and understands the basic concept of the electrostatic field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ANW104_W03**
Description:	The student knows and understands the basic concept of the electrostatic field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW104_W03**
Description:	The student knows and understands the basic concept of the electrostatic field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW104_W04**
Description:	The student knows and understands the basic concept of a magnetic field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W01

Table 8. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ANW104_W04**
Description:	The student knows and understands the basic concept of a magnetic field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ANW104_W04**
Description:	The student knows and understands the basic concept of a magnetic field.
Verification:	Test 01
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW104_W05**
Description:	Student distinguishes macroscopic and microscopic entensywne and extensive physical quantities sa well. He/she knows the concept of an ideal gas. He/she knows the basic law of the thermodynamics. He / she can distinguish the basic thermodynamic processes.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ANW104_W05**
Description:	Student distinguishes macroscopic and microscopic entensywne and extensive physical quantities sa well. He/she knows the concept of an ideal gas. He/she knows the basic law of the thermodynamics. He / she can distinguish the basic thermodynamic processes.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ANW104_W05**
Description:	Student distinguishes macroscopic and microscopic entensywne and extensive physical quantities sa well. He/she knows the concept of an ideal gas. He/she knows the basic law of the thermodynamics. He / she can distinguish the basic thermodynamic processes.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW104_W05**
Description:	Student distinguishes macroscopic and microscopic entensywne and extensive physical quantities sa well. He/she knows the concept of an ideal gas. He/she knows the basic law of the thermodynamics. He / she can distinguish the basic thermodynamic processes.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ANW104_W06**

Table 8. Learning outcomes	
Description:	The student knows the basic concepts and laws in hydrodynamics.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW104_W06**
Description:	The student knows the basic concepts and laws in hydrodynamics.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ANW104_W06**
Description:	The student knows the basic concepts and laws in hydrodynamics.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ANW104_W06**
Description:	The student knows the basic concepts and laws in hydrodynamics.
Verification:	Test 02
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ANW104_U01**
Description:	The student is able to identify basic physical quantities and distinguish the scalar and vector quantities.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U01**
Description:	The student is able to identify basic physical quantities and distinguish the scalar and vector quantities.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U01**
Description:	The student is able to identify basic physical quantities and distinguish the scalar and vector quantities.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U01**
Description:	The student is able to identify basic physical quantities and distinguish the scalar and vector quantities.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U02**
Description:	Student is able to define the analyzed system

Table 8. Learning outcomes	
	from the environment, and describe the processes taking place in it. He can also apply the laws of motion to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U02**
Description:	Student is able to define the analyzed system from the environment, and describe the processes taking place in it. He can also apply the laws of motion to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U02**
Description:	Student is able to define the analyzed system from the environment, and describe the processes taking place in it. He can also apply the laws of motion to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U02**
Description:	Student is able to define the analyzed system from the environment, and describe the processes taking place in it. He can also apply the laws of motion to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U03**
Description:	The student can determine the momentum, momemnt of momentum, moment of inertia and apply the appropriate conservation laws to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U03**
Description:	The student can determine the momentum, momemnt of momentum, moment of inertia and apply the appropriate conservation laws to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U03**
Description:	The student can determine the momentum, momemnt of momentum, moment of inertia and apply the appropriate conservation laws to solve

Table 8. Learning outcomes	
	engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U03**
Description:	The student can determine the momentum, momemnt of momentum, moment of inertia and apply the appropriate conservation laws to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U04.**
Description:	The student can describe the translational and rotational motion, and identify the potential energy. Has/she is able to use the energy conservation law to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U04.**
Description:	The student can describe the translational and rotational motion, and identify the potential energy. Has/she is able to use the energy conservation law to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U04.**
Description:	The student can describe the translational and rotational motion, and identify the potential energy. Has/she is able to use the energy conservation law to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U04.**
Description:	The student can describe the translational and rotational motion, and identify the potential energy. Has/she is able to use the energy conservation law to solve engineering problems.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U05**
Description:	Student can correctly interpretate the theory of the gravitational field and is able to use the knowledge in engineering issues.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U05**
Description:	Student can correctly interpretate the theory of the gravitational field and is able to use the

Table 8. Learning outcomes	
	knowledge in engineering issues.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U05**
Description:	Student can correctly interpretate the theory of the gravitational field and is able to use the knowledge in engineering issues.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U05**
Description:	Student can correctly interpretate the theory of the gravitational field and is able to use the knowledge in engineering issues.
Verification:	Test 01.
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U06**
Description:	The student is able to correctly interpret the phenomena in the electrostatic field and are able to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U06**
Description:	The student is able to correctly interpret the phenomena in the electrostatic field and are able to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U06**
Description:	The student is able to correctly interpret the phenomena in the electrostatic field and are able to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U06**
Description:	The student is able to correctly interpret the phenomena in the electrostatic field and are able to solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U07**
Description:	The student is able to correctly describe the phenomena occurring in the magnetic field, and solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U07**

Table 8. Learning outcomes	
Description:	The student is able to correctly describe the phenomena occurring in the magnetic field, and solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U07**
Description:	The student is able to correctly describe the phenomena occurring in the magnetic field, and solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U07**
Description:	The student is able to correctly describe the phenomena occurring in the magnetic field, and solve engineering problems.
Verification:	Test 01
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U08**
Description:	The student is able to determine the intensive physical quantities, and is able to distinguish macroscopic and microscopic description. He/she can use the ideal gas model, and can apply the Clapeyron's and Dalton's laws to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U08**
Description:	The student is able to determine the intensive physical quantities, and is able to distinguish macroscopic and microscopic description. He/she can use the ideal gas model, and can apply the Clapeyron's and Dalton's laws to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U08**
Description:	The student is able to determine the intensive physical quantities, and is able to distinguish macroscopic and microscopic description. He/she can use the ideal gas model, and can apply the Clapeyron's and Dalton's laws to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U08**
Description:	The student is able to determine the intensive physical quantities, and is able to distinguish macroscopic and microscopic description. He/she

Table 8. Learning outcomes	
	can use the ideal gas model, and can apply the Clapeyron's and Dalton's laws to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U09**
Description:	The student can describe the basic gas processes. He/she can determine the extensive physical quantities and has the ability to apply the first law of thermodynamics to solve the engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U09**
Description:	The student can describe the basic gas processes. He/she can determine the extensive physical quantities and has the ability to apply the first law of thermodynamics to solve the engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U09**
Description:	The student can describe the basic gas processes. He/she can determine the extensive physical quantities and has the ability to apply the first law of thermodynamics to solve the engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U09**
Description:	The student can describe the basic gas processes. He/she can determine the extensive physical quantities and has the ability to apply the first law of thermodynamics to solve the engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U10**
Description:	The student can describe the basic thermodynamic cycles, has the ability to use the second law of thermodynamics to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U10**
Description:	The student can describe the basic thermodynamic cycles, has the ability to use the second law of thermodynamics to solve

Table 8. Learning outcomes	
	engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U10**
Description:	The student can describe the basic thermodynamic cycles, has the ability to use the second law of thermodynamics to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U10**
Description:	The student can describe the basic thermodynamic cycles, has the ability to use the second law of thermodynamics to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ANW104_U11**
Description:	The student is able to describe the flow of fluids. He/she knows how to apply the continuity and Bernoulli's equations to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ANW104_U11**
Description:	The student is able to describe the flow of fluids. He/she knows how to apply the continuity and Bernoulli's equations to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ANW104_U11**
Description:	The student is able to describe the flow of fluids. He/she knows how to apply the continuity and Bernoulli's equations to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ANW104_U11**
Description:	The student is able to describe the flow of fluids. He/she knows how to apply the continuity and Bernoulli's equations to solve engineering problems.
Verification:	Test 02
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ANW104_K01**

Table 8. Learning outcomes	
Description:	The student is able to interpret correctly the basic concepts and apply the knowledge to solve engineering problems.
Verification:	Test 01, test 02.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ANW104_K01**
Description:	The student is able to interpret correctly the basic concepts and apply the knowledge to solve engineering problems.
Verification:	Test 01, test 02.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ANW104_K01**
Description:	The student is able to interpret correctly the basic concepts and apply the knowledge to solve engineering problems.
Verification:	Test 01, test 02.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	
Code of effect:	**ANW104_K01**
Description:	The student is able to interpret correctly the basic concepts and apply the knowledge to solve engineering problems.
Verification:	Test 01, test 02.
Field of study related learning outcomes	Aero1_K05
Area of study related learning outcomes	

Description of course

Code of course	ANW109	
Name of course	Environment Protection	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering	
Coordinator of course	Nikolaj Uzunow, PhD, Eng., assistant professor	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Secondary school certificate exam in physics and mathematics.	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	Basic knowledge of the environment protection problems.	
Effects of education	See Table 9.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Objectives of the environment protection policy. National, European, and global environment protection legal system. Human health vs. technical and economical problems. Mechanisms and instruments of the environment protection policy. Air protection. Greenhouse gases, European Trading System. Water and soil protection. Waste utilisation. Protection against noise and vibration. Radiation protection.	
Methods of evaluation	The assessment is based on two tests, held in the middle and at the end of the semester. The tests consist of several questions to be answered. Students have to obtain positive grades on both tests. The final grade is calculated as an average from the two tests.	
Methods of verification of effects of education	See Table 9.	
Exam	no	
Literature	Recommended texts (reading): No relevant issues.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	2	

Description of course

Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures-30 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 15 hours; • preparing for tests -10 hours. TOTAL: 58 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures-30 hours; b) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	

E. Additional information

Notes	
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Table 9. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW109_W1**
Description:	Student has knowledge about main areas of environmental protection (air, water, soil etc).
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ANW109_W2**
Description:	Student has knowledge about main pollutants of environment as well as sources of them.
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ANW109_W3**
Description:	Student has knowledge about climate changes.
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ANW109_W4**
Description:	Student has knowledge about the global worming and ozone depletion mechanisms.
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ANW109_W5**
Description:	Student has knowledge about fossil fuel power plants (one of the main sources of environmental pollution).
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ANW109_W6**
Description:	Student has knowledge about renewable energy sources.

Table 9. Learning outcomes	
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ANW109_U1**
Description:	Student is able to specify main areas of environmental protection and their pollutants as well as sources of them.
Verification:	Test.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ANW109_U2**
Description:	Student is able to specify impact of demographic and technical development on the environmental pollution.
Verification:	Test.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ANW109_U3**
Description:	Student is able to specify evidences of climate change.
Verification:	Test.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ANW109_U4**
Description:	Student is able to specify and describe types of fossil fuel power plant, renewable energy sources and nuclear power plants.
Verification:	Test.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**Test.**
Description:	Student is able to assess the impact of energy on the environment.
Verification:	ANW109_K1
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	

Description of course

Code of course	ANW 107	
Name of course	Materials I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering	
Coordinator of course	Piotr Czarnocki, PhD, Eng.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	To gain fundamental engineering knowledge about various structures of engineering materials to be able to understand their mechanical properties.	
Effects of education	See Table 10.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Important mechanical properties of metals and polymers definitions, measures and related most important tests. Background of material structure: crystal structures, defects and imperfections, polymer chains and polymerisation. Phase transformations and equilibrium diagrams. Heat treatment of ferrous metals, and aluminum and titanium alloys. Background of fiber reinforced composite materials. Corrosion and corrosion prevention.	
Methods of evaluation	100% assessment based on four tests.	
Methods of verification of effects of education	See Table 10.	
Exam	no	
Literature	1) Book 1: J.F. Shackelford, „Introduction to Material Science for Engineers”. 2) Book 2: W. D. Callister Jr., “Materials Science and Engineering An Introduction”.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve	1) Number of hours that require the presence of a	

Description of course

effects of education	teacher - 32, including: a) attendance at the lectures-30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 10 hours; • preparing for tests -16 hours. TOTAL: 58 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures-30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	

E. Additional information

Notes	
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Table 10. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW 107_W1**
Description:	He knows the characteristics of the main groups of materials, ie. metal, polymer, ceramic and composite materials including, among others, level indicators of strength, wear resistance and prices.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_W1**
Description:	He knows the characteristics of the main groups of materials, ie. metal, polymer, ceramic and composite materials including, among others, level indicators of strength, wear resistance and prices.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_W2**
Description:	He knows the relations between the structure of materials and their properties.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_W2**
Description:	He knows the relations between the structure of materials and their properties.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_W3**
Description:	Knows the specific characteristics of each group of materials and possibilities of their modification.

Table 10. Learning outcomes	
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_W3**
Description:	Knows the specific characteristics of each group of materials and possibilities of their modification.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW 107_U1**
Description:	Knows how on the basis of knowledge and literature sources to formulate the requirements for material for a specific application.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_U1**
Description:	Knows how on the basis of knowledge and literature sources to formulate the requirements for material for a specific application.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_U1**
Description:	Knows how on the basis of knowledge and literature sources to formulate the requirements for material for a specific application.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_U2**
Description:	He use databases of materials and use methodology of material selection.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_U2**
Description:	He use databases of materials and use methodology of material selection.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANW 107_U3**
Description:	He knows how to choose heat treatment for select group of materials.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	

Description of course

Code of course	ANW108	
Name of course	Mechanics I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering	
Coordinator of course	Elżbieta Jarzębowska, PhD, Eng.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	1 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Students are required skills in vector calculus.	
Limit of students	80 per lecture room	
C. Effects of education and manner of teaching		
Purpose of course	Let students acquire basics in theory in statics and acquire skills in numerical problems solving in statics.	
Effects of education	See Table 11.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Fundamental concepts and principles of statics. Equilibrium of a particle: forces in a plane and in space. Equilibrium of a rigid body in two and three dimensions: external and internal forces, reactions and constraints, equivalent systems of forces, moment of a force about a point and about an axis, reduction of a force system to one force and one couple (wrench). Statically determinate and indeterminate systems. Dry friction. Geometry of masses: centre of mass/gravity, areal and mass moments of inertia.	
Methods of evaluation	3 written tests during semester.	
Methods of verification of effects of education	See Table 11.	
Exam	no	
Literature	Recommended texts (reading): 1. Ferdinand P. Beer, E. Russell Johnston, Jr. (in last editions + three other co-authors): Vector Mechanics for Engineers STATICS, McGraw-Hill, Inc., any edition, last one 2004. 2.R.C. Hibbeler: Engineering Mechanics STATICS, Pearson, any edition, last one 2004. 3. Any academic textbook (engineering course) on General Mechanics, part: Statics. 4.	

Description of course

	Solving of problems, in addition to the above textbooks: 4a) Fogiel M. (editor): THE MECHANICS PROBLEM SOLVER. A Complete Solution Guide to Any Textbook. Redearch and Education Association (REA), 1992. 4b) COLLECTION OF PROBLEMS IN MECHANICS, in Russian, and in Polish as: I. Mieszczerski: ZBIÓR ZADAÑ Z MECHANIKI, PWN, many editions; solutions to this COLLECTION ... in German (author Neuber H., VEB Verlag, Berlin 1962, 1963) and in Polish as: Romuald Romicki: ROZWIĄZANIA ZADAŃ Z MECHANIKI ZBIORU I. W. MIESZCZERSKIEGO, PWN, many editions.
Website of the course	-

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 20 hours; • preparing for tests - 24 hours. TOTAL: 77 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

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Table 11. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW108_W1**
Description:	Acquired knowledge in: basic pronciples in statics, including force system types acting upon mechanical systems and methods of a force system reduction.
Verification:	Written tests.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ANW108_W2**
Description:	Students know basic methods of a mechanical system equilibrium determination for various types of supports and constraints.
Verification:	Written tests.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	

Table 11. Learning outcomes	
Code of effect:	**ANW108_W3**
Description:	Students learn how to generate free body diagrams and determination of equilibrium conditions for a mechanical system.
Verification:	Written tests.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ANW108_U1**
Description:	Students can reduce an arbitrary force system for a single force and a force/couple system.
Verification:	Written tests.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ANW108_U2**
Description:	Students can generate a free body diagram of a system and determine its equilibrium conditions.
Verification:	Written tests.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ANW108_U2**
Description:	Students can generate a free body diagram of a system and determine its equilibrium conditions.
Verification:	Written tests.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	

Description of course

Code of course	ANW112	
Name of course	Economics	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Administration and Social Sciences	
Coordinator of course	prof. dr hab. Janusz Gudowski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	HES Courses	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Communication in English.	
Limit of students	50	
C. Effects of education and manner of teaching		
Purpose of course	Learning the fundamental micr- and macroeconomics.	
Effects of education	See Table 12.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Economics as the science. The sense of processes of production. The ideas of wealth and its sources. The sense of value. The essence of economic growth. Quantitative and qualitative aspects of economic growth. The level of life. The idea of development. Notions: market-supply-demand; elasticities measures; types of goods, the theory of consumer. Types of market; theory of competition; the state contribution to market economy. Genesis of contemporary macroeconcs. The conflict between demand and neoliberal approach. The essence of the main today’s schools of economics. The main research interest in contemporary economics. Searching the new paradigm. Neoclassical, post-Keynes and institutional economics. Development economics. Ecologic approach in economics.	
Methods of evaluation	Colloquium.	
Methods of verification of effects of education	See Table 12.	
Exam	no	
Literature	P.A. Samuelson, W.D. Nordhaus, Introduction to economics (latest issue).	
Website of the course	www.wains.pw.edu.pl	

Description of course

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 31, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 1 hours. 2) The number of hours of independent work of student: studying literature; preparing presentation of selected issue; preparing to final test - 20 hours. TOTAL: 51 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number of hours that require the presence of a teacher - 31, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 1 hours.
Number of ECTS credits on practical activities on the course	-

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Table 12. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW112_W01**
Description:	Student gets basic knowledge necessary to understand social, economic, legal and other non-technical conditions of engineering.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ANW112_U01**
Description:	Student may use an information coming from d-base or other sources, also in English, may interpret data, make conclusions and judgemenst.
Verification:	Presentation of selected topic.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

General academic profile - social competences

Code of effect:	**ANW112_K01**
Description:	Student understands the need for continuous learning to enlarge professional and personal competences. Students is conscious of responsibility in joint tasks.
Verification:	Presentation, discussion
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ANW112_K01**
Description:	Student understands the need for continuous learning to enlarge professional and personal competences. Students is conscious of responsibility in joint tasks.

Table 12. Learning outcomes	
Verification:	Presentation, discussion
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ANHES_2	
Name of course	HES 12	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Administration and Social Sciences.	
Coordinator of course	Academic teachers of the Faculty of Administration and Social Sciences. Detailed data contains syllabus of specific course.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	HES Courses	
Type of course	Elective	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Detailed data contains syllabus of specific course.	
Limit of students	Detailed data contains syllabus of specific course.	
C. Effects of education and manner of teaching		
Purpose of course	Detailed data contains syllabus of specific course.	
Effects of education	See Table 13.	
Form of didactic studies and number of hours per semester	Lecture	450h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Detailed data contains syllabus of specific course.	
Methods of evaluation	Detailed data contains syllabus of specific course.	
Methods of verification of effects of education	See Table 13.	
Exam	no	
Literature	Detailed data contains syllabus of specific course.	
Website of the course	Detailed data contains syllabus of specific course.	
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	Number of hours that require the presence of a teacher ~30 lectures. The number of hours of independent work of student ~30.	
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit - number of hours that require the presence of a teacher ~30 lectures.	
Number of ECTS credits on practical activities on the course	Detailed data contains syllabus of specific course.	
E. Additional information		
Notes	Specific learning outcomes are defined for the chosen course.	
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Table 13. Learning outcomes

General academic profile - social competences

Table 13. Learning outcomes	
Code of effect:	**Detailed data contains syllabus of specific course.**
Description:	Detailed data contains syllabus of specific course.
Verification:	Detailed data contains syllabus of specific course.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**Detailed data contains syllabus of specific course.**
Description:	Detailed data contains syllabus of specific course.
Verification:	Detailed data contains syllabus of specific course.
Field of study related learning outcomes	Aero1_K05
Area of study related learning outcomes	

Description of course

Code of course	ANJ1/ANPL1	
Name of course	Foreign/Polish Language 1	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	The Foreign Language Centre.	
Coordinator of course	mgr Marta Szpak	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Languages	
Type of course	Compulsory	
Language of course	polski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students	12-24	
C. Effects of education and manner of teaching		
Purpose of course	Achieving general competence in Polish at the A1 level, in particular the following language skills: listening comprehension of numerals, politeness structures and simple questions. Interaction in the social context. Ability to write simple words in Polish. Attempting to use the language in everyday life. Maintaining contact - nie rozumiem, proszę powtórzyć, proszę mówić wolniej. After completing his course the students will be able to: introduce themselves (name, surname, country), make contact (Cześć, jak się masz?), read in Polish and pronounce all sounds quite correctly. They will know numerals to 1000, basic politeness structures, names of most common food products. They will be able to ask for directions, do basic shopping.	
Effects of education	See Table 14.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Greetings, my name is..., etc. 2. Alphabet, pronunciation exercises, social phrases. 3. Formal and informal social phrases in Polish. 4. Numbers 1-20, words and phrases useful in the city, phonetic exercises. 5. At the airport, greetings-continuation. 6. How are you? Maintaining conversation. 7. Spelling. Asking to repeat and speak slowly. 8. Phonetic exercises. Days of the week, numbers 20-100. 9. Asking for directions,	

Description of course

	part 1: names of buildings at WUT, basic academic language (dean’s office, department etc.). 10. At a photocopy centre, topping up a mobile phone. 11. Numbers 100-1000, exercises: what’s your phone number, simple mathematical operations. 12. Classroom language, numbers – practice. Phonetic exercises. 13. Numbers 100-1000 - practice. 14. Personal details. Documents. 15. Verb to be and personal pronouns. 16. The conjugation –m, -sz. 17. Giving the personal details and address. 18. At a party – words and expressions, polite requests, verbs to eat, to drink.. 19. Revision: numbers, greetings, social language. 20. Names of objects in the city, directions. 21. Asking for directions – vocabulary, dialogue. Verb to know. 22. Asking for giving directions – practising. 23. Grammar: gender of nouns. 24. Names of basic food products. 25. Specifics of the Polish cuisine – presentation. 26. What is it? Fruits and vegetables. 27. Asking for food products. 28. Revision. 29. Mid-term test. 30. Mid-term test.
Methods of evaluation	Attendance (two absences are allowed). Passing all tests. Completing 90 % of homework assignments. In-class participation. Passing the module test (weight of the mark for the module test in the final grade: 50%).
Methods of verification of effects of education	See Table 14.
Exam	no
Literature	Recommended texts: Obligatory: Piotrowska-Rola E. Porębska M., Polski jest cool, Lublin 2013 Supplementary materials: 1. Kowalska M., Polish in 4 weeks REA, Warszawa 2009 2. Lachowicz J., Podsiadły J., Ten, ta, to. Ćwiczenia nie tylko gramatyczne dla cudzoziemców, wyd. WING 2001 3. Machowska J., Gramatyka? Dlaczego nie?! Ćwiczenia gramatyczne dla poziomu A1, Universitas, Kraków 2010, 4. Madelska L., Discovering Polish. A Learner's Grammar / Polnisch entdecken. Eine Lerngrammatik / Odkrywamy język polski. Gramatyka dla uczących (się) języka polskiego jako obcego, Prolog, Kraków 2008 5. Polish for foreigners. Audio Course (CD), Warszawa, Edgard 2006 6. Seretny A., A co to takiego? Obrazkowy słownik języka polskiego, Universitas, Kraków 2008 http://www.oneness.vu.lt/ www.poland.gov.pl http://e-polish.eu/main/dictionary/definition.html www.e-polish.eu
Website of the course	http://www.sjo.pw.edu.pl/anglojez_info_en.php

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the

Description of course

	exercises - 30 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 15 hours; • work on homework (solving tasks) – 15 hours. Total -2 ECTS credits.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit.
Number of ECTS credits on practical activities on the course	2 ECTS credits.

E. Additional information

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Table 14. Learning outcomes

General academic profile - knowledge

Code of effect:	**W_1**
Description:	Has a very basic resource of words and simple expressions related to personal and individual, specific situations. Shows limited mastery of a few simple grammatical structures and sentence patterns.
Verification:	Work on the lesson, homeworks, test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**U_1**
Description:	Student can fill out forms with personal data as name, address, citizenship. Student can write with hearing unknown word. The student understands the familiar names and words and very simple sentences,for example. on the information boards on the shops and facilities of general interest. The student can take part in the conversation, provided that other person talks slowly and reiterates its of expression. Student is able to pronounce the Polish sounds.
Verification:	Assessment of the work of the student as part of lesson
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**U_1**
Description:	Student can fill out forms with personal data as name, address, citizenship. Student can write with hearing unknown word. The student understands the familiar names and words and very simple sentences,for example. on the information boards on the shops and facilities of general interest. The student can take part in the conversation, provided that other person talks slowly and reiterates its of expression. Student is able to pronounce the Polish sounds.
Verification:	Assessment of the work of the student as part of

Table 14. Learning outcomes	
	lesson
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	

Description of course

Code of course	ANWF2	
Name of course	Physical Education and Sport 2	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	College of Physical Education and Sport.	
Coordinator of course	Teacher at College of Physical Education and Sport.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Physical Education and Sports	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	The development of physical activity of students. Detailed data contains syllabus of specific course.	
Effects of education	See Table 15.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The exercise program offer by College of Physical Education and Sport.	
Methods of evaluation	According to the rules of classes developed by College of Physical Education and Sport.	
Methods of verification of effects of education	See Table 15.	
Exam	no	
Literature	-	
Website of the course		
D. Student’s activity		
Number of ECTS credits	0	
Number of hours of student’s work to achieve effects of education	Participation in classes - 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0.0 ECTS credit (30 hours of classes, without ECTS).	
Number of ECTS credits on practical activities on the course	-	
E. Additional information		
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Table 15. Learning outcomes

Description of course

Code of course	ANW90	
Name of course	Calculus II	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Mathematics and Information Science	
Coordinator of course	Andrzej Fryszkowski, Professor	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Calculus I	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	1. To convey and reinforce the knowledge on definite integrals (proper and improper) and their applications, series (numeric and functional), functions of many variables (sets, limits and continuity, multivariable calculus), ordinary differential equations, Frenet trihedron, line and surface integrals, Green, Stokes and Gauss Theorems. 2. To acquire thorough understanding of basic concepts and computational processes and to master skills of using them (labs) and to master the skill of correct mathematical reasoning and inference.	
Effects of education	See Table 16.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	First order ordinary differential equation. General and particular solutions. Initial value conditions. Existence and uniqueness. Separable equation and transformation a differential equat ion to that form. Linear equations of the first order. General solution. Solving nonhomogenous linear differential equations by the method of integrating factor and the method of variation of a parameter. Linear equations of the higher order. General and particular solutions. Initial value problems. Linear equation of the second order transformable to equation of the first order. Method of trial functions for nonhomogenous equation of the m-	

Description of course

	th order with constant coefficients. Double integral on a rectangle; integrability theorem. Mean value and integral mean value theorem. Double integral and iterated integral. Double integral on a standard domain. The Fubini theorem. Change of variable in a double integral. Region mapping: Jacobian determinant. Double integral in polar coordinates. Application of double integral to computation of areas and volumes of figures and solids. Double integral application: surface area of a frustum. Triple integral on parallelepiped. Fubini theorem for triple integral on standard solids (standard 3D domains). Changing of variables. Geometric application of a triple integral - volumes of solids, centers of mass. Line integrals. Green Theorem. Potentials. Work of a vector field.
Methods of evaluation	50% continuous assesment based on laboratory work and tests, 50% written final exam.
Methods of verification of effects of education	See Table 16.
Exam	yes
Literature	Recommended texts (reading): 1. Thomas “Calculus” 2. Robert A. Adams, Calculus. A complete course 3. Thomas G. Finney: Calculus, ed. Addison-Wesley.
Website of the course	

D. Student’s activity

Number of ECTS credits	5
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 64, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 4 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 41 hours; • work on homework (solving tasks) – 10 hours; • preparation for written tests – 15 hours; • preparation for the final examination – 15 hours. TOTAL – 145 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2,5 ECTS credits – number of hours that require the presence of a teacher - 34, including: a) attendance at the lectures- 30 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 4 hours.
Number of ECTS credits on practical activities on the course	-

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Table 16. Learning outcomes

General academic profile - knowledge

Code of effect:	**ANW90_W1**

Table 16. Learning outcomes	
Description:	Student knows theoretical foundations of the theory of ordinary differential equations.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW90_W2**
Description:	Student knows methods of solution of 1st-order ODEs and n-th order linear ODEs.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW90_W3**
Description:	Student knows selected solution methods for systems of ODEs, in particular the elimination and matrix methods.
Verification:	Exam
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW90_W4**
Description:	Student has essential knowledge in the area of integral calculus of functions with 2 or 3 variables. Student knows applications of double and triple integrals in geometry and physics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ANW90_W5**
Description:	Student has basic knowledge about curvllinear integrals and their applications in geometry and physics. Student knows basic concepts in vector analysis.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ANW90_U1**
Description:	Student can solve basic 1st-order ODEs and investigate uniqueness of the solution of the Cauchy problem.
Verification:	Activity/progress during tutorials. Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW90_U2**
Description:	Student has skills to determine the fundamental system for an ODE with constant coefficients and the Euler equation. Student can use the prediction method and the method of variation of parameters.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW90_U3**
Description:	Student can solve a system of linear ODEs using

Table 16. Learning outcomes	
	the method of elimination and/or the matrix method.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW90_U4**
Description:	Student can evaluate double and triple integrals, also using the polar and spherical coordinates.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ANW90_U5**
Description:	Student can calculate curvilinear integrals and applied them in geometry and physics. Student can determine the potential of a vector field and use it in evaluation of the oriented curvilinear integral.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ANW90_K1**
Description:	Student is aware of necessity of self-study and thoroughness and exactitude.
Verification:	Homework, exam.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	

Description of course

Code of course	ANW114	
Name of course	Computer Science II	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr hab. inż. Jacek Szumbarski, prof.PW	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Basic skills in algebra and mathematical analysis on the level corresponding to the 1st-semester engineering courses, basic programming skills in C or C++.	
Limit of students	60	
C. Effects of education and manner of teaching		
Purpose of course	Development of basic knowledge and practical skills in the area of numerical techniques applied to the problems like: post-processing of measurement data and numerical analysis of simple dynamical systems	
Effects of education	See Table 17.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	15h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Contents (lectures programme): Polynomial interpolation: Lagrange and Newton methods, Runge effect and Chebyshev nodes. 2. Least-squares approximation: formulation and geometrical interpretation, the method of normal equations, the method of orthogonal polynomials. 3. Numerical integration: the trapezoidal and Simpson methods, the Gauss-Legendre method. 4. Numerical solution of initial-value problems for ordinary differential equations: transformation to the standard form, the Euler method and convergence analysis, single-step higher-order methods, the standard RK4 method, problem of the time step adaptation. 5. Cubic spline interpolation: formulation, end-point conditions, 3-diagonal systems and the Thomas algorithm. Method of Gauss Elimination: formulation, method	

Description of course

	with pivoting, LU factorization and its applications.
Methods of evaluation	2 tests on theoretical part, work and progress of each student are evaluated in the framework of the point system, individual semester project.
Methods of verification of effects of education	See Table 17.
Exam	no
Literature	Recommended texts (reading): 1. Lecture notes provided by the course instructor. 2. Heinbockel J.H.: Numerical methods in Scientific Computing. Trafford Publishing, 2006. 3. Numerical Recipes in C++, 3rd Ed., Cambridge UP, 2007.
Website of the course	Didactic materials at http://c-cfd.meil.pw.edu.pl/ccfd/index.php?item=6 (restricted access)

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures -14 hours; b) attendance at the labs - 16 hours; c) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • preperation to each laboratory meeting - 7*1h = 7h; • preperation for the tests (2 during the course) - 2*5 h = 10h; • work on the individual home project and report - 10 h. TOTAL: 59 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.5 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures-14 hours; b) attendance at the labs - 16 hours; c) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	1.5 ECTS credits.

E. Additional information

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Table 17. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK114_W1**
Description:	Student has elementary knowledge about formulation and solution methods of polynomial interpolation and approximation problems. Student knows the concept of interpolation by spline functions.
Verification:	Tests 1 and 2, lab tutorial.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_W2**
Description:	Student is acquainted with the basic numerical algorithms for approximate evaluation of determined integrals.
Verification:	Test 1, lab ex. 2.

Table 17. Learning outcomes	
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_W3**
Description:	Student has basic knowledge in the area of elementary algorithms applied to a nonlinear algebraic equation and to systems of linear equations (elimination methods).
Verification:	Tests 1 and 2, lab ex. 3 and 6.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_W4**
Description:	Student has acquired elementary knowledge related to concepts and basic numerical techniques applied to initial value problems formulated for ordinary differential equations.
Verification:	Test 2, lab ex. 4 and 5.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK114_U1**
Description:	Student is able to describe nasic features of known algorithms and illustrate them using adequate examples .
Verification:	Tests 1 and 2.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_U2**
Description:	Using provided library routines, a student is able to implement selected numerical algorithms in the form of computer codes written in a high-level programming language.
Verification:	Lab meetings, evaluation of a home project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_U3**
Description:	Using a provided programming environment, a student is able to run the computer codes implementing selected numerical algorithms and to verify correctness of the obtained results.
Verification:	Lab meetings, evaluation of a home project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_U4**
Description:	Student has skills to solve by him/herself a simple problem in the area of scientific computing or mechanics, perform critical analysis of an obtained solution and prepare a report in an electronic form.
Verification:	Lab meetings, evaluation of a home project.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK114_U4**
Description:	Student has skills to solve by him/herself a simple problem in the area of scientific

Table 17. Learning outcomes	
	computing or mechanics, perform critical analysis of an obtained solution and prepare a report in an electronic form.
Verification:	Lab meetings, evaluation of a home project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW 113	
Name of course	Electric Circuits I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. Tadeusz Skoczkowski, Ph.D., El. Eng.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Mathematics, Physics.	
Limit of students	The lecture - 60 students, exercises - 30 students.	
C. Effects of education and manner of teaching		
Purpose of course	To be able to use fundamental laws of linear electric circuits to solve electric dc ac circuits. Know how to analyse electric circuits containing independent and dependent sources using loop and nodal techniques. Know how to analyse electric circuits using additional techniques e.g. superposition, source transformation, Thevenin and Norton equivalent circuits. To get familiar with calculation of electric power and energy in dc and ac electric circuits. To be able to analyse first- and second order transient circuits. To understand variable-frequency performance of basic elements, resonant circuits and passive filters.	
Effects of education	See Table 18.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Basic concepts of electric field and magnetic field. Role of Electromagnetic Field Theory. Electromagnetic Field Quantities. Properties of Electrostatic Fields. Gausss Law. Conservation Law. Electric Potential. Electric Fields for a System of Charges. Capacitance. Dielectrics. Electric Flux Density. Electric Potential for a System of Charges. Electrostatic Energy. Magnetic Force. Magnetostatics in Free Space. Magnetic Vector Potential. Biot-Savart Law. Faradays Law of Induction. Time Harmonic Fields. Basic Electric Circuit Concept. System of Units. Basic Quantities.	

Description of course

	Circuit Elements. Analysis of Resistive Circuits. Element Constraints. Connection Constraints. Combined Constraints. Ohms Law. Kirchhoffs Laws. Single Loop Circuits. Single-Node-Pair Circuits. Circuits with Series Parallel Combinations of Resistor. Wye-Delta Transformation. Circuit Reduction. Equivalent Circuits. Voltage and Current Division.. Circuits with Dependant Sources. Resistors for Electronics. Computer-Aided Circuit Analysis. Loop and Nodal Techniques. Nodal analysis. Loop analysis. Additional Techniques. Superposition. Network. Linearity Properties. Thevenins and Nortons Theorems. Maximum Power Transfer. Signal Waveforms. Step Waveform. Exponential Waveform. Sinusoidal Waveform. Composite Waveforms. Waveform Partial Descriptors. Energy Storage Elements. Capacitors. Inductors. Capacitors and Inductors Combinations. Equivalent Capacitance and Inductance. Analysis of First- and Second-Order Transient Circuits. First-Order Circuits. RC and RL Circuits. First-Order Circuit Step Response. Initial and Final Conditions. First-Order Circuit Sinusoidal Response. Second-Order Circuits. Series RLC Circuit. Parallel RLC Circuit. Second-Order Circuit Step Response. Other Second-Order Circuits. AC Circuits Analysis Techniques. Sinusoids. Sinusoidal and Complex Forcing Function. Phasors. Phasor Relationship for Circuits Elements. Impedance. Admittance. Phasor Diagrams. Basic analysis Using Kirchhoffs Laws. Analysis Techniques. Power Calculations in AC Circuits. Instantaneous Power. Average Power. Maximum Average Power Transfer. RMS Values. Power Factor. AC Power. Complex Power. Power Factor Correction. Single-Phase Three-Wire Circuits. Home Power. Poly-Phase Circuits. Resonant Circuits. Analysis of Magnetically Coupled Networks. Mutual Inductance. Dot Convention. Energy Analysis. Ideal Transformer. Transformer Equivalent Circuits. Analysis of Three-Phase Circuits. Three-Phase Circuits. Three-Phase Connections. Power Relationship. Power Factor Correction. Variable-Frequency Circuits. Variable-frequency-Response Analysis. Sinusoidal Frequency Analysis. Bode Plots. Resonant Circuits. Passive Filters. Electrical Safety Considerations. Electric shock protection.
Methods of evaluation	Two colloquia, final examine.
Methods of verification of effects of education	See Table 18.
Exam	yes
Literature	Recommended texts (reading): 1. Irwin J. D., Nelms R. M.: Basic Engineering Circuit Analysis, Willey, 9th edition. Further Readings: 1. Griffiths

Description of course

	D.J.: Introduction to Electrodynamics, Prentice Hall, 3rd edition. 2. Dorf R.C., Svoboda J.A.: Introduction to Electric Circuits, 7th edition. 3. Svoboda J.A.: Worked Examples from the Electric Circuit Study Applets, Willey, 2006. 4. Thomas R. E., Rosa A.J., Toussaint G.J.: The Analysis and Design of Linear Circuits, Willy, 2009, 6th edition.
Website of the course	http://estudia.meil.pw.edu.pl/

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 50, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student: • work on homework (solving tasks) – 10 hours; • preparation for colloquia – 10 hours; • preparation for the final examination – 5 hours. TOTAL: 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 50, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	

E. Additional information

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Table 18. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK113_W1**
Description:	Student has the knowledge on how to apply mathematics, basic sciences, and engineering to solve problems encompassing electric circuits.
Verification:	Colloquium 1. Colloquium 2. Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK113_W2**
Description:	Student knows how to formulate and describe in mathematical terms problems related to electric and magneticts circuits.
Verification:	Colloquium 1. Colloquium 2. Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK113_W3**
Description:	Student knows how to apply the fundamental laws of electric circuit to compute basic electric quantities (current, voltage, powers).
Verification:	Colloquium 1. Colloquium 2. Exam.
Field of study related learning outcomes	Aero1_W02

Table 18. Learning outcomes	
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK113_U1**
Description:	Student has the ability to apply knowledge of mathematics, basic science, and engineering to solve problems encompassing electric circuits.
Verification:	Colloquium 1. Colloquium 2. Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK113_U2**
Description:	Student has the ability to identify and formulate a problem related to electric circuits.
Verification:	Colloquium 1. Colloquium 2 Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK113_U3**
Description:	Student has the ability to apply the fundamental laws of electric circuit to compute basic electric quantities (current, voltage, powers).
Verification:	Colloquium 2. Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK113_U3**
Description:	Student has the ability to apply the fundamental laws of electric circuit to compute basic electric quantities (current, voltage, powers).
Verification:	Colloquium 2. Exam.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW118	
Name of course	Engineering Graphics – CAD1	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr inż. Witold M.Mirski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Base information concerning the orthogonal projection of spatial geometrical forms onto adequate projection plane (Engineering Graphics).	
Limit of students	Group of 12 students for one teacher.	
C. Effects of education and manner of teaching		
Purpose of course	The skill of making views of machines element based on the real object according to the rules of International Standards (ISO) and reading of the technical drawing.	
Effects of education	See Table 19.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Introduction to technical drawing. Part view and axonometric projection of machines element based on the real object. Technical drawing of assemblies and parts with thread. Threaded and keyed joints. Technical drawing of gears. Assembly drawing of machines elements based on the real object. Part views based on assembly drawing. Introduction to CAD-2D system. Enjoyment of the computer library of CAD-2D system.	
Methods of evaluation	Positive results of tests as well as home and class work.	
Methods of verification of effects of education	See Table 19.	
Exam	no	
Literature	1. George C. Beakley, Ernst G. Chilton Introduction to Engineering Design and Graphics. 2. International Standards (Polish Standards).	
Website of the course	http://www.meil.pw.edu.pl/zpk/ZPK/Dydaktyka/	
D. Student’s activity		

Description of course

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 10 hours; • work on homework – 10 hours; • preparation for tests – 4 hours; TOTAL – 56 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credits - 56 hours, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 10 hours; • work on homework – 10 hours; • preparation for tests – 4 hours.

E. Additional information

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Table 19. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW118_W1**
Description:	Student knows the rules of the working detail drawing.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_W2**
Description:	Student knows the rules of the surface roughness notation.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_W3**
Description:	Student understands the necessity of using Polish Standards for the Technical Drawing and ISO Standards.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_W4**
Description:	Student knows the rules of the working assembly drawing.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_W5**

Table 19. Learning outcomes	
Description:	Student has the basic knowledge of creating the documentation using 2D-CAD systems.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW118_U4**
Description:	Student can make an assembly drawing.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_U1**
Description:	Student is able to make the working detail drawing from nature.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_U2**
Description:	Student can use Polish Standards and ISO Standards.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_U3**
Description:	Student is able to make the technical drawing of the thread joint, keyed joint and gear joint.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_U5**
Description:	Student is able to make a detail drawing based on an assembly drawing.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANW118_U6**
Description:	Student can make a detail drawing using a 2D-CAD system.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW115	
Name of course	Mechanics II	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Elżbieta Jarzębowska, prof. PW	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Students are required some basic skills in differential calculus.	
Limit of students	80 per lecture room	
C. Effects of education and manner of teaching		
Purpose of course	The goal is to teach students basic theory in vector mechanics, i.e. basics in kinematics and dynamics, as well as formulating and solving numerical problems in these areas.	
Effects of education	See Table 20.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Kinematics (geometry of motion): equations of motion of a particle in various reference frames. Motions of a rigid body: translation; rotation about a fixed axis; plane motion, including motion of a particle relative to a moving frame. Dynamics (Kinetics): dynamic equations of motion of a particle in various reference frames. Concepts of linear and angular momentum and theorems about the rate of change of linear momentum and angular momentum. Concept of energy of a particle, a system of particles and a rigid body. Dynamic equations of translation, rotation about a fixed axis, and plane motion for a rigid body. Determination of dynamic reactions in rotation about fixed axes.	
Methods of evaluation	3 written tests during semester and a final written exam.	
Methods of verification of effects of education	See Table 20.	
Exam	yes	
Literature	Recommended texts (reading): 1. Ferdinand P.	

Description of course

	Beer, E. Russell Johnston, Jr. (in last editions + three other co-authors): Vector Mechanics for Engineers STATICS, McGraw-Hill, Inc., any edition, last one 2004. 2. R.C. Hibbeler: Engineering Mechanics STATICS, Pearson, any edition, last one 2004. 3. Any academic textbook (engineering course) on General Mechanics, part: Statics. 4. Solving of problems, in addition to the above textbooks: 4a) Fogiel M. (editor): THE MECHANICS PROBLEM SOLVER. A Complete Solution Guide to Any Textbook. Redearch and Education Association (REA), 1992. 4b) COLLECTION OF PROBLEMS IN MECHANICS, in Russian, and in Polish as: I. Mieszczerski: ZBIÓR ZADAŃ Z MECHANIKI, PWN, many editions; solutions to this COLLECTION ... in German (author Neuber H., VEB Verlag, Berlin 1962, 1963), and in Polish as: Romuald Romicki: ROZWIĄZANIA ZADAŃ Z MECHANIKI ZBIORU I. W. MIESZCZERSKIEGO, PWN, many editions.
Website of the course	-

D. Student’s activity

Number of ECTS credits	5
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 64, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 4 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 30 hours; • preparing for tests -24 hours; • Preparing for exam -15 hours. TOTAL: 133 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2,5 ECTS credits – number of hours that require the presence of a teacher - 64, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -30 hours; c) consultancy meetings - 4 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 20. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW115_W1**
Description:	Students get knowledge in enegry methods of analysis of dynamics of a particle, set od particles and a rigid body.
Verification:	Written test, exam.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	

General academic profile - skils

Table 20. Learning outcomes	
Code of effect:	**ML.ANW115_U1**
Description:	Students can determine kinematic characteristics for particles and rigid bodies w.r.t. inertial and non-inertial frames.
Verification:	Written test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW115_U2**
Description:	Students can generate physical and mathematical models of simple mechanical systems.
Verification:	Written test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW115_U3**
Description:	Students can determine potential and kinetic energies of parts of a mechanical system and determine their velocities and positions based upon the energy information.
Verification:	Written test, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW115_U3**
Description:	Students can determine potential and kinetic energies of parts of a mechanical system and determine their velocities and positions based upon the energy information.
Verification:	Written test, exam.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW115_K1**
Description:	Students get understand the place of knowledge and resarch, and the role of an engineer in society.
Verification:	Written test.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ML.ANW115_K1**
Description:	Students get understand the place of knowledge and resarch, and the role of an engineer in society.
Verification:	Written test.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW117	
Name of course	Mechanics of Structures I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr inż. Jakub Pawlicki	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Mechanics I - Statics.	
Limit of students	min 15	
C. Effects of education and manner of teaching		
Purpose of course	To learn fundamentals of deformable bodies mechanics: stress, strain, material behavior as a introduction to structural analysis and design for static loads. Presenting concepts of statical structural analysis: equilibrium conditions, stress-strain relation (Hookes law) and structure deformation. Develop knowledge for strength analysis of one-dimensional structures in basic load cases: tension-compression, torsion and bending.	
Effects of education	See Table 21.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Introduction: material solid, concepts of mechanics of structures: equilibrium, deformation behavior models. Fundamentals: internal and external forces, stresses strains and displacements. Idealization of the material (elastic, plastic, elastic-plastic,, visco elastic, visco-plastic), idealization of the structure and idealization of the geometry of strains. General principles of structural analysis. Analysis of stresses and strains. General Hookes low, plane stress and plane strain. Safety criteria: Huber-Mises criterion, maximum shear-stress criterion, concept of equivalent stress. Geometric properties of plane areas: moment of inertia, polar moment of inertia, product of inertia. One-dimensional	

Description of course

	problems of linear structures: tension and compression, torsion and bending of bars. Determination of stresses and displacements, safety evaluation. Elastic buckling of columns.
Methods of evaluation	Tests, home works, examination.
Methods of verification of effects of education	See Table 21.
Exam	yes
Literature	Recommended texts (reading): 1) Roy Craig Jr. “Mechanics of Materials”. 2) John Hearn “Mechanics of Structures”. 3) Documentation on http:// - Will be provided by lecturer. Further Readings: - Will be provided by lecturer.
Website of the course	-

D. Student’s activity

Number of ECTS credits	4
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 50, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student • systematic preparation for classes - 15 hours; • work on homework – 24 hours; • preparation for tests – 12 hours; • preparation for exam – 10 hours. TOTAL: 111 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 50, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	-

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Table 21. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW117_W1**
Description:	Well-grounded in mechanics of solids.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_W2**
Description:	Well-grounded in mechanics and stress analysis of beam and bar structures.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_W3**
Description:	Fundamentals of column buckling.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_W05

Table 21. Learning outcomes	
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW117_U4**
Description:	Computation of displacement field for bar and beam structures.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_U4**
Description:	Computation of displacement field for bar and beam structures.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_U1**
Description:	Representing real structures by beam and bar models.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_U2**
Description:	Determining force resultants distributions for beam and bar structures.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_U3**
Description:	Applying strength hypothesis. Computation of equivalent stress. Checking stress condidtion.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW117_U5**
Description:	Computation of critical loads of column structures by linear buckling analysis.
Verification:	Tests, home works, examination.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW116	
Name of course	Thermodynamics I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. dr hab. inż. Piotr Furmański	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	2 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Basic calculus.	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	Knowledge of basic laws governing energy conversion and ways to determine quality of different energy conversion processes. Knowledge of the fundamentals of thermodynamics applied to combustion processes.	
Effects of education	See Table 22.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Lecture: Thermodynamic system and its properties, thermodynamic functions, irreversible and reversible transformations,microscopic and macroscopic energy, internal energy. Energy interactions (work, heat, energy exchange accompanying mass flow). Enthalpy. 1st Law of Thermodynamics for open system. Special cases (closed system, steady state, cycles). Thermal efficiency of engines and Coefficent of performance (COP) for refrigerators and heat pumps. Entropy and its features. Balance of entropy for open systems. Entropy generation and 2nd Law of Thermodynamics. Carnot cycle. Thermodynamic equilibrium and its types. Conditions for thermal, mechanical and phase equilibrium. Chemical potential. Simple substance. Diagrams of state. Thermal expansion and isothermal compressibility. Thermodynamic functions for simple substances. Special cases of simple substances (incompressible substance,	

Description of course

	perfect gas). Thermodynamic functions for incompressible substances and perfect gases. Specific heats of the perfect gases. Characteristic transformations of perfect gases (polytropic process,throttling). Fundamentals of thermodynamics in combustion. Stoichiometric and nonstoichiometric reactions. Air excess ratio. Mass balance of reactants. Standard state. Thermal effects of combustion. Exercises: Examples of thermodynamic analysis of processes based on the 1st Law of Thermodynamics. Determination of a system state after transformations as well as amount and form of energy exchanged between the system and the surroundings. Calculation of efficiency of different engine cycles and COP of refrigerators and heat pumps. Examples of thermodynamic analysis based on the entropy balance. Thermodynamic transformations in systems containing incompressible substances, vapours and perfect gases. Determination of an amount of air needed for combustion, composition of combustion products and the maximum temperature of combustion.
Methods of evaluation	4 tests, practical and theoretical exams, point system.
Methods of verification of effects of education	See Table 22.
Exam	yes
Literature	Recommended texts (reading): 1) Y.A. Cengel, M.A. Boles: “Thermodynamics. An Engineering Appproach, McGraw Hill. 2) Materials for students placed on website.
Website of the course	www.itc.pw.edu.pl

D. Student’s activity

Number of ECTS credits	5
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 63, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student: • systematic preparation for classes (tasks solving) - 20 hours; • preparation for tests – 20 hours; • preparation for exam – 15 hours. TOTAL: 118 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2,5 ECTS credits – number of hours that require the presence of a teacher - 63, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Description of course

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Table 22. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW116_W1**
Description:	The student acquires knowledge about relations between thermodynamic functions a measurable thermodynamic properties.
Verification:	Written tests, exam.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANW116_W2**
Description:	The student knows balances of energy, entropy, thermodynamic principles and ways of their application.
Verification:	Written tests, exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW116_W3**
Description:	He knows basic theoretical circulations of aircraft engines
Verification:	Written tests, exam.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANW116_W4**
Description:	He knows the ways of determining the thermodynamic functions describing substances.
Verification:	Written tests, exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANW116_U1**
Description:	The student is able to find in datebases values of properties and thermodynamic functions.
Verification:	Written tests, exam.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW116_U2**
Description:	The student is able to find in literature and inthernet information related to thermodynamic problems and energy conversion in different processes.
Verification:	Written tests, exam.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANW116_U3**
Description:	The student is able to describe simple processes basing on thermodynamics methods taking in account both steady and transient states of these processes.
Verification:	Written tests, exam.

Table 22. Learning outcomes	
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	

Description of course

Code of course	ANJ2/ANPL2	
Name of course	Foreign/Polish Language 2	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	SJO PW	
Coordinator of course	mgr Marta Szpak	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Languages	
Type of course	Compulsory	
Language of course	polski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	Achieving general competence in Polish at the A1 level, in particular the following language skills: listening comprehension – ability to interact at a shop, at the restaurant, order food products. Talking about everyday activities and hobbies. Practise the pronunciation.	
Effects of education	See Table 23.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. The idea of cases, how to translate Polish sentences. 2. Typical Polish products, simple word formatting (e.g.: tomato – tomato soup). 3. Poproszę herbatę – introduction of the accusative case. 4. What do you eat for breakfast, lunch, dinner? 5. Simple word formation (e.g.: tomato – tomato soup). 6. At the grocery – dialogue. 7. “In the shop” – dialogue practice. 8. At the café. 9. At the restaurant – dialogues. 10. At the restaurant – ordering a meal. 11. Ordering pizza and pierogi – giving simple data: address, phone. 12. A workshop: going out – asking for directions, buying food at a local shop, at a fast-food outlet. 13. Colours and basic adjectives. 14. Describing objects and people. 15. Plural of nouns – food products. 16. Plural of nouns and adjectives in nominative case. 17. At the railway station. 18. At the railway station. 19. At the post office. 20. Easter traditions in Poland. 21. Easter traditions in	

Description of course

	Poland. 22. What are you doing? Introduction to the present tense. 23. What do you like to do? How often do you...? 24. 4 types of conjugations. 25. Verbs you already know – “international” verbs. 26. What do you like doing? Hobbies. 27. Verb practice. 28. Revision. 29. End-of-term test. 30. End-of term test.
Methods of evaluation	Attendance (two absences are allowed) Passing all tests Completing 90 % of homework assignments In-class participation Passing the module test (weight of the mark for the module test in the final grade: 50%)
Methods of verification of effects of education	See Table 23.
Exam	no
Literature	Recommended texts: Obligatory: Piotrowska-Rola E. Porębska M., Polski jest cool, Lublin 2013 Supplementary materials: 1. Kowalska M., Polish in 4 weeks REA, Warszawa 2009 2. Lachowicz J., Podsiadły J., Ten, ta, to. Ćwiczenia nie tylko gramatyczne dla cudzoziemców, wyd. WING 2001 3. Machowska J., Gramatyka? Dlaczego nie?! Ćwiczenia gramatyczne dla poziomu A1, Universitas, Kraków 2010, 4. Madelska L., Discovering Polish. A Learner's Grammar / Polnisch entdecken. Eine Lerngrammatik / Odkrywamy język polski. Gramatyka dla uczących (się) języka polskiego jako obcego, Prolog, Kraków 2008 5. Polish for foreigners. Audio Course (CD), Warszawa, Edgard 2006 6. Seretny A., A co to takiego? Obrazkowy słownik języka polskiego, Universitas, Kraków 2008 http://www.oneness.vu.lt/ www.poland.gov.pl http://e-polish.eu/main/dictionary/definition.html www.e-polish.eu
Website of the course	-

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	-
Number of ECTS credits on the course with direct participation of academic teacher	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the exercises - 30 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 15 hours; • work on homework (solving tasks) – 15 hours. Total -2 ECTS credits.
Number of ECTS credits on practical activities on the course	1 ECTS credit.

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Table 23. Learning outcomes	
General academic profile - knowledge	
Code of effect:	**W_1**
Description:	The person using the language to understand speech and frequently used expressions in terms of topics, related to the life daily.
Verification:	Test, assessment of student work in class.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**U_1**
Description:	Can write short, simple notes, or messages, the resulting ad hoc needs. Can write a simple letter private, for example. thanking someone for something. Can communicate in simple, routine communication situations, requiring only the direct Exchange of information on familiar and typical. Can in a simple way to describe its origin and the environment in which it lives, and move the case, linked with the most important needs of daily life.
Verification:	Evaluation of homework, test, assessment of the work of the student during the lesson.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**U_1**
Description:	Can write short, simple notes, or messages, the resulting ad hoc needs. Can write a simple letter private, for example. thanking someone for something. Can communicate in simple, routine communication situations, requiring only the direct Exchange of information on familiar and typical. Can in a simple way to describe its origin and the environment in which it lives, and move the case, linked with the most important needs of daily life.
Verification:	Evaluation of homework, test, assessment of the work of the student during the lesson.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	

Description of course

Code of course	ANWF3	
Name of course	Physical Education and Sport 3	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	College of Physical Education and Sport.	
Coordinator of course	Teacher at College of Physical Education and Sport.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Physical Education and Sports	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	The development of physical activity of students. Detailed data contains syllabus of specific course.	
Effects of education	See Table 24.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The exercise program offer by College of Physical Education and Sport.	
Methods of evaluation	According to the rules of classes developed by College of Physical Education and Sport.	
Methods of verification of effects of education	See Table 24.	
Exam	no	
Literature		
Website of the course		
D. Student’s activity		
Number of ECTS credits	0	
Number of hours of student’s work to achieve effects of education	Participation in classes - 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0.0 ECTS credit (30 hours of classes, without ECTS).	
Number of ECTS credits on practical activities on the course		
E. Additional information		
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Table 24. Learning outcomes

Description of course

Code of course	ML.ANK467	
Name of course	Aeronautical Systems I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Maciej Zasuwa	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	Overview of aeronautical systems: functionalities, design, fundamentals and principles of operation.	
Effects of education	See Table 25.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Aeronautical systems overview. Cockpit human factors. Electrical systems: generation and distribution. Hydraulic system. Air data sensors and computer. Foundamentals of navigation. Foundations of radionavigation systems: NDB and ADF, VOR, DME, TACAN, ILS, MLS, TCAS, (E)GPWS. Doppler radar. Flight data recorders. Cabin environment.	
Methods of evaluation	Two written tests during semester and written exam.	
Methods of verification of effects of education	See Table 25.	
Exam	yes	
Literature	Literature is given for each lecture from books available in university or faculty libraries.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	3	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of student: • systematic preparation for classes - 20 hours; • preparation for written tests	

Description of course

	– 10 hours; • preparation for the final examination – 12 hours; TOTAL – 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

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Table 25. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK467_W1**
Description:	Student knows the basic principles of operation of the onboard aircraft systems. Student is able to describe physical phenomena relevant to the operation of the aeronautical systems.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W2**
Description:	Student knows the purpose of a given aeronautical system. Student is able to mention the basic functions of aeronautical systems.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W3**
Description:	Student is able to point out the essential components of the aeronautical system and explain the interaction between these components. Student is able to present in a systematic manner the principle of of operation of the aeronautical system.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W3**
Description:	Student is able to point out the essential components of the aeronautical system and explain the interaction between these components. Student is able to present in a systematic manner the principle of of operation of the aeronautical system.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W3**
Description:	Student is able to point out the essential components of the aeronautical system and

Table 25. Learning outcomes	
	explain the interaction between these components. Student is able to present in a systematic manner the principle of of operation of the aeronautical system.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W4**
Description:	Student knows the basis of determining the position, velocity and attitude of aircraft. Student is able to explain to methods of determining position, velocity and attitude which are used in navigation systems of an aircraft.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W5**
Description:	Student knows the sources and methods of energy management on aircraft. Student is able to provide the types of energy used on aircraft, advantages, disadvantages and limitations in the use of a particular type of energy.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W5**
Description:	Student knows the sources and methods of energy management on aircraft. Student is able to provide the types of energy used on aircraft, advantages, disadvantages and limitations in the use of a particular type of energy.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_W5**
Description:	Student knows the sources and methods of energy management on aircraft. Student is able to provide the types of energy used on aircraft, advantages, disadvantages and limitations in the use of a particular type of energy.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK467_U1**
Description:	Student is able to analyze the system in terms of its reliability. Student is able to make the analysis of the impact of components (including sensors) failure on the aeronautical system.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK467_U1**
Description:	Student is able to analyze the system in terms of

Table 25. Learning outcomes	
	its reliability. Student is able to make the analysis of the impact of components (including sensors) failure on the aeronautical system.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW123
Name of course	Basics of Automation and Control 1
Version of course	2013

A. Place of the course in system of studies

Level of education	First cycle studies
Form and mode of studies	full-time
Profile of studies	General academic profile
Specialisation	-
Place of teaching of course	Faculty of Power and Aeronautical Engineering
Place of realization of course	Faculty of Power and Aeronautical Engineering, Division of Theory of Machines and Robots
Coordinator of course	dr inż. Paweł Malczyk

B. General characteristic of the course

Block of courses	Aerospace Engineering
Group of courses	Specialization
Type of course	Compulsory
Language of course	angielski
Nominal semester	3 (r.a. 2019/2020)
Time of completion in the academic year	summer semester
Preliminary requirements	Calculus 1 (ML.ANW102); Calculus 2 (ML.ANW90).
Limit of students	-

C. Effects of education and manner of teaching

Purpose of course	1. Remember the basic structure of feedback control systems and understand the purpose of its components. Be able to offer some illustrative examples of control systems in engineering fields. 2. Be able to recognize that ordinary differential equations (ODEs) can describe the dynamic behavior of physical systems. 3. Understand the application of Laplace transforms and their role in solving ODEs and obtaining transfer functions. 4. Be able to linearize a nonlinear algebraic and ODEs through the use of Taylor series expansion. 5. Be able to calculate and interpret the time-responses of linear dynamic systems. 6. Understand the concepts of state variables, state differential equations, and output equations. Know how to calculate the transfer function from a state variable model, and vice versa. 7. Be aware of block diagrams and be able to transform them. 8. Be aware of frequency spectrum of continuous-time signals. 9. Understand the powerful concept of frequency response and its role in control system design. 10. Understand the differences between controlling the transient response and the steadystate response of a system. 11. Be aware of key test signals used in controls and of the resulting transient response characteristics of basic linear dynamic systems. 12. Understand the concept of absolute, relative stability, and bounded-input, bounded-output stability of dynamic systems. 13. Know how to apply Routh-

Description of course

	Hurwitz stability criteria to determine absolute and parametric stability of linear systems. 14. Understand the Nyquist stability criteria and the role of Nyquist and Bode plots. 15. Be capable of analyzing the relative stability and performance of feedback control system using frequency response methods considering phase and gain margin. 16. Be familiar with time-domain and frequency domain performance specifications. 17. Be able to choose and apply P, PD, PI, and PID controllers to improve the system performance. 18. Recognize the improvements afforded by feedback in reducing system sensitivity to parameter changes, disturbance rejections, and measurement noise attenuation.	
Effects of education	See Table 26.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Introduction to control systems 2. The Laplace transform and its applications. 3. Transfer function and dynamic response. 4. Control systems analysis in state space. 5. Block diagrams of dynamic systems. 6. Frequency analysis of continuous-time signals. 7. Introduction to the frequency response methods. 8. Basic linear dynamical systems. 9. Stability analysis of linear control systems. 10. Stability in the frequency domain. 11. The performance of feedback control systems. 12. Introduction to PID controllers.	
Methods of evaluation	1. Two tests including both computational and theoretical problems. 2. Two graded homework assignments. The details of the grading policy are published on the course website.	
Methods of verification of effects of education	See Table 26.	
Exam	no	
Literature	1. K. Ogata. Modern Control Engineering, Prentince Hall, 3rd Edition, 1997. 2. R. Dorf, R. Bishop. Modern Control Systems, Pearson Prentice Hall, 11th Edition, 2008. 3. K. Astrom, R. Murray. Feedback Systems. An Introduction for Scientists and Engineers, Princeton University Press, 2008. 4. N. Nise. Control Systems Engineering, John Wiley and Sons, 6th Edition, 2011. 5. G. Franklin, J. Powell, A. Emami-Naeini. Feedback Control of Dynamic Systems, Prentice Hall, 4th Edition, 2002. 6. User’s guides: Matlab Control System Toolbox.	
Website of the course	http://ztmir.meil.pw.edu.pl/web/eng/Teaching/Offered-Courses2/Basics-of-Automation-and-Control-I	

D. Student’s activity

Description of course

Number of ECTS credits	4
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 50, including: a) lectures - 30 hours; b) tutorials -15 hours; c) office hours - 5 hours. 2) The number of hours of independent work of a student: • systematic preparation for the lectures - 25 hours; • systematic preparation for the tutorials - 25 hours; TOTAL: 100 hours (4 ECTS).
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 50 including: a) lectures - 30 hours; b) tutorials -15 hours; c) office hours - 5 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 26. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW123_W1**
Description:	Have a knowledge of the Laplace transform and associated theorems.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W1**
Description:	Have a knowledge of the Laplace transform and associated theorems.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W2**
Description:	Have a knowledge of the transfer function and the sinusoidal transfer function for the linear time-invariant system.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W2**
Description:	Have a knowledge of the transfer function and the sinusoidal transfer function for the linear time-invariant system.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W3**
Description:	Have a knowledge of the feedback loop, open- and closed-loop control systems.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	

Table 26. Learning outcomes	
Code of effect:	**ML.ANW123_W3**
Description:	Have a knowledge of the feedback loop, open- and closed-loop control systems.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W4**
Description:	Have a knowledge of the stability theorem of linear time-invariant systems.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W4**
Description:	Have a knowledge of the stability theorem of linear time-invariant systems.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W5**
Description:	Have a knowledge of chosen stability criteria for linear time-invariant systems.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W5**
Description:	Have a knowledge of chosen stability criteria for linear time-invariant systems.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W6**
Description:	Have a knowledge of PID controllers and its basic applications.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_W6**
Description:	Have a knowledge of PID controllers and its basic applications.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW123_U1**
Description:	Can apply Laplace transform for chosen technical signal.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_U2**
Description:	Can determine the response of a linear time-invariant system due to the chosen input signal.
Verification:	Test 1, Homework 1.
Field of study related learning outcomes	Aero1_U10

Table 26. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_U3**
Description:	Can apply various stability criteria for linear time-invariant systems.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_U4**
Description:	Can describe at least one of the PID controller tuning rules.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW123_U5**
Description:	Can specify basic performance indices for the dynamic response.
Verification:	Test 2, Homework 2.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW91	
Name of course	Calculus III	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Mathematics and Information Science.	
Coordinator of course	Prof. dr hab. Andrzej Fryszkowski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Calculus I, Calculus II.	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	To convey and reinforce the knowledge on real number sequences, functions of one variable, the constant e, one-variable differential and integral calculus, definite and improper integrals, and their application, to acquire thorough understanding of basic concepts and computational processes, and to master skills of using them, to acquire the skill of correct mathematical reasoning and inference.	
Effects of education	See Table 27.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Non oriented surface integrals and their applications. 2. Oriented surface integrals. 3. Stokes and Gauss Theorems. Elements of vector fields calculus. 4. Infinite real and complex series convergence and divergence, necessary condition for convergence. Tests for convergence. Absolute and conditional convergence. 5. Cauchy's root test, d'Alembert ratio test. Integral test. Convergence of the Dirichlet series. Alternating series. Absolute and conditional convergence of a series. 6. Power series real and complex. Radius and interval of convergence. Power series integration and differentiation. Taylor and Maclaurin expansions of functions. Applications of power series. Trigonometric series. Formulas for coefficients. Dirichlet conditions. Sum of a trigonometric series. Applications.	

Description of course

Methods of evaluation	50% continuous assesment based on laboratory work and tests, 50% written final exam.
Methods of verification of effects of education	See Table 27.
Exam	yes
Literature	1. Thomas “Calculus”. 2. Robert A. Adams, Calculus. A complete course. 3. Thomas G. Finney: Calculus, ed. Addison-Wesley.
Website of the course	

D. Student’s activity

Number of ECTS credits	3
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 48, including: a) attendance at the lectures- 15 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student • systematic preparation for classes, work on homework - 20 hours; • preparation for written tests – 10 hours; • preparation for the final examination – 10 hours; TOTAL – 88 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number hours that require the presence of a teacher - 48, including: a) attendance at the lectures- 15 hours; b) attendance at the exercises - 30 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 27. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW91_W1**
Description:	Student basic knowledge about calculation of surface integrals. Student knows The Gauss and Stokes theorems.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW91_W2**
Description:	Student has basic knowledge in the theory of series of numbers and functions.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW91_W3**
Description:	Student knows the comcept of the Fourier series and the Fourier integral formula.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	

General academic profile - skils

Table 27. Learning outcomes	
Code of effect:	**ML.ANW91_U1**
Description:	Student can calculate simple surface integrals and applied them in physics. Student can apply the Gauss and Stokes theorems.
Verification:	Activity/progress during tutorials. Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW91_U2**
Description:	Student has skills to investigate properties of series of real and complex numbers.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW91_U3**
Description:	Student is able to determine an interval of convergence of a power series and represent simple function by means of a power series.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW91_U4**
Description:	Student can represent simple function by means of the Fourier series and using the Fourier integral formula.
Verification:	Assessment of activity and progress during tutorials, tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW91_K1**
Description:	It is aware of the need for self-study, regularity and accuracy.
Verification:	Homework, exam.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK431	
Name of course	Engineering Graphics – CAD2	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr inż. Agnieszka Jarzębińska-Dziegciar	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Base information concerning the technical drawing of one machines element and assembly drawing as well as CAD-2D system (Engineering Graphics CAD1).	
Limit of students	Group of 12 students for one teacher.	
C. Effects of education and manner of teaching		
Purpose of course	Creating the technical drawing of machines element and assembly drawing using the CAD-2D system. Making plain paper documentation based on given spatial model created using the CAD-3D system.	
Effects of education	See Table 28.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Marking of fitting and tolerance, and notation of heat and anticorrosion treatment. Part view of and assembly, based on the real object. Technical drawing of machines element created using the CAD-2D system. Axonometric projection of joined machines element based on the assembly drawing. Introduction to making plain paper documentation based on given spatial model created using the CAD-3D system.	
Methods of evaluation	Positive results of tests as well as home and class work.	
Methods of verification of effects of education	See Table 28.	
Exam	no	
Literature	Recommended literature:1. Cecil Jensen, Jay D. Helsel, Dennis R. Short; Engineering Drawing & Design.	
Website of the course	http://www.meil.pw.edu.pl/zpk/ZPK/Dydaktyka/	

Description of course

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • systematic preparation for classes, work on homework - 15 hours; • preparation for tests – 8 hours; TOTAL – 55 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credits - 55 hours, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • systematic preparation for classes, work on homework - 15 hours; • preparation for tests – 8 hours.

E. Additional information

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Table 28. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK431_W1**
Description:	Student knows rules for preparing a workshop drawing of a single part, including roughness of surfaces finishing.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_W2**
Description:	Student knows the rule for preparing a technical drawing of mating parts, including tolerance and fit.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_W3**
Description:	Student understands the necessity of using Polish Standards for the Technical Drawing and ISO Standards..
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_W4**
Description:	Student knows the rule for preparing an assembly drawing in CAD-2D system with use of the library of standardized parts' drawings.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_W19

Table 28. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_W5**
Description:	Student has a basic knowledge of how to create a two-dimensional documentation in CAD-3D system.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK431_U1**
Description:	Student can make a workshop drawing of a real part, including tolerances, fit and surfaces finishing.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_U2**
Description:	Student can make a workshop drawing of mating parts based on the assembly drawing.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_U3**
Description:	Student can use Polish Standards and ISO Standards.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_U4**
Description:	Student can make an assembly drawing in CAD-2D system with use of the library of standardized parts' drawings.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK431_U5**
Description:	Student can make a workshop drawing of a part with use of CAD-3D system.
Verification:	Controlled self-work of students.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW122	
Name of course	Fluid Mechanics I	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr hab. inż. Jacek Szumbarski, prof. PW	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Solid knowledge of the fundamentals of linear algebra, analytical geometry and mathematical analysis on the level typical for the first-year mathematical courses run in technical universities.	
Limit of students	60	
C. Effects of education and manner of teaching		
Purpose of course	Good knowledge of the fundamental concepts and principles of the Fluid Mechanics, skills in solving basic problems in fluid statics and dynamics of an ideal and viscous liquid.	
Effects of education	See Table 29.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Contents (lectures programme): Fluid as a continuous medium 2. Elements of fluid statics: equilibrium equations and condition, manometers, fluid reaction on the solid walls, the Archimedes law. 3. Fluid kinematics: Lagrangian and Eulerian descriptions, vector field of the fluid velocity, trajectories of fluid elements and streamlines, the streamfunction, vorticity and related theorems, tensor description of the fluid deformation. 4. Principle of mass conservations and the continuity equation. 5. Dynamics of continuum: tensor description of stress in fluid, the linear momentum principle and general equation of motion, the principle of angular momentum and the symmetry of the stress tensor. 6. Viscous fluids: rheological model of the Newtonian fluid, Navier-Stokes Equation, problem of the boundary conditions,	

Description of course

	examples of analytical solutions. 7. Model of an ideal fluid: Euler equation, first integral of Bernoulli and Cauchy-Lagrange, some applications. 8. Integral form of the momentum principle and its application to determination of the reaction force exerted on immersed bodies. Aerodynamic coefficients. 9. Flow similitude. 10. Elements of hydraulics: motion of a viscous liquid in pipes, Bernoulli Equation with pressure-loss terms. 11. Introduction to the boundary layer theory: Prandtls equation, the layer thickness, The Blasius solution, integral von Karman equation, boundary layer separation. Elementary introduction to the theory of turbulent flows: physical characteristics of a turbulent flow, the laminar-turbulent transition, averaging procedure and the Reynolds Equations, the closure problem.
Methods of evaluation	2 tests in the tutorial part, the final exam.
Methods of verification of effects of education	See Table 29.
Exam	yes
Literature	1. Kundu P.K., Cohen I.M.: Fluid Mechanics. Elsevir Academic Press, 3rd Ed. (2004) or newer. 2. Aris R.: Vectors, tensors and the basic equations of Fluid Mechanics. Dover Publications Inc., 1989.
Website of the course	Didactic materials at http://c-cfd.meil.pw.edu.pl/ccfd/index.php?item=6 (restricted access)

D. Student's activity

Number of ECTS credits	4
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 48, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student: • systematic preparation for classes, solving tasks - 20 hours; • preparation for written tests – 15 hours; • preparation for the final examination – 20 hours. TOTAL: 103 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 48, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	1.5 ECTS.

E. Additional information

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Table 29. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW122_W1**

Table 29. Learning outcomes	
Description:	Students knows theoretical foundations of fluid statics and kinematics.
Verification:	Test 1, final exam.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_W2**
Description:	Student acquired basic knowledge on formulation of conservation laws for fluids, governing equations and determination of aero/hydrodynamic forces.
Verification:	Test 1 and 2, final exam
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_W3**
Description:	Student acquired basic knowledge on the Newtonian fluid model, on the basic engineering methods for laminar and turbulent flows in ducts, and on the concept and criteria of dynamic flow similarity.
Verification:	Test 2, final exam.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_W4**
Description:	Student knows fundamentals theoretical facts and methods in the area of gas dynamics.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW122_U1**
Description:	Student can solve simple problems in fluid statics.
Verification:	Test 1, final exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U1**
Description:	Student can solve simple problems in fluid statics.
Verification:	Test 1, final exam.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U2**
Description:	Using methods of algebra and analysis, student is able to compute kinematic characteristics of fluid motion.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U2**
Description:	Using methods of algebra and analysis, student is able to compute kinematic characteristics of fluid motion.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_U10

Table 29. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U3**
Description:	Student can solve simple problems for ideal and real liquid flows using the basic or generalized Bernoulli equation.
Verification:	Test 1 and 2, final exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U3**
Description:	Student can solve simple problems for ideal and real liquid flows using the basic or generalized Bernoulli equation.
Verification:	Test 1 and 2, final exam.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U4**
Description:	Using the integral form of the Linear Momentum Principle student is able to determine aero/hydrodynamic reactions in simple cases.
Verification:	Test 2, final exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U4**
Description:	Using the integral form of the Linear Momentum Principle student is able to determine aero/hydrodynamic reactions in simple cases.
Verification:	Test 2, final exam.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U5**
Description:	Student is able to perform a simple analysis of flow similarity and to predict the form of the physical law using dimensional arguments.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U5**
Description:	Student is able to perform a simple analysis of flow similarity and to predict the form of the physical law using dimensional arguments.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U6**
Description:	Student is able to solve simple problems in gas dynamics using the energy equation, isentropic relations, or basic results concerning the normal shock wave.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW122_U6**
Description:	Student is able to solve simple problems in gas dynamics using the energy equation, isentropic

Table 29. Learning outcomes	
	relations, or basic results concerning the normal shock wave.
Verification:	Final exam.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK466	
Name of course	Introduction to Aerospace	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Tomasz Goetzendorf-Grabowski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Mechanics, Calculus.	
Limit of students	50	
C. Effects of education and manner of teaching		
Purpose of course	After subject is completed student should have the basic knowledge on: • the history of aviation, • present problems of aviation, • basic terms on aeronautics and aircraft technology.	
Effects of education	See Table 30.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	15h
	Computer lessons	0h
Contents of education	Basic knowledge about history of aviation. Knowledge of present problems of aviation. Knowledge of basic terms on aeronautical technology.	
Methods of evaluation	Assessment of presentation, assessment of project, tests.	
Methods of verification of effects of education	See Table 30.	
Exam	no	
Literature	1. Projects Guide: http://www.meil.pw.edu.pl/add/ADD/Teaching/Subjects/IntAero. 2. Selected lectures in electronic form (web site above). 3. J.D. Anderson – Introduction to Flight, McGraw-Hill , 2004.	
Website of the course	http://www.meil.pw.edu.pl/add/ADD/Teaching/Subjects/IntAero	
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures-15 hours; b) attendance at the project - 15 hours; c) consultancy meetings - 2 hours. 2)	

Description of course

	The number of hours of independent work of student - 20, including: a) homework to prepare projects and presentation - 20 hours. Total 75h = 3 ECTS.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 32, including a) attendance at the lectures -15 hours; b) attendance at the project - 15 hours; c) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	1,5 ECTS credits.

E. Additional information

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Table 30. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK466_W1**
Description:	Student knows the basics of aviation technique.
Verification:	Assessment of project.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_W1**
Description:	Student knows the basics of aviation technique.
Verification:	Assessment of project.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_W2**
Description:	Student knows the basic international legal acts relating to aviation and the history of their creation.
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_W3**
Description:	Student knows the rules to make the trend analysis.
Verification:	Assessment of project and of presetation.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK466_U1**
Description:	Student is able to make the trend analysis.
Verification:	Assessment of project and of presetation.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_U1**
Description:	Student is able to make the trend analysis.
Verification:	Assessment of project and of presetation.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_U2**

Table 30. Learning outcomes	
Description:	Student is able to prepare and present a short presentation of the results of the analysis of the engineering task related to aviation.
Verification:	Assessment of project and of presetation.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_U2**
Description:	Student is able to prepare and present a short presentation of the results of the analysis of the engineering task related to aviation.
Verification:	Assessment of project and of presetation.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK466_K1**
Description:	Student can work within group.
Verification:	Assessment of the project team.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	
Code of effect:	**ML.ANK466_K2**
Description:	Student is able to transfer knowledge / information to the wider audience.
Verification:	Evaluation of the presentation before the entire group.
Field of study related learning outcomes	Aero1_K06
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW124	
Name of course	Machine Design I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Stanisław Bogdański; profesor PW.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Materials I, Mechanics I, Mechanics of Structures I.	
Limit of students	70	
C. Effects of education and manner of teaching		
Purpose of course	To gain an understanding of design philosophies and to learn how to incorporate into the process of design the earlier-studied principles of strength of materials, materials science, mechanics, etc. To learn the fundamentals of designing for static and fatigue loading with the use of simple machine elements (joints, fasteners, beams and shafts) as the examples.	
Effects of education	See Table 31.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Introduction to design: design process, problem formulation and calculation, experimental tests, the engineering model, factors of safety and design codes, patents and standards, safety regulations, limiting conditions, optimization and evaluation criteria. Static failure theories Fatigue failure theories: fatigue failure models, fatigue loads, notches and stress concentrations, designing for high-cycle fatigue, designing for fully reversed and fluctuating stresses. Modelling and calculations in selected areas of machine design: welded, riveted and cemented joints, fasteners, interference fits.	
Methods of evaluation	Continuous assessment during the whole semester. Three regular tests organized during the semester plus one additional as the test for improvement at the end of semester. See the	

Description of course

	regulations for the course at WWW: http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Regulaminy-zajec-dydaktycznych.
Methods of verification of effects of education	See Table 31.
Exam	no
Literature	1.Machine Design, An Integrated Approach, Fourth edition, by Robert L.Norton, Prentice Hall 2010. 2. Machine Elements in Mechanics and Design Fourth Edition, by Robert L. Mott, Prentice Hall 2006. 3. Design of Machine Elements seventh edition, by M.F.Spotts and T.E.Shoup, Prentice Hall 1998.
Website of the course	http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Materialy-dla-studentow-Files-for-students

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher – 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student • systematic preparation for classes, solving tasks - 30 hours; • preparation for tests - 12 hours; TOTAL: 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – number of hours that require the presence of a teacher - 48, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	
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Table 31. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW124_W1**
Description:	He/She is familiar with the general and detailed principles and procedures of machine design.
Verification:	Test.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_W2**
Description:	He/She is familiar with the main reasons of wear and failures of components of machines and mechanical devices.
Verification:	Test.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANW124_U1**

Table 31. Learning outcomes	
Description:	He/She is able to use correctly basic concepts, names and units, which are typical for machine design. In particular such as: durability, loading capacity, ultimate and fatigue strength, safety factor, allowable stress, limiting condition, deterministic and probabilistic modelling, reliability and safety.
Verification:	Test.
Field of study related learning outcomes	Aero1_U07
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U2**
Description:	He/She is able to perceive the physical limitations (concerning mainly the strength, elasticity, durability and heat resistance of materials) and non physical related to economy, and standardisation as well as that resulting from an incomplete knowledge of engineers and imperfect tools being in their disposal.
Verification:	Test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U2**
Description:	He/She is able to perceive the physical limitations (concerning mainly the strength, elasticity, durability and heat resistance of materials) and non physical related to economy, and standardisation as well as that resulting from an incomplete knowledge of engineers and imperfect tools being in their disposal.
Verification:	Test.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U3**
Description:	He/She is able to formulate limiting conditions, which are essential for completing calculations in designing simple mechanical devices.
Verification:	Test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U3**
Description:	He/She is able to formulate limiting conditions, which are essential for completing calculations in designing simple mechanical devices.
Verification:	Test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U4**
Description:	He/She is able to build simple models of states and phenomena typical for machines, mechanical devices and structures, which are necessary for performing engineering calculations, among others the models of: stresses and deflections, fatigue and failure, properties of materials and machine components

Table 31. Learning outcomes	
	as well as their dependence on the manufacturing techniques.
Verification:	Test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U5**
Description:	He/She knows how to perform engineering analysis (calculations) necessary for estimating fatigue strength and durability of simple components of machines, devices and structures.
Verification:	Test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW124_U6**
Description:	He/She knows how to design and perform all necessary calculations for the following simple connections: welded, riveted, cemented, screw fastened, keyed and splined.
Verification:	Test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK399
Name of course	Manufacturing Technology
Version of course	2013.

A. Place of the course in system of studies

Level of education	First cycle studies
Form and mode of studies	full-time
Profile of studies	General academic profile
Specialisation	-
Place of teaching of course	Faculty of Power and Aeronautical Engineering
Place of realization of course	Faculty of Production Engineering, Department of Finishing and Erosion Machining.
Coordinator of course	prof. dr hab. Joanna Radziejewska

B. General characteristic of the course

Block of courses	Aerospace Engineering
Group of courses	Specialization
Type of course	Compulsory
Language of course	angielski
Nominal semester	3 (r.a. 2019/2020)
Time of completion in the academic year	summer semester
Preliminary requirements	Basic knowledge of materials, their constructional properties and mach inability. heat treatment methods. Basic knowledge of processing methods.
Limit of students	120

C. Effects of education and manner of teaching

Purpose of course	The presentation of contemporary methods of manufacturing of machines elements, devices and the structure and their influence on properties of the product, analysis of produce ability of designed products.	
Effects of education	See Table 32.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The technological process as the sequence of functional properties forming. Basic model of a production process. Process control and supervision Properties of metals susceptible to plastic processing. The plastic state by principles and the possibility of a plastic deformation of metals. Properties of semi-finished products Shaping elements by rolling, forging or pressing, die forging, extrusion, drawing, Stamping, and others. Products obtained in the rolling plastic working process, and their properties. Foundry as one of the basic technologies for the manufacturing of objects castings from metals and their alloys. Classification of casting application. Main processes of castings production. Casting design productivity related to the processes and quality. Preparation of molds,	

Description of course

	cores, liquid metals added tools. Solidification, casting production and their properties. Types of machining processes (machine tools, machining accuracy), work-piece positioning, work-piece clamping, jigs and fixtures, dimensioning in machining operations, general rules for machining process planning, application of CNC machines and machining centers, some aspects of CNC programming, cellular manufacturing, flexible machining cells, programming of flexible robotized machining cells. Cutting tools, Abrasive processes, grinding. Joining processes. General characteristics. Brazing, Standard symbols for wells. FW, FSW processes. Surface technology surface finishing. Coatings, surface treatments. Powder Metallurgy. Sinters forming, sintering sinters finishing. Cermets. Sinters properties, application and design.
Methods of evaluation	There are two tests for verifying the teaching effect: the half-way test (test 1) and the final test (test 2) . There is also an attractive industrial visit in the Factory Outlet Company aimed both at providing practical knowledge and for verifying the teaching effect.
Methods of verification of effects of education	See Table 32.
Exam	no
Literature	Basic reading: Serope Kalpakjian, Steven R.Schmid: Manufacturing Engineering and Technology, edition 2006, 2014 Pearson Education S.Asia. Additional reading : Wit Grzesik Advanced Machining Processes of Metallic Materials: Theory, Modelling and Application, Elsevier Science Ltd., 2008
Website of the course	

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 31, including: a) attendance at the lectures -30 hours; b) consultancy meetings – 1 hours. 2) The number of hours of independent work of student • systematic preparation for classes - 10 hours; • preparation for tests – 10 hours; TOTAL: 51 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credits – number of hours that require the presence of a teacher - 30, including: a) attendance at the lectures - 30 hours; b) consultancy meetings – 1 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	Final test is twice as important as the half-way test. Industrial Visit attendance is critically

Description of course

	important for the students who failed at test 1 or test 2.
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Table 32. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK399_W01**
Description:	Student is able to describe traditional as well as non-conventional manufacturing processes used in industry.
Verification:	Test 1, test 2, Industrial Visit.
Field of study related learning outcomes	Aero1_W10
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK399_U01**
Description:	Student can make a choice from the available pool of manufacturing processes, selecting feasible methods for the given environment and the processes ensuring the optimum balance of technical and economical indices.
Verification:	Industrial Visit.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

General academic profile - social competences

Code of effect:	**ML.ANK399_K01**
Description:	Student is able to exchange the acquired information within the student group to identity, select or reject the suggested method of part machining.
Verification:	Industrial Visit.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK427	
Name of course	Materials in Aerospace Technology	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Dorota Szczęśniak	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	Course results: acquiring skills in structural materials selection following strength, technological and usable factors, composite structures properties design, and engineers methods of their strength evaluations.	
Effects of education	See Table 33.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Mutual stimulation of grows in aerospace engineering and materials engineering. Materials for aeronautical structures. Airworthiness of structural materials. 2. Influence of materials on aircraft aerodynamic performance. 3. Application of steel in aerospace structures. Carbon steel, alloy steel. 4. Structural materials based on aluminum, magnesium, cooper, nickel, cobalt or titanium. 5. Methods of machining and structure manufacturing. Processes of forming strength and durability properties. 6. Comparative analysis of properties of main structural materials. 7. Lightness criteria of structural materials. 8. Examples of structural designs for different materials. 9. Application of wood in aeronautical structures. Airworthiness requirements. Isotropy as a joint feature of wood and composite structures. Joints of concentrated forces introductions and connection of wood structures. 10. Polymer composites – reinforced by fiber.	

Description of course

	Properties of components. Laminar and sandwich structures properties. Isotropy. Basic manufacturing processes. Joints of concentrated forces introductions and glue connections. 11. Polymer composites reinforced by powders. Main applications: gelcoat, glue & compensation layers, stuff for casting. 12. metallic composites – physical, strength, technological and maintenance properties. Application in aeronautical structures. 13. Prognostic and evaluation of mechanical properties. 14. Ageing of metallic and composite structures. Basics of corrosion and anticorrosive protection. 15. Grow-trends of composite materials – nanocomposites.
Methods of evaluation	Tests.
Methods of verification of effects of education	See Table 33.
Exam	no
Literature	1. B. Cantor, H. Sssender, P. Grant: “Aerospace Materials”, Institute of Physics Publishing, Bristol and Philadelphia, 2001. 2. D. Gay, S.V. Hoa, S.W. Tsai: “Composite Materials: Design and Applications”, CRC Press, 2003.
Website of the course	-

D. Student’s activity

Number of ECTS credits	3
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 2 hours. 2) The number of hours of independent work of student - 40 hours, including: • systematic preparation for classes - 15 hours; • preparation for tests – 15 hours; • reading recommended by the teacher of literature – 10 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,2 ECTS credits - 32 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	-
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Table 33. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK427_W1**
Description:	Student has knowledge of material science, icluding: atomic bonding, the structure and imperfections of crystalline solids, dislocation motion, slip systems.
Verification:	Test.

Table 33. Learning outcomes	
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W2**
Description:	Student has knowledge of materials for aircraft engines, icluding: introduction & basics of materials selections, phase diagrams, plastic deformation, mechanisms of material straightening, the role of alloying elements, Nickel, Cobalt, Titanium, Aluminum base alloys.
Verification:	Test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W3**
Description:	Student has knowledge of Materials Analysis Methods, icluding: replication technique for field applications, metallography & microstructure, Scanning Electron Microscopy, Spark Optical Emission Spectroscopy, hardness test, tensile test, impact test, creep test, fatigue test.
Verification:	Test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W3**
Description:	Student has knowledge of Materials Analysis Methods, icluding: replication technique for field applications, metallography & microstructure, Scanning Electron Microscopy, Spark Optical Emission Spectroscopy, hardness test, tensile test, impact test, creep test, fatigue test.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W4**
Description:	Student has knowledge of Steels, icluding: where steels can be used in aviation, chemical composition vs heat treatment vs material properties (general).
Verification:	Test.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W4**
Description:	Student has knowledge of Steels, icluding: where steels can be used in aviation, chemical composition vs heat treatment vs material properties (general).
Verification:	Test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W5**
Description:	Student has knowledge of coatings, icluding: why we used coatings, where (engine modules) coatings are used in aviation, types of coatings.
Verification:	Test.
Field of study related learning outcomes	

Table 33. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W6**
Description:	Student has knowledge of non-destructive evaluation methods, icluding: what type of non-destructive evaluation methods are mostly used in aviation (plus basic principles of each presented method), advantages and Limitation of each of the method.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK427_W7**
Description:	Student has knowledge of polymers, icluding: difference between composite and standard one material, what does it means “composite” – what are the components of the material and what is purpose of these components, recognition of classical composite materials used in aviation industry : polymer matrix composites with glass or carbon or aramid fibers and what are the major advantages and disadvantages of these materials.
Verification:	Test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW427	
Name of course	Mechanics of Structures II	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr inż. Jakub Pawlicki	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Elective	
Language of course	angielski	
Nominal semester	3 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Mechanics of Structures I.	
Limit of students	min 15	
C. Effects of education and manner of teaching		
Purpose of course	Semi advanced knowledge for strength analysis of one-dimensional structures (bars, beams, frames)cand two-dimensional structures (axisymmetric shells) including stress and deformation aspects of classic elastostatic problems.	
Effects of education	See Table 34.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Complex problem of bending of beams. Complex loading of bars. Bar structures: trusses and frames: statically determinate and indeterminate problems. Thermal stresses and assembly stresses. Membrane stresses in axisymmetric vessels and shells.	
Methods of evaluation	Tests, home works.	
Methods of verification of effects of education	See Table 34.	
Exam	no	
Literature	1) Roy Craig Jr. “Mechanics of Materials” . 2) John Hearn “Mechanics of Structures” .	
Website of the course	-	
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 30, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -15 hours. 2) The number of hours of independent work of student - 27, including: • systematic	

Description of course

	preparation for classes - 5 hours; • work on homework – 10 hours; • preparation for tests – 12 hours. TOTAL: 57 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit - 30 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -15 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	-
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Table 34. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW427_W1**
Description:	Student knows how to analyze satically determinate and statically undeterminate frames.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_W2**
Description:	Student understands basics of membrane and bending stress for axisymmetrical shells.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_W3**
Description:	Student knows energy methods and can apply them to elastostatics of bars and frames.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANW427_U1**
Description:	Student can reduce real structure to frame model.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U2**
Description:	Student can determine force resultants distributions at statically determinate and statically undeterminate frames.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U2**
Description:	Student can determine force resultants distributions at statically determinate and statically undeterminate frames.
Verification:	Proficiency test.

Table 34. Learning outcomes	
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U3**
Description:	Student can check safety of the structure based on allowable stress approach.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U4**
Description:	Student can calculate structural displacement and deformation applying virtual work principle.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U4**
Description:	Student can calculate structural displacement and deformation applying virtual work principle.
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U5**
Description:	Student can determine axial and hoop streses on axisymmetrical shells .
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW427_U5**
Description:	Student can determine axial and hoop streses on axisymmetrical shells .
Verification:	Proficiency test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	

Description of course

Code of course	ANJ3	
Name of course	Foreign Language 3	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	The Foreign Language Centre	
Coordinator of course	For details, refer to the syllabus of the course.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Languages	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	For details, refer to the syllabus of the course.	
Limit of students	For details, refer to the syllabus of the course.	
C. Effects of education and manner of teaching		
Purpose of course	For details, refer to the syllabus of the course.	
Effects of education	See Table 35.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	For details, refer to the syllabus of the course.	
Methods of evaluation	For details, refer to the syllabus of the course.	
Methods of verification of effects of education	See Table 35.	
Exam	no	
Literature	For details, refer to the syllabus of the course.	
Website of the course	-	
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	Number of hours that require the presence of a teacher ~30 exercises hours. The number of hours of independent work of student ~30.	
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit.	
Number of ECTS credits on practical activities on the course	-	
E. Additional information		
Notes	Detailed information about the effects of teaching presents a course syllabus.	
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Table 35. Learning outcomes

Description of course

Code of course	ANWF4	
Name of course	Physical Education and Sport 4	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	College of Physical Education and Sport.	
Coordinator of course	Teacher at College of Physical Education and Sport.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Physical Education and Sports	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	The development of physical activity of students. Detailed data contains syllabus of specific course.	
Effects of education	See Table 36.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The exercise program offer by College of Physical Education and Sport.	
Methods of evaluation	According to the rules of classes developed by College of Physical Education and Sport.	
Methods of verification of effects of education	See Table 36.	
Exam	no	
Literature	-	
Website of the course		
D. Student’s activity		
Number of ECTS credits	0	
Number of hours of student’s work to achieve effects of education	Participation in classes - 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0.0 ECTS credit (30 hours of classes, without ECTS).	
Number of ECTS credits on practical activities on the course		
E. Additional information		
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Table 36. Learning outcomes

Description of course

Code of course	ML.ANK473	
Name of course	Aerodynamics I	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Jerzy Majewski, dr inż. Zbigniew Ratata.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Solid knowledge of the fundamentals of fluid mechanics and mathematical analysis on the level typical for the first three semesters of courses run in technical universities.	
Limit of students	150	
C. Effects of education and manner of teaching		
Purpose of course	To extend students' knowledge in the area of the fluid mechanics and gas dynamics. To teach students the fundamental concepts and principles of the aerodynamics of an airplane.	
Effects of education	See Table 37.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. Contents (lectures programme): Elements of Gas Dynamics. Energy equation. Bernouli equation for compressible flow. Normal and oblique shock wave. Supersonic flow over convex corner (Prandtl-Mayer flow) 2. Potential flow. Conformal mapping. Kutta-Joukowski condition. Joukowski formula for lift. Pressure distribution and flow around wing section. Aerodynamics coefficients. Airfoil polar. Thin airfoil theory (Glauerts). High lift devices. 3. Wing of finite span. Induced velocity. Induced angle. Induced drag. 4. Influence of compressibility on aerodynamic characteristics. Prandtl-Glauert correction. 5. Transonic flow. Critical flow parameters. Critical Mach number. Drag divergence Mach number. Wave drag. Transonic buffeting. Supersonic flow over airfoil. Wave drag in supersonic flow. Supersonic airfoil.	

Description of course

Methods of evaluation	Exam.
Methods of verification of effects of education	See Table 37.
Exam	yes
Literature	1. Bertin J.J., Smith M.L., Aerodynamics for Engineers, Printice Hall, 1989. 2. Anderson Jr. J.D. - Fundamentals of Aerodynamics, McGraw-Hill International, 2006. 3. Kuethe A.M., Chow C-Y, Fundations of aerodynamics: bases of aerodynamic design, John Wiley and Sons, 1998. 4. Houghton E.L., Carpenter P.W., Aerodynamics for Engineering Students, 6th ed., Elsevier, 2013.
Website of the course	Educational materials for lectures: http://c-cfd.meil.pw.edu.pl

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures -15 hours; b) exam - 2 hours. 2) The number of hours of independent work of student - 18, including: • systematic preparation for classes - 10 hours; • systematic preparation for exam – 8 hours. TOTAL – 50 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.3 ECTS credits - 32 hours, including: a) attendance at the lectures -15 hours; b) exam - 2 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 37. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK473_W1**
Description:	Student is familiar with physical foundations of generation of aerodynamic forces and related flow phenomena.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W1**
Description:	Student is familiar with physical foundations of generation of aerodynamic forces and related flow phenomena.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W2**
Description:	Student is familar with the equations governing fluid flows, knows levels and outcome of simplifications.
Verification:	Exam.

Table 37. Learning outcomes	
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W2**
Description:	Student is familar with the equations governing fluid flows, knows levels and outcome of simplifications.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W3**
Description:	Student is familiar with the flow past an airfoil, knows relation between the circulation and lift force, the meaning of Kutta-Joukovsky cond., knows definitions of aerodynamic coefficients and aerodynamic efficiency.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W3**
Description:	Student is familiar with the flow past an airfoil, knows relation between the circulation and lift force, the meaning of Kutta-Joukovsky cond., knows definitions of aerodynamic coefficients and aerodynamic efficiency.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W3**
Description:	Student is familiar with the flow past an airfoil, knows relation between the circulation and lift force, the meaning of Kutta-Joukovsky cond., knows definitions of aerodynamic coefficients and aerodynamic efficiency.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W4**
Description:	Student has basic knowledge on the flow past a wing with finite span, knows the influence of the finite span on the aerodynamic characteristics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W4**
Description:	Student has basic knowledge on the flow past a wing with finite span, knows the influence of the finite span on the aerodynamic characteristics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W5**
Description:	Student is familar with foundations of gas dynamics and knows the influence of compressibility on aerodynamic characteristics.

Table 37. Learning outcomes	
Verification:	Exam.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W5**
Description:	Student is familar with foundations of gas dynamics and knows the influence of compressibility on aerodynamic characteristics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W6**
Description:	Student has basic orientation in the area of subsonic, transonic and supersonic flows; knows the concept of wave drag, critical Mach number, transonic buffeting and aerodynamic heating.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_W6**
Description:	Student has basic orientation in the area of subsonic, transonic and supersonic flows; knows the concept of wave drag, critical Mach number, transonic buffeting and aerodynamic heating.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK473_U1**
Description:	Student can describe the method of determination of the potential flow past an airfoil, obeying the Kutta-Joukovsky condition.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U18
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U1**
Description:	Student can describe the method of determination of the potential flow past an airfoil, obeying the Kutta-Joukovsky condition.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U2**
Description:	Student can determine an induced drag, explain its physical sources and relation to the wing's geometry.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U2**
Description:	Student can determine an induced drag, explain its physical sources and relation to the wing's geometry.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U18

Table 37. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U3**
Description:	Student can evaluate corrections related to compressibility of a medium.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U3**
Description:	Student can evaluate corrections related to compressibility of a medium.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U18
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U4**
Description:	Student os able to describe a pattern of supersonic flow past a thin airfoil and determine its aerodynamic characteristics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK473_U4**
Description:	Student os able to describe a pattern of supersonic flow past a thin airfoil and determine its aerodynamic characteristics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U18
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK468	
Name of course	Astronautics	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Dr inż. Łukasz Mężyk	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Mechanics; Termodynamics; Fluid Mechanics.	
Limit of students	160	
C. Effects of education and manner of teaching		
Purpose of course	Learn basics of rocket design, theory of space flights, types of satellites and spacecraft as well as with benefits from space exploration. After the course student will acquire basic knowledge on space mechanics, rocket propulsion, manned space flights, application satellites, benefits from space exploration as well as most important recent questions regarding space exploration. Students will also have sufficient knowledge to sign to more advanced courses such as: rocket's propulsion, space technology, spacecraft design and other related subjects.	
Effects of education	See Table 38.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	1. History of Space Exploration. 2. Orbital Mechanics. 2.1. Two Body Motions. 2.2. Orbital Velocity. 2.3. Escape Velocity. 2.4. Escape Velocity from the Solar System. 2.5. Elliptical Orbits. 2.6. Geostationary Orbit and Sun Synchronized Orbit. 2.7. Three Body System, Lagrange's Points of Equilibrium. 2.8. Orbital Transfer by Elliptical Orbits and by low Thrust. 2.9. Gravity assist (increase or decrease of spacecraft's velocity during flyby planets). 3. Ciolkovski's Formula for Rocket Motion. 4. Rocket Propulsion. 4.1. Principles of Rocket Propulsion; Thrust, Specific Impulse, Efficiency (internal, propulsion and	

Description of course

	overall). 4.2. Chemical Rockets and Propellants. 4.3. Electrical Rockets (Ion, Plasma, Thermo-resistant, etc). 4.4. Nuclear Rocket Engines. 4.5. Other Techniques of Space Propulsion. 5. Rocket Components (Engines, Fuel Tanks, Guidance, etc). 5.1 Rocket flight into orbit (trajectory, maximum dynamic pressure, etc). 6. Spacecraft Design (Manned and Unmanned). 6.1 Reentry of unmanned and manned spacecraft from orbit, thermal protection. 7. Apollo Program of sending Man to the Moon. 7.1 Saturn-5 Rocket. 7.2 Apollo Spacecraft. 7.3 Typical flight in Apollo program (to the Moon surface and back). 8. Space Shuttle – design and performance (benefits and the week points). 9. Exploration of the Solar System (Venus, Mars, Jupiter and beyond). 10. Application Satellites (Meteorological, Teledetection, Geodesy and Navigation. Telecommunication and other) 11. Near Earth's Objects. 12. Space Debris. 13. Benefits from Space Expiration.
Methods of evaluation	Two written tests are necessary to pass to get the credit.
Methods of verification of effects of education	See Table 38.
Exam	no
Literature	1. AIAA Aerospace Design, Engineering Guide. 2. Charles D. Brown, : "Element of Spacecraft Design", AIAA Education Series. 3. http://www.nasa.gov/home/. 4. http://www.esa.int/esaCP/index.html. 5. http://www.jaxa.jp/index_e.html. 6. http://www.unoosa.org/oosa/en/COPUOS/copuos.html.
Website of the course	-

D. Student's activity

Number of ECTS credits	4
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures -30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student - 70, including: • systematic preparation for classes - 20 hours; • preparing for tests 1 - 25 hours; • preparing for tests 2 - 25 hours; TOTAL: 102 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.3 ECTS credits - 32, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 38. Learning outcomes

General academic profile - knowledge	
Code of effect:	**ML.ANK468_W1**
Description:	Student knows the basis of space rocket construction, theory of space flight, type of satellites and space ships.
Verification:	Test.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_W1**
Description:	Student knows the basis of space rocket construction, theory of space flight, type of satellites and space ships.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_W2**
Description:	Student has knowledge of: principle of motion of space rockets and satellites, types of orbits, chemical and future propulsion systems, manned and un-manned space flights and space exploration.
Verification:	Test.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_W3**
Description:	Student knows the pboblems of space debris and Near Earth Objects.
Verification:	Test.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_W4**
Description:	Student is aware of prectical use of artyfical satellites – telecomunication, teledetection, navigation, meteorology.
Verification:	Test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK468_U1**
Description:	Student is able to describe benefits of space exploration.
Verification:	Test.
Field of study related learning outcomes	Aero1_U16
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_U1**
Description:	Student is able to describe benefits of space exploration.
Verification:	Test.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_U2**
Description:	Student understands the basis of space flights especially: rocket propulsion, artyfical satellites and space probes, manned flight.
Verification:	Test.

Table 38. Learning outcomes	
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_U3**
Description:	Student is able to identify the requirements to introducing a satellites into Earth and other planets orbits, and also sending the space probes into interplanetary paths.
Verification:	Test.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_U4**
Description:	Student is able to identify the optimal propellant for different propulsion systems.
Verification:	Test.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANK468_U5**
Description:	Students is able to calculate the basic parameters of orbits and also planetary and interplanetary trajectories.
Verification:	Test.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW 135	
Name of course	Electronics 1	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. Tadeusz Skoczkowski, Ph.D., El. Eng.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Electric Circuit I, Electric Circuit II.	
Limit of students	The lecture - 60 students, exercises - 30 students.	
C. Effects of education and manner of teaching		
Purpose of course	To obtain basic knowledge on analogue and digital electronic circuit. To understand the principle of operation, construction and characteristics of basic semiconductor devices. To learn the terminology of electronics. To understand the functions performed by typical analogue and digital components and circuits. To be able to analyse simple electronic circuit. To get familiar with troubleshooting in electronic circuits. To get familiar with manufactures specification sheets and application guidelines.	
Effects of education	See Table 39.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	ANALOGUE FUNDAMENTALS. Fundamental Solid-State Principles. Atom Theory. Doping. PN Junction. Bias. Diodes. PN-Junction Diode. Ideal Diode. Practical Diode Model. Other Practical Considerations. Complete Diode Model. Diode Specification Sheets. Zener Diodes. Zener Diode Specification Sheets. Light-Emitting Diodes (LEDs). Diode Testing. Common Diodes Applications. Basic Power Supply Circuits. Transformers. Half-Wave Rectifiers. Full-Wave Rectifiers. Full-Wave Bridge Rectifiers. Working with Rectifiers. Filters. Zener Voltage. Special Application. Regulators. Clippers, Clampers. Voltage Multipliers. Displays. Special application Diodes. Varactor Diodes.	

Description of course

	Transient Suppressors and Constant-Current Diodes. Tunnel Diodes. Other Diodes. Bipolar Junction Transistors. Bipolar Junction Transistors (BJTs). Transistor Construction and Operation. Transistor Current and Voltage Ratings. Transistor Characteristic Curves. Transistor Specification Sheets. Transistor Testing. DC Biasing Circuits. DC Biasing. DC Load Line. Base Bias. Voltage-Divider Bias. Other Transistor Biasing Circuit. Introduction to Amplifiers. Amplifier Properties. BJT Amplifier Configurations. Amplifier Classifications. Decibels Common-Emitter Amplifiers. AC Concepts. Roles of Capacitors in Amplifiers. Common-Emitter AC Equivalent Circuit. Amplifier Gain. Gain and Impedance Calculations. Swamped Amplifiers. h-Parameters. Amplifier Trouble Shooting. Other BJT Amplifiers. Emitter Follower (Common-Collector Amplifier). Emitter Follower AC Analysis. Emitter Followers: Practical Considerations. Applications. Darlington Emitter-Follower. Common-Base Amplifier. Common-Base Applications. Power Amplifiers. AC Load Line. RC-Couple Class A Amplifiers. Transformer-Coupled Class A Amplifiers. Class B Amplifiers. Class AB Amplifiers (Diode Bias). Field-Effect Transistors. Introduction to JFETs. JFET Biasing Circuits. Common-Source Amplifier. Common-Drain Amplifier. Common-Gate Amplifier. Trouble Shooting JFET Circuits. JFET Specification Sheets. Applications. MOSFETs. D-MOSFETs. E-MOSFETs. Dual-Gate MOSFETs. Power MOSFETs. Complementary MOSFETs (CMOS). MOSFET Applications. Amplifier Frequency Response. Basic Concepts. BJT Amplifier Frequency Response. FET Amplifier Frequency Response. Multistage Amplifiers. Operational Amplifiers. Op-Amps: An Overview. Operation Overview. Differential Amplifiers and Op-Amp Specifications. Inverting Amplifiers. Non-inverting Amplifiers. Troubleshooting Basic Op-Amp Circuits. Op-Amp Frequency Response. Negative Feedback Additional Op-Amp Applications. Comparators Integrators and Differentiators Summing Amplifiers. Instrumentation Amplifiers Other Op-Amp Circuits. Tuned Amplifiers. Tuned Amplifier Characteristics. Active Filters: An Overview. Low-Pass and High-Pass Filters. Band-Pass and Notch Filters. Active Filter Applications. Discrete Tuned Amplifiers. Class C Amplifiers. Oscillators. Introduction Phase-Shift Oscillators. Wien-Bridge Oscillator. Colpitts Oscillator. Other LC Oscillators Crystal-Controlled Oscillators. Oscillator Troubleshooting. Solid-State Switching Circuits. Introductory Concepts. Basic Switching

Description of course

	Circuits: Practical Considerations. Schmitt Triggers. Thyristor and Optoelectronics Devices. Introduction to Thyristors: Silicon Unilateral Switch (SUS). Silicon-Controlled Rectifiers (SCRs). Diacs and Triacs. Unijunction Transistors (UJTs). Discrete Photodetectors. Optoisolators and Optointerrupters. Discrete and Integrated Voltage Regulators. Voltage Regulation: An Overview. Series Voltage Regulators. Shunt Voltage Regulators. Linear IC Voltage Regulators. Switching Regulators. DIGITAL FUNDAMENTALS. Number Systems, Operations, and Codes. Decima1Numbers. Binary Numbers. Decima1-to-BinaryConversion. Binary Arithmetic. First and Second Comp1ements of Binary Numbers Signed Numbers. Arithmetic Operations with Signed Numbers. Hexadecimal Numbers. Octal Numbers. Binary Coded Decimal(BCD). Digital Codes. Error Detection and Correction Codes. Logic Gates. Inverter. AND Gate. OR Gate. NAND Gate. NOR Gate. Exclusive-OR and Exclusive-NOR Boolean Algebra and Logic Simplification. Boolean Operations and Expressions. Laws and Rules of Boolean Algebra. DeMorgan's Theorem. Boolean Analysis of Logic Circuits. Simplification Using Boolean Algebra. Standard Forms of Boolean Expressions. Boolean Expressions and Truth Tables. Kamaugh Map. Kamaugh Map SOP Minimization. Karnaugh Map POS Minimization. Five-Variable Kamaugh Maps. Combinational Logic Analysis. Basic Combinational Logic Circuits. Imp1ementing Combinational Logic. Universal Property of NAND and NOR Gates. Combinational Logic Using NAND and NOR Gates. Logic Circuit Operation with Pulse Waveform Inputs. Functions of Combinational Logic. Basic Adders. Parallel Binary Adders. Ripple Carry versus Look Ahead Carry. Comparators. Decoders. Encoders. Latches, Flip-Flops, and Timers. Latches. Edge-Triggered Flip-Flops. Flip-Flop Operating Characteristics Flip-Flop Applications. One-Shots. The 555 Timer. Counters. Asynchronous Counter Operation. Synchronous Counter Operation. Up/Down Synchronous Counters. Design of Synchronous Counters. Cascaded Counters. Counter Decoding. Counter Applications. Logic Symbols with Dependency Notation. Shift Registers. Basic Shift Register Functions. Serial In/Serial Out Shift Registers. Serial In/Parallel Out Shift Registers. Parallel In/Serial Out Shift Registers. Parallel In/Parallel Out Shift Registers. Bidirectional Shift Registers. Shift Register Counters. Shift Register Applications. Logic Symbols with Dependency

Description of course

	Notation. Memory and Storage. Basics of Semiconductor Memory. Random-Access Memories (RAMs). Read-Only Memories (ROMs). Programmable ROMs (PROMs and EPROMs). Flash Memories. Memory Expansion. Special Types of Memories. Magnetic and Optical Storage. Introduction to Digital Signal Processing. Digital Signal Processing Basics. Converting Analog Signals to Digital. Analog-to-Digital Conversion Methods. Digital Signal Processor (DSP). Digital-to-Analog Conversion Method. Integrated Circuit Technologies. Basic Operational Characteristics and Parameters. CMOS Circuits. TTL Circuits. Practical Considerations in the Use of TTL. Comparison of CMOS and TTL Performance. Emitter-Coupled Logic (ECL) Circuits. PMOS, NMOS, and E2CMOS.
Methods of evaluation	Lesson quizzes, homework project, final test.
Methods of verification of effects of education	See Table 39.
Exam	no
Literature	• Paynter R. T.: Introductory electronic devices and circuits, Person Prentice Hall, 7th edition. • Floyd T .L.: Digital Fundamentals Person Prentice Hall, 9th edition. Further Readings: • Irwin J. D., Nelms R. M.: Basic Engineering Circuit Analysis, Willey,8th edition. • Paynter R. T., Boydell B. J. T.: Electronics Technology Fundamentals Electron Flow Version and Conventional Flow Version, Person Prentice Hall, 2nd Edition. EWB MultiSim Student Edition Lite v.10. • Buchala D.M.: Experiments in Digital Fundamentals, Person Prentice Hall, 2006. • Boydell B. J. T.: Experiments in Digital Fundamentals, Person Prentice Hall,2005. • Mohan N., Undeland T.M. Robbins W.P.: Power Electronics, J. Wiley&Sons, Inc, 2003.
Website of the course	http://estudia.meil.pw.edu.pl/

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including a) attendance at the lectures -15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 2 hours. 2) The number of hours of independent work of student: • systematic preparation for classes, home work - 15 hours; • systematic preparation for final tests – 3 hours. TOTAL – 50 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures -15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-

Description of course

E. Additional information

Notes	
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Table 39. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW135_W1**
Description:	Student understands fundamentals, functions and limits of modern electronic devices and circuits.
Verification:	Lesson quizzes, final test.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
Code of effect:	**ML.ANW135_W2**
Description:	Student recognises and understands basic electronic circuits.
Verification:	Lesson quizzes, homework project, final test.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
Code of effect:	**ML.ANW135_W3**
Description:	Student has basic knowledge on application of simple electronic devices and circuits in power industry and electric drive.
Verification:	Lesson quizzes, homework project, final test.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANW135_U1**
Description:	Student knows how to select and design simple electronic circuits in power industry and electric drive.
Verification:	Lesson quizzes, homework project, final test.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW135_U1**
Description:	Student knows how to select and design simple electronic circuits in power industry and electric drive.
Verification:	Lesson quizzes, homework project, final test.
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ML.ANW135_U1**
Description:	Student knows how to select and design simple electronic circuits in power industry and electric drive.
Verification:	Lesson quizzes, homework project, final test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	

General academic profile - social competences

Code of effect:	**ML.ANW135_K1**
Description:	Student understands and values the importance of electronics in engineering and modern life.

Table 39. Learning outcomes	
Verification:	Lesson quizzes, homework project, final test.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK316	
Name of course	Electronics 2	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Krzysztof Rafał	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Electric circuit theory, attendance in Electronics 1.	
Limit of students	12	
C. Effects of education and manner of teaching		
Purpose of course	Learn practical methods of electronic circuit analysis. Learn the use of research equipment in Laboratory of electronics.	
Effects of education	See Table 40.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	15h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Laboratory: transistor amplifiers, operational amplifiers, sinusoidal signal generators, stabilized DC supplies, switched-mode power supplies, sequential and combinational logic circuits.	
Methods of evaluation	Passing every laboratory exercise. Homework: preparation for classes, during which student should prepare and use simple circuit for measurement of electronic circuit.	
Methods of verification of effects of education	See Table 40.	
Exam	no	
Literature	1. P. Horowitz, W. Hilll “The Art of Electronics”. 2. V. Vodozov “Introduction to Electronic Engineering”. 3. V. Vodozov “Introduction to Power Electronics”. 4. N. Mohan “Power Electronics. A First Course”.	
Website of the course	-	
D. Student’s activity		
Number of ECTS credits	1	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 18, including: a) attendance at the labs - 15 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of	

Description of course

	student • systematic preparation for classes - 5 hours; • preparation of laboratory reports – 6 hours TOTAL: 29 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credits – number of hours that require the presence of a teacher - 18, including: a) attendance at the labs - 15 hours; b) consultancy meetings - 3 hours .
Number of ECTS credits on practical activities on the course	1 ECTS credits – 28 hours, including: a) attendance at the labs - 15 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of student • systematic preparation for classes - 5 hours; • preparation of laboratory reports – 6 hours.

E. Additional information

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Table 40. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK316_W3**
Description:	Students has basic knowledge on electrical measurements.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_W3**
Description:	Students has basic knowledge on electrical measurements.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_W1**
Description:	Student knows properties of basic electronic components.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_W2**
Description:	Student knows properties of basic electronic circuits.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_W4**
Description:	Students has basic knowledge on electric circuits.
Verification:	Tests before and after laboratories, exercise reports.

Table 40. Learning outcomes	
Field of study related learning outcomes	Aero1_W08
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK316_U1**
Description:	Student knows how to use measurement equipment (oscilloscope, waveform generator, power supply, multimeter).
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U1**
Description:	Student knows how to use measurement equipment (oscilloscope, waveform generator, power supply, multimeter).
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U2**
Description:	Student knows how to analyse phenomena in semiconductor devices.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U2**
Description:	Student knows how to analyse phenomena in semiconductor devices.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U2**
Description:	Student knows how to analyse phenomena in semiconductor devices.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U4**
Description:	Student knows how to use electronic equipment data sheets.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U4**
Description:	Student knows how to use electronic equipment data sheets.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	

Table 40. Learning outcomes	
Code of effect:	**ML.ANK316_U4**
Description:	Student knows how to use electronic equipment data sheets.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U5**
Description:	Student is able to design and implement a simple electronic circuit.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK316_U5**
Description:	Student is able to design and implement a simple electronic circuit.
Verification:	Tests before and after laboratories, exercise reports.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK690	
Name of course	Integrated CAD/CAM/CAE Systems	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Stanisław Bogdański; profesor PW	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Machine Design I.	
Limit of students	Multiple of number 12.	
C. Effects of education and manner of teaching		
Purpose of course	Introduction to the most advanced Integrated CAD/CAM/CAE Systems and learning the basic functions of 2D and 3D modeling as well as the fundamentals of “Drafting”.	
Effects of education	See Table 41.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	30h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Introduction to the advanced contemporary CAD/CAM/CAE systems used in industry typical structure, main modules their roles and functions, strategy of use. Practical applications of the selected system in the following tasks: ; 2D modelling; points and curves on the plane, introduction to parametric sketcher, ; 3D modelling; creating separate objects (components) and building virtual models of machines and devices (assemblies); drafting; creating 2D engineering drawings (documentation) on the basis of 3D models.	
Methods of evaluation	Two regular tests during the semester + one additional for improvement. Continuous assessment during the whole semester. See the regulations for the course at WWW: http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Regulaminy-zajec-dydaktycznych	
Methods of verification of effects of education	See Table 41.	
Exam	no	
Literature	Tutorials and manuals for NX-Unigrphics issued by	

Description of course

	Siemens UGS PLM Software available „on line” in the lab. Tutorials and manuals for CATIA available „on line” in the lab. Tutorials and manuals for ProEngineer available „on line” in the lab.
Website of the course	http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Materialy-dla-studentow-Files-for-students

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student • systematic preparation for classes and tests - 10 hours; • finishing tasks at home - 5 hours; • reading literature recommended by the teacher - 5 hours. TOTAL – 52 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.2 ECTS credits - 32 hours, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	1.2 ECTS credits - 32 hours, including: a) attendance at the exercises - 30 hours; b) consultancy meetings - 2 hours.

E. Additional information

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Table 41. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK690_W1**
Description:	Student is familiar with the principle knowledge about the applied in mechanical engineering Computer Aided Design Systems of different level of advancement including the most advanced Integrated CAD/CAM/CAE systems. This knowledge should cover the purpose of using these systems, their structure, capabilities and way of operation.
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_W1**
Description:	Student is familiar with the principle knowledge about the applied in mechanical engineering Computer Aided Design Systems of different level of advancement including the most advanced Integrated CAD/CAM/CAE systems. This knowledge should cover the purpose of using these systems, their structure, capabilities and way of operation.
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_W19

Table 41. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_W2**
Description:	Student has a wide-ranged and entrenched knowledge of at least one of the three most popular around the world, contemporary, most advanced, integrated CAD/CAM/CAE Systems (NX-Unigraphics, CATIA, ProEngineer-CREO) including its structure, abilities and scopes of applications of its main modules. This knowledge should include in particular creating the 3D virtual models of assemblies and its components together with their 2D drawings (drafting).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_W2**
Description:	Student has a wide-ranged and entrenched knowledge of at least one of the three most popular around the world, contemporary, most advanced, integrated CAD/CAM/CAE Systems (NX-Unigraphics, CATIA, ProEngineer-CREO) including its structure, abilities and scopes of applications of its main modules. This knowledge should include in particular creating the 3D virtual models of assemblies and its components together with their 2D drawings (drafting).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK690_U1**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for 2D modelling (creating points, curves including splines), for creating parameterized sketches (working in "sketcher"), for 3D modelling of single 3D parts (simple components of machines, devises and structures).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U1**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for 2D modelling (creating points, curves including splines), for creating parameterized sketches (working in "sketcher"), for 3D modelling of single 3D parts (simple components of machines, devises and

Table 41. Learning outcomes	
	structures).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U1**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for 2D modelling (creating points, curves including splines), for creating parameterized sketches (working in "sketcher"), for 3D modelling of single 3D parts (simple components of machines, devises and structures).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U1**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for 2D modelling (creating points, curves including splines), for creating parameterized sketches (working in "sketcher"), for 3D modelling of single 3D parts (simple components of machines, devises and structures).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U1**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for 2D modelling (creating points, curves including splines), for creating parameterized sketches (working in "sketcher"), for 3D modelling of single 3D parts (simple components of machines, devises and structures).
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U2**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for creating 3D virtual models of simple machines, devices' and structures (assemblies) and for partly automatic

Table 41. Learning outcomes	
	creation of 2D drawings (drafting) from 3D parts and assembiles.
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U2**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for creating 3D virtual models of simple machines, devices' and structures (assemblies) and for partly automatic creation of 2D drawings (drafting) from 3D parts and assembiles.
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U2**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for creating 3D virtual models of simple machines, devices' and structures (assemblies) and for partly automatic creation of 2D drawings (drafting) from 3D parts and assembiles.
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK690_U2**
Description:	He/she is able to make use of the selected System (from the mentioned above three advanced, Integrated CAD/CAM/CAE systems) at the basic level. In particular, he/she is able to apply this system in practice for creating 3D virtual models of simple machines, devices' and structures (assemblies) and for partly automatic creation of 2D drawings (drafting) from 3D parts and assembiles.
Verification:	Colloquia and current tests.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK471	
Name of course	INTEGRATED LABORATORY	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	MGR INŻ. MAREK TRACZ	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Fluid mechanics 1 (ANW122) , Mechanics of structures 1 (ANW117) , Thermodynamics 1 (ANW116).	
Limit of students	6 students in one group	
C. Effects of education and manner of teaching		
Purpose of course	To learn about EXPERIMENTAL METHODS.	
Effects of education	See Table 42.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	30h
	Project type of course	0h
	Computer lessons	0h
Contents of education	- Aerodynamics Laboratory 1) Velocity measurement with use of the thermoanemometer. Calibrating, measurement's rules,turbulence, parameter. 2) Velocity measurement with use of the accumulative Prandtl's and Pitot's pipes. Air industrial average velocity measurement devices. Applicability and accuracy of them. 3) Flow visualisation - compressible and uncompressible. Acquainting with characteristic points in the aerodynamic trace and on the model surface. Leading of appearance and shock (impact) wave shape visualisation. 4) The cylinder resistance measurement. Measurement of the pressure distribution on the cylinder surface and evaluation of its total resistance basing on the momentum conservation rule. 5) Weight measurements of aerodynamic coefficients. Loads measurements on a model with help of threecomponent tensometric balance. Recounting of forces to coefficients, calculation of polar curve and the middle of the model pressure. - Thermodynamics Laboratory. 1) Temperature measurements -	

Description of course

	thermodynamics temperature scale, calibration of temperature measurement gauges. 2) Open system balance - combustion heat measurement. 3) Conversion of the air - air moisture investigation. 4) Measurement of insulators heat conductivity - plate device method in the steady state. 5) Searching of the heat diffiusivity. - Mechanics of Structures Laboratory. 1) Torsion - determination of the revolution angle, the unit twisting angle and Kirchhoff modulus in the compact cross-section bars. Determination of strains and stresses in the thin walled close profile and the middle of transversal forces in the thin walled open profile. 2) Bending - verification of the superposition and Betti's rules with help of flexometer measuring beam deflection. Verification of the de Saint Venant rule by tensometrical method. Determination of the Young modulus. Investigation of the oblique bending. 3) Tensometer method (strain gauge)- wide application range. Determination of plane stress state.Stress concentration coefficient. 4) Buckling - Southwell's metod giving experimental value of critical forces. Advanced loading cases of invesigated bars. 5) Elastooptics - foundation of physical phenomenon, basic application of the elastooptics method. Determination of plane stress state. Stress concentration coefficient.
Methods of evaluation	Final mark on the base of report and short test reffered to each laboratory session.
Methods of verification of effects of education	See Table 42.
Exam	no
Literature	1. Bijak-Żochowski M., Jaworski A., Krzesiński G., Zagrajek T.: Mechanika Materiałów i Konstrukcji,Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2006. 2. Brzoska Z.: Wytrzymałość Materiałów, PWN, Warszawa, 1979. 3. M. Litwińczyk i in.: Ćwiczenia Laboratoryjne z Mechaniki Płynów, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa. 4. P. Bader, K. Błogowska: Laboratorium Termodynamiki, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2008. 5. R. Domański: Wymiana Ciepła Laboratorium Dydaktyczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1996.
Website of the course	

D. Student’s activity

Number of ECTS credits	3
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the labs - 30 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of student - 45 hours, including: • preparation to

Description of course

	exercises: 15 hours; • preparation of reports: 15 hours, • studying of recommended literature by the teacher: 15 hours. TOTAL: 78 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits - 33 hours, including: a) attendance at the labs - 30 hours; b) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credits - 78 hours, including: a) attendance at the labs - 30 hours; b) consultancy meetings - 3 hours; c) preparation to exercises: 15 hours; d) preparation of reports: 15 hours; e) studying of recommended literature by the teacher: 15 hours.

E. Additional information

Notes	Two six-person subgroups made from one laboratory group.
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Table 42. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK471_W1**
Description:	Grounded knowledge of mechanics of structures .
Verification:	Short test.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK471_W2**
Description:	Grounded knowledge of thermodynamics and fluid mechanics .
Verification:	Short test.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANK471_W3**
Description:	Knowledge of experimental methods in solid mechanics , thermodynamics and fluid mechanics .
Verification:	Short test.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK471_U1**
Description:	Independent planning and leading of measuring exercises .
Verification:	Evaluation of the report.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK471_U1**
Description:	Independent planning and leading of measuring exercises .
Verification:	Evaluation of the report.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANK471_U2**
Description:	Ability to evaluate experimental results and to

Table 42. Learning outcomes	
	analyze of measurement errors .
Verification:	Evaluation of the report.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW125	
Name of course	Machine Design II	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Stanisław Bogdański; profesor PW.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Machine Design I.	
Limit of students	70	
C. Effects of education and manner of teaching		
Purpose of course	To present methods of analysis and design of various important machine elements and subassemblies as well as to explaintheir role and way of functioning in machines and systems. To make an introduction to surface failure phenomena and to the tooth gear, belt and chain drives.	
Effects of education	See Table 43.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Screws and fasteners: theory of thread, stresses in threads, preloaded bolts under static and dynamic loading. Springs and flexible elements: accumulated energy, designing for minimum mass. Surface failure: surface geometry, friction and wear, surface fatigue, spherical and cylindrical contact. Machine subassemblies: sliding bearings, rolling element bearings, couplings (rigid and compliant couplings, flexible couplings), clutches and brakes (selection and specification, materials, disk clutches and brakes, drum brakes), basic features and selection of tooth gears and belt and chain drives.	
Methods of evaluation	Continuous assessment during the whole semester. Three regular tests organized during the semester plus one additional as the test for improvement at the end of semester. See the regulations for the course at WWW: http://meil.pw.	

Description of course

	edu.pl/zpk/ZPK/Dydaktyka/Regulaminy-zajec-dydaktycznych.
Methods of verification of effects of education	See Table 43.
Exam	yes
Literature	Machine Design An Integrated Approach, Fourth edition, by Robert L.Norton, Prentice Hall 2010. Machine Elements in Mechanics and Design Fourth Edition, by Robert L. Mott, Prentice Hall 2006. Design of Machine Elements seventh edition, by M.F.Spotts and T.E.Shoup, Prentice Hall 1998.
Website of the course	http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Materialy-dla-studentow-Files-for-students

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher – 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student - 45, including: • systematic preparation for classes, solving tasks - 20 hours; • preparation for tests -15 hours; • preparation for exam - 10 hours. TOTAL: 78 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 43. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW125_W1**
Description:	He/She is familiar with the design of typical machines and machine subassemblies used especially in power transmission systems as well as components of different mechanical devices such as; screw mechanisms, rolling element bearings, sliding bearings, shafts and axles, springs, couplings, clutches and gears, etc. He is also familiar with the engineering challenges and problems accompanying the process of design.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	

Code of effect:	**ML.ANW125_W1**
Description:	He/She is familiar with the design of typical machines and machine subassemblies used

Table 43. Learning outcomes	
	especially in power transmission systems as well as components of different mechanical devices such as; screw mechanisms, rolling element bearings, sliding bearings, shafts and axles, springs, couplings, clutches and gears, etc. He is also familiar with the engineering challenges and problems accompanying the process of design.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW125_U1**
Description:	He/She is able to perceive and define the wider context of the analyzed detail problem including the context related to the required features of the component of the mechanical device being designed. During designing and calculating a particular component of the machine or structure (for example: the shaft support, the clutch or the joint of the two parts of piping) he/she is able to take into account the requirements related to its role in the system transmitting power or mass.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U1**
Description:	He/She is able to perceive and define the wider context of the analyzed detail problem including the context related to the required features of the component of the mechanical device being designed. During designing and calculating a particular component of the machine or structure (for example: the shaft support, the clutch or the joint of the two parts of piping) he/she is able to take into account the requirements related to its role in the system transmitting power or mass.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U1**
Description:	He/She is able to perceive and define the wider context of the analyzed detail problem including the context related to the required features of the component of the mechanical device being designed. During designing and calculating a particular component of the machine or structure (for example: the shaft support, the clutch or the joint of the two parts of piping) he/she is able to take into account the requirements related to its role in the system transmitting power or mass.
Verification:	Tests and exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U2**

Table 43. Learning outcomes	
Description:	He/She is able to perceive the physical limitations (concerning mainly the strength, elasticity, durability and heat resistance of materials) and non physical related to economy, and standardisation as well as that resulting from an incomplete knowledge of engineers and imperfect tools being in their disposal – needed for designing the typical components and subassemblies of mechanical devices.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U2**
Description:	He/She is able to perceive the physical limitations (concerning mainly the strength, elasticity, durability and heat resistance of materials) and non physical related to economy, and standardisation as well as that resulting from an incomplete knowledge of engineers and imperfect tools being in their disposal – needed for designing the typical components and subassemblies of mechanical devices.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U2**
Description:	He/She is able to perceive the physical limitations (concerning mainly the strength, elasticity, durability and heat resistance of materials) and non physical related to economy, and standardisation as well as that resulting from an incomplete knowledge of engineers and imperfect tools being in their disposal – needed for designing the typical components and subassemblies of mechanical devices.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U3**
Description:	On the bases of the perceived limitations and requirements being relevant to a role performed by the designed subassembly/component (for example: joint of the two parts of piping, support of the shaft, clutch) in a machine, device or system, he/she is able to formulate limiting conditions, which are essential for completing calculations in designing. Then he/she is able to utilise them for determining or selecting the appropriate features of the subassembly/component being designed.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U3**

Table 43. Learning outcomes	
Description:	On the bases of the perceived limitations and requirements being relevant to a role performed by the designed subassembly/component (for example: joint of the two parts of piping, support of the shaft, clutch) in a machine, device or system, he/she is able to formulate limiting conditions, which are essential for completing calculations in designing. Then he/she is able to utilise them for determining or selecting the appropriate features of the subassembly/component being designed.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U3**
Description:	On the bases of the perceived limitations and requirements being relevant to a role performed by the designed subassembly/component (for example: joint of the two parts of piping, support of the shaft, clutch) in a machine, device or system, he/she is able to formulate limiting conditions, which are essential for completing calculations in designing. Then he/she is able to utilise them for determining or selecting the appropriate features of the subassembly/component being designed.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U4**
Description:	He/She is able to build or to select from the literature (as well as from the standards) adequate models of states and phenomena, which are necessary for utilising the limiting condition in engineering calculations of analysed or designed object/component/subassembly. He/She is able to evaluate the usefulness of the build/selected model in respect of its accuracy and meticulosity.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U4**
Description:	He/She is able to build or to select from the literature (as well as from the standards) adequate models of states and phenomena, which are necessary for utilising the limiting condition in engineering calculations of analysed or designed object/component/subassembly. He/She is able to evaluate the usefulness of the build/selected model in respect of its accuracy and meticulosity.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U12

Table 43. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U4**
Description:	He/She is able to build or to select from the literature (as well as from the standards) adequate models of states and phenomena, which are necessary for utilising the limiting condition in engineering calculations of analysed or designed object/component/subassembly. He/She is able to evaluate the usefulness of the build/selected model in respect of its accuracy and meticulosity.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U5**
Description:	He/She knows how to perform the essential engineering calculations necessary for determining features of the analysed/designed subassembly/component of mechanical device, (for example: connection of the two parts of piping, shaft support or clutch.) .
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U5**
Description:	He/She knows how to perform the essential engineering calculations necessary for determining features of the analysed/designed subassembly/component of mechanical device, (for example: connection of the two parts of piping, shaft support or clutch.) .
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U5**
Description:	He/She knows how to perform the essential engineering calculations necessary for determining features of the analysed/designed subassembly/component of mechanical device, (for example: connection of the two parts of piping, shaft support or clutch.) .
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U6**
Description:	He/She knows how to apply in practice the general and detail principles of design. He/She is also able to follow the design guidelines resulting from engineering practice.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U6**
Description:	He/She knows how to apply in practice the

Table 43. Learning outcomes	
	general and detail principles of design. He/She is also able to follow the design guidelines resulting from engineering practice.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U7**
Description:	He/She is able to apply in practice the guidelines formulated in the engineering standards, which concern the geometrical features of typical machine elements, as well as their physical properties including the strength properties. He/She knows how to use the catalogues of typical machine elements/subassemblies and engineering materials.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U7**
Description:	He/She is able to apply in practice the guidelines formulated in the engineering standards, which concern the geometrical features of typical machine elements, as well as their physical properties including the strength properties. He/She knows how to use the catalogues of typical machine elements/subassemblies and engineering materials.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U8**
Description:	He/She is able to undertake decisions concerning the characteristics/features of analysed/designed elements/subassemblies taking into account both, the results of calculations and the limitations, which cannot be defined mathematically.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW125_U8**
Description:	He/She is able to undertake decisions concerning the characteristics/features of analysed/designed elements/subassemblies taking into account both, the results of calculations and the limitations, which cannot be defined mathematically.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	

Description of course

Code of course	ANK400
Name of course	Manufacturing Technology II LAB
Version of course	2013.

A. Place of the course in system of studies

Level of education	First cycle studies
Form and mode of studies	full-time
Profile of studies	General academic profile
Specialisation	-
Place of teaching of course	Faculty of Power and Aeronautical Engineering
Place of realization of course	Faculty of Production Engineering, Department of Finishing and Erosion Machining.
Coordinator of course	Dr Zbigniew Lechniak, dr hab. inż. Marek Rozenek, prof. PW

B. General characteristic of the course

Block of courses	Aerospace Engineering
Group of courses	Specialization
Type of course	Compulsory
Language of course	angielski
Nominal semester	4 (r.a. 2019/2020)
Time of completion in the academic year	summer semester
Preliminary requirements	Manufacturing Technology I (30 hours of lecture given in the 3rd sem.)
Limit of students	12 students in one group

C. Effects of education and manner of teaching

Purpose of course	Getting basic knowledge on the most used manufacturing processes and industrial measurement methods.	
Effects of education	See Table 44.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	30h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Analysis of measurement errors, measurements of typical geometric features, machine parts shaping by plastic forming, bonding materials by welding, part programming for numerically controlled machine tools, abrasive machining for surface finish, metal cutting by turning and milling with cutting tool life investigation, electrochemical machining, electro-discharge machining.	
Methods of evaluation	Checking students preliminary knowledge prior a lab class and a lab class mandatory report assessment.	
Methods of verification of effects of education	See Table 44.	
Exam	no	
Literature	1) Selected English translation of an academic book “Obróbka Skrawaniem Ścierna i Erozyjna”(in Polish), L.Dąbrowski et al., OWPW, Warszawa 2007. 2) Selected English translation of an academic book “Metrologia wielkości geometrycznych”(in Polish), B.Nowicki et al.,	

Description of course

	OWPW, Warszawa 2007. 3) Documentation on http://zowie.meil.pw.edu.pl Further Readings: 1) “Manufacturing Engineering and Technology”, S. Kalpakjian, Prentice Hall 2006.
Website of the course	

D. Student’s activity

Number of ECTS credits	2
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the labs - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student - - preparation of laboratory reports – 10 hours; - preparation for short tests - 10 hours; - reading literature recommended by the teacher – 10 hours; TOTAL : 62 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,2 ECTS credits - 32 hours, including: a) attendance at the labs - 30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credits - 62 hours, including: a) attendance at the labs - 30 hours; b) consultancy meetings - 2 hours; c) preparation of laboratory reports – 10 hours; d) preparation for short tests - 10 hours; e) reading literature recommended by the teacher – 10 hours.

E. Additional information

Notes	
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Table 44. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK400_W01**
Description:	Student is familiar with the basic and modern manufacturing processes and is aware of the process outcome and of the product performance as well as the quality of the part mating.
Verification:	Test taking different form is performed at each lab exercise.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK400_W01**
Description:	Student is familiar with the basic and modern manufacturing processes and is aware of the process outcome and of the product performance as well as the quality of the part mating.
Verification:	Test taking different form is performed at each lab exercise.
Field of study related learning outcomes	Aero1_W10
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK400_U01**
Description:	Student can select proper manufacturing process depending upon the technological requirements

Table 44. Learning outcomes	
	given in the product documentation, student can forecast the selected process effect on the product perfomance.
Verification:	Test taking different form at each lab exercise.
Field of study related learning outcomes	Aero1_U15
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK400_K01**
Description:	Student can present and explain his/her observation within the group as to the selection of the manufacturing process ensuring its conformance with the given technological requirements. Student can explain the applied measurement method for verifying the required product quality.
Verification:	Test taking different form at each lab exercise.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK472	
Name of course	MECHANICS OF FLIGHT 1	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aerospace Engineering, Mechanics Division, Institute of Aeronautics and Applied Mechanics.	
Coordinator of course	dr inż. Zbigniew Paturski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	Course results: after completing his course the students will be able to estimate basic aerodynamic characteristics and performances of the airplane.	
Effects of education	See Table 45.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	15h
	Computer lessons	0h
Contents of education	Atmosphere properties. International Standard Atmosphere. Aerodynamic forces and moments, and aerodynamic characteristics of the airplane (sub- trans- and supersonic). Gliding (unpowered) flight. Aircraft propulsion: propellers and jets. Performances in powered flight: climb characteristics, ceiling, endurance and range. Take-off and landing of the airplane.	
Methods of evaluation	60% continuous assessment based on guided projects, 40% test work. Practical work: Six (6) projects covering aerodynamic and basic performance of the airplane.	
Methods of verification of effects of education	See Table 45.	
Exam	no	
Literature	1.John D. Anderson: Introduction to Flight, McGravHill, 2005. 2.Warren F. Philips: Mechanics of Flight, John Willey and Sons, 2004. 3.Jan Roskam, ChuanTau E. Lan: Airplane Aerodynamics and Performance, DARCorporation, Lawrence,	

Description of course

	Kansas 1997.
Website of the course	http://meil.pw.edu.pl/zm/ZM/Dydaktyka/Do-pobrania/Mechanics-of-Flight-I

D. Student's activity

Number of ECTS credits	4
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the lectures - 15 hours; b) attendance at the exercise design -15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - • systematic preparation for classes - 15 hours; • homework - 6 projects - 50 hours. TOTAL: 100 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits - 35, including: a) attendance at the lectures - 15 hours; b) attendance at the exercise design -15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	4 ECTS credits - 100 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the exercise design -15 hours; c) consultancy meetings - 5 hours; d) systematic preparation for classes - 15 hours; e) homework - 6 projects - 50 hours.

E. Additional information

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Table 45. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK472_W1**
Description:	Atmosphere properties. International Standard Atmosphere. Aerodynamic forces and moments, and aerodynamic characteristics of the airplane (sub-, trans- and supersonic). Gliding (unpowered) flight. Aircraft propulsion systems: propellers and jets. Performances in powered flight: climb characteristics, ceiling, endurance and range. Takeoff and landing of the airplane.
Verification:	60% continuous assessment based on guided projects, 40% test work. Practical work: Six (6) projects covering aerodynamic and basic performance of the airplane.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK472_U1**
Description:	Ability to analyze aerodynamic properties an steady state performances of fixed wing airplanes.
Verification:	60% continuous assessment based on guided projects, 40% test work. Practical work: Six (6) projects covering aerodynamic and basic

Table 45. Learning outcomes	
	performance of the airplane.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK433	
Name of course	Propulsion Systems	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. dr hab. inż. Andrzej Teodorczyk	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	4 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Thermodynamics, Fluid Dynamics.	
Limit of students	60	
C. Effects of education and manner of teaching		
Purpose of course	Learning about basic kinds of aircraft propulsions. Skills in calculations of basic parameters of the aircraft engine cycle like thrust, efficiencies, fuel consumption.	
Effects of education	See Table 46.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	History of the aircraft engines. Requirements for the aircraft engines. Efficiencies. Theoretical and real cycles of piston, turbine, ramjet and rocket engines. Air fuel mixture creation and combustion. Kinds of piston engines. Cooperation of a propeller with the engine. Performances of the engines. Elements of the turbine engines: intake, compressor, combustion chamber, turbine, nozzle, thrust reverser and afterburner. Calculation of the engine cycles. Ecological problems.	
Methods of evaluation	Two tests 50% each.	
Methods of verification of effects of education	See Table 46.	
Exam	no	
Literature	1) J. Mattingly „Elements of Propulsion”. 2) G.C. Oates „Aerothermodynamics of Aircraft Engine Components”. 3) R. Stone „Introduction to Internal Combustion Engines”.	
Website of the course	http://estudia.meil.pw.edu.pl/	
D. Student’s activity		
Number of ECTS credits	5	
Number of hours of student’s work to achieve	1) Number of hours that require the presence of a	

Description of course

effects of education	teacher - 50, including: a) attendance at the lectures -30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - 74, including: • systematic preparation for classes, solving tasks – 30 hours; • systematic preparation for 2 tests – 24 hours; • studying of literature recommended by the teacher - 20 hours. TOTAL: 124 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits - 50 hours, including: a) attendance at the lectures -30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 46. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK433_W1**
Description:	Student has a knowledge about principles of piston and turbine engine work cycles.
Verification:	Test 1
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W1**
Description:	Student has a knowledge about principles of piston and turbine engine work cycles.
Verification:	Test 1
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W2**
Description:	Student understands propulsion efficiencies of propulsions systems: engine - propeller, jet engine, turbine engine.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W2**
Description:	Student understands propulsion efficiencies of propulsions systems: engine - propeller, jet engine, turbine engine.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W3**
Description:	Student has a knowledge about principles of turbine aircraft propulsion systems: turbo jet, turbo fan, turbo prop.
Verification:	Test 2.

Table 46. Learning outcomes	
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W3**
Description:	Student has a knowledge about principles of turbine aircraft propulsion systems: turbo jet, turbo fan, turbo prop.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W3**
Description:	Student has a knowledge about principles of turbine aircraft propulsion systems: turbo jet, turbo fan, turbo prop.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W4**
Description:	Student has knowledge about principles of piston engine construction.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W4**
Description:	Student has knowledge about principles of piston engine construction.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W5**
Description:	Student has a knowledge about principles of turbine engine construction.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_W5**
Description:	Student has a knowledge about principles of turbine engine construction.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK433_U1**
Description:	Student is able to determine which type of propulsion system is proper for given aircraft.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_U2**
Description:	Student is able to calculate parameters of work cycle and performance of piston engine.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_U2**

Table 46. Learning outcomes	
Description:	Student is able to calculate parameters of work cycle and performance of piston engine.
Verification:	Test 1.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_U3**
Description:	Student is able to calculate parameters of work cycle and performance of turbine engine.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_U4**
Description:	Student is able to determine optimal compression for turbine engine compressor and its specicfic fuel consumption.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANK433_U4**
Description:	Student is able to determine optimal compression for turbine engine compressor and its specicfic fuel consumption.
Verification:	Test 2.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	

Description of course

Code of course	ANJ4	
Name of course	Foreign Language 4	
Version of course	2014.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	The Foreign Language Centre PW	
Coordinator of course	For details, refer to the syllabus of the course	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Languages	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	For details, refer to the syllabus of the course	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	For details, refer to the syllabus of the course.	
Effects of education	See Table 47.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	For details, refer to the syllabus of the course.	
Methods of evaluation	For details, refer to the syllabus of the course.	
Methods of verification of effects of education	See Table 47.	
Exam	no	
Literature	For details, refer to the syllabus of the course.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	Number of hours that require the presence of a teacher ~30 exercises hours. The number of hours of independent work of student ~30.	
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit.	
Number of ECTS credits on practical activities on the course		
E. Additional information		
Notes	Detailed information about the effects of teaching presents a course syllabus.	
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Table 47. Learning outcomes

Description of course

Code of course	ANWF5	
Name of course	Physical Education and Sport 5	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	College of Physical Education and Sport.	
Coordinator of course	Teacher at College of Physical Education and Sport.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Physical Education and Sports	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	?	
Effects of education	See Table 48.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The development of physical activity of students. Detailed data contains syllabus of specific course.	
Methods of evaluation	The exercise program offer by College of Physical Education and Sport.	
Methods of verification of effects of education	See Table 48.	
Exam	no	
Literature		
Website of the course		
D. Student’s activity		
Number of ECTS credits	0	
Number of hours of student’s work to achieve effects of education	Participation in classes - 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0.0 ECTS credit (30 hours of classes, without ECTS).	
Number of ECTS credits on practical activities on the course		
E. Additional information		
Notes		
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Table 48. Learning outcomes

Description of course

Code of course	ML.ANK458	
Name of course	Aeronautical Systems II	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Maciej Zasuwa	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students	12 students in one group	
C. Effects of education and manner of teaching		
Purpose of course	The presentation of basics of aeronautical systems: principles of operation and applications.	
Effects of education	See Table 49.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	15h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Lectures: Flight instruments. Cockpit design. Aeronautical pneumatic systems (pitot-static system, Air Data Computer, low speed measurement). Sensor integration in aeronautical systems. Laboratory: The familiarization with principles of operation of elements of pneumatic and hydraulic, systems, magnetic and inertial sensors, IMU, electromagnetic actuations.	
Methods of evaluation	60% continuous assessment based on laboratory work, 40% on theory presented during lectures. 1 test at the end of lectures, all laboratory exercises completed (report and test).	
Methods of verification of effects of education	See Table 49.	
Exam	no	
Literature	1) Grewal, Mohinder S., Global positioning systems, inertial navigation, and integration, 2001. 2) Moir I., Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration, Third Edition,AIAA, 2008. 3) Moir I., Seabridge A., Design and Development of Aircraft Systems: An Introduction, AIAA, 2004. 4) Pallet E.H.J., Aircraft Instrument Systems, IAP, 1993. 5) Spitzer, Cary R. Red., „The avionics handbook”, 2001. 6) Stevens	

Description of course

	B., Lewis F., Aircraft Control and Simulation, Second Edition, John Wiley, 2003.
Website of the course	-

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the labs - 15 hours; b) attendance at the lecture - 15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student - 45, including: • preparation to exercises: 15 hours; • preparation of reports: 15 hours; • preparation to tests: 15 hours. TOTAL: 78 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits - 33 hours, including: a) attendance at the labs - 15 hours; b) attendance at the lecture - 15 hours;
Number of ECTS credits on practical activities on the course	3 ECTS credits - 78 hours, including: a) attendance at the labs - 15 hours; b) attendance at the lecture - 15 hours; c) consultancy meetings - 3 hours. d) preparation to exercises: 15 hours; e) preparation of reports: 15 hours; f) preparation to tests: 15 hours.

E. Additional information

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Table 49. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK458_W1**
Description:	Student knows the physical bases of operation of modern aeronautical systems. Student can discuss physical phenomena relevant to the operation of the aeronautical system.
Verification:	Test.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W2**
Description:	Student knows the purpose of the system. Student can point out the basic functions of aeronautical systems.
Verification:	Test.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W3**
Description:	Student is able to point out the major components of the aeronautical system and explain the interaction between these components. Student knows how to present in a systematic manner the principle of the operation of aeronautical system.
Verification:	Test.
Field of study related learning outcomes	Aero1_W08

Table 49. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W3**
Description:	Student is able to point out the major components of the aeronautical system and explain the interaction between these components. Student knows how to present in a systematic manner the principle of the operation of aeronautical system.
Verification:	Test.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W3**
Description:	Student is able to point out the major components of the aeronautical system and explain the interaction between these components. Student knows how to present in a systematic manner the principle of the operation of aeronautical system.
Verification:	Test.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W4**
Description:	Student knows the principles of operation of the modern navigation and attitude systems. Student can explain the principles of operation of satellite and inertial navigation systems.
Verification:	Test.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W5**
Description:	Student knows the principles of operation of aircraft control systems. Student can present signal flow diagram in aircraft control systems.
Verification:	Test.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_W5**
Description:	Student knows the principles of operation of aircraft control systems. Student can present signal flow diagram in aircraft control systems.
Verification:	Test.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK458_U1**
Description:	Student can analyze the system for the effects of component failure and sensor errors. Student is able to analyze the impact of a single component failure, sensor errors and ambient disturbances on the aeronautical system.
Verification:	Laboratory report evaluation.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_U2**

Table 49. Learning outcomes	
Description:	Student is able to make an experiment on a selected aeronautical equipment, make a report and conclude it.
Verification:	Laboratory report evaluation.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK458_U3**
Description:	Student can interpret measurement results and draw conclusions in relation to the objectives of the experiment.
Verification:	Laboratory report evaluation.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK458_K1**
Description:	Student is able to work in a team to solve technical problems.
Verification:	Laboratory report evaluation.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK307	
Name of course	Aircraft design I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Cezary Galiński	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Mechanics; Fluid mechanics; Aerodynamics; Mechanics of flight 1.	
Limit of students	No limit at the lecture, max. 12 in each of the project groups.	
C. Effects of education and manner of teaching		
Purpose of course	Familiarization with the aircraft design process is a main goal of the subject. Familiarization with the airplane performance and structural design basics is an additional goal of the subject.	
Effects of education	See Table 50.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	15h
	Computer lessons	0h
Contents of education	Lecture: Introduction, trends analysis, cost analysis. Mission profile. Sizing -initial weight analysis, wing loading analysis and power (thrust) loading analysis. Fuselage - ergonomics, operational characteristics, wing-fuselage configuration, basics of the fuselage and wing-fuselage fairing aerodynamics. Landing gear - requirements, configurations and their characteristics, typical design solutions. Integration of the propulsion system – types of propulsion systems and their ranges of application, engines number and distribution, engines mounts, cooling, inlets and nozzles. Propellers - types, typical design solutions, advanced designs. Empennages – basics of sizing, configurations and their characteristics; selected advanced designs and their characteristics. Airplane initial draft and weight analysis. Examples: light piston driven training airplane for	

Description of course

	student and instructor; large passenger airplane. Wing – basic information on airfoil characteristics and their selection, selection of remaining geometric features of the wing (aspect ratio, taper ratio, dihedral, sweep angle, twist angle, etc.), delta wing. High lift devices and control surfaces. Airplane stability and controllability criteria. Airplane loads envelope. Loads of the wing and empennages. Loads of the fuselage and landing gear. Loads caused by propulsion system. Project: Trends analysis, mission profile, estimation of empty weight, fuel weight and take-off weight. Selection of the wing loading and power (thrust) loading. Initial cost analysis. Airplane draft and weight analysis. Detailed analysis of weight configurations. Estimation of Centre of Mass. Aerodynamic characteristics. Performance and loads envelope. Assessment of the design.
Methods of evaluation	Components of the evaluation: 1) Colloquium 1 (test) – max. 25 pts. 2) Colloquium 2 (problem) – max. 25 pts. 3) Projects - max . 50 pts (5x10) Maximum amount of points for each project decreases by 2 every week after it’s deadline. 0 pts. from any project is equivalent to the overall course failure. Final evaluation More than 13 pts. From each colloquium + all projects accepted with at least 25 pts. collected Marks graduation: 0-49 2 50-61 3 62-73 3,5 74-85 4 85-95 4,5 95-100 5.
Methods of verification of effects of education	See Table 50.
Exam	no
Literature	Main: EASA airworthiness regulations. T. C. Corke „Design of Aircraft”. D.P. Raymer „Aircraft Design, a Conceptual Approach”. Auxiliary: J. Roskam „Airplane Design”. D. Stinton „The Design of the Aeroplane”. E.Torenbeek „Synthesis of Subsonic Airplane Design”. J.D. Anderson „Aircraft Performance & Design”. J.P. Fielding „Introduction to Aircraft Design”. L.R. Jenkinson, J.F.Marchman III „Aircraft Design Projects”. N. Currey „Aircraft landing gear design”.
Website of the course	http://www.meil.pw.edu.pl/add/ADD/Teaching/Subjects/Aircraft-Design

D. Student’s activity

Number of ECTS credits	4
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises project -15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student • systematic preparation for classes - 10 hours; • preparation to colloquia – 10 hours; • projects preparation – 65 hours. TOTAL: 120 hours.

Description of course

Number of ECTS credits on the course with direct participation of academic teacher	1.4 ECTS credit - 35 hours, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises project -15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	3 ECTS credit - 90 hours, including: a) attendance at the exercises project -15 hours; b) systematic preparation for classes - 10 hours; c) projects preparation – 65 hours.

E. Additional information

Notes	Passing this subject is highly improbable without previous passing the Flight Mechanics 1.
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Table 50. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK307_W1**
Description:	Student knows components of the aircraft design process.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_W2**
Description:	Student knows functions, characteristics and loads of an airplane components.
Verification:	Colloquium, assessment of the project.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_W2**
Description:	Student knows functions, characteristics and loads of an airplane components.
Verification:	Colloquium, assessment of the project.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_W3**
Description:	Student knows selected rules of current airworthiness regulations.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_W4**
Description:	Student knows how to conduct trends analysis in aeronautics.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK307_U1**
Description:	Student is capable to prepare the documentation of his/her engineering work.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	

Table 50. Learning outcomes	
Code of effect:	**ML.ANK307_U1**
Description:	Student is capable to prepare the documentation of his/her engineering work.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U2**
Description:	Student is capable to analyze costs.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U2**
Description:	Student is capable to analyze costs.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U16
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U3**
Description:	Student is capable to design simple airplane.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U21
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U4**
Description:	Student knows how to conduct trends analysis in aeronautics.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U4**
Description:	Student knows how to conduct trends analysis in aeronautics.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U4**
Description:	Student knows how to conduct trends analysis in aeronautics.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_U5**
Description:	Student is capable to analyze flight characteristics and loads of an airplane, select and evaluate the propulsion system and equipment.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U18
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK307_K1**
Description:	Student is aware of deadlines importance.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_K1**

Table 50. Learning outcomes	
Description:	Student is aware of deadlines importance.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	
Code of effect:	**ML.ANK307_K2**
Description:	Student is capable to analyse costs.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_K05
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS619	
Name of course	Aircraft Engine Design I	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Phd. Eng. Paweł Oleszczak	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Machine Design, Strength of Materials, Thermodynamics, Propulsion Systems, Aircraft Turbine Engines.	
Limit of students	60	
C. Effects of education and manner of teaching		
Purpose of course	Acquainting students with construction, operation, and application of aircraft engines; the selection and rational designing and calculation techniques for parts and units of aircraft engines.	
Effects of education	See Table 51.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Turbine aviation engines: scope of using, design schemas, overview of units, aerothermodynamics calculations techniques. Short overview of basic design problems, overview basic responsibilities of control, diagnostic and monitoring unit.	
Methods of evaluation	100 % - the subject is completed on the basis of the final written test.	
Methods of verification of effects of education	See Table 51.	
Exam	no	
Literature	Recommended texts (reading): 1) J. Mattingly „Aircraft Engine Design”. 2) J. Mattingly “Elements of Propulsion” . Further readings: Flight International, Awiation Week and Space Technology.	
Website of the course	http://www.itc.pw.edu.pl/Pracownicy/Naukowo-dydaktyczni/Oleszczak-Pawel/Aircraft-Engine-Design-I	
D. Student’s activity		
Number of ECTS credits	3	
Number of hours of student’s work to achieve	1) Number of hours that require the presence of a	

Description of course

effects of education	teacher - 32, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 2 hours. 2) The number of hours of independent work of student • systematic preparation for classes, reading recommended by the teacher of literature - 20 hours; • preparing for tests - 20 hours; TOTAL: 72 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,2 ECTS credits - 32 hours, including: a) attendance at the lectures - 30 hours; b) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 51. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS619_W1**
Description:	Student has a knowledge about construction of modern piston and turbine engines.
Verification:	Test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W1**
Description:	Student has a knowledge about construction of modern piston and turbine engines.
Verification:	Test.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W2**
Description:	Student has a knowledge about construction, work and applications of piston and turbine engines.
Verification:	Test.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W2**
Description:	Student has a knowledge about construction, work and applications of piston and turbine engines.
Verification:	Test.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W2**
Description:	Student has a knowledge about construction, work and applications of piston and turbine engines.
Verification:	Test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W3**

Table 51. Learning outcomes	
Description:	Student knows the fundamental problems concerned with aircraft engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W3**
Description:	Student knows the fundamental problems concerned with aircraft engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W3**
Description:	Student knows the fundamental problems concerned with aircraft engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_W3**
Description:	Student knows the fundamental problems concerned with aircraft engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANS619_U1**
Description:	Student is able to analyse solutions of piston and turbine engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U1**
Description:	Student is able to analyse solutions of piston and turbine engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U1**
Description:	Student is able to analyse solutions of piston and turbine engines constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U2**
Description:	Student is able to perform calculations necessary in case of simple engine constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U2**
Description:	Student is able to perform calculations necessary in case of simple engine constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	

Table 51. Learning outcomes	
Code of effect:	**ML.ANS619_U2**
Description:	Student is able to perform calculations necessary in case of simple engine constructions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U3**
Description:	Student is able to valuate specific solution of engine construction.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U3**
Description:	Student is able to valuate specific solution of engine construction.
Verification:	Test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U3**
Description:	Student is able to valuate specific solution of engine construction.
Verification:	Test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U3**
Description:	Student is able to valuate specific solution of engine construction.
Verification:	Test.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U4**
Description:	Student is able to read technical documentation and withdraw conclusions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U4**
Description:	Student is able to read technical documentation and withdraw conclusions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U4**
Description:	Student is able to read technical documentation and withdraw conclusions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS619_U4**
Description:	Student is able to read technical documentation and withdraw conclusions.
Verification:	Test.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK 359	
Name of course	Chemistry of Combustion	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. dr. hab. inż. Rudolf Klemens	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Student should have basic knowledge in the field of chemical kinetics, differential equations, thermodynamics and fluid mechanics.	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	To obtain knowledge in the field of: basic properties of fuels and combustible mixtures; mechanisms of combustion and flame propagation including thermal dissociation; methods of limitation of emission of toxic combustion products dynamics of development and suppression of industrial explosions.	
Effects of education	See Table 52.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Basic properties of fuels and combustible mixtures; fundamentals of chemical kinetics; thermal and chain theory of self-ignition; diffusion combustion-laminar and turbulent; kinetic combustion-laminar and turbulent, kinetic-diffusion combustion-laminar and turbulent; flame stabilization; mechanism of fuel droplets combustion, thermal dissociation, transition from deflagration to detonation, detonation combustion; dynamics of explosion development and suppression; toxic properties of combustion products.	
Methods of evaluation	The subject is completed on the basis of the written test.	
Methods of verification of effects of education	See Table 52.	
Exam	no	

Description of course

Literature	1. Jerzy Chomiak ”Combustion: A study in theory, fact and application”. 2. Gordon and Breach Science Publisher, 1990. 3. John H.S. Lee “The detonation phenomenon”, Cambridge University Press,2008. 4. Ryszard Wilk “Low-emission combustion”, Wydawnictwa Politechniki Śląskiej, Gliwice,2002. 5. Kenneth Kuo "Principles of Combustion", John Wiley and Sons; Rolf Eckhoff "Dust Explosions in the Process Industries" Butterworth and Heinemann. 6. J. Warnatz, U. Maas, R. Dibble "Combustion", Springer. 7. Forman A. Williams "Combustion Theory" The Benjamin/Cummings Publishing Company Inc. 8. J. Jarosiński, B. Veyssiere: "Combustion Phenomena, Selected Mechanisms of Flame Formation, Propagation and Extinction", CRC Press, Taylor and Francis Group.
Website of the course	

D. Student’s activity

Number of ECTS credits	3
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 32, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 2 hours. 2) The number of hours of independent work of student - 40 hours, including: • systematic preparation for classes - 20 hours; • preparing for 2 tests - 20 hours. TOTAL: 72 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,2 ECTS credits - 32 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 2 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	As the subject is of an interdisciplinary character and is not based on a particular text book, students participation in lectures is highly recommended. The students absent from the lectures usually find it later difficult to comprehend courses in physical-chemical phenomena presented during the lectures and definitely attain poorer results at subject completion.
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Table 52. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK359_W1**
Description:	Student has basic knowledge in the field of kinetics of chemical reactions, mechanisms of ignition and flame propagation in the mixtures of

Table 52. Learning outcomes	
	different fules with air and in gas-dynamics of combustion.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_W1**
Description:	Student has basic knowledge in the field of kinetics of chemical reactions, mechanisms of ignition and flame propagation in the mixtures of different fules with air and in gas-dynamics of combustion.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_W1**
Description:	Student has basic knowledge in the field of kinetics of chemical reactions, mechanisms of ignition and flame propagation in the mixtures of different fules with air and in gas-dynamics of combustion.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_W2**
Description:	Student has knowledge in the field of fire and explosion hazard in industry.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_W2**
Description:	Student has knowledge in the field of fire and explosion hazard in industry.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_W3**
Description:	Student knows the properties of fuels and combustible mixtures including the bio-fuels and alternative fuels.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK359_U1**
Description:	Student can organize the combustion process taking into consideration the maximal efficiency and minimal air pollution.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_U2**
Description:	Student can determine a toxic properties of combustion products.
Verification:	Colloquium.

Table 52. Learning outcomes	
Field of study related learning outcomes	Aero1_U15
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_U3**
Description:	Student is able to determine the explosion hazard in different industrial installations and can suggest an application of proper explosion suppression system.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U15
Area of study related learning outcomes	
Code of effect:	**ML.ANK359_U4**
Description:	Student can make calculations on the basic parameters of combustion processes, for instance: combustion temperature, oxidizer demand for combustion, coefficient of excess oxidizer, mass and volume of combustion products.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK365	
Name of course	Machine Design III	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Stanisław Bogdański; profesor PW.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Machine Design II.	
Limit of students	70	
C. Effects of education and manner of teaching		
Purpose of course	To supplement the material taken within MDI and MDII with the more advanced topics (listed in the course programme). To deepen the knowledge about designing for fatigue loading, designing to avoid surface failure and about tooth gears.	
Effects of education	See Table 53.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Lubrication of sliding and rolling element bearings. Probabilistic modelling of endurance of rolling bearing, selection of bearings and bearings systems for different levels of reliability. Cumulative damage hypothesis, variable loading of bearings. Designing for multi axial stresses in fatigue. Dynamic contact stresses, safety factors against surface failure, designing to avoid surface failure. Dynamic model of shafts with flexible coupling, critical speed and frequency. Dynamic modelling of disc clutch, wear and endurance, energy balance and flow of heat. Tooth gear theory; law of gearing; spur, bevel, helical, worm and planetary gears; interference and undercutting, minimum number of teeth, profile shifting, contact ratio. Bearings reaction forces, bending and surface stresses in gears, AGMA* and ISO** approach and standards. Modelling of chain and belt drives, efficiency and endurance. * AGMA American Gear Manufacturers Association. ** ISO	

Description of course

	International Organisation for Standardisation.
Methods of evaluation	Continuous assessment during the whole semester. Three regular tests organised during the semester plus one additional as the test for improvement at the end of semester. See the regulations for the course at WWW: http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Regulaminy-zajec-dydaktycznych.
Methods of verification of effects of education	See Table 53.
Exam	yes
Literature	Machine Design An Integrated Approach, Fourth edition, by Robert L.Norton, Prentice Hall 2010. Machine Elements in Mechanics and Design Fourth Edition, by Robert L. Mott, Prentice Hall 2006. Design of Machine Elements, Seventh edition, by M.F.Spotts and T.E.Shoup, Prentice Hall 1998.
Website of the course	http://meil.pw.edu.pl/zpk/ZPK/Dydaktyka/Materialy-dla-studentow-Files-for-students

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student - 44, including: • systematic preparation for classes - 20 hours; • preparing for tests - 24 hours. TOTAL : 77 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures- 15 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	
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Table 53. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK365_W1**
Description:	Student is familiar with modelling of fatigue of machine elements under combined load (bi-axial and three axial) and with the methods of determining their durability for synchronous periodically variable loads. He/she is also familiar with modelling of fatigue damage accumulation.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	

Table 53. Learning outcomes	
Code of effect:	**ML.ANK365_W1**
Description:	Student is familiar with modelling of fatigue of machine elements under combined load (bi-axial and three axial) and with the methods of determining their durability for synchronous periodically variable loads. He/she is also familiar with modelling of fatigue damage accumulation.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W2**
Description:	He/she knows about the possibilities of applying the probabilistic approach in engineering calculations and about the means of taking into account the randomness of physical phenomena in deterministic calculations (for instance in fatigue analyses and in selecting the rolling element bearings).
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W3**
Description:	He/she is familiar with modelling of the surface effort of components of highly loaded non-conforming contact couples operating in dry and wet conditions.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W3**
Description:	He/she is familiar with modelling of the surface effort of components of highly loaded non-conforming contact couples operating in dry and wet conditions.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W4**
Description:	He/She is familiar with the basic forms of surface wear and fatigue of machine components and with the methods of estimating their durability for pure rolling and rolling-sliding conditions.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W4**
Description:	He/She is familiar with the basic forms of surface wear and fatigue of machine components and with the methods of estimating their durability for pure rolling and rolling-sliding conditions.
Verification:	Test, exam.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W5**

Table 53. Learning outcomes	
Description:	He/she is familiar with the geometry and kinematics of gearings for spur, helical, bevel, worm and planetary gears as well as with the typical structure of power transmission system and with roles performed by its components. He/she is familiar with the phenomena and processes occurring in the system and its components during operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W5**
Description:	He/she is familiar with the geometry and kinematics of gearings for spur, helical, bevel, worm and planetary gears as well as with the typical structure of power transmission system and with roles performed by its components. He/she is familiar with the phenomena and processes occurring in the system and its components during operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W13
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W5**
Description:	He/she is familiar with the geometry and kinematics of gearings for spur, helical, bevel, worm and planetary gears as well as with the typical structure of power transmission system and with roles performed by its components. He/she is familiar with the phenomena and processes occurring in the system and its components during operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W5**
Description:	He/she is familiar with the geometry and kinematics of gearings for spur, helical, bevel, worm and planetary gears as well as with the typical structure of power transmission system and with roles performed by its components. He/she is familiar with the phenomena and processes occurring in the system and its components during operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W6**
Description:	He/she is familiar with the basic methods and procedures of strength and durability of gears calculations according to AGMA and ISO.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	

Table 53. Learning outcomes	
Code of effect:	**ML.ANK365_W6**
Description:	He/she is familiar with the basic methods and procedures of strength and durability of gears calculations according to AGMA and ISO.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_W6**
Description:	He/she is familiar with the basic methods and procedures of strength and durability of gears calculations according to AGMA and ISO.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK365_U1**
Description:	He/she is able to determine the fatigue durability of typical machine components (shafts, axles, levers etc.) operating under the synchronous, periodic, multi axial load.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U1**
Description:	He/she is able to determine the fatigue durability of typical machine components (shafts, axles, levers etc.) operating under the synchronous, periodic, multi axial load.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U2**
Description:	With the use of cumulative damage hypotheses, he/she is able to determine the fatigue durability for typical machine components (shafts, axles, levers, etc.) operating under the varying (but periodically constant) amplitude of load.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U2**
Description:	With the use of cumulative damage hypotheses, he/she is able to determine the fatigue durability for typical machine components (shafts, axles, levers, etc.) operating under the varying (but periodically constant) amplitude of load.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U3**
Description:	He/she is able to calculate and select the rolling element bearings with non-standard durability operating under the periodically variable load. He/she is able to take into account the

Table 53. Learning outcomes	
	probability of failure in the deterministic fatigue analyses of components of devices and machines.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U3**
Description:	He/she is able to calculate and select the rolling element bearings with non-standard durability operating under the periodically variable load. He/she is able to take into account the probability of failure in the deterministic fatigue analyses of components of devices and machines.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U4**
Description:	He/she is able to determine the wear rate of the surface of the contact couple component, as well as the required and real minimum EHD oil film thickness for the contact couple.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U4**
Description:	He/she is able to determine the wear rate of the surface of the contact couple component, as well as the required and real minimum EHD oil film thickness for the contact couple.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U5**
Description:	He/she is able to design the layout (structure) of the gearbox for the power transmission system and the geometric details of the particular gears taking into account the geometric, design, kinematic and technological limitations. Moreover, he/she is able to determine the loads exerted on particular components of this gearbox (gears, shafts and its supports) for typical conditions of operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U5**
Description:	He/she is able to design the layout (structure) of the gearbox for the power transmission system and the geometric details of the particular gears taking into account the geometric, design, kinematic and technological limitations. Moreover, he/she is able to determine the loads exerted on particular components of this gearbox

Table 53. Learning outcomes	
	(gears, shafts and its supports) for typical conditions of operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U5**
Description:	He/she is able to design the layout (structure) of the gearbox for the power transmission system and the geometric details of the particular gears taking into account the geometric, design, kinematic and technological limitations. Moreover, he/she is able to determine the loads exerted on particular components of this gearbox (gears, shafts and its supports) for typical conditions of operation.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U6**
Description:	For the preliminary estimations of loads in the power transmission system , he/she is able to build the simple dynamic model of this system. Next, on the basis of calculations he/she is able to select the appropriate features (characteristics) of the flexible coupling installed for protecting the system from overload and resonance. Additionally, he/she knows how to formulate the prescriptions and recipes concerning the safe start up and stop of the system.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_U6**
Description:	For the preliminary estimations of loads in the power transmission system , he/she is able to build the simple dynamic model of this system. Next, on the basis of calculations he/she is able to select the appropriate features (characteristics) of the flexible coupling installed for protecting the system from overload and resonance. Additionally, he/she knows how to formulate the prescriptions and recipes concerning the safe start up and stop of the system.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK365_K1**
Description:	He/she knows the importance of the role of an engineer in the society and his responsibility in his individual and collective professional activities. He/she is familiar with the principles

Table 53. Learning outcomes	
	and possibilities of fulfilling properly this role through assuring the correct selection of properties and features (including safety and ecology) of the designed/planned objects, systems and undertakings. He/she realises the necessity of permanent informing of the society about the technical and social aspects of his activities and is able to do it in the commonly comprehensible and acceptable way.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K1**
Description:	He/she knows the importance of the role of an engineer in the society and his responsibility in his individual and collective professional activities. He/she is familiar with the principles and possibilities of fulfilling properly this role through assuring the correct selection of properties and features (including safety and ecology) of the designed/planned objects, systems and undertakings. He/she realises the necessity of permanent informing of the society about the technical and social aspects of his activities and is able to do it in the commonly comprehensible and acceptable way.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K1**
Description:	He/she knows the importance of the role of an engineer in the society and his responsibility in his individual and collective professional activities. He/she is familiar with the principles and possibilities of fulfilling properly this role through assuring the correct selection of properties and features (including safety and ecology) of the designed/planned objects, systems and undertakings. He/she realises the necessity of permanent informing of the society about the technical and social aspects of his activities and is able to do it in the commonly comprehensible and acceptable way.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K1**
Description:	He/she knows the importance of the role of an engineer in the society and his responsibility in his individual and collective professional activities. He/she is familiar with the principles and possibilities of fulfilling properly this role through assuring the correct selection of properties and features (including safety and

Table 53. Learning outcomes	
	ecology) of the designed/planned objects, systems and undertakings. He/she realises the necessity of permanent informing of the society about the technical and social aspects of his activities and is able to do it in the commonly comprehensible and acceptable way.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K06
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K2**
Description:	He/she realises the necessity of lifelong learning, which results from the social responsibility of an engineer. He/she knows how to supplement his knowledge and skills, which are necessary for active, enterprising and creative work in the profession of engineer.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K2**
Description:	He/she realises the necessity of lifelong learning, which results from the social responsibility of an engineer. He/she knows how to supplement his knowledge and skills, which are necessary for active, enterprising and creative work in the profession of engineer.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K05
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K2**
Description:	He/she realises the necessity of lifelong learning, which results from the social responsibility of an engineer. He/she knows how to supplement his knowledge and skills, which are necessary for active, enterprising and creative work in the profession of engineer.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K2**
Description:	He/she realises the necessity of lifelong learning, which results from the social responsibility of an engineer. He/she knows how to supplement his knowledge and skills, which are necessary for active, enterprising and creative work in the profession of engineer.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANK365_K2**
Description:	He/she realises the necessity of lifelong learning, which results from the social responsibility of an engineer. He/she knows how to supplement his knowledge and skills, which are necessary for

Table 53. Learning outcomes	
	active, enterprising and creative work in the profession of engineer.
Verification:	Tests, exam.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK457	
Name of course	MECHANICS OF FLIGHT 2	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Zbigniew Paturski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Completed course of Mechanics of Flight 1.	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	Ability to analyze longitudinal and lateral equilibrium, stability and control of fixed wing airplanes as well as analyze simple cases of steady and unsteady motion of the airplane.	
Effects of education	See Table 54.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	15h
	Computer lessons	0h
Contents of education	Longitudinal aerodynamic moments acting on the airplane. Longitudinal equilibrium, static stability and control of the airplane. Center of gravity location problem. Lateral forces and moments. Lateral equilibrium, static stability and control. Introduction into dynamics of flight: simple cases of steady and unsteady motion of the airplane. Basic natural modes of airplane (phygoid, short period, and Dutchroll oscillations).	
Methods of evaluation	60% continuous assessment based on guided projects, 40% test work. Practical work: Five (5) projects covering longitudinal stability and control, and simple cases of steady and unsteady motion of the airplane.	
Methods of verification of effects of education	See Table 54.	
Exam	no	
Literature	1.Warren F. Philips: Mechanics of Flight, John Willey and Sons, 2004. 2.Bernard Etkin, Lloyd D. Reid: Dynamics of Flight, John Willey and Sons, 1996. 3.Jan Roskam: Airplane Flight Dynamic and Control, part I, DARCorporation, Lawrence, Kansas	

Description of course

	1999.
Website of the course	http://meil.pw.edu.pl/zm/ZM/Dydaktyka/Do-pobrania/Mechanics-of-Flight-II

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the lectures - 15 hours; b) attendance at the exercise design -15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - 45, including: • systematic preparation for classes – 15 hours; • homework - 5 projects - 30 hours. TOTAL: 80 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits - 35, including: a) attendance at the lectures - 15 hours; b) attendance at the exercise design -15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	3 ECTS credits - 80 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the exercise design -15 hours; c) consultancy meetings - 5 hours; d) systematic preparation for classes - 15 hours; e) homework - 6 projects - 30 hours.

E. Additional information

Notes	
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Table 54. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK457_W1**
Description:	Longitudinal aerodynamic moments acting on the airplane. Longitudinal equilibrium, static stability and control of the airplane. Center of gravity location problem. Lateral forces and moments. Lateral equilibrium, static stability and control. Introduction into dynamics of flight: simple cases of steady and unsteady motion of the airplane. Basic natural modes of airplane (phygoid, short period, and Dutch-Roll oscillations).
Verification:	60% continuous assessment based on guided projects, 40% test work. Practical work: Five (5) projects covering longitudinal stability and control, and simple cases of steady and unsteady motion of the airplane.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK457_U1**
Description:	Ability to analyze longitudinal and lateral equilibrium, stability and control of fixed wing airplanes as well as analyze simple cases of

Table 54. Learning outcomes	
	steady and unsteady motion of the airplane.
Verification:	60% continuous assessment based on guided projects, 40% test work. Practical work: Five (5) projects covering longitudinal stability and control, and simple cases of steady and unsteady motion of the airplane.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS611	
Name of course	Risk and Reliability in Aviation	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Marek Matyjewski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Machine Design I, Probabilistics.	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	Knowledge about analysis methods and techniques in reliability. Application of risk analysis to problems in engineering.	
Effects of education	See Table 55.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Concept and kinds of risk. Causes and kinds of losses in the man-technology-environment system. Elements of probability theory: event, definitions of probability; random variable, probability density function, cumulative distribution function, moments; elements of statistics. Relationships between concepts of risk, reliability and hazard. Measures of losses, hazard, reliability and risk. Human reliability. Models of system reliability. Fault tree analysis. Event tree analysis. Pronciples and procedure of risk analysis. Probabilistic modelling of losses, hazards, reliability and risk. Quantitative methods of risk analysis and estimation. Tree methods in risk modelling. Human factor in risk analysis. Safety and safety factor.	
Methods of evaluation	Two part written examination (theory an problems). Passing of all three tests during semester exempts from the examination. Two positive marks admit to a catch up test.	
Methods of verification of effects of education	See Table 55.	
Exam	no	

Description of course

Literature	Recommended texts (reading): 1. Patrick D.T. OConnor: Practical Reliability Engineering. John Wiley & Sons, Ltd., 2008. 2. Efstratios Nikolaidis, Dan M. Ghiocel, Suren Singhal: Engineering Design Reliability Applications. Taylor & Francis Group, 2003. 3. Photocopies of slides from lecture or slides in pdf format.
Website of the course	-

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 34, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 4 hours. 2) The number of hours of independent work of student - 40, including: • systematic preparation for classes, homework - 25 hours; • preparation for written tests, exam – 20 hours; TOTAL – 74 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,4 ECTS credits – number of hours that require the presence of a teacher - 34, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 4 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 55. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS611_W1**
Description:	Student understands what is the risk and safety.
Verification:	Colloquium no. I.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANS611_W2**
Description:	Student knows the basics of reliability analysis.
Verification:	Colloquium no. I., exam.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANS611_W2**
Description:	Student knows the basics of reliability analysis.
Verification:	Colloquium no. I., exam.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANS611_U1**
Description:	Able to assess the occupational risk.
Verification:	Colloquium no. III.
Field of study related learning outcomes	Aero1_U15

Table 55. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANS611_U2**
Description:	Student knows how to apply the methods of risk analysis.
Verification:	Colloquium no. III., exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS611_U3**
Description:	Able to perform the reliability calculations of the Man-Technology-Environment system.
Verification:	Colloquium no. II, exam.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANS611_K1**
Description:	Student is aware of the possible impact of undesirable events and knows how to counteract them.
Verification:	Colloquium no. II.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS609	
Name of course	Rotorcraft aeromechanics	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Przemysław Bibik	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Basic knowledge of mechanics, aerodynamics and flight mechanics of fixed-wing aircraft.	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	Familiarize with the specificity of rotorcraft flight, control methods and basic phenomena. Teaching methods for simplified performance analysis and modeling of rotorcraft flight.	
Effects of education	See Table 56.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Methods of vertical take-off and landing of various aircraft. Rotorcraft systems design. Rotorcraft control methods: torque balancing of rotors, directional control. The design of the rotor – the rotorhub and blades. Control system design. Rotor aerodynamic loads models. The momentum theory. Vortex models. Airfoil unsteady flow. Strip theory. Simplified calculation of main rotor performance. The equations of elementary movements of blades: flapping, lagging, feathering. Modeling of elastic blades. Construction of the power units of helicopters. Energy methods for calculating performance of the helicopter. Loads of the tail rotor. Trim conditions of a single-rotor helicopter. Autorotation. Resonances: ground and air. Modeling of spatial movement of the helicopter. Special cases - longitudinal and transverse movements. Static and dynamic stability. Controllability of the helicopter. Methods of active	

Description of course

	and passive stability augmentation. New concepts in the design of rotorcraft.
Methods of evaluation	Three tests (75%) and one project (25%)
Methods of verification of effects of education	See Table 56.
Exam	no
Literature	1. Done G., Balmford D.: „Bramwell's Helicopter Dynamics", 2001. 2. Prouty R.W., „Helicopter Performance, Stability and Control", PWS Engineering Boston 1986. 3. Seddon, J. Basic Helicopter Aerodynamics, Blackwell Publishing, e-book Additional - Materials provided by the course leader.
Website of the course	-

D. Student's activity

Number of ECTS credits	5
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 50, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - 80, including: • preparation for tests – 15 hours; • preparation of the homework and the report: 20 hours; • systematic preparation for classes – 30 hours; • reading literature recommended by the teacher - 15 hours. Total: 130.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits - 50 hours, including: a) attendance at the lectures - 30 hours; b) attendance at the exercises -15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 56. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS609_W1**
Description:	Knows the basicconfigurations of rotorcraft.
Verification:	Test no.1.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W1**
Description:	Knows the basicconfigurations of rotorcraft.
Verification:	Test no.1.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W1**
Description:	Knows the basicconfigurations of rotorcraft.
Verification:	Test no.1.
Field of study related learning outcomes	Aero1_W17

Table 56. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W2**
Description:	Can describe the control method of selected configurations of helicopters.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W2**
Description:	Can describe the control method of selected configurations of helicopters.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W3**
Description:	Can explain the phenomenon of the emergence of resistance torque in a single-rotor helicopter and methods of its compensation.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W3**
Description:	Can explain the phenomenon of the emergence of resistance torque in a single-rotor helicopter and methods of its compensation.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W3**
Description:	Can explain the phenomenon of the emergence of resistance torque in a single-rotor helicopter and methods of its compensation.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W4**
Description:	Knows the basic aerodynamic models used for modeling the helicopter rotors.
Verification:	Test no. 1
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W5**
Description:	Knows the structure of the control system of a typical helicopter.
Verification:	Test no. 2
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W6**
Description:	Knows the structure of a typical helicopter rotor.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W6**
Description:	Knows the structure of a typical helicopter rotor.
Verification:	Test no. 2.

Table 56. Learning outcomes	
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W6**
Description:	Knows the structure of a typical helicopter rotor.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W6**
Description:	Knows the structure of a typical helicopter rotor.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W7**
Description:	Can explain the role of the rotor blades hinges.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W7**
Description:	Can explain the role of the rotor blades hinges.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W7**
Description:	Can explain the role of the rotor blades hinges.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W7**
Description:	Can explain the role of the rotor blades hinges.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W8**
Description:	Is able to explain the principles of main rotor thrust vector control.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W8**
Description:	Is able to explain the principles of main rotor thrust vector control.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W8**
Description:	Is able to explain the principles of main rotor thrust vector control.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANS609_W9**
Description:	Can explain the phenomenon of the autorotation.
Verification:	Test no. 3.

Table 56. Learning outcomes	
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	

Description of course

Code of course	ML.NS630	
Name of course	Spacecraft Design	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Łukasz Mężyk	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	5 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Astronautics I.	
Limit of students	150	
C. Effects of education and manner of teaching		
Purpose of course	To learn about basic methods in design and manufacturing of spacecraft.	
Effects of education	See Table 57.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Specifics of space flight, basic subsystems of spacecrafts. Kinds, objectives and requirements of space missions. Space projects phases. Examples of projects and spacecrafts.	
Methods of evaluation	100 % final essay/project.	
Methods of verification of effects of education	See Table 57.	
Exam	no	
Literature	1) D. Darling „The Complete Book of Spaceflight”, 2) P. Fortescue, J. Stark, G. Swinerd “Spacecraft Systems Engineering”.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	1	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 20, including: a) attendance at the lectures -15 hours; b) consultancy meetings - 5 hours. 2) The number of hours of independent work of student: homework (essay/project) : 10 hours. Total: 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0,5 ECTS credits - 20 hours, including: a) attendance at the lectures -15 hours; b) consultancy meetings - 5 hours.	
Number of ECTS credits on practical activities on	0,5 ECTS credits - 15 hours, including: a)	

Description of course

the course	consultancy meetings - 5 hours. b) homework (essay/project) - 10 hours.

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Table 57. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.NS630_W1**
Description:	Student know the specific problems of design of spacecraft systems related to the space environment.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W1**
Description:	Student know the specific problems of design of spacecraft systems related to the space environment.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W2**
Description:	Students understand meaning of proper definition of requirements and mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W2**
Description:	Students understand meaning of proper definition of requirements and mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W2**
Description:	Students understand meaning of proper definition of requirements and mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W2**
Description:	Students understand meaning of proper definition of requirements and mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W22
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W4**
Description:	Students know basic systems of spacecrafts and

Table 57. Learning outcomes	
	their functions.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.NS630_W4**
Description:	Students know basic systems of spacecrafts and their functions.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.NS630_U1**
Description:	Student is able to define mission requirements for defined mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U1**
Description:	Student is able to define mission requirements for defined mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U1**
Description:	Student is able to define mission requirements for defined mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U1**
Description:	Student is able to define mission requirements for defined mission objectives.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U21
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U2**
Description:	Student is able to define the necessary spacecraft systems for defined mission requirements.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U2**
Description:	Student is able to define the necessary spacecraft systems for defined mission requirements.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U21
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U2**
Description:	Student is able to define the necessary spacecraft systems for defined mission requirements.
Verification:	Essay/project.

Table 57. Learning outcomes	
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.NS630_U2**
Description:	Student is able to define the necessary spacecraft systems for defined mission requirements.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.NS630_K1**
Description:	Student is able to work in team on space mission analysis.
Verification:	Essay/project.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ANWF6	
Name of course	Physical Education and Sport 6	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	College of Physical Education and Sport.	
Coordinator of course	Teacher at College of Physical Education and Sport.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Physical Education and Sports	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	-	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	The development of physical activity of students. Detailed data contains syllabus of specific course.	
Effects of education	See Table 58.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	30h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	The exercise program offer by College of Physical Education and Sport.	
Methods of evaluation	According to the rules of classes developed by College of Physical Education and Sport.	
Methods of verification of effects of education	See Table 58.	
Exam	no	
Literature		
Website of the course		
D. Student’s activity		
Number of ECTS credits	0	
Number of hours of student’s work to achieve effects of education	Participation in classes - 30 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	0.0 ECTS credit (30 hours of classes, without ECTS).	
Number of ECTS credits on practical activities on the course	-	
E. Additional information		
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Table 58. Learning outcomes

Description of course

Code of course	ML.ANK308	
Name of course	Aircraft design II	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Cezary Galiński	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Mechanics; Fluid mechanics; Aerodynamics; Mechanics of flight; Materials; Mechanics of structures; Aircraft Design 1.	
Limit of students	No limit at the lecture, max. 12 in each of the project groups.	
C. Effects of education and manner of teaching		
Purpose of course	Familiarization with the aircraft design process is a main goal of the subject. Familiarization with the airplane performance and structural design basics is an additional goal of the subject.	
Effects of education	See Table 59.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	30h
	Computer lessons	0h
Contents of education	Lecture: Introduction, materials applicable in aeronautics, airplane structural breakdown, difference between characteristic points of the loads envelope. Wing – main types of the structure, main components of the structure: spars, ribs, stringers, skins, cut-outs. Examples of structural designs. Simplified analysis of the torsion box, basic information about buckling of shear webs and skins. Fuselage – main types of structures, frames. Selected design problems: cut-outs, introduction of concentrated forces, pressurized fuselages. Operations according to the safe live and fail safe concepts. Initial estimation of the skin thickness and stringers distribution. Examples of structural designs. Fuselage – wing installation – types, characteristics. Examples of structural designs. Empennage and its installation. Examples of	

Description of course

	structural designs. High lift devices and mechanical control system. Examples of structural designs. Project: Longitudinal stability and control, selection of the elevator aerodynamic balancing. Lateral control. Structural design of the airplane. Loads of the fuselage and wing. Loads caused by propulsion system.
Methods of evaluation	Components of the evaluation 1) Colloquium (problem and open questions) – max. 50 pts. 2) Projects - max . 50 pts (5x10) Maximum amount of points for each project decreases by 2 every week after it’s deadline. 0 pts. from any project is equivalent to the overall course failure. Final evaluation More than 26 pts. from colloquium + all projects accepted with at least 25 pts. collected Marks graduation: 0-50 2 51-62 3 63-74 3,5 75-86 4 87-94 4,5 95-100 5.
Methods of verification of effects of education	See Table 59.
Exam	no
Literature	EASA airworthiness regulations. M. Chun-Yung Niu „Airframe Structural Design”. J. Roskam „Airplane Design. Part III. Layout design of cockpit, fuselage, wing and empennage: cutaways and inboard profiles". D. Howe „Aircraft loading and structural layout”. T. Megson „Aircraft structures for engineering students”.
Website of the course	http://www.meil.pw.edu.pl/add/ADD/Teaching/Subjects/Aircraft-Design

D. Student’s activity

Number of ECTS credits	4
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 45, including: a) attendance at the lectures - 15 hours; b) attendance at the design exercises - 30 hours. 2) The number of hours of independent work of student - 55, including: a) projects preparation - 40 hours; b) preparation to colloquia - 15 hours. Total: 100 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits - 45 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the design exercises - 30 hours.
Number of ECTS credits on practical activities on the course	3 ECTS credits - 70 hours, including: a) attendance at the design exercises - 30 hours. b) projects preparation - 40 hours.

E. Additional information

Notes	Passing this subject is highly improbable without previous passing the Aircraft Design1.
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Table 59. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK308_W1**
Description:	Student knows components of the aircraft design

Table 59. Learning outcomes	
	process.
Verification:	Project.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_W2**
Description:	Student knows functions, characteristics and loads of an airplane components.
Verification:	Colloquia, project.
Field of study related learning outcomes	Aero1_W12
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_W2**
Description:	Student knows functions, characteristics and loads of an airplane components.
Verification:	Colloquia, project.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_W3**
Description:	Student knows selected rules of current airworthiness regulations.
Verification:	Project.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK308_U1**
Description:	Student is capable to prepare the documentation of his/her engineering work.
Verification:	Project.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_U1**
Description:	Student is capable to prepare the documentation of his/her engineering work.
Verification:	Project.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_U2**
Description:	Student is capable to design simple airplane.
Verification:	Project.
Field of study related learning outcomes	Aero1_U21
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_U3**
Description:	Student is capable to analyze flight characteristics, loads and strength of selected components of an airplane.
Verification:	Project.
Field of study related learning outcomes	Aero1_U18
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK308_K1**
Description:	Student is aware of deadlines importance.
Verification:	Project.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANK308_K1**

Table 59. Learning outcomes	
Description:	Student is aware of deadlines importance.
Verification:	Project.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS631	
Name of course	Aircraft Engine Design II	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	DR INŻ. ARKADIUSZ KOBIERA	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Practical training based on the course “Design of Aircraft Engines I”.	
Limit of students	60	
C. Effects of education and manner of teaching		
Purpose of course	Practical training based on Designing of aviation engines I After completing his course the students will be able to specify and implement methods of design of aircraft engines and its elements.	
Effects of education	See Table 60.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	30h
	Computer lessons	0h
Contents of education	Guided, individual or group project of aircraft engines or its elements.	
Methods of evaluation	100% assesment of the project. Practical work: e.g., project classes where students learn application of modern design tools in aircraft engine design.	
Methods of verification of effects of education	See Table 60.	
Exam	no	
Literature	Recommended texts (reading): 1) Mattingly “Aircraft Engine Design. Further Readings: - Mattingly “Elements of Propulsion”, - Will be provided by lecturer.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 36, including: a) attendance at the design exercises - 30 hours; b) consultancy meetings - 6 hours. 2) The number of hours of independent work of student - 27, including: a)	

Description of course

	homework (work on the projects) - 27 hours. Total: 63 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits - 36 hours, including: a) attendance at the design exercises - 30 hours; b) consultancy meetings - 6 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credits - 63 hours, including: a) attendance at the design exercises - 30 hours; b) consultancy meetings - 6 hours; c) homework (work on the projects) - 27 hours.

E. Additional information

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Table 60. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS631_W1**
Description:	Student knows fundamental rules of aircraft engine desining.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_W1**
Description:	Student knows fundamental rules of aircraft engine desining.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_W1**
Description:	Student knows fundamental rules of aircraft engine desining.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANS631_U1**
Description:	Student is able to independently analyse and design elements of chosen aircraft engines.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U1**
Description:	Student is able to independently analyse and design elements of chosen aircraft engines.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U1**
Description:	Student is able to independently analyse and design elements of chosen aircraft engines.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	

Table 60. Learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U18
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U2**
Description:	Student is able to independently analyse and design simple systems of aircraft engines: carrying, bearing, gears, sealings, discs.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.

Table 60. Learning outcomes	
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U16
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U3**
Description:	Student can validate which solution of turbine engine system (compressor, combustion chamber, turbine) is optimal for given, specific propulsion system.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U4**
Description:	Student is able to work in group and to present results of work.

Table 60. Learning outcomes	
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U4**
Description:	Student is able to work in group and to present results of work.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U4**
Description:	Student is able to work in group and to present results of work.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANS631_U4**
Description:	Student is able to work in group and to present results of work.
Verification:	Projects 1,2 and 3.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK315	
Name of course	Aircraft Maintenance	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Kamila Kustron, Ph. D.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Basics of aircraft design and probabilistics.	
Limit of students	Lecture: no limit, scientific vesit - max 20 person in one group.	
C. Effects of education and manner of teaching		
Purpose of course	The major learning objectives of this subject are to give the student an understanding why we have to do maintenance and how is it accomplished for a commercial air operator in accordance to legal and commercial requirements. After successfully completing this unit, student should be able to: (1) understand maintenance concepts and practices, \ (2) demonstrate knowledge of aircraft maintenance practices and their control in the context of legal and commercial requirements, (3) understand the regulatory standards for aircraft maintenance and airworthiness, (4) explain the various engineering processes used in an airline to return an aircraft to service after maintenance, (5) discuss the influence of planning an aircraft maintenance in an air operator context, (6) demonstrate knowledge of Aviation Human Factors, (7) demonstrate knowledge of Aviation Safety and (8) work autonomously and in a team within organisations with a focus on safety, reliability, quality, legality and profitability in civil aviation applying ethical standards with professional accountability.	
Effects of education	See Table 61.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h

Description of course

Contents of education	Maintenance regulations. Dependencies between design and maintenance philosophies from safety and cost-effectiveness point of view. Aircraft and airspace as elements in exploitations systems. Maintenance systems. Modeling of operation&maintenance process and effectiveness of exploitation system. Reliability, availability, durability, safety and security problems and their assessment . Maintenance of aging aircraft and novel aircraft. Reliability and maintenance characterization. Diagnostic methods: non destructive testing (NDT) and health monitoring (SHM, EHM, HUMS). Flight safety.
Methods of evaluation	Grading criteria: positive mark (min.60%) of the final test consist of 7 tasks to solve, each 0-10 points; 3 homework, each 0-10 points + presentation (5 minutes) about Aviation Authority (10 points); and additional if requested: one subtopic of the scheduled program (10 points) which have to be declared minimum 2 weeks before.
Methods of verification of effects of education	See Table 61.
Exam	no
Literature	1) Kinnison H. Aviation Maintenance Management. McGraw-Hill Companies, NY,USA, 2004. 2) Kinnison H.A., Siddiqui T., Aviation Maintenance Management, Second Edition McGraw-Hill Professional, 2013. 3) http://www.easa.europa.eu, http://www.icao.int, http://www.caa.co.uk, http://www.ntsb.gov, http://www.ulc.gov.pl, http://www.casa.gov.au.
Website of the course	http://www.meil.pw.edu.pl/add/ADD/Teaching/Subjects/Aircraft-Maintenance

D. Student’s activity

Number of ECTS credits	3
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 30, including: a) attendance at the lectures - 24 hours; b) 6 hours scientific visit in organization Part M or/ and Part 145. 2) The number of hours of independent work of student - 27, including: a) completing 3 homework consist of short tasks which have the main objective to familiarize with aircraft maintenance issues - 12 hours, b) one team homework and next presenting during the lecture - 5 hours, c) preparing to final test - 10 hours. Total: 57 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit - 30 hours, including: a) attendance at the lectures - 24 hours; b) 6 hours scientific visit in organization Part M or/ and Part 145.
Number of ECTS credits on practical activities on the course	1 ECTS credit - 30 hours, including: a) 6 hours scientific visit in organization Part M or/ and Part 145; b) completing 3 homework consist of short tasks which have the main objective to familiarize

Description of course

	with aircraft maintenance issues - 12 hours, c) one team homework and next presenting during the lecture - 5 hours.

E. Additional information

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Table 61. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK315_W1**
Description:	The student knows the rules for implementing the requirements of the project documentation of an applicant for the issuance of an air operator certificate.
Verification:	Homework1 and final test.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W1**
Description:	The student knows the rules for implementing the requirements of the project documentation of an applicant for the issuance of an air operator certificate.
Verification:	Homework1 and final test.
Field of study related learning outcomes	Aero1_W21
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W1**
Description:	The student knows the rules for implementing the requirements of the project documentation of an applicant for the issuance of an air operator certificate.
Verification:	Homework1 and final test.
Field of study related learning outcomes	Aero1_W23
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W2**
Description:	The student knows the causes and effects of degradation processes for aircraft structures as the 7 level of matter .
Verification:	Final test.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W2**
Description:	The student knows the causes and effects of degradation processes for aircraft structures as the 7 level of matter .
Verification:	Final test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W3**
Description:	Student have knowledge of the processes of degradation aviation materials and ways of their elimination or mitigation of occurrence.
Verification:	Homework 1, final test.

Table 61. Learning outcomes	
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W3**
Description:	Student have knowledge of the processes of degradation aviation materials and ways of their elimination or mitigation of occurrence.
Verification:	Homework 1, final test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W4**
Description:	The student knows the methods of protection against fatigue and corrosion of the aviation materials.
Verification:	Final test.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W5**
Description:	The student knows the proceedings in order to approve an air operator certificate in terms of aviation regulations.
Verification:	Final test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W5**
Description:	The student knows the proceedings in order to approve an air operator certificate in terms of aviation regulations.
Verification:	Final test.
Field of study related learning outcomes	Aero1_W21
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W6**
Description:	The student can determine the reliability characteristics for different probability distribution of random airworthiness variable.
Verification:	Homework 2, final test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W7**
Description:	The student can demonstrate coherent knowledge of Aviation Human Factors.
Verification:	Final test.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W7**
Description:	The student can demonstrate coherent knowledge of Aviation Human Factors.
Verification:	Final test.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W8**
Description:	The student knows and understand the development trends in aviation diagnostics with a focus on systems integrated with aircraft.
Verification:	Homework 3, final test.

Table 61. Learning outcomes	
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_W9**
Description:	The student can determine the risk of a damage to the known environment conditions of operating aircraft.
Verification:	Final test.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK315_U1**
Description:	The student is able to determine the characteristics of reliability based on data sets of damages, failures.
Verification:	Homework 2, final test.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANK315_K1**
Description:	The student understands the need for improving methods of manufacture of aircraft in order to reduce uncertainty design assessment, understands the need to work in a team to achieve common success.
Verification:	Team homework.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ML.ANK315_K1**
Description:	The student understands the need for improving methods of manufacture of aircraft in order to reduce uncertainty design assessment, understands the need to work in a team to achieve common success.
Verification:	Team homework.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK342	
Name of course	Finite Element Method I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Grzegorz Krzesiński, prof. PW.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	ML.ANW117 Mechanics of Structures 1 (MOS1).	
Limit of students	min. 15	
C. Effects of education and manner of teaching		
Purpose of course	To supply the basic knowledge and skills required for understanding and simple practical applications of FEM.	
Effects of education	See Table 62.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Lecture: Approximate methods in mechanics of structures - Finite Element Method, Finite Difference Method, Boundary Element Method. Approximate solutions of 2D Poisson equation. FEM versus Ritz method. Basic relations in analysis of truss structures. Simple finite elements for 2D and 3D stress analysis. Typical algorithms of FEM in static linear stress analysis, popular commercial FE software packages. Accuracy of FE analysis. Computer lab: Introduction to practical problems of FE modeling in ANSYS. 2D and 3D linear stress analysis. Static analysis of simple shell structure.	
Methods of evaluation	Assessment based on tests and results of computer lab work. Practical work: Project/laboratory classes, where students will built and analyse the results of simple FE models of structural elements.	
Methods of verification of effects of education	See Table 62.	
Exam	no	
Literature	Recommended: Huebner K.H., Dewhirst D.L., Smith D.E., Byrom T.G.: The finite element	

Description of course

	method for engineers, J. Wiley & Sons 2001, Zienkiewicz O.C., Taylor R.: The Finite Element Method - different publishers and editions.
Website of the course	http://mel.pw.edu.pl/zwmik/ZWMiK/Dla-studentow2/Finite-Element-Method-1

D. Student's activity

Number of ECTS credits	4
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 50, including: a) presence of the lectures - 30 hours; b) presence in the labs – 15 hours; c) presence on consultation – 5 hours. 2) The number of hours of independent work of student – 65, including: a) preparation for tests and the presence at colloquia: 15 hours, b) preparation for lecture, analyse of the literature - 15 hours; c) preparing for the lab: 15 hours; d) preparation of reports from the lab: 20 hours. TOTAL – 115 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits – Number of hours that require the presence of a teacher - 50, including: a) presence of the lectures - 30 hours; b) presence in the labs – 15 hours; c) presence on consultation – 5 hours.
Number of ECTS credits on practical activities on the course	1 ECTS credits – 30 hours, including: a) presence at computer labs: 15 hours; b) preparation of reports from the lab: 15 hours.

E. Additional information

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Table 62. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK342_W1**
Description:	The knowledge about the stiffness matrices of different finite elements (truss, beam, 2D, 3D).
Verification:	Based on tests.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_W1**
Description:	The knowledge about the stiffness matrices of different finite elements (truss, beam, 2D, 3D).
Verification:	Based on tests.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_W2**
Description:	The knowledge about the algorithms leading to FEM equations for static stress analysis.
Verification:	Based on tests.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_W2**
Description:	The knowledge about the algorithms leading to FEM equations for static stress analysis.
Verification:	Based on tests.

Table 62. Learning outcomes	
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_W3**
Description:	Knowledge of standard FEM algorithms and programs.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_W3**
Description:	Knowledge of standard FEM algorithms and programs.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK342_U1**
Description:	The ability to build 2D linear finite element model for stress analysis problem (the cases of: plane stress, plane strain, axisymmetry), to perform analysis, to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U1**
Description:	The ability to build 2D linear finite element model for stress analysis problem (the cases of: plane stress, plane strain, axisymmetry), to perform analysis, to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U1**
Description:	The ability to build 2D linear finite element model for stress analysis problem (the cases of: plane stress, plane strain, axisymmetry), to perform analysis, to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U2**
Description:	The ability to build linear finite element model for 3D stress problem, to perform analysis , to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.

Table 62. Learning outcomes	
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U2**
Description:	The ability to build linear finite element model for 3D stress problem, to perform analysis , to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U2**
Description:	The ability to build linear finite element model for 3D stress problem, to perform analysis , to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U3**
Description:	The ability to build linear finite element model for shell structure, to perform analysis , to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U3**
Description:	The ability to build linear finite element model for shell structure, to perform analysis , to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U3**
Description:	The ability to build linear finite element model for shell structure, to perform analysis , to present results in the form of tables, graphs, contour plots and to draw the adequate conclusions.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U4**
Description:	The ability to build and to solve linear finite element models for truss and frame structures

Table 62. Learning outcomes	
	under the applied forces and constraints.
Verification:	Based on tests.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK342_U5**
Description:	The ability to find the equivalent nodal forces for simple cases of finite elements and loads.
Verification:	Based on tests.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW127	
Name of course	Intermediate Engineering Project	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	The teacher authorized by the Faculty Council.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	The aim of the course is to get the student's ability to perform advanced design, especially through the work of their own, with a little help of the teacher. In particular, the solution of the problem, selection of literature, research methods, presentation and critical analysis of the results. The exact specification depends on the subject of work.	
Effects of education	See Table 63.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	60h
	Computer lessons	0h
Contents of education	Detailed course content depends on the subject and character of the work (design and construction, computational, experimental).	
Methods of evaluation	The evaluation shall assess the appropriate separation of tasks, analysis of the literature, the solution of the problem and its written presentation.	
Methods of verification of effects of education	See Table 63.	
Exam	no	
Literature	Books and academic textbooks, journals, Internet.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	6	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher – 60, including a) consultancy meetings - 54 hours; b) final completion of the course – 6 hours; 2) The number of hours of independent	

Description of course

	work of student: a) work on the project - 110 hours. Total: 170 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,6 ECTS credits – 40 hours, including: a) consultancy meetings - 54 hours; b) final completion of the course – 6 hours.
Number of ECTS credits on practical activities on the course	6 ECTS credits - 170 hours, including: a) consultancy meetings - 54 hours; b) final completion of the course – 6 hours; c) work on the project - 110 hours.

E. Additional information

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Table 63. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW127_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANW127_U1**
Description:	Student can identify the solved problem in a wide range of science, based on the literature.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U1**
Description:	Student can identify the solved problem in a wide range of science, based on the literature.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	

Table 63. Learning outcomes	
Code of effect:	**ML.ANW127_U2**
Description:	Student can use the literature to search for tips to solve research or engineering problems.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U2**
Description:	Student can use the literature to search for tips to solve research or engineering problems.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U2**
Description:	Student can use the literature to search for tips to solve research or engineering problems.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U3**
Description:	Can solve simple engineering task with the help of the tutor.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U3**
Description:	Can solve simple engineering task with the help of the tutor.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U4**
Description:	Student can critically assess the results of the solved problem.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U5**
Description:	Student can personally prepare a report on the work and defend the thesis in conversation of the tutor.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U07
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U5**
Description:	Student can personally prepare a report on the work and defend the thesis in conversation of the tutor.
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANW127_U5**
Description:	Student can personally prepare a report on the work and defend the thesis in conversation of the tutor.

Table 63. Learning outcomes	
Verification:	The final report assessed by the teacher.
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW127_K1**
Description:	Development of self-learning needs in order to achieve the desired effect.
Verification:	The current assessment of the progress of work.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK368	
Name of course	Machine Design VI	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Jacek Gadomski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Materials I, Mechanics of structures II, Engineering graphics - CAD II, Manufacturing technology II, Machine design III, Materials in aerospace technology, Integrated CAD/CAM/CAE systems.	
Limit of students	12	
C. Effects of education and manner of teaching		
Purpose of course	Skill of individual designing of device (aircraft subassembly) at a given technical assumptions. Skill of making synthesis of the received knowledge in accordance with the valid standards.	
Effects of education	See Table 64.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	30h
	Computer lessons	0h
Contents of education	Designing of an aircraft subassembly or other devices (with the similar way of working to an aircraft subassembly) . Proposals of shapes and dimensions of components. Choosing of available materials. Kinematic, static and strength calculations. Engineering drawings - assembly and several components (CAD system is required).	
Methods of evaluation	1. Discussion during classes. 2. Checking and evaluating of the technical documentation i.e. drawings and calculations. 3. Faults analysis of the checked project (individual discussion with tutor).	
Methods of verification of effects of education	See Table 64.	
Exam	no	
Literature	1) Mott R.L: Machine Elements in Mechanical Design, Pearson Education. 2) Norton N.L.: Machine Design An Integrated Approach, Prentice Hall.	

Description of course

Website of the course	-

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the design exercises - 30 hours; b) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - 40 hours, work on the preparation of structural design. Total: 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.4 ECTS credits - 35 hours, including: a) attendance at the design exercises - 30 hours; b) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	3 ECTS credits - 75 hours, including: a) attendance at the design exercises - 30 hours; b) consultancy meetings - 5 hours. c) work on the preparation of structural design - 40 hours.

E. Additional information

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Table 64. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK368_W1**
Description:	Student is able to select the constructional materials for machine design purpose.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_W04
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_W2**
Description:	Student is familiar with fitting selection and dimensions tolerance as factors influencing the machine ability to perform specific functions and determining its durability, reliability and maintainability.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANK368_U1**
Description:	Student can design the drive transfer system or part of the aircraft superstructure that fulfills specified function and includes given design assumptions.

Table 64. Learning outcomes	
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U1**
Description:	Student can design the drive transfer system or part of the aircraft superstructure that fulfills specified function and includes given design assumptions.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U1**
Description:	Student can design the drive transfer system or part of the aircraft superstructure that fulfills specified function and includes given design assumptions.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U1**
Description:	Student can design the drive transfer system or part of the aircraft superstructure that fulfills specified function and includes given design assumptions.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U2**
Description:	Student is able to prepare a simplified machine model that allows a correct kinematics and statics analysis.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	

Table 64. Learning outcomes	
Code of effect:	**ML.ANK368_U3**
Description:	Student is capable of developing the machine part shapes and dimensions; taking into consideration the constructional material selection and manufacturing method, student calculates proper stiffness, durability and stability that condition the safe functionality.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U4**
Description:	Student knows how to use the CAD/CAM/CAE systems at all stages of project.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U5**
Description:	Student is able to design the drive transmission elements support using proper bearings; student is able to select proper type of bearings (considering functionality, durability, lubrication, corrosion, sealing, etc.) and embed them; student is able to propose and design an easy to assemble and disassemble bolt connection for a kinematic pair.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U5**
Description:	Student is able to design the drive transmission elements support using proper bearings; student is able to select proper type of bearings (considering functionality, durability, lubrication, corrosion, sealing, etc.) and embed them; student is able to propose and design an easy to assemble and disassemble bolt connection for a kinematic pair.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.

Table 64. Learning outcomes	
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U6**
Description:	Student can decide on machine elements machining accuracy using tolerance analysis, specified fittings and roughness selection.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U6**
Description:	Student can decide on machine elements machining accuracy using tolerance analysis, specified fittings and roughness selection.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U7**
Description:	Student can design a machine with a proper assembly and maintenance access.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U8**
Description:	Student is able to find and use ready-made drive systems available on market; can use the norms, regulations and constructional material specifications.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week. Dialogue on the checked project and mistakes analysis
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK368_U8**
Description:	Student is able to find and use ready-made drive systems available on market; can use the norms, regulations and constructional material specifications.
Verification:	Discussion during classes. Student technical drawings and analytical calculations to be submitted and checked for progress each week.

Table 64. Learning outcomes	
	Dialogue on the checked project and mistakes analysis
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW126	
Name of course	Physics I	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Physics.	
Coordinator of course	dr inż. Cezariusz Jastrzębski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Basic knowledge of mathematics and elementary course of physics.	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	The objective of the subject is to acquaint students with elements of modern physics especially quantum mechanics and to present its recent history, importance in general word perception and particularly its importance in physics, chemistry, modern electronics and materials science. Another objective is to teach students the skills of defining correctly area of physics and nanoscience where classical approach fails and quantum mechanical approach is needed to understand the physical phenomena. The scope covered by the subject is basis of quantum mechanics and its applications in atomics physics , chemistry and materials science . Basic level skills of quantum mechanical problems solving complete the task.	
Effects of education	See Table 65.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Lecture 1. Fundamental assumptions of classical and quantum mechanics, where classical physics fails, blackbody radiation, Plancks formula, de Broglie waves, optical spectra of light atoms, photoelectric effect. Lecture 2. Electron and photons waves and particles. Thomson cathode ray experiment, e/m calculation. Compton effect. Light and photon diffraction. Wave particle duality	

Description of course

	solution, one and two slits electron diffraction. X-ray production and diffraction. Lecture 3. Uncertainity principle, energy uncertainity, momentum uncertainity, Quantum states. Expectation values. Superposition of states. Probability, wave function and Copenhagen interpretation. Examples. Lecture 4. Wave motion. Light and matter - Schrödinger equation. General solution of Schrödinger equation. Classical examples. Schrödinger equation of a free particle. Particle in a finite and infinite potential well. Lecture 5. Schrödinger equation continued.. Properties of valid wave function. Time independent Schrödinger equation. Stationary states.. Particle in a box. Potential barrier. Schrödinger equation solutions, classical and quantum approach. Reflection and transmission of electron wave. Wave particle duality solution, one and two slits electron diffraction. Lecture 6. Harmonic oscillator-recall. Classical and quantum solution of harmonic oscillator. equation. Analogy with optics. Application in nuclear physics. Alpha particle decay. Structure of the atom. Thomson model of atom. Rutherford scattering experiment. Rutherford model of atom Successes and failures. Bohr model of atom. The correspondence principle. Limitations of the Bohr model. Lecture 7. Schrödinger equation in three dimensions. Spherical coordinates. Separable solution. Solution of Schrödinger equation for hydrogen atom. Lecture 8. Quantum numbers in spherical coordinates, principal quantum number, magnetic (azimuthal) quantum number, spin quantum number. Magnetic effects on atomic spectra the Zeeman effect. Energy levels on electrons in atom. Optical spectra and selection rules. The role of spin. Lecture 9. Atomic structure many electron atoms. Electronic structure of many electron atoms. Building principle. The periodic table. Lecture 10. Molecules. Molecular bonding and spectra. Molecular bonds; ionic bonds, covalent bonds, Van der Waals bonds, hydrogen bonds, metallic bonds. Molecular orbitals, orbitals overlap, bonding and antibonding orbital. Classification of molecular states. Vibrations of molecules. Rotational and vibrational states. Lecture 11. Quantum mechanics applications in solid state physics. Fourier analysis of solid state physics of crystals. Bloch theory of electron in a periodic crystal lattice. Energy bands. Velocity of electron in Bloch formalism. Effective mass. “Free” Bloch electrons vs. tight binding. Lecture 12. Crystal and amorphous solids. Dielectrics,

Description of course

	semiconductors, metals. Fermi level. X-ray and neutron analysis of solids. Bragg formula. Electron diffraction in solid state physics. Surface analysis. RHEED. Lecture 13. Quantum mechanics applications in modern optics. Blackbody and laser. Stimulated and spontaneous emission. Inversion of electron population. Three and four step laser model.. Examples of lasers; gas laser semiconductor laser, cascade laser. Lecture 14. Analogy between optics and solid state physics. Optical constants-recall, wave equation and Schrödinger equation. Light in periodic structures. Photonic crystals. Energy gap in a crystal and in a photonic crystal. Lecture 15. Entangled quantum states. Principles of quantum computing. Build a quantum computer, what it means. How to build it? Introduction to quantum cryptography.
Methods of evaluation	100% exam.
Methods of verification of effects of education	See Table 65.
Exam	yes
Literature	To be decided later on the basis of availability of books, Internet sources etc.
Website of the course	

D. Student’s activity

Number of ECTS credits	3
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 30, including: a) attendance at the lectures - 30 hours. 2) The number of hours of independent work of student - 45: a) preparing for an exam - 22 hours; b) systematic preparing for lectures, analyzing literature - 23 hours. Total: 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credits – attendance at the lectures - 30 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 65. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW126_W1**
Description:	Student knows and understands basic concepts and laws of quantum mechanics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_W1**
Description:	Student knows and understands basic concepts and laws of quantum mechanics.
Verification:	Exam.

Table 65. Learning outcomes	
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_W2**
Description:	Student knows technological applications of quantum mechanics and quantum chemistry.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_W3**
Description:	Student understands principles of operation of modern devices using quantum mechanics and nanotechnology.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_W3**
Description:	Student understands principles of operation of modern devices using quantum mechanics and nanotechnology.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANW126_U1**
Description:	Student can solve basic problems in quantum mechanics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_U2**
Description:	Student is able to carry out critical assessment of experiments in quantum physics and chemistry.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_U3**
Description:	Student is able expand his/her knowledge on modern physics and technology by literature-based self-study.
Verification:	Exam.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW126_K1**
Description:	Student understands the progress in quantum physics and technology, and notes its relationship to social development.
Verification:	Exam.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANW126_K2**
Description:	Student has awareness of significance of physical science in technological development and recognizes the meed of permanent self-study in

Table 65. Learning outcomes	
	this area.
Verification:	Exam.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS614	
Name of course	Simulation of Aeronautical Systems	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Maciej Zasuwa, Ph.D., Associate Professor	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Aeronautical Systems I, Aeronautical Systems II, Informatics I, Informatics II.	
Limit of students	12 students in one group.	
C. Effects of education and manner of teaching		
Purpose of course	To acquire practical skills of creating simulation software, related to operation of selected on-board aircraft systems. After completing the course students will be able to use and create simulation tools in various fields of technology.	
Effects of education	See Table 66.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	15h
	Computer lessons	0h
Contents of education	Introduction to programming in Matlab and Simulink software. The architecture of the simulation software. Mathematical models of selected aeronautical systems and components (sensors, controllers and actuators: electric motors, hydraulic and mechanical components, etc.). Introduction to real-time simulation, program optimization, verification and validation. Individual supervised project - simulation of selected aeronautical system or component.	
Methods of evaluation	Final mark based on: assessment of students' projects.	
Methods of verification of effects of education	See Table 66.	
Exam	no	
Literature	Recommended texts (reading): 1) general literature on programming theory, 2) general literature on programming in Matlab / Simulink. Further Readings: 1) books / manuals of selected aeronautical system.	

Description of course

Website of the course	http://zaiol.meil.pw.edu.pl

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 35, including: a) attendance at the lectures - 15 hours; b) attendance at the design exercises - 15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - 40, homework above the project. Total: 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.25 ECTS credits 35 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the design exercises - 15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	2 ECTS credit - 60 hours, including: a) attendance at the design exercises - 15 hours; b) consultancy meetings - 5 hours. c) homework above the project - 40 hours.

E. Additional information

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Table 66. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS614_W1**
Description:	Student knows what is architecture of simulation software.
Verification:	Project.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_W1**
Description:	Student knows what is architecture of simulation software.
Verification:	Project.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANS614_U1**
Description:	Student can write a simple software simulation in Matlab/Simulink environment.
Verification:	Project.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_U1**
Description:	Student can write a simple software simulation in Matlab/Simulink environment.
Verification:	Project.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_U1**
Description:	Student can write a simple software simulation in Matlab/Simulink environment.

Table 66. Learning outcomes	
Verification:	Project.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_U2**
Description:	Student can select develop mathematical models for aeronautical systems components.
Verification:	Project.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_U3**
Description:	Student can integrate modules of the simulation software.
Verification:	Project.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_U4**
Description:	Student knows how to develop a simple documentation of simulation software.
Verification:	Project.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANS614_U4**
Description:	Student knows how to develop a simple documentation of simulation software.
Verification:	Project.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANS614_K1**
Description:	Student knows how to work in team to develop simulation software.
Verification:	Project.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK401	
Name of course	Structure and assembling of airframes	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. Piotr Czarnocki, prof. PW	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	6 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	To learn about fabrication methods of metal and composite airframe parts and about frame assembling methods.	
Effects of education	See Table 67.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	15h
	Computer lessons	0h
Contents of education	Terminology. Metal sheet forming methods-basics. Engineering reference system of airframe and lofting. Master tooling. Jig design and assembling. Assembling of airframe components and final assembling. Modern methods for jig assembling. Jigless assembling. Application of composite materials for airframes manufacturing, manufacturing methods, tooling for composite parts of airframes-basics.	
Methods of evaluation	Average of two project marks.	
Methods of verification of effects of education	See Table 67.	
Exam	no	
Literature	Will be provided by the lecturer.	
Website of the course	-	
D. Student’s activity		
Number of ECTS credits	2	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 30, including a) attendance at the lectures - 15 hours; b) attendance at the design exercises - 15 hours; 2) The number of hours of independent work of student : 30, homework above the project. Total - 60 hours.	

Description of course

Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credit - 30 hours, including: a) attendance at the lectures - 15 hours; b) attendance at the design exercises - 15 hours.
Number of ECTS credits on practical activities on the course	1,5 ECTS credits - 45 hours, including: a) attendance at the design exercises - 15 hours; b) homework above the project - 30 hours.

E. Additional information

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Table 67. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK401_W1**
Description:	Knows basic methods for metal sheet forming.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W1**
Description:	Knows basic methods for metal sheet forming.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W1**
Description:	Knows basic methods for metal sheet forming.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W2**
Description:	Knows basic methods for manufacturing of composite airframe parts.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W2**
Description:	Knows basic methods for manufacturing of composite airframe parts.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W2**
Description:	Knows basic methods for manufacturing of composite airframe parts.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W3**
Description:	Knows basic methods of airframe assembling.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W3**
Description:	Knows basic methods of airframe assembling.

Table 67. Learning outcomes	
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W3**
Description:	Knows basic methods of airframe assembling.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W4**
Description:	Knows basic principles of jig design and checking of their geometry.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W02
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W4**
Description:	Knows basic principles of jig design and checking of their geometry.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_W4**
Description:	Knows basic principles of jig design and checking of their geometry.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK401_U1**
Description:	Can design basic joining processes related to manufacturing of airframes.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U1**
Description:	Can design basic joining processes related to manufacturing of airframes.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U1**
Description:	Can design basic joining processes related to manufacturing of airframes.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U2**
Description:	Can design assembling airframe process.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U2**
Description:	Can design assembling airframe process.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U02

Table 67. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U2**
Description:	Can design assembling airframe process.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U3**
Description:	Can design jigs.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U3**
Description:	Can design jigs.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U02
Area of study related learning outcomes	
Code of effect:	**ML.ANK401_U3**
Description:	Can design jigs.
Verification:	Assessment of the project.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS613	
Name of course	Aeronautical Regulations	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	mgr Wiesław Jedynak (external expert).	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Aircraft Design, Aircraft Maintenance.	
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	Knowledge regarding certification, rules of maintenance management as well as continued airworthiness of aircraft according to ICAO and EASA standards and regulations. Preparing of students as quality and continuing airworthiness managers.	
Effects of education	See Table 68.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Regulatory Framework: role of International Civil Aviation Organisation, role of EASA, role of the Member States; relationship between Part-145, Part-66, Part-147 and Part-M; relationship with other Aviation Authorities. Part-66 — Certifying Staff — Maintenance: Detailed understanding of Part-66. Part-145 — Approved Maintenance Organizations: Detailed understanding of Part-145. JAR-OPS — Commercial Air Transportation: Air Operators Certificates, operators responsibilities, documents to be carried, aircraft placarding (markings). Aircraft Certification. General: certification rules: such as EACS 23/25/27/29, type certification; supplemental type certification, Part-21 Design/Production Organization Approvals. Documents: Certificate of Airworthiness, Certificate of Registration, Noise Certificate, Weight Schedule, Radio Station License and	

Description of course

	Approval. Part-M detailed understanding of Part-M. Applicable National and International Requirements for (if not superseded by EU requirements Maintenance Programs, Maintenance checks and inspections, Master Minimum Equipment Lists, Minimum Equipment List, Dispatch Deviation Lists, Airworthiness Directives, Service Bulletins, manufacturers service information. Modifications and repairs; Maintenance documentation: maintenance manuals, structural repair manual, illustrated parts catalogue, etc. Continuing airworthiness: test flights, ETOPS, maintenance and dispatch requirements, All Weather Operations, Category 2/3 operations and minimum equipment requirements.
Methods of evaluation	Colloquium scores, home work.
Methods of verification of effects of education	See Table 68.
Exam	no
Literature	1) Convention on International Civil Aviation, Signed at Chicago, 7 December 1944 Annex 6 (ICAO): Operation of Aircraft, Annex 8 (ICAO): Airworthiness of Aircraft COMMISSION REGULATION (EC) No 2042/2003 of 20 November 2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks. 2) COMMISSION REGULATION (EC) No 1702/2003 of 24 September 2003 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production.
Website of the course	

D. Student’s activity

Number of ECTS credits	1
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher - 15, including a) attendance at the lectures - 15 hours. 2) The number of hours of independent work of student: a) homework -10 hours; b) preparation for colloquium - 5 hours.
Number of ECTS credits on the course with direct participation of academic teacher	0.5 ECTS credits - 15 hours, attendance at the lectures.
Number of ECTS credits on practical activities on the course	-

E. Additional information

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Table 68. Learning outcomes

General academic profile - knowledge

Table 68. Learning outcomes	
Code of effect:	**ML.ANS613_W1**
Description:	Knows the most important aviation legal instruments and their mutual interrelations.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_W2**
Description:	Knows important requirements corresponding to rules of certification both for flying platforms and related products, their components and equipment with the respect to airworthiness certificate and environmental protection as well as with to certification of design and production organisations.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_W2**
Description:	Knows important requirements corresponding to rules of certification both for flying platforms and related products, their components and equipment with the respect to airworthiness certificate and environmental protection as well as with to certification of design and production organisations.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W23
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_W3**
Description:	Knows requirements related to keeping the continuous airworthiness for flying platforms and aeronautical products and also law procedures necessary for approval of aviation-related organisations responsible for performing their tasks in respective areas.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_W3**
Description:	Knows requirements related to keeping the continuous airworthiness for flying platforms and aeronautical products and also law procedures necessary for approval of aviation-related organisations responsible for performing their tasks in respective areas.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_W4**
Description:	Knows the most fundamental requirements related to commercial air transport and special aviation tasks.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W20

Table 68. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_W4**
Description:	Knows the most fundamental requirements related to commercial air transport and special aviation tasks.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W23
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANS613_U1**
Description:	Is able to find, interpret and apply the suitable requirements related to executive rules of certification for flying objects and corresponding products, components and on-board equipment as well as for design and production organisations, all with respect to airworthiness and environmental protection.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U1**
Description:	Is able to find, interpret and apply the suitable requirements related to executive rules of certification for flying objects and corresponding products, components and on-board equipment as well as for design and production organisations, all with respect to airworthiness and environmental protection.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U1**
Description:	Is able to find, interpret and apply the suitable requirements related to executive rules of certification for flying objects and corresponding products, components and on-board equipment as well as for design and production organisations, all with respect to airworthiness and environmental protection.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U15
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U2**
Description:	Is able to find, interpret and apply the suitable requirements related to continuous airworthiness for flying platforms and aeronautical products and also law procedures necessary for approval of aviation-related organisations responsible for performing their tasks in respective areas.
Verification:	Homework.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U2**
Description:	Is able to find, interpret and apply the suitable

Table 68. Learning outcomes	
	requirements related to continuous airworthiness for flying platforms and aeronautical products and also law procedures necessary for approval of aviation-related organisations responsible for performing their tasks in respective areas.
Verification:	Homework.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U2**
Description:	Is able to find, interpret and apply the suitable requirements related to continuous airworthiness for flying platforms and aeronautical products and also law procedures necessary for approval of aviation-related organisations responsible for performing their tasks in respective areas.
Verification:	Homework.
Field of study related learning outcomes	Aero1_U15
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U3**
Description:	Is able to find, interpret and apply the suitable requirements related to commercial air transport and special aviation tasks.
Verification:	Homework.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U3**
Description:	Is able to find, interpret and apply the suitable requirements related to commercial air transport and special aviation tasks.
Verification:	Homework.
Field of study related learning outcomes	Aero1_U15
Area of study related learning outcomes	
Code of effect:	**ML.ANS613_U3**
Description:	Is able to find, interpret and apply the suitable requirements related to commercial air transport and special aviation tasks.
Verification:	Homework.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS608	
Name of course	Aircraft engines maintenance	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Inż. Piotr Korsieko (external expert).	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Student should have basic knowledge in the field of aircraft engines design- typical aircraft engine layout and components and operation - interaction of each component.	
Limit of students	160	
C. Effects of education and manner of teaching		
Purpose of course	To teach students about the basic principles of aircraft engines maintenance systems. Familiar students with planned and unplanned engine on-wing and off-wing maintenance activities. As a result of subject completion a student acquires knowledge in: basic aircraft engines maintenance systems, typical damages of aircraft engine parts and methods of engine diagnostic and monitoring.	
Effects of education	See Table 69.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Aircraft engines maintenance systems, maintenance limits of aircraft engines, planning of aircraft engines overhauls, tasks of maintenance organizations, types of services, maintenance activities on an aircraft engines, ground testing of engine, typical damages of aircraft engine parts, methods of engine testing, the engine monitoring on the ground and in the flight, maintenance safety problems, maintenance documents and manufacture requirements.	
Methods of evaluation	The subject is completed on the basis of the final written tests 100%.	
Methods of verification of effects of education	See Table 69.	
Exam	no	

Description of course

Literature	Recommended texts (reading): 1) Rolls Royce plc. 1986. The jet engine. Birmingham, Renault Printing Co Ltd. 2) Systems of Commercial Turbofan Engines- An Introduction to Systems Functions - Andreas Linke-Diesinger (2008 -Springer Berlin Heidelberg). 3) Aircraft Gas Turbine Engine Technology - Irwin E. Treager . 4) FAA-H-8083-32, Aviation Maintenance Technician Handbook-Powerplant Volume 1 and 2 - www.faa.gov.
Website of the course	

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures- 30 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of student a) reading the suggested literature -10 hours; b) regular preparations for classes, tests - 10 hours. TOTAL: 53 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1.3 ECTS credits - 33 hours, including: a) attendance at the lectures- 30 hours; b) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	As the subject is of interdisciplinary character and is not based on a particular text book or comes from Engine Manufacture documentation and data, students participation in lectures is highly recommended.
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Table 69. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS608_W1**
Description:	Student knows a methods how the aircraft engine maintenance systems are designed.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_W2**
Description:	Student knows the troubleshoot methods and technics in aircraft engine maintenance.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_W18
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANS608_U1**
Description:	Student can name primary aircraft engine maintenance systems.
Verification:	Colloquium.

Table 69. Learning outcomes	
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U2**
Description:	Student is able to draft a simple aircraft engine maintenance systems.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U2**
Description:	Student is able to draft a simple aircraft engine maintenance systems.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U2**
Description:	Student is able to draft a simple aircraft engine maintenance systems.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U3**
Description:	Student can plan a simple repair procedure for planned and unplanned aircraft engine maintenance activity.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U3**
Description:	Student can plan a simple repair procedure for planned and unplanned aircraft engine maintenance activity.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U4**
Description:	Student can name typical defects and damages of aircraft engine assembly and piece parts.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U5**
Description:	Student can troubleshoot aircraft engines base on methods and technics in aircraft engine maintenance.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U5**
Description:	Student can troubleshoot aircraft engines base on methods and technics in aircraft engine maintenance.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	

Table 69. Learning outcomes	
Code of effect:	**ML.ANS608_U6**
Description:	Student is familiar and knows how the aircraft engine health monitoring process looks like.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U6**
Description:	Student is familiar and knows how the aircraft engine health monitoring process looks like.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANS608_U7**
Description:	Student knows the aircraft engine manuals types and how to use such documentation.
Verification:	Colloquium.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK348	
Name of course	Computational Fluid Dynamics	
Version of course	2013	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. J. Rokicki	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Fluid Mechanics, Computer Science II.	
Limit of students	90 - lecture, 12 - lab. groups.	
C. Effects of education and manner of teaching		
Purpose of course	To familiarize the students with the computational methods of flow simulations After completing this course the students will be able to understand basic algorithms of CFD as well as perform simulations using comertial CFD code (mesh generation, setting up boundary and initial conditions, monitoring simulations, assessment nad visualization of results).	
Effects of education	See Table 70.	
Form of didactic studies and number of hours per semester	Lecture	30h
	Exercise type of course	0h
	Laboratory	15h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Basic models in fluid mechanics. Conservative versus non-conservative formulation. Basic discretisation methods for model equations (boundary and initial conditions, stability, CFL condition, Godunov barier). General algorithms for nonlinear problems (pseudo-time iterations, frozen coefficients, quasi-linearisation). Simulation of incompressible flows (stream-function vorticity formulation, projection method and artificial compressibility). Finite volume method for compressible flows. Flux-vector splitting technique. Modelling of shock-waves. Basic information on spectral methods.	
Methods of evaluation	Assesment method: 2 lecture tests (60 points), lab. continuous assignement (20 points), lab. test (20 points), resulting mark: (30-49 N, 50-59 3.0, 60-69 3.5, 70-79 4.0, 80-89 4.5, 90-100 5.0), if	

Description of course

	necessary the optional final exam may override the score received during both lecture tests.
Methods of verification of effects of education	See Table 70.
Exam	yes
Literature	Hirsch, Charles, Numerical computation of internal and external flows, 2007 Versteeg. Henk Kaarle, An introduction to computational fluid dynamics, 2007.
Website of the course	http://c-cfd.meil.pw.edu.pl/ccfd/index.php?item=6

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 50, including: a) attendance at the lectures - 30 hours; b) attendance at the labs - 15 hours; c) consultancy meetings - 5 hours. 2) The number of hours of independent work of student - 25, including: a) 15 hours – preparation for labs and lectures, b) 10 hours – preparation for the exam. Total: 75 hours.
Number of ECTS credits on the course with direct participation of academic teacher	2 ECTS credits - 50 hours, including: a) attendance at the lectures - 30 hours; b) attendance at the labs - 15 hours; c) consultancy meetings - 5 hours.
Number of ECTS credits on practical activities on the course	1 ECTS credit - 23 hours, including: a) attendance at the labs - 15 hours; b) preparation for the labs - 8 hours.

E. Additional information

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Table 70. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK348_W1**
Description:	Student knows basic models and equations of fluid mechanics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_W1**
Description:	Student knows basic models and equations of fluid mechanics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_W1**
Description:	Student knows basic models and equations of fluid mechanics.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W07
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_W2**
Description:	Student knows basic techniques of discretization of differential equations.

Table 70. Learning outcomes	
Verification:	Exam.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_W3**
Description:	Student knows stability limiatations of various discretization methods.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_W3**
Description:	Student knows stability limiatations of various discretization methods.
Verification:	Exam.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK348_U1**
Description:	Student can discretize and solve numerically a simple boundary value problem.
Verification:	Exam, lab meetings.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_U1**
Description:	Student can discretize and solve numerically a simple boundary value problem.
Verification:	Exam, lab meetings.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_U1**
Description:	Student can discretize and solve numerically a simple boundary value problem.
Verification:	Exam, lab meetings.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_U2**
Description:	Using an appropriate engineering computer package, a student is able to solve simple engineering flow problem and critically assess obtained solution.
Verification:	Assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_U2**
Description:	Using an appropriate engineering computer package, a student is able to solve simple engineering flow problem and critically assess obtained solution.
Verification:	Assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK348_U2**
Description:	Using an appropriate engineering computer package, a student is able to solve simple engineering flow problem and critically assess

Table 70. Learning outcomes	
	obtained solution.
Verification:	Assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_U13
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ANK348_K1**
Description:	Student is able to identify and eliminate threats implied by erroneously performed computer simulations.
Verification:	Assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ANK348_K1**
Description:	Student is able to identify and eliminate threats implied by erroneously performed computer simulations.
Verification:	Assessment of progress/activity in lab tutorials.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW128	
Name of course	Engineering Diploma Seminar	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Prof. dr hab. inż. Paweł Pyrzanowski	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	The aim of the course is to familiarize with the methods of collecting information on a given topic and its presentation in a public forum.	
Effects of education	See Table 71.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	30h
	Computer lessons	0h
Contents of education	1. Collection of materials on a given topic taking into account all available sources, including books, academic textbooks, journals and the Internet. The collected material should be included in the form of a written brief containing references to the sources of information used and their analysis. This part should be formed in cooperation with the leading job and be controlled during individual meetings. 2. Defense work. It is recommended that the defense takes place in a larger group of students. Each person during 10-15 minutes shows the result of the work in the form of a presentation, then answer questions about the work asked by all present.	
Methods of evaluation	The evaluation shall assess the quality of collected information and the manner of its presentation. It is recommended that the presentation took place in a wide circle of students, who together with the teacher will evaluate the work.	
Methods of verification of effects of education	See Table 71.	
Exam	no	

Description of course

Literature	Books and academic textbooks, journals, Internet.
Website of the course	

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 20, including: a) consultancy meetings - 18 hours. b) final completion – 2 hours; 2) The number of hours of independent work of student –30 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1 ECTS credits - number of hours that require the presence of a teacher - 20, including: a) consultancy meetings - 18 hours; b) final completion – 2 hours.
Number of ECTS credits on practical activities on the course	1,2 ECTS credits.

E. Additional information

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Table 71. Learning outcomes

General academic profile - skils

Code of effect:	**ML.ANW128_U1**
Description:	He can search the available sources of knowledge in the field of aerospace engineering.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_U1**
Description:	He can search the available sources of knowledge in the field of aerospace engineering.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_U2**
Description:	Able to carry out a detailed analysis of the literature. Is critical to the analyzed materials, including non-technical aspect.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_U2**
Description:	Able to carry out a detailed analysis of the literature. Is critical to the analyzed materials, including non-technical aspect.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_U3**

Table 71. Learning outcomes	
Description:	Able to provide written results of their work in the form of a short report.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_U4**
Description:	Student can a short and clearly present the results of their work in the form of oral presentation at the seminar.
Verification:	Oral presentation of the work.
Field of study related learning outcomes	Aero1_U04
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW128_K1**
Description:	Understands the need for life-long learning; can inspire and organise the learning process of other people.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_K01
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_K2**
Description:	Understands the need for discussion in order to present their results, as well as work together on the the subject.
Verification:	Oral presentation of the work.
Field of study related learning outcomes	Aero1_K04
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_K2**
Description:	Understands the need for discussion in order to present their results, as well as work together on the the subject.
Verification:	Oral presentation of the work.
Field of study related learning outcomes	Aero1_K06
Area of study related learning outcomes	
Code of effect:	**ML.ANW128_K3**
Description:	The student is aware of the non-technical aspects of engineering activities.
Verification:	Prepared and evaluated report, oral presentation of the work.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	

Description of course

Code of course	ML.ANW136	
Name of course	Engineering Diploma Thesis	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Teacher authorized by the Faculty Council.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements		
Limit of students		
C. Effects of education and manner of teaching		
Purpose of course	Selection of a proper literature; the choice of methods; solution of the simple engineering problem; presentation and critical analysis of the results. The exact specification dependents on the subject of work.	
Effects of education	See Table 72.	
Form of didactic studies and number of hours per semester	Lecture	0h
	Exercise type of course	0h
	Laboratory	0h
	Project type of course	180h
	Computer lessons	0h
Contents of education	Detailed course content depends on the subject.	
Methods of evaluation	Teacher (promoter of the Thesis) and the reviewer assumed execution of tasks In case of a positive evaluation followed the final assessment is issued by the exam committee during the final exam.	
Methods of verification of effects of education	See Table 72.	
Exam	yes	
Literature	Books and academic textbooks, journals, Internet.	
Website of the course		
D. Student’s activity		
Number of ECTS credits	15	
Number of hours of student’s work to achieve effects of education	1) Number of hours that require the presence of a teacher – 150, including: a) consultancy meetings - 149 hours, b) final exam – 1 hours. 2) The number of hours of independent work of student – 225. TOTAL: 375 hours.	
Number of ECTS credits on the course with direct participation of academic teacher	6 ECTS credits – number of hours that require the presence of a teacher – 150, including: a) consultancy meetings - 149 hours. b) final exam – 1 hours.	

Description of course

Number of ECTS credits on practical activities on the course	15 ECTS credits.

E. Additional information

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Table 72. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANW136_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_W16
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_W17
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_W1**
Description:	Student has acquired extensive knowledge on the chosen topic within his field of study.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	

General academic profile - skils

Code of effect:	**ML.ANW136_U1**
Description:	Student can identify the solved problem in a wide range of science, based on the literature.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U2**
Description:	Student can use the literature to search for tips to solve research or engineering problems.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U05
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U2**
Description:	Student can use the literature to search for tips to solve research or engineering problems.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U19
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U3**

Table 72. Learning outcomes	
Description:	Student can solve simple engineering tasks.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U20
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U3**
Description:	Student can solve simple engineering tasks.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U4**
Description:	Student can critically assess the results of the solved problem.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U5**
Description:	Student can personally prepare a report on the work and defend the thesis in conversation.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U5**
Description:	Student can personally prepare a report on the work and defend the thesis in conversation.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U06
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U5**
Description:	Student can personally prepare a report on the work and defend the thesis in conversation.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U07
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_U6**
Description:	The student is able to formulate and solve engineering tasks perceive their system aspects and non-technical.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
General academic profile - social competences	
Code of effect:	**ML.ANW136_K1**
Description:	Development of self-learning needs in order to achieve the desired effect.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_K01

Table 72. Learning outcomes	
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_K2**
Description:	Student is aware of the importance of non-technical aspects and effects of engineering activities, including its impact on the environment, and the associated responsibility for decisions.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_K02
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_K3**
Description:	Student correctly identifies and resolves dilemmas associated with his profession.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_K03
Area of study related learning outcomes	
Code of effect:	**ML.ANW136_K4**
Description:	Student understands the need to inform the society - also through the mass media - about the achievements of technology and other aspects of engineer activity. Student can transfer such information in a commonly understood manner.
Verification:	Assessment of engineering thesis and the diploma examination.
Field of study related learning outcomes	Aero1_K06
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK343	
Name of course	FINITE ELEMENT METHOD II	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr hab. inż. Grzegorz Krzesiński, prof. PW.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	summer semester	
Preliminary requirements	Mechanics of Structures, FEM I.	
Limit of students	min.15.	
C. Effects of education and manner of teaching		
Purpose of course	To supply the knowledge and skills required for applications of the method in typical problems of mechanics of structures After completing the course the students will be able to use FE models in different typical applications to solve problems of thermal stresses, dynamic of structures and nonlinear problems of stress analysis.	
Effects of education	See Table 73.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	0h
	Laboratory	15h
	Project type of course	0h
	Computer lessons	0h
Contents of education	FEM in steady state heat flow and thermal stresses. Introduction to structural dynamics, free vibrations. Buckling of elastic structures, critical load. Nonlinear problems in mechanics of structures basic numerical techniques. Parametric modeling and design optimization. Computer lab: Modeling simple problems of: thermal stresses, contact mechanics, plasticity and residual stresses, free vibrations, buckling.	
Methods of evaluation	Assessment based on tests and results of computer lab work.	
Methods of verification of effects of education	See Table 73.	
Exam	no	
Literature	1) Huebner K.H., Dewhirst D.L., Smith D.E., Byrom T.G.: The finite element method for engineers, J. Wiley & Sons 2001. 2) Zienkiewicz O.C., Taylor R.: The Finite Element Method. Vol 1- The Basis, Butterworth Heinemann, London 2000. 3) Notes	

Description of course

	provided by lecturer.
Website of the course	http://mel.pw.edu.pl/zwmik/ZWMiK/Dla-studentow2

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including a) attendance at the lectures - 15 hours; b) attendance at the labs – 15 hours; c) consultancy meetings – 3 hours. 2) The number of hours of independent work of student – 30, including: a) preparing for the lab, for tests: 15 hours; b) preparation of reports from the lab: 15 hours. TOTAL – 63 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 15 hours; b) attendance at the labs – 15 hours; c) consultancy meetings – 3 hours.
Number of ECTS credits on practical activities on the course	1 ECTS credit – 30 hours, including: a) presence at computer labs: 15 hours; b) preparation of reports from the lab: 15 hours.

E. Additional information

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Table 73. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK343_W1**
Description:	Basic knowledge and skills in modeling free vibrations of elastic structures, buckling and nonlinear problems of mechanics of structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_W1**
Description:	Basic knowledge and skills in modeling free vibrations of elastic structures, buckling and nonlinear problems of mechanics of structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_W1**
Description:	Basic knowledge and skills in modeling free vibrations of elastic structures, buckling and nonlinear problems of mechanics of structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_W2**
Description:	Knowledge concerning computational methods of heat flow, thermal stresses, parametric modeling and design optimization and stress analysis of

Table 73. Learning outcomes	
	composite structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_W2**
Description:	Knowledge concerning computational methods of heat flow, thermal stresses, parametric modeling and design optimization and stress analysis of composite structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_W2**
Description:	Knowledge concerning computational methods of heat flow, thermal stresses, parametric modeling and design optimization and stress analysis of composite structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_W2**
Description:	Knowledge concerning computational methods of heat flow, thermal stresses, parametric modeling and design optimization and stress analysis of composite structures.
Verification:	Based on tests and practical FEM modeling.
Field of study related learning outcomes	Aero1_W19
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK343_U1**
Description:	After completing the course the students will be able to use FEM in different applications to effectively solve typical problems of thermal stresses, dynamics of structures and elasto-plastic deformations, including contact and residual stresses.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U01
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U1**
Description:	After completing the course the students will be able to use FEM in different applications to effectively solve typical problems of thermal stresses, dynamics of structures and elasto-plastic deformations, including contact and residual stresses.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U03
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U1**
Description:	After completing the course the students will be able to use FEM in different applications to

Table 73. Learning outcomes	
	effectively solve typical problems of thermal stresses, dynamics of structures and elasto-plastic deformations, including contact and residual stresses.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U07
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U1**
Description:	After completing the course the students will be able to use FEM in different applications to effectively solve typical problems of thermal stresses, dynamics of structures and elasto-plastic deformations, including contact and residual stresses.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U1**
Description:	After completing the course the students will be able to use FEM in different applications to effectively solve typical problems of thermal stresses, dynamics of structures and elasto-plastic deformations, including contact and residual stresses.
Verification:	Based on tests and the reports created during computer labs.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U2**
Description:	The students will be familiar with understanding different FE models and their results as well with preparing reports describing FE analysis.
Verification:	Evaluation of work of the student during the laboratory, evaluation of reports.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U2**
Description:	The students will be familiar with understanding different FE models and their results as well with preparing reports describing FE analysis.
Verification:	Evaluation of work of the student during the laboratory, evaluation of reports.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK343_U2**
Description:	The students will be familiar with understanding different FE models and their results as well with preparing reports describing FE analysis.
Verification:	Evaluation of work of the student during the laboratory, evaluation of reports.
Field of study related learning outcomes	Aero1_U08
Area of study related learning outcomes	

Table 73. Learning outcomes	
Code of effect:	**ML.ANK343_U2**
Description:	The students will be familiar with understanding different FE models and their results as well with preparing reports describing FE analysis.
Verification:	Evaluation of work of the student during the laboratory, evaluation of reports.
Field of study related learning outcomes	Aero1_U09
Area of study related learning outcomes	

Description of course

Code of course	ML.ANS627	
Name of course	Simulators	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	Maciej Zasuwa, Ph.D., Associate Professor.	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Aeronautical systems 1 , Aeronautical Systems 2.	
Limit of students	-	
C. Effects of education and manner of teaching		
Purpose of course	To make students familiar with the base principles of simulators design in aeronautics and other fields of technology After completing the course students will be familiar with modern simulator technology, having background for design of simulators.	
Effects of education	See Table 74.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Definition of simulator and training devices. Simulator architectures and applications. Pilot training procedures. Human perception and proprioception. Influence of human physiology on simulator design: the role of human senses in flight control, sight physiology and hearing. Recording and analysis of training process. Simulation software: architecture and components, DIS, HLA, real-time computation. Mobile platform simulators: classification, control methods. Vision systems: image generation and display. Real-time computer graphics. Databases of terrain and 3D objects. Imitation and modeling of indicators in cockpit, flight control systems, force feedback systems. Simulation models of mobile platforms. Sound effects generation. Simulation sickness. Demonstration of available simulator.	
Methods of evaluation	Two tests.	

Description of course

Methods of verification of effects of education	See Table 74.
Exam	no
Literature	Recommended texts (reading): 1. David Allerton, Principles of Flight Simulation, John Wiley and Sons, 2009. 2. Dominic J. Diston, Computational Modelling and Simulation of Aircraft and the Environment, John Wiley and Sons, 2009.
Website of the course	http://zaiol.meil.pw.edu.pl

D. Student's activity

Number of ECTS credits	2
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including a) attendance at the lectures-15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 3 hours. 2) The number of hours of independent work of student - a) preparing for the test no. 1 - 10 hours; b) preparing for the test no. 2 - 10 hours. Total - 53 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,5 ECTS credits – number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures- 15 hours; b) attendance at the exercises - 15 hours; c) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	1 ECTS credit.

E. Additional information

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Table 74. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANS627_W1**
Description:	Student knows the design principles of indicators imitators in the cockpit.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W06
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_W1**
Description:	Student knows the design principles of indicators imitators in the cockpit.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_W2**
Description:	Student knows the basic stages of modeling the moving objects.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_W2**
Description:	Student knows the basic stages of modeling the moving objects.

Table 74. Learning outcomes	
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_W09
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_W3**
Description:	Student knows what are the symptoms of the cyber sickness and knows the rules of prevention.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W20
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_W4**
Description:	Student knows the basic concepts of distributed simulation.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_W03
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANS627_U1**
Description:	Student knows how to classify and briefly discuss the types of simulators and training devices used in aviation.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U1**
Description:	Student knows how to classify and briefly discuss the types of simulators and training devices used in aviation.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U16
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U1**
Description:	Student knows how to classify and briefly discuss the types of simulators and training devices used in aviation.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U2**
Description:	Student knows how to classify and briefly discuss the types of simulators and training devices ground vehicles.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_U10
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U2**
Description:	Student knows how to classify and briefly discuss the types of simulators and training devices ground vehicles.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U2**
Description:	Student knows how to classify and briefly discuss

Table 74. Learning outcomes	
	the types of simulators and training devices ground vehicles.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_U16
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U3**
Description:	Student knows how to classify and briefly discuss the types of visualization systems.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U4**
Description:	Student knows how to classify and briefly discuss the types of motion cueing systems.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U5**
Description:	Student knows how to design software architecture for simple training device.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U5**
Description:	Student knows how to design software architecture for simple training device.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U6**
Description:	Student knows the basic functions of the instructor's stand.
Verification:	Test no. 2.
Field of study related learning outcomes	Aero1_U14
Area of study related learning outcomes	
Code of effect:	**ML.ANS627_U7**
Description:	Student knows the concept of verification, validation and accreditation of the simulation model.
Verification:	Test no. 1.
Field of study related learning outcomes	Aero1_U17
Area of study related learning outcomes	

Description of course

Code of course	ML.ANK459	
Name of course	VIBRATIONS AND AEROELASTICITY	
Version of course	2013.	
A. Place of the course in system of studies		
Level of education	First cycle studies	
Form and mode of studies	full-time	
Profile of studies	General academic profile	
Specialisation	-	
Place of teaching of course	Faculty of Power and Aeronautical Engineering	
Place of realization of course	Faculty of Power and Aeronautical Engineering.	
Coordinator of course	dr inż. Franciszek Dul	
B. General characteristic of the course		
Block of courses	Aerospace Engineering	
Group of courses	Specialization	
Type of course	Compulsory	
Language of course	angielski	
Nominal semester	7 (r.a. 2019/2020)	
Time of completion in the academic year	winter semester	
Preliminary requirements	Calculus, Differential equations, Mechanics, Mechanics of structures, Fluid mechanics, Aerodynamics.	
Limit of students	60	
C. Effects of education and manner of teaching		
Purpose of course	Basic knowledge of vibrations phenomena. Basic knowledge of unsteady aerodynamics. Basic knowledge of aeroelastic phenomena. Basic competency in computational methods of vibrations and aeroelasticity. After completing his course student will have the basic knowledge of vibrations and aeroelasticity. He will be able to recognize various vibration and aeroelastic phenomena and implement adequate methods of analysis. He will be familiar with industrial methods of vibration and aeroelastic analysis.	
Effects of education	See Table 75.	
Form of didactic studies and number of hours per semester	Lecture	15h
	Exercise type of course	15h
	Laboratory	0h
	Project type of course	0h
	Computer lessons	0h
Contents of education	Vibrations in physics and engineering. Models of vibration systems. Natural, free and forced vibrations. Resonance. Nonlinear, parametric, self-excited and stochastic vibrations. Vibrations of continuous systems and aerospace structures. Numerical determination of vibration modes. Ground vibration tests. Models of wing aerodynamics. Models of unsteady aerodynamics. Computational methods of unsteady aerodynamics. Aeroelastic phenomena in aviation. Critical velocity. Static and dynamics aeroelastic phenomena. Models of aeroelastic phenomena .	

Description of course

	Properties of flutter. Computational methods of flutter analysis. Methods of flutter suppression. Aeroelasticity of helicopters. Flutter tests. Aeroelasticity in aviation regulations. Modern aeroelastic analysis. Laboratory demonstration of forced vibrations and various types of wing flutter.
Methods of evaluation	Assessment based on homework or a classroom test.
Methods of verification of effects of education	See Table 75.
Exam	no
Literature	Recommended texts (reading): 1) Bisplinghof, R.L., Ashley, H., Halfman, R.L.; Aeroelasticity, Addison-Wesley, Cambridge, Mass. 1955. 2) Dowell, E.H., Curtiss, H.C., Scanlan, R.H., Sisto, F.; A modern course in aeroelasticity, Sijthof & Noordhoff, Alpen aan den Rijn, 2004. 3) Documentation on http Further Readings: Wright, J., Cooper, J.E. Introduction to Aircraft Aeroelasticity and Loads, Wiley, 2007.
Website of the course	

D. Student's activity

Number of ECTS credits	3
Number of hours of student's work to achieve effects of education	1) Number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; b) consultancy meetings - 3 hours. 2) The number of hours of independent work of student a) homework -15 hours; b) reading the suggested literature -15 hours; c).regular preparations for tests - 15 hours; TOTAL: 78 hours.
Number of ECTS credits on the course with direct participation of academic teacher	1,3 ECTS credits – number of hours that require the presence of a teacher - 33, including: a) attendance at the lectures - 15 hours; b) attendance at the exercises - 15 hours; b) consultancy meetings - 3 hours.
Number of ECTS credits on practical activities on the course	-

E. Additional information

Notes	
Date of last edition	2019-10-01 07:48:09

Table 75. Learning outcomes

General academic profile - knowledge

Code of effect:	**ML.ANK459_W1**
Description:	Student has the basic knowledge on vibrations of discrete systems: linear, nonlinear, parametric and self-excited.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK459_W2**
Description:	Student has the basic knowledge on vibrations of

Table 75. Learning outcomes	
	distributed parameter systems. He/she knows the concepts of natural frequency and natural modes of vibrations.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_W05
Area of study related learning outcomes	
Code of effect:	**ML.ANK459_W3**
Description:	Student has the basic knowledge on vibrations of aerospace structures, ground vibrations tests ant the basic computational methods used in vibrations analysis with special attention to the Finite Element Method.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_W01
Area of study related learning outcomes	
Code of effect:	**ML.ANK459_W4**
Description:	Student has the basic knowledge on unsteady aerodynamics, unsteady aerodynamic phenomena in aviation and basic computational methods of unsteady aerodynamics with special attention to the panel methods.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_W11
Area of study related learning outcomes	
Code of effect:	**ML.ANK459_W5**
Description:	Student has the basic knowledge on aeroelastic phenomena in aviation with special attention to the various types of flutter. He/she knows the basic computational methods used in aeroelasticity and knows the idea of airborne flutter tests.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_W15
Area of study related learning outcomes	
General academic profile - skils	
Code of effect:	**ML.ANK459_U1**
Description:	Student has the skill of modeling of the vibrations of mechanical systems based on the Lagrange's equations of the second kind.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_U12
Area of study related learning outcomes	
Code of effect:	**ML.ANK459_U2**
Description:	Student has the skill of calculating the natural frequencies and natural modes of vibrations of simple mechanical devices.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_U11
Area of study related learning outcomes	
Code of effect:	**ML.ANK459_U3**
Description:	Student has the skill of calculating the critical velocities of basic aeroelastic phenomena.
Verification:	Homework or test.
Field of study related learning outcomes	Aero1_U09

Table 75. Learning outcomes	
Area of study related learning outcomes	