Appendix 1
To the resolution of the Senate of the MUT No. 96/WAT/2023
dated June 22, 2023

WOJSKOWA AKADEMIA TECHNICZNA
im. JAROSŁAWA DĄBROWSKIEGO
MILITARY UNIVERSITY OF TECHNOLOGY
NAMED AFTER JAROSŁAW DĄBROWSKI
FACULTY OF MECHATRONICS, ARMAMENT AND AEROSPACE

CURRICULUM

Level of education: first cycle programme

for the field of study: AERONAUTICS AND ASTRONAUTICS

Profile of study: general academic

Mode of study: full-time

Resolution of the Senate of the Military University of Technology named after Jarosław Dąbrowski No 96/WAT/2023 of June 22, 2023

Effective from the academic year 2023/2024

Warsaw

2023

CURRICULUM

for the field of study "Aeronautics and Astronautics”

Level of education: first-cycle programme

Profile of study: general academic

Mode(s) of study: full-time programme

Qualification and title conferred on graduates: inżynier [engineer]

Polish Qualification Framework level: 6

Field of study is assigned to:

Field of science	engineering and technology
Scientific discipline	mechanical engineering, 70% ECTS credits
Field of science	engineering and technology
Scientific discipline	automation, electronics, electrical engineering and space technology, 30% ECTS credits

Leading discipline:[1] mechanical engineering

Language of instruction: Polish

Number of semesters: 7

Total number of hours:

Avionics:	2418
Airframes and Propulsion Systems:	2498

Number of ECTS credits required to graduate: 210

Total number of ECTS credits a student is required to obtain for the course:

- conducted with direct participation of academic staff or other instructors:

Avionics:	126.5
Airframes and Propulsion Systems:	128.5

- in the humanities or social sciences:[2] 18

Dimension, number of ECTS credits, rules and form of apprenticeship:
4 weeks, 5 ECTS

[1] *in case of assigning the field of study to more than one scientific discipline mechanical engineering*
[2] *does not apply to fields of study which are assigned to disciplines within the disciplines of humanities or social sciences respectively.*

DESCRIPTION OF THE INTENDED LEARNING OUTCOMES

Description of the assumed learning outcomes takes into account:

- a first-degree universal characteristics set out in the Annex to the Act of 22 December 2015 on the Integrated Qualifications System
- a second-degree characteristics set out in the Annex to the Regulation of the Minister of Science and Higher Education of 14 November 2018 on second-degree characteristics of learning outcomes for qualifications at levels 6-8 of the Polish Qualification Framework, including those, which allow for acquiring engineering competence [3]

and is included in three categories:

- a **knowledge** category **(W)**, which specifies:
  - breadth and depth **(G)** - completeness of cognitive perspective and relationships,
  - context **(K)** - conditions, outcomes.

- a **skills** category **(U)**, which specifies:
  - in terms of knowledge application (**W**) - problems solved and tasks performed,
  - in terms of communication (**K**) - receiving and creating statements, disseminating knowledge in a scientific environment and using a foreign language,
  - in terms of work organisation (**O**) - planning and teamwork,
  - in terms of learning (**U**) - planning one's own development and development of others.

- a **social competence** category **(K)** - which specifies:
  - in terms of assessments **(K)** - a critical approach,
  - in terms of responsibility (O) - fulfilling social obligations and acting in the public interest,
  - in relation to the professional role **(R)** - independence and ethos of development.

[3] *applies to the fields of study, the graduates of which get a degree of inż., mgr inż.*

Explanation of designations:
- in a **symbol and outcome number** column:
  - K – field-related learning outcomes;
  - W, U, K (after the underscore) - category - respectively: knowledge, skills, social competence;
  - 01, 02, 03, …. – a number of learning outcome.
- in a ***code of description component***[4] - Inż[5]_P7S[6]_WG - a code of description component of the second-degree characteristics for qualification at level 7 of the Polish Qualification Framework.

Symbol and outcome number	Description of the intended learning outcomes	Code of description component
KNOWLEDGE	**The graduate:**	
K_W01	has knowledge of mathematics, encompassing algebra, elements of matrix calculus, mathematical analysis, including problems of differential and integral calculus of functions of many variables, elements of ordinary and partial differential equations, probability theory and elements of applied mathematics, necessary to: 1. describe and analyse the issues of general mechanics, including dynamics of material points and rigid bodies of constant and variable mass, and vibrating systems; 2. describe the state and motion of fluids, describe and analyse the fundamental physical phenomena in flows and drags, and analyse steady and transient flight issues; 3. describe the dynamics of mechanical, electrical and electronic components, systems and devices; 4. describing the strength issues and basic elasticity theory	P6S_WG
K_W02	has knowledge of physics, encompassing mechanics, optics, electricity and electromagnetic waves, and solid state physics, including the knowledge necessary to understand the fundamental physical phenomena occurring in aircraft components, circuits, equipment, installations and systems, and their operational systems and environments	P6S_WG
K_W03	has basic knowledge of electrical and electronic engineering covering relevant aeronautics and astronautics issues	P6S_WG Inż_P6S_W
K_W04	has well-structured and theoretically grounded knowledge of the fundamentals of control and automation, metrology of mechanical and electrical quantities and techniques of performing measurements	P6S_WG Inż_P6S_WG
K_W05	has well-structured knowledge of computer science, digital technology and the organisation, architecture and software of computers, including on-board computers	P6S_WG Inż_P6S_WG
K_W06	has well-structured and theoretically grounded knowledge of general mechanics, including knowledge covering the key aspects of aircraft design and operation	P6S_WG Inż_P6S_WG

[4] *6/7 - keep the appropriate one;*
[5] *In case of engineering competences;*

K_W07	has well-structured and theoretically grounded knowledge of the basics of machine design and strength of materials as well as engineering graphics and construction notation	P6S_WG Inż_P6S_WG
K_W08	has well-structured and theoretically grounded knowledge of the fluid and flight mechanics in relation to the key issues of aircraft design and operation	P6S_WG
K_W09	has well-structured and theoretically grounded knowledge of the structural, technological and operational problems of machines, object evaluation criteria, reliability and safety and processes leading to failures of mechanical objects	P6S_WG Inż_P6S_WG
K_W10	has well-structured knowledge of aeronautic materials and aeronautic and astronautic technology	P6S_WG Inż_P6S_WG
K_W11	has well-structured knowledge of aerospace engine design and engineering thermodynamics, including thermodynamic circuits, heat transfer.	P6S_WG Inż_P6S_WG
K_W12	has well-structured knowledge of aircraft operations engineering and aircraft continuing airworthiness	P6S_WG Inż_P6S_WG
K_W13	has well-structured knowledge of aircraft and spacecraft construction and design, and of airborne equipment including airborne systems, circuits and installations	P6S_WG Inż_P6S_WG
K_W14	has detailed knowledge of aircraft operation, including knowledge necessary to understand the physical basis of operation of aircraft components, circuits, equipment, installations and systems	P6S_WG Inż_P6S_WG
K_W15	is familiar with the current status and latest development trends in aerospace technology	P6S_WK Inż_P6S_WK
K_W16	has basic knowledge of the life cycle of aircraft equipment and systems	P6S_WG Inż_P6S_WG
K_W17	has basic knowledge necessary to understand non-technical conditions of engineering activities, knows basic health and safety rules applicable in aviation	P6S_WK Inż_P6S_WK
K_W18	knows and understands the general principles for creating and developing forms of individual entrepreneurship, using the knowledge of aircraft construction and operation	P6S_WK Inż_P6S_WK
K_W19	has advanced knowledge of the selected facts about objects and phenomena and concerning the methods and theories which explain the complex interrelationships among them, constituting the basic general knowledge within the disciplines of mechanics, mechanical engineering and operation, electronics, electrical engineering, computer science	P6S_WG
K_W20	has basic knowledge of economic, legal, social and humanistic aspects, including the basic concepts and principles of industrial property protection, intellectual property, copyright and patent law	P6S_WK
SKILLS		**The graduate:**
K_U01	is able to obtain information from literature, databases and other sources, can integrate acquired information, interpret them and draw conclusions as well as formulate and justify opinions and identify and describe components, circuits, equipment, installations and systems of aircraft and spacecraft using information and communication technologies	P6S_UW

K_U02	is able to communicate using a variety of techniques in professional and other environments	P6S_UK
K_U03	is able to prepare documentation for the execution of an engineering task, can prepare a text describing the results of the task and give a short presentation of the results of the engineering task	P6S_UW Inż._P6S_UW
K_U04	Is able to self-educate, including with a view to improving professional competence	P6S_UU
K_U05	has sufficient language skills corresponding to level B2 of the Common European Framework of Reference for Languages to be able to communicate and read technical texts with comprehension	P6S_UK
K_U06	Is able to use properly the selected methods and equipment to plan and perform measurements of the principal characteristic quantities of aircraft components, circuits, equipment and installations	P6S_UW
K_U07	Is able to determine basic parameters in an analytical manner and formulate simple mathematical models to simulate aircraft components, circuits, equipment, installations and systems, and additionally can use the appropriately selected computer tools - simulators and programming environments	P6S_UW Inż._P6S_UW
K_U08	Is able to develop an algorithm, use programming languages and appropriate computer tools to develop application software	P6S_UW Inż._P6S_UW
K_U09	Is able to use the known methods, measurement and computer techniques to analyse and evaluate the performance of aircraft components	P6S_UW Inż._P6S_UW
K_U10	Is able to design aircraft components, circuits, equipment, installations and simple systems, taking into account given performance and economic criteria, as well as safety regulations	P6S_UW Inż._P6S_UW
K_U11	Is able to compare the design solutions of aircraft systems, equipment and installations with regard to the type of mission and the given performance, economic and safety criteria, and solve technical tasks in the area of aircraft preliminary or conceptual design, airborne system, airborne installation design, proposal for technology of manufacturing, repair and operation procedure	P6S_UW Inż._P6S_UW
K_U12	Is able to operate aircraft subsystems in accordance with the required continuing airworthiness regulations, and is familiar with the safety rules applicable to such work	P6S_UW Inż._P6S_UW
K_U13	Is able to connect results of research work with engineering practice conditioning the improvement of functionality or modernity of solutions of airframe, power unit or particular sub-assemblies constituting the element of strength structure, control system or on-board equipment	P6S_UW Inż._P6S_UW
K_U14	Is able to analyse conceptual and design solutions in relation to technological capabilities and operational conditions of aircrafts	P6S_UW Inż._P6S_UW
K_U15	Is able to make observations and interpretations of surrounding humanistic, legal and social phenomena	P6S_UW Inż._P6S_UW

K_U16	is able to plan and organise his/her individual and team work	P6S_UO
K_U17	Is able at the identification and formulation of specifications of engineering tasks and their solution to: • use analytical, simulation and experimental methods, • recognise their systemic and non-technical aspects, • make an initial economic assessment of proposed solutions and engineering actions undertaken	P6S_UW
K_U18	is able to critically analyse how the existing technical solutions work and assess these solutions	P6S_UW
SOCIAL COMPETENCES		**The graduate:**
K_K01	is aware of the responsibility for his/her own work and is ready to follow the rules of teamwork and take responsibility for the tasks performed jointly, can think and act in an entrepreneurial manner	P6S_KO P6S_KR
K_K02	is able to define priorities in order to accomplish a task defined by him/herself or others	P6S_KK
K_K03	is aware of the importance of acting in a professional manner, observing professional ethics and respecting diversity of opinion	P6S_KR
K_K04	is aware of the social role of a technical university graduate, and in particular understands the need to formulate and convey to the society – among others through the mass media - information and opinions concerning aeronautical achievements and other aspects of aeronautical engineer's activity); undertakes efforts to convey such information and opinions objectively and in a commonly understood way	P6S_KO P6S_KR

Groups of classes / subjects[6], their short descriptions (outline programs), ECTS credits allocated to them and learning outcomes (reference to the field-related outcomes)

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	Group of content of general education General subjects			
1	*Professional ethics:* *General ethics, which constitute the basis for professional ethics: subject and divisions of ethics, basic ethical concepts and categories, ethical systems and directions. Professional ethics: essence and objectives of professional ethics, essence and functions of codes of ethics, traditional and contemporary codes of ethics and ethical requirements in technical professions*	**1.5**	**NS**	*K_W17, K_W20, K_U02, K_U15, K_U17, K_K01, K_K03, K_K04,*
2	*Introduction to study:* *The aim of the course is to familiarise a student with modern methods of studying and to enable a student to acquire the skills necessary for studying, such as the ability to learn independently, self-presentation, public speaking, scientific discussion, responsible teamwork, studying scientific literature, preparing research reports, initiating topics for study, developing a research and creative attitude, as well as managing his/her time and coping with stress - thus all those elements of knowledge and skills and competences that are required in the course of studying other subjects. The course is intended to help students to overcome difficulties they may encounter at the beginning of their studies in connection with the need to change the style of learning typical to school into the academic style of independent knowledge acquisition and the acquisition of skills and competences.*	**0.5**	**NS**	*K_U04* *K_K01*
3	*Basics of management and entrepreneurship:* *The aim of the course is to provide theoretical and practical knowledge of the basics of management in contemporary companies. To introduce students to the basic issues of contemporary management and the mechanisms of organization functioning. To present the most important methods and tools for supporting entrepreneurship in Poland.*	**3.0**	**NZJ**	*K_W17, K_W20, K_U01, K_U04, K_U15, K_U17, K_K01, K_K04,*
4	*Selected issues of law:* *Basic knowledge of law and sources of law. Learning the basics of legal nomenclature necessary to understand the legal language, and elements of the law of the Republic of Poland in the field of constitutional, civil and economic law. The specificity of international law and European Union law.*	**1.5**	**NP**	*K_W17, K_W20, K_U02, K_U15, K_U17, K_K01, K_K03, K_K04,*
5	*Introduction to computer science:* *Introduction to the architecture and functioning of contemporary computers. Basics of computer networks and the Internet. Windows and Linux operating systems. Standards, formats and computer software*	**3.0**	**ITT**	K_W05, K_W19, K_U08

[6] course information sheets shall be drawn up and made available 30 days before the beginning of the semester in which the course is taught – template in Annex 4
[7] names of groups of classes / subjects
[8] the discipline code as set out in Annex 10

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	for electronic office documents. Text editors - selected functions and applications. Spreadsheets. Software for multimedia presentations. Graphics processing packages. Basics of programming in high-level language programming.			
6	*Physical education:* *Shaping of the desired behaviour and attitudes towards one's own health, awakening sports interests. Taking part in variety of sports and physical activities (outdoor athletics and Nordic walking, badminton, orienteering, gymnastics, bodybuilding, athletics, volleyball, football, basketball, combat sports, shooting, table tennis, rowing ergometer). Developing and improving the functional efficiency of the cardiorespiratory and muscular systems, stimulating the development of the musculoskeletal system.*	**0.0**	**-**	-
7	*Foreign language:* *Structural-grammatical material: revision, expansion and systematisation of the following topics: grammatical tenses/ tenses of narration; active/passive voice; de-pendent speech; conditionals; question formation; collocations; compound sentences; word order in a sentence; modal verbs; phrasal verbs. Conceptual-functional material: requests; suggestions; offers; ad-vice; consent/refusal; negations; agree/disagree; ex-pressing opinion, cause/effect; reason/purpose; wishes, apology; summary; choice of register/style, specialized language*	**8.0**	**J**	*K_U01, K_U02, K_U05*
8	*Protection of intellectual property:* *A history of industrial property protection in Poland and in the world. International organizations for protection of intellectual property. Patent protection, utility models and industrial designs. Trademarks, geographical indications, brand name and service marks. Topographies of integrated circuits. Proceedings before the Polish Patent Office. Procedures, fees, registers. Law on Copyright and Related Rights*	**1.5**	**NP**	*K_W20 K_U01*
9	*Occupational Health and Safety:* *Occupational health and safety in the applicable law. Principles of occupational (academic) safety and health - rules of safe conduct, required in the performance of specific work (activities), resulting from scientific and technical requirements. Protection against threats to students' health and safety. Use of personal protective equipment during classes (exercises). Insurance against accidents. Behaviour in case of accidents and emergency situations. The principles of first aid.*	**0.0**	**-**	-
10	*a)* *Polish history:* *A history of Poland from the beginning of a Polish statehood to the turn of the 20th and 21st centuries: Poland of the Piasts, the Jagiellons, the Elected Rulers, the era of the Partitions, the regaining of independence in 1918 and the history of the Polish state in the inter-war period, World War II and after.*	**2.0**	**H**	*K_W20, K_U15, K_U18*
	b) *Philosophy:* *The origins of philosophy, its object and methods of cognition, as well as divisions and trends in development. The main issues and fundamental problems of philosophical thought in history, their eras and periods and schools. Philosophy of the ancient period, its periods and main schools and basic problems. Philosophy of the medieval period, its periods and main schools and basic problems. Philosophy of the modern and contemporary periods, their periods and main schools*	**2.0**	**F**	*K_W20, K_U15, K_U18*

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	and basic problems. Main issues and fundamental problems of ontology. Main issues and fundamental problems of epistemology. Main issues and fundamental problems of axiology.			
	c) *Fundamentals of Music Education:* *Basic information about music and culture. Learning about the history and tradition of patriotic songs. Principles of music (sound, musical notation, elements of a musical work, classification of instruments of music). Basics of correct voice emission with improvement of elements of self-presentation.*	**2.0**		*K_W20, K_U15, K_U18*
Content group of basic education Basic subjects				
1	*Introduction to Metrology:* *The place and role of metrology as an interdisciplinary area of knowledge in contemporary society. Definitions of basic concepts in metrology. The essence of basic measurement methods. The structure and purpose of basic standards and measurement instruments of physical quantities. Errors and uncertainty of measurement*	**2.0**	**AEE**	*K_W04, K_W05, K_U01, K_U06, K_U09,*
2	*Mathematics 1:* *The course aims to provide students with knowledge and understanding of basic concepts and theorems of mathematics, particularly algebra with analytical geometry, and to master elementary calculus skills with a range of knowledge including: real numbers; elementary functions; complex numbers; matrices, determinants, systems of linear algebraic equations, vector spaces; lines, planes and surfaces of second degree in three-dimensional space.*	**6.0**	**M**	K_W01, K_U07
3	*Mathematics 2:* *The course aims to provide students with knowledge and understanding of basic concepts and theorems of mathematics, particularly mathematical analysis, and to master elementary calculus skills with a range of knowledge including: real numbers, number sequences and number series; differential and integral calculus of functions of one real variable and ordinary differential equations..*	**6.0**	**M**	K_W01, K_U07
4	*Basics of Engineering Graphics:* *Basics of preparing and knowing how to read engineering technical documentation. Methods of representing geometric figures in the plane based on parallel and median projection. Standardization in the field of technical documentation. Learning about basic software supporting the process of developing technical documentation.*	**3.0**	**IM/AEE**	K_W09, K_W07; K_U01, K_U03
5	*Mathematics 3:* *The course aims to provide students with knowledge and understanding of basic concepts and theorems of mathematics, particularly mathematical analysis, and to master elementary calculus skills including: differential and integral calculus of real functions of many variables; vector analysis; calculus of probability and elements of mathematical statistics.*	**4.0**	**M**	K_W01, K_U07
6	*Physics 1:* *Discussing the basic concepts and laws governing the motion of bodies for models of material point and rigid solid: finding equations of motion, applying principles of dynamics to rectilinear and curvilinear motion in inertial and non-inertial systems. Comparing the Newtonian and relativistic physics. Discussing classical theory of gravitation and quantities describing the gravitational field. Presenting the basic con-*	**6.0**	**NF**	K_W02, K_U07

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	cepts and laws governing oscillatory and wave motion and phenomena characteristic for these movements. Discussing the fundamentals of classical thermodynamics. Discussing electrostatic interactions and the quantities describing this field.			
7	*Engineering Graphics:* *CAD/CAM/CAE systems - organisation and structure. Performing 2D drawings. Modelling solids based on primitives and NURBS curves. Modelling solid assemblies using standards. Performing detailed drawings (2D) from solid components and assembly drawings (2D) from solid subassemblies. Introducing changes to 2D drawings and solids.*	**3.0**	**IM/AEE**	K_W09, K_W07; K_U01, K_U03
8	*Computer Science:* *Basic concepts of computer science. Algorithmisation of data processing objectives. Basics of programming in high-level language programming. Management support software using databases. Database functions. Data-base and database management system (DBMS). Relational data models. Structured query language SQL. Architectures of DBMS. Computer networks and DBMS.*	**3.0**	**ITT**	K_W05, K_W19, K_U08
9	*Materials Science:* *Fundamentals of materials engineering. Principles of proper selection of materials and their impact on safety in operation of machines and technical equipment. Types of engineering materials. Methods of type designation according to EU standards. Relation between physical and functional properties of engineering materials and their chemical composition and state of processing.*	**4.0**	**IMat**	K_W02, K_W07, K_W09, K_W10, K_W19, K_U01, K_U06
10	*Manufacturing Engineering:* *Basic knowledge of the cutting process. Materials used for cutting tools. Machining technology. Abrasive technology and other methods of reductive machining. Metal cutting machines - jigs and fixtures. Fundamentals of technology process design - components of the machining process, selection of semi-finished products. Technological aspects of powder metallurgy. Processing technologies applied to selected plastics. Fundamentals of welding. Welding methods and heat sealing. Welding methods of applying coatings.*	**3.0**	**IM**	K_W06, K_W07, K_W09, K_W19, K_U01, K_U02, K_U06
11	*Metrology:* *Measurement of geometric quantities. Analogue and digital instruments for measuring electrical quantities. Measurement of electrical quantities. Measurements of non-electrical quantities by electrical methods. Measuring transducers in mechatronic systems.*	**3.0**	**IM/AEE**	K_W04, K_U01, K_U06, K_U09,
12	*Physics 2:* *Discussing the basic concepts and laws governing electric current. Introducing the concepts of magnetic field and the quantities describing it and comparing with electrostatic and gravitational fields. Discussing the electromagnetic field and its laws. Introducing the basic concepts of optics. Discussing the corpuscular-wave dualism of radiation. Discussing the structure of atom including quantum concepts. Introducing the concept of corpuscular-wave dualism of matter. Discussing the principle of laser construction and features of laser light. Learning the fundamentals of solid state physics, introducing a band model, discussing basic physical phenomena in semiconductors. Discussing the structure of the atomic nuclei, phenomena and laws of radioactivity and reactions of heavy nuclei fission and synthesis of light nuclei*	**4.0**	**NF**	K_W02, K_U07
13	*Electrical Engineering and Electronics:*	**6.0**	**AEE**	K_W01, K_W02, K_W03,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	Basic concepts and laws of electrical engineering, methods of analysis of DC and AC circuits. Basic electronic components and their application in circuits. Basics of construction and analysis of electrical circuits, necessary for synthesis and analysis of more complex electrical and mechatronic systems. *DC and AC electric circuits. Methods of analysis and design and determination of basic parameters and characteristics. Principles of operation of selected DC and AC machines. Basic electronic components and systems, their parameters and characteristics.*			K_W19, K_U01, K_U07,
14	*Engineering Mechanics:* *Statics includes the concepts and principles of statics, reduction of force systems and equilibrium conditions, laws of friction and the calculation of centres of gravity. Strength of materials includes the basic concepts of strength of materials, tension, compression, bending, torsion and buckling, characterisation of multidimensional stress states, deflection calculations of beams and plane trusses. Kinematics includes the basic concepts and terms of kinematics, point kinematics, rigid body motion, compound point motion, plane motion, and spherical rigid body motion. Dynamics includes the basic concepts and definitions of dynamics, dynamics of a point and system of material points, dynamics of rotary motion and motion of a plane rigid body. Elements of analytical mechanics includes description of the dynamics model of a real object and definitions of special deformable elements with linear properties: It introduces an extended classification of bonds, definitions of the general equation of dynamics and Lagrange's equation*	**6.0**	**IM/AEE**	K_W01, K_W02, K_W06, K_W07, K_W09, K_W19, K_U01, K_U04, K_U07,
15	*Strength and Materials Science Laboratory:* *Experimental determination of strain and stress in a selected section of a bending beam. Experimental verification of the formula determining the deflection line of a bending beam. Calculation of reactions of a statically indeterminate structure. Experimental determination of material constants, i.e. Young's modulus and Poisson's number of a metal sample. Experimental determination of critical force in a compression bar. Thermal analysis of alloys. Microscopic examination of the structure of steels, cast steels and cast irons. Microscopic examination of non-ferrous metal alloys. Dilatometric analysis of metals. Measurements of metal hardness. Examination of hardiness of steel. Precipitation strengthening of aluminium alloys. Density testing of porous materials and powders.*	**2.0**	**IM/IMat**	K_W06, K_W07, K_W09, K_W19, K_U01, K_U06, K_U16, K_U17,
Content group of field-related education Field-related subjects				
1	*Mathematics 4:* *Probability calculus. Basic probability distributions and their applications. Mathematical statistics and its application in experimental research. Using numerical methods in probability calculus and statistics.*	**6.0**	**IM/AEE**	K_W01, K_U07
2	*Human Factor:* *Necessity to consider human factors, incidents influenced by human factors/human error, Murphy's Law. Formation of executive processes and activities. The role of training and habits. Human capabilities and limitations. Vision, lighting, hearing, association and inference, concentration and perception, memory, claustrophobia and physical limitations, health hygiene, nutrition. Social psychology (sociology). Responsibility: individual and group, motivation and inhibition of motivation, group pressure on the individual, cultural background/influences, working in groups, management, supervision and*	**2.0**	**IM/AEE**	K_W09, K_W17, K_W18, K_W20, K_K01,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	leadership. Factors affecting the performance capabilities. Physical fitness/health, stress: domestic and work related, time pressure and deadlines, workload: excess and lack, sleep and fatigue, shift work, alcohol, medication, drugs. Surrounding environment. Noise and fumes, lighting, climate and temperature, movement and vibration, working conditions. Tasks/activities. Physical work, repetitive activities, visual inspection, complex systems. Communication. Communication within and between teams, work distribution and recording, updating, information circulation, sharing information (access levels). Human error. Models and theories of error, types of error in maintenance activities, consequences of errors (e.g. accidents), avoiding and controlling errors. Hazards in the workplace. Recognising and avoiding hazards, dealing with emergency situations.			
3	*Aviation Law and Regulations:* *General knowledge of law. Areas and branches of law. The system of law in Poland - basic legal acts. The European Union and Community law. Aviation law - basic concepts and subject matter. A history of aviation law. Applicable regulations of the national and international aviation law. Conventions and legal systems in international aviation law - International Civil Aviation Organisation (ICAO). Selected problems of law jurisdiction in the field of aviation law. The concept of common aviation regulations in the European Union and the role and importance of EASA. National aviation law - the 'Aviation Law' Act. Relationship between 'civil' EASA Part and military Mil Part regulations. Principles and legal basis for the operation and management of continuing airworthiness of aircraft regulations: Part-M continuing airworthiness requirements. Part-145 regulations, approved maintenance organisations. Air transport regulations: Part OPS, Part-AWO, Part - MMEL and Part - MEL. ATA Maintenance Specifications 100/104. Applicable documentation and document specimens.*	**2.0**	**NP**	K_W20, K_U01, K_U04, K_U15, K_U17, K_K01, K_K04
4	*Basics of Machine Constructions:* *Basics of mechanical construction theory. Fatigue and shape strength of structural elements and assemblies. Inseparable and separable connections used in machine construction. Susceptible elements used in mechanical engineering. Mechanical transmissions – gear transmissions. Mechanical transmissions - friction gears and pulley-based transmissions. Mechanical clutches. Mechanical brakes. Tubular connections and valves. Fundamentals of hydrostatic propulsion. Modelling of design process.* *Elements of tribology.*	**4.0**	**IM/AEE**	K_W02, K_W07, K_W09, K_W19, K_U01, K_U03, K_U07, K_U10, K_U11,
5	*Basics of Automation:* *Basic concepts of control theory. Types and structures of control systems. Structure of automatic control system. Elements of automation systems. Modelling of objects and elements of automatics. Operator transmittance, spectral, state space.* *Controllability and observability. Time and frequency characteristics. Stability - stability criteria. Quality of regulation processes - criteria of regulation quality. Types of correction and types of regulators. Synthesis of control systems by classical methods. Impulse control. Discrete transmittance of impulse control system. Digital control - basic structures. Logic and sequential control. Technology of automation systems: measuring devices (angle position sensors), regulators (controllers), and actuators (setting and executive elements). Automated and robotic systems. Structures of 1st, 2nd and 3rd generation robots. Simulation methods of dynamic systems study*	**4.0**	**AEE**	K_W01, K_W04, K_U01, K_U06, K_U07, K_U16,
6	*Digital and microprocessor systems:*	**3.0**	**AEE**	K_W03, K_W05,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	Counting systems and conversions. Binary codes. Fixed and floating point arithmetic. Basics of Boolean algebra. Logic gates and flip-flops. Basic combinatorial, sequential and arithmetic blocks. Programmable circuits. Classification and organisation of memory. Microprocessor architecture, command cycle, command list. Design and operation of microprocessors and microcontrollers. Microprocessor system organisation. Input-output (I/O) systems and embedded peripherals of microcontrollers. Introduction to microprocessor programming - languages and programming environments.			K_U03, K_U07, K_U08, K_U17,
7	*Basics of Modelling Physical Systems:* *Basics of modelling. Introduction to Matlab-Simulink and LabView. Determination of mathematical models of complex mechatronic systems. Modelling of complex mechatronic systems in LabView and Matlab-Simulink. Data input to simulation. Basic data structures and their representation. Basic structures used in modelling. M-function and script files, VI and subVI. Presentation of simulation results. Graphical user interface in the process of modelling and testing complex mechatronic structures.*	**2.0**	**IM/AEE**	K_W06, K_W07, K_W19, K_U01, K_U04, K_U07, K_U08, K_U10, K_U11, K_U17,
8	*Aircraft Materials:* *Requirements for aircraft construction materials.* *Strength, technological (formability, heat treatment, joining methods) and performance (heat resistance, corrosion resistance, fatigue life, abrasion resistance, erosion resistance, etc.) characteristics of the main groups of materials used in the construction of airframes and aircraft propulsion systems.*	**2.0**	**IMat**	K_W06, K_W07, K_W09, K_W10, K_W15, K_W19, K_U01, K_U14,
9	*Aircraft Integrated Laboratory:* *Health and safety rules applicable during aircraft maintenance. Current maintenance of aircrafts. Airframe assembly maintenance of aircraft and helicopter. Aircraft airborne equipment maintenance. Damage verification and replacement of airframe components. Controlling the main operating parameters of individual airframe systems. Operation of aircraft emergency systems and equipment. Analysis of operational parameters of an aircraft propulsion system based on an engine test.*	**5.0**	**IM/AEE**	K_W04, K_W09, K_W11, K_W12, K_W17, K_W18, K_U06, K_U09, K_U16, K_U17, K_U18, K_K01, K_K03,
10	*Aircraft Maintenance Engineering:* *Aircraft as an object of operation. Operation strategies. Organisation of aircraft operations. Standardisation of aircraft operation process. Probability of service in airworthiness. Operation definitions and methods. Major components of operation system structure and selection criteria. Structure of safe working life. Passenger aircraft operation. Operational safety factors of flights.*	**3.0**	**IM/AEE**	K_W06, K_W10, K_W12, K_W15, K_W16, K_W17, K_U01, K_U04, K_U17, K_U18,
content group of elective education elective subjects AVIONICS				
1	*Fluid Mechanics and Aerodynamics:*	**4.0**	**IM/AEE**	K_W01, K_W08,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	Description of fluid state and motion, local motion of a fluid element, deformation velocity tensor and stress tensor. Basic equations of fluid mechanics, similarity of flows. Equation of equilibrium of a fluid, standard atmosphere. Euler's equation of motion, Bernoulli's equation, boundary layer issues, boundary layer detachment. Determination of basic flow parameters. Wave phenomena, effects of gas compressibility. *Introduction to aerodynamics, aerodynamic objectives and research methods in aerodynamics. Aerofoil theory: description of geometry, aerodynamic characteristics of the aerofoil. Lifting surface: description of geometry, aerodynamic characteristics. Subcritical and supercritical aerofoil and wing flow. Elements of high speed aerodynamics.*			K_W14, K_W19, K_U01, K_U03, K_U07, K_U11,
2	*Propulsion Systems* *Thermodynamic state. The equations of state of perfect and real gases. Properties of gas mixtures. Principles of thermodynamics. Characteristic transformations. Thermodynamic circuits. Fundamentals of flow thermodynamics. Heat transfer: conduction, convection and radiation. Theoretical fundamentals of piston engines. Theoretical fundamentals of single and dual flow turbine jet engines and propeller turbine engines. Theoretical fundamentals of jet engines. Fundamentals of aeroplane propulsion systems (jet, helicopter and propeller) with piston and turbine engines. Basic engine systems (oiling, power, starting and ignition). Hydromechanical and electronic control systems (FADEC). Engine parameter display systems.*	**4.0**	**IM/AEE**	K_W09, K_W11, K_W13, K_W14, K_W16, K_U01, K_U02, K_U04, K_U07, K_U11, K_U18,
3	*Aircraft construction and installation:* *Aircraft requirements and classification. Forces on aircrafts and helicopters. Static and dynamic loads. Overload factor, disposable overload, limitations. Selection of layout and basic airframe parameters, statistical factors. Wing structure and its components. Work of girder, semi-shell, shell structures. Structure and work of the wing near the recess, nodes and connections. Wing mechanisation. Ailerons, empennage and control system. Fuselage and flight deck. Landing gear, characteristics and classification, landing gear requirements. Main and auxiliary landing gear design, suspension, airwheel design. Selection of layout and basic parameters of helicopter airframe. Lift rotor requirements; types and parameters defining lift rotors. Carrier rotor operating range characteristics, purpose of joints. Carrier rotor hub design. Control disc design, control system design. General helicopter control principles: periodic, pitch and tail rotor control. Tail rotor design. Transmission systems, arrangement of engines in a helicopter. Fuselage and flight deck, constructional peculiarities. Helicopter landing gear. Developmental trends. Fire-fighting and anti-icing systems. Aircraft engine ignition systems. Aircraft hydraulic and pneumatic systems.*	**7.0**	**IM/AEE**	K_W06, K_W13, K_W15, K_U01, K_U04, K_U03, K_U11, K_U18,
4	*Basics of Flight Mechanics:* *Objectives of flight mechanics, forces acting on the aircraft. Dynamics of aircraft motion as a material point. Motion of aircraft on rectilinear trajectories inclined at any angle. Aircraft transient motion on vertical and horizontal straight and curvilinear tracks and on space tracks. Issues of aircraft take-off and landing, aerodynamic characteristics in take-off and landing configurations. Dynamics of aircraft motion as a material solid. Aircraft equilibrium, static stability and longitudinal controllability. Equilibrium, static stability and lateral controllability, aircraft equilibrium curve. Moments acting on an aircraft in transient motion. Peculiarities of aircraft flight at large angles of attack. Suborbital and orbital flights of spacecraft.*	**3.0**	**IM/AEE**	K_W01, K_W08, K_W14, K_U11,
5	*Aircraft Measurement Systems and Sensors:* *Classification of aircraft measuring instruments and systems. Aircraft Traffic Environment. International Standard Atmosphere. On-*	**3.0**	**IM/AEE**	K_W02, K_W04, K_W08,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	board installation of air pressure receivers. Aerometric Switchboards. Angle of attack and glide sensors. Accelerometers and stall transmitters. *Aircraft heading measurement. Magnetic and inductive compasses. Theory and classification of gyroscopes. Review and characterisation of aeronautical gyroscopes. Characteristics of aeronautical gyroscopic instruments and systems. Measurement and indication of engine exhaust gas temperature. Measurement and indication of rotational speed of engine rotors. Measurement and indication of pressure, fuel quantity and flow rate. Measurement and indication of other engine operating parameters (vibrations, position of control bodies, unsteady compressor operation, etc.). Basic concepts, definitions, performance characteristics of sensors and smart transmitters. Principle of measuring sensors of basic physical quantities. Technologies used to produce integrated measurement sensors. Integrated measuring transducers and smart sensors. Integrated transducer designs. Determination, measurement of metrological para-meters of selected sensors and transducers. Electronic circuit design of integrated measurement sensors acquisition and processing of measurement data and simulation of electronic circuits.*			K_W13, K_W16, K_U01, K_U07, K_U09,
6	*Modelling of Avionic Systems:* *Modelling of avionic systems and circuits in Matlab-Simulink environment. Basic principles of dynamic model creation based on the description using difference and differential equations to describe dynamic models. Modelling by finite element method of mechanical and electromagnetic processes in the Comsol Multiphysic environment. Software for virtual construction of measuring instruments in the LabView environment. Principles of integration of the Matlab-Simulink with Comsol Multiphysic and LabView.*	**4.0**	**IM/AEE**	K_W07, K_U02, K_U03, K_U07, K_U08, K_U10, K_U17
7	*Servoactuators and actuators:* *General characteristics of actuators and servo systems. Basic requirements. Fluids - thermodynamic and flow properties. Flow losses. Pneumatic control and drive systems. Control and actuators elements. Mathematical model of pneumatic propulsion system. System characteristics. Structure and principle of operation of a hydraulic system. Assemblies of hydrostatic propulsion system. Throttle and displacement control. Hydraulic and electrohydraulic amplifiers. Mathematical model of electrohydraulic drive system. Static and dynamic characteristics of the system. Construction and principle of operation of electric drives. Structure of an electric drive. Structure of an electric servomechanism (functional diagram). Mechanical and control characteristics of an electric motor. Characteristics of stepper motor. Mathematical model of an electric closed drive system. Static characteristics of the system. Comparative analysis of different types of actuator systems.*	**3.0**	**IM/AEE**	K_W01, K_W03, K_W04, K_W08, K_W14, K_U06, K_U07, K_U11,
8	*Airborne Diagnostic Systems:* *Classification of aircraft measuring instruments and systems. Aircraft Traffic Environment. International Standard Atmosphere. Onboard installation of air pressure receivers. Aerometric Switchboards. Angle of attack and glide sensors. Accelerometers and stall transmitters.* *Aircraft heading measurement. Magnetic and inductive compasses. Theory and classification of gyroscopes. Review and characterisation of aeronautical gyroscopes. Characteristics of aeronautical gyroscopic instruments and systems. Measurement and indication of engine exhaust gas temperature. Measurement and indication of rotational speed of engine rotors. Measurement and indication of pressure, fuel quantity and flow rate. Measurement and indication of other engine operating parameters (vibrations, position of control bodies,*	**2.0**	**IM/AEE**	K_W02, K_W04, K_W08, K_W13, K_W16, K_U01, K_U07, K_U09,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	unsteady compressor operation, etc.). Essence of technical diagnostics. Basic terms and terminology. Diagnostic signals and parameters. Diagnostic models. Diagnostic algorithms. Diagnostic methods and equipment. Expert systems in diagnostic inference process. Artificial neural networks in diagnostic systems. Overview of design solutions for measurement circuits and systems of selected aircraft used in the Polish Armed Forces.			
9	*Control Theory:* *Basic concepts of control theory. Time and frequency characteristics of basic elements. Control system structure. Basic quality indicators used to evaluate control systems. Stability of linear systems. Overview of basic control laws. Design of controllers. Theory of state estimators and observers. Control from state vector using observers. Combinational and sequential control systems. Impulse control using time dependence. Fundamentals of nonlinear control. Non-linear regulators. Stability testing of nonlinear systems.*	**5.0**	AEE	K_W01, K_W04, K_U02, K_U07, K_U17, K_U18,
10	*Aircraft Power Systems* *Classification of on-board electrical and energy systems (PUEE). Aircraft accumulator batteries. Aircraft DC generators. Aircraft generators of alternating current. Secondary sources of electrical power. On-board electrical power systems and their components. Structures of electrical power systems in a state of inoperability. Elements of on-board transmission and distribution systems. Light signalling systems. Fire-fighting and anti-icing systems. Aircraft engine ignition systems.*	**4.0**	IM/AEE	K_W03, K_W13, K_W14, K_U01, K_U11,
11	*Basics of Mechatronics Devices Construction:* *Characteristics, classification, applications and constructions of mechatronic, electronic, electrical and electromechanical components and systems. Applied materials and technologies. Basic calculations taking into account technical and reliability conditions. Basic kinematics and dynamics analysis calculations. Basic modelling principles in the environment of computer-aided design systems, construction and drafting (CAD). Geometric analysis of system models. Concurrent and conceptual design. Collaborative design using CAD systems. Visualisation and simulation of product operation in CAD systems.*	**2.0**	IM/AEE	K_W02, K_W06, K_W07, K_W09, K_W10, K_W16, K_W19, K_U01, K_U03, K_U05, K_U07, K_U10, K_U11, K_U14, K_K02
12	*Avionics Modules and Systems Programming:* *Characteristics of programming languages. Principles of creating programs in high and low level languages. General characteristics of integrated programming environments supporting programming and starting microprocessor-based systems. Program syntax in assembler language and C language. Declaration of variables and constants. Operations on arithmetic operators. Operations on logical operators. The use of pointers and variable arrays. Standard input/output functions, input/output formatting. Operation of interrupt systems. Operation of input/output circuits and serial interfaces. Operation of built-in peripherals of microprocessor systems: counters, timers, real-time clock, A/D and D/A converters. Operation of external devices. General characteristics of visual high-level languages. Introduction to integrated programming environments. Basic data types. Characteristics of JAVA and NET runtime environments. Internal instructions and functions of the language. Definition and calling of user functions. Methods of returning values through a function argument. Basic features of object-oriented programming: range of available arguments*	**6.0**	*AEE*	K_W05, K_U01, K_U06, K_U07, K_U10, K_U17,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	and methods, inheritance, classes. Developing a graphic interface of an application. The use of the interrupt system in an application. Operation of computer hardware resources.			
13	*Aircraft Radioelectronic Systems:* *Theoretical fundamentals of radioelectronic systems. Fundamentals of radioelectronics and radiolocation. Range of radioelectronic equipment and systems. Radioelectronic methods of measurement of navigation parameters. Distance measurement by impulse method - DME system. Distance measurement by the frequency method. Direction finding by a phase method - VOR system. Non-directional radio beacon and automatic radio compass. Aeronautical radio-communication equipment. Satellite communications. Aircraft rescue equipment and systems. Radioelectronic equipment for military air defence systems. Air traffic control equipment and systems. Principle of operation and use of secondary radar in aviation. Collision avoidance systems - TCAS. Low Altitude Flight Control Systems TAWS. Pulse Doppler Radar. Multi-role airborne radar - Principle of operation and use.*	**3.0**	**AEE**	K_W02, K_W03, K_W13, K_W14, K_W15, K_U01, K_U11, K_U18,
14	*Aircraft Control Systems:* *Aircraft as an object of regulation in an automatic control system. Mathematical description of dynamic properties of aircraft. Steering, stability and manoeuvrability characteristics of an aircraft. The construction and principles of operation of semi-automatic flight control systems, vibration damping automatics, longitudinal control automatics, lateral control automatics, stability automatics, load automatic, trim automatics, balance automatics and kinematic ratio control automatics. Technical structures, operating ranges, construction and principle of operation of selected solutions of aircraft control systems.*	**5.0**	**IM/AEE**	K_W02, K_W04, K_W08, K_W14, K_W15, K_U07, K_U11, K_U13, K_U14, K_U18,
15	*Aircraft Navigation Systems:* *Objectives and basic functions of the navigation system. Classification and characteristics of basic aircraft navigation systems. Geophysical fields used in aircraft navigation. Shape and representation of the Earth. Time-keeping. Elements of astronomy. Fundamentals of astronavigation. Aeronautical charts. Navigational parameters of flight performance. Orthodromy and loxodromy. Using magnetic field to determine flight parameters. Inertial track counting systems. Inertial navigation systems. Integrated aircraft navigation systems. Preliminary knowledge of radio navigation. Positioning accuracy of radio navigation systems. Autonomous radio navigation equipment. Radioelectronic systems for short-range navigation. Satellite navigation systems. Systems and equipment supporting landing process*	**5.0**	**IM/AEE**	K_W04, K_W10, K_W13, K_W14, K_W15, K_U11, K_U12, K_U18,
16	*Aircraft Digital Systems and Computer Networks:* *Architectures and components of aircraft avionics systems. Selected organisational elements of on-board computers and avionics modules. Digital circuits used for on-board computers and avionics modules.* *Integrated avionics modular systems. Input and output devices of on-board computer and avionics modules. General principles and tools for hardware design and software implementation of avionic digital systems Specificity of technologies implemented in hardware and software of digital flight systems. Protection of digital aircraft equipment against electrostatic discharges.* *Fundamentals of data exchange in aircraft computer systems. On-board computer network architectures. Fibre optics and fibre optics technology on aircraft. "Glass Cockpit" Information Imaging Systems. On-board operational support systems. Cabin systems. Information systems.*	**4.0**	**AEE**	K_W05, K_W13, K_W14, K_U08, K_U03, K_U10, K_U11, K_U13, K_U14,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
17	*On-board Visualization Systems and Simulators:* *Evolution of aeronautical information imaging systems. Examples of instrument layout in the cockpit. Perception of information, characteristics of pilot-operator receptors. Elements of aeronautical ergonomics. Electronic indicators. Computer-based information imaging systems. Construction and principle of operation of cathode ray tube and panel displays. Types and formats of information presented on the pictorial displays. Construction of HUD and HMD type indicators. Methods and systems of information visualization in simulators. General diagram and fundamentals of simulators. Types of simulators and training devices and their applications. Standards. Fundamentals of human physiology and psychology as a mechatronic system operator. Fundamentals of modelling for simulators. Visualization system. Motion system. Simulator cabins. Imitators of instruments and indicators. Simulation of sounds. Control signal processing and data transmission. Modelling of the environment and emergencies of the simulated system. Analysis of the construction and operation of simulators of different technical systems.*	**5.0**	AEE	K_W13, K_W14, K_W15, K_U01, K_U03, K_U11,
Content group of elective subjects **elective subjects** **AIRFRAMES AND AIRCRAFT PROPULSION**				
1	*Fluid mechanics:* *Description of fluid state and motion, kinematics elements, velocity circulation. Local motion of a fluid element, deformation velocity tensor and stress tensor. Basic equations of fluid mechanics, Navier-Stokes equation, similarity of flows. Elements of hydrostatics - equilibrium equation, hydrostatic thrust and buoyancy, standard atmosphere. Euler's equation of motion, Bernoulli's equation, elements of applied hydraulics. Laminar and turbulent motion, boundary layer, Prandtl equation, Karman equation. Karman equation. "Well and badly" flowing bodies, issues of boundary layer detachment, effect of detachment on aerodynamic coefficients. Wave phenomena, effect of gas compressibility, isentropic flows.*	**4.0**	IM/AEE	K_W01, K_W08, K_W14, K_W19, K_U01, K_U07, K_U11
2	*Thermodynamics:* *Thermodynamic state. The equations of state of perfect and real gases. Properties of gas mixtures. Principles of thermodynamics. Characteristic transformations. Thermodynamic circuits. Properties of single-component real substances.* *Phase transitions. Multicomponent systems. Equilibrium conditions of thermodynamic system. Combustion of liquid and solid fuels. Properties of combustion products. Fundamentals of flow thermodynamics. Heat transfer: conduction, convection and radiation. External and internal heat sources heating a structure. Fundamentals of energy conversion from renewable sources.*	**4.0**	IM/AEE	K_W02, K_W11, K_W19, K_U01, K_U06, K_U14,
3	*Strength of Materials and Structures:* *Introductory information. Experimental basis for the determination of mechanical properties of materials. Calculation of tensile and compressive strength of rods. Moments of inertia of plane figures. Internal forces in rods. Bending of a straight bar.* *Axis of deflection of a straight bar. Statically indeterminate bending beams. Stress state theory. Strain state theory. Relationships between deformation state and stress state. Stress hypotheses. Torsion of bars. Compound action of internal forces in simple rods. General energy theorems and their application. Curved rods. Stability of rods. Fundamentals of stress analysis, free torsion of rods of any cross-section. Non-free deformation of thin-walled rods of open cross-sections. Axially symmetric thin-walled*	**7.0**	IM/AEE	K_W07, K_W19, K_U01, K_U03, K_U07, K_K03,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	tanks. Thin plates. Elements of dynamics of elastic systems. Stress of materials under periodically varying loads. Material creep.			
4	*Aerodynamics:* *Introduction to aerodynamics, aerodynamic objectives and research methods in aerodynamics. Aerofoil theory: description of geometry, pressure distribution over the aerofoil, aerodynamic force coefficients, aerofoil aerodynamic characteristics. Finite extension aerofoil: description of geometry, rotary lifting line theory, induced drag, aerofoil aerodynamic characteristics. Subcritical and supercritical aerofoil and wing flow. Elements of high speed aerodynamic theory: small disturbance theory, sound barrier, densification and dilution waves, aerodynamic heating. Aerodynamic interference, supersonic air flow, elements of complete aircraft aerodynamics, experimental aerodynamic characteristics of model aircraft.*	**3.0**	**IM/AEE**	K_W01, K_W08, K_U01, K_U03, K_U11,
5	*Avionics Systems:* *Definition, architectures and basic characteristics of avionics systems. Electrical power sources on aircraft. Lighting and light signalling systems. Rain and ice protection systems. Aircraft engine ignition systems. Organisation elements of aircraft on-board computer and data exchange systems. Fibre optics and fibre optics technology. Integrated avionics modular systems. On-board information and operation imaging systems. Flight data and cabin voice recorders. Cabin and information systems. Construction and principles of aeronautical measuring instruments and systems. Autonomous Navigation Systems. Aircraft Control Systems: Electromagnetic compatibility issues. Flight and traffic management systems. Servomechanisms and actuators. Fundamentals of radio wave propagation. Radio-electronic communication equipment. Non-autonomous navigation systems. Systems and devices supporting instrumented landing. Secondary radar in air traffic control, collision avoidance systems. Radio altimeters and ground proximity warning devices. Weather radars, Doppler radars, area navigation systems.*	**7.0**	**AEE**	K_W03, K_W05, K_W14, K_W15, K_U01,
6	*Heat Transfer:* *Concepts and quantities of description of heat transfer issues. Laws: Fourier, Newton and Stefan-Boltzmann. Calculation of steady-state heat transfer through multilayered flat and cylindrical walls using thermal resistance. Calculation of heat transfer through bars and ribs under different types of boundary conditions. Determination of heat transfer coefficients for fluid flows inside and outside channels. Determination of heat interception coefficients for flowing of flat walls. Cooling of gas turbine blades. Heat transfer boundary conditions for gas turbine blades. Determination of temperature distribution in a model turbine blade using Excel.*	**2.0**	**IM/AEE**	K_W01, K_W02, K_W08, K_W11, K_U01, K_U07,
7	*Theory of Aircraft Engines:* *Operating principles of an aircraft piston engine and their characteristics. Operating parameters of a single-flow turbine jet engine. Two-flow turbine jet engine and its application. Propeller and helicopter turbine engine. Parameters and operating characteristics of components (inlet, compressor, combustion chamber, turbine and types of exhaust systems in turbine engines). Basic characteristics of turbine engines. Analysis of engine characteristics linking engine parameters to flight parameters. Conclusions resulting from the analysis of fundamental importance to the problems of construction and operation of aircraft engines.*	**5.0**	**IM**	K_W06, K_W07, K_W11, K_W14, K_U01, K_U07, K_U17
8	*Propellers and Rotors:* *Aerodynes, rotorcraft, propellers, helicopters. Main rotors, rotor hubs, joints and blades of rotors. Geometric and aerodynamic quantities characterising a propeller and rotor. Main rotor thrust. Reverse flow*	**2.0**	**IM**	K_W07, K_W08, K_W13, K_W14,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	zone. Main rotor energy losses. Tail rotor thrust. Disposable power of the main rotor. Flux theory, blade element, vortex theory. Coordinate system of helicopter axes. Balance, equilibrium, steerability of the helicopter. Control disc principle. Forces on starter levers, hydraulic amplifiers. Basic characteristics of controllability. Hovering, vertical ascent and descent, horizontal flight of the helicopter. Helicopter glide flight, autorotation, helicopter flight range and longevity. Helicopter take-off, landing and manoeuvring. Propeller forces, vibration, resonance. Materials used for propeller construction. Propeller pitch change control. Propeller synchronisation. Propeller icing. Static and dynamic balancing, blade path delineation, blade damage assessment, propeller-engine interaction. Propeller storage and maintenance.			K_U11, K_U18,
9	*Manufacturing techniques in aeronautical structures:* *Principles of process design in CAD/CAM systems. Numerically controlled machine tools. Systems for programming machine tools and process equipment. Methods for developing post-processors in the GRIP programming language for the NX system. Concurrent design of product structure and technology. Automation of the manufacturing process. Manufacturing methods for airframe and powerplant components and assemblies.*	2.0	IM	K_W09, K_W16, K_U01, K_U02, K_U03, K_K01
10	*Aircraft Fuels and lubricants:* *General information about fuels and lubricants. Aviation fuels - methods of obtaining, properties, energy characteristics. Combustion process of hydrocarbon fuels. Basic fuel combustion reactions. Aviation fuels - basic characteristics, normative requirements, assortment range and principles of use. Additives to aviation fuels. Methods of assessing resistance to knocking combustion. Fuels for aviation turbine engines - basic characteristics, normative requirements, assortment range and principles of use. Fuel additives. Airport control of fuel quality. Deposits and smoking. Malfunctions of aviation turbine engines related to fuel quality. Lubricating oils used in aviation - basic characteristics, normative requirements, range and principles of use. Greases, technical and auxiliary fluids used in aviation. Transport, storage and distribution of fuels and lubricants.*	2.0	IM	K_W10, K_U06, K_U18
11	*Strength of Aircraft Structures:* *General information. Girders. Membrane theory of cylindrical shells. Free torsion of thin-walled prismatic bars. Bending and shearing of thin-walled bars with open section. Bending and shear of thin-walled bars with closed section. Sandwich construction (three layer construction). Elastic stability of bars. Elastic stability of plates. Structural work after loss of stability. Current development trends of strength calculation methods for aeronautical structures.*	4.0	IM	K_W07, K_W13, K_W09, K_W14, K_W16, K_U07, K_U18
12	Hydropneumatic Systems: *Working fluids and gases used in hydropneumatic systems and conditions of their use. Hydropneumatic energy sources used on-board of aircraft. Hydraulic and pneumatic actuators. Hydraulic boosters. Control elements for flow direction, pressure and flow rate of liquids and working gases. Rigid and flexible hoses. Couplings and connections. Filters. Reservoirs and dampers. Fuel systems. Fire suppression systems. Air-conditioning systems. Anti-icing systems. Hydraulic systems. Oil systems and cooling. Oxygen systems and aircrew rescue equipment Principles of operation of on-board hydropneumatic equipment.*	5.0	IM/AEE	K_W13, K_W14, K_W15, K_U01, K_U11, K_U12,
13	*Aeroelasticity:* *General knowledge of aerodynamics of non-stationary flow, main equations, Lagrange integral, velocity potential, boundary conditions, aerodynamic effects of circulationless and circulatory flow. Flow of a*	2.0	IM	K_W01, K_W02, K_W14

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	thin aerofoil with finite velocity at the flow edge. Effect of wing haunch. Flatter, equations of motion, flexion-torsion flatter of wing aerofoil. Influence of geometric, elastic and mass characteristics on critical flatter velocity. Flex-torsional flatter of a finite span wing, equations of equilibrium. Approximate methods for calculating flatter velocity and frequency. Galerkin method. Criteria of elastic stability of a structure in flow. Wing flatter oblique wing. Low elongation wing flatter. Flatter of the tailplane. Flatter with one degree of freedom. Flatter free-from-attachment aircraft. Flatter of plates and shells. Non-linear flatter issues. Detachment Flatter. Static aeroelasticity problems. Flatter research from historical perspective.			
14	*Aircraft Propulsion Systems:* *Construction of aircraft propulsion systems with turbine engines (jet, propeller and helicopter) and piston engines; construction, loads and strength calculations of basic engine units and their parts; construction materials; engine installations - construction and principles of operation, structure and operation of individual units, propellants and lubricants; hydro-mechanical and electronic control systems; reduction gearing of aircraft engines; propeller construction, propeller pitch control; inlet air dust collectors; starting of turbine and piston engines; operation and diagnosis of aircraft propulsion systems; indication of operational parameters of propulsion systems.*	4.0	IM/AEE	K_W07, K_W08, K_W10, K_W13, K_W14, K_W15, K_U06, K_U11, K_U12, K_U18,
15	*Flight Mechanics:* *Flight mechanics objectives, forces acting on the aircraft (SP). Dynamics of aircraft motion as a material point. Aircraft motions on rectilinear trajectories inclined at any angle. Aircraft transient motion on vertical and horizontal straight and curvilinear tracks and on space tracks. SP take-off and landing issues, aerodynamic characteristics in the take-off configuration and in the landing configuration. Dynamics of SP motion as a material solid. Aircraft equilibrium, static stability and longitudinal controllability. Equilibrium, static stability and lateral controllability, aircraft equilibrium curve. Moments acting on an aircraft in transient motion. Peculiarities of aircraft flight at large angles of attack. Suborbital and orbital flights of spacecraft.*	5.5	IM/AEE	K_W01, K_W08, K_W14, K_U11,
16	*Aircraft construction:* *Aircraft requirements and classification. Selection of layout and basic airframe parameters, statistical factors. Wing structure and its components. Work of girder, semi-shell, shell structures. Structure and work of the wing near the recess, nodes and connections. Wing mechanisation. Ailerons, empennage and control system. Fuselage and flight deck. Landing gear, characteristics and classification, landing gear requirements. Main and auxiliary landing gear design, suspension, airwheel design. Selection of layout and basic parameters of helicopter airframe. Main rotor requirements; types and parameters defining main rotors. Carrier rotor operating range characteristics, purpose of joints. Main rotor hub design. Control disc design, control system design. General helicopter control principles: periodic, pitch and tail rotor control. Tail rotor design. Transmission systems, arrangement of engines in a helicopter. Fuselage and flight deck, constructional peculiarities. Helicopter landing gear. Developmental trends. Mission definition. Design trend analysis. Project cost analysis. Preliminary mass estimation. Forces on aircrafts and helicopters. Static and dynamic loads. Overload factor, disposable overload, limitations. Selected aspects of related to airworthiness regulations for aircraft. Load curve. Aeroplane and helicopter limitations and tests. Wing and rotor blade loads. Loads on ailerons, flaps and spoilers and control system. Fuselage and landing gear loads. Airframe and helicopter fatigue calculations. Main aerofoil and fuselage design. Selection of configuration of fairings. Selection of propulsion units.. Design of flaps, slots, brakes. Structural component design and material selection. Consideration of*	6.0	IM	K_W06, K_W07, K_W08, K_W13, K_W15, K_W16, K_U07, K_U10, K_U11, K_U13, K_U14, K_U17, K_U18,

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	stability and controllability requirements in design. Compromises in aeronautical design. Elements of rocket and spacecraft design.			
17	*Design and manufacture of aircraft structures:* *Specificity of the airframe as a production object. Methods of mapping airframe geometry. Methods of shaping parts from thin sheets and sections. Methods of manufacturing integral metal and composite parts. Connection technologies used in the assembly of parts and subassemblies of airframes (riveting, bonding, gluing). Sub-assembly and final assembly. Methods of assuring quality and reliability of parts.* *Aircraft wear and damage. Capabilities and technologies for the repair of airframe coverings and strength members.* *Repairs of sandwich and composite structures.*	3.5	IM/AEE	K_W04, K_W06, K_W09, K_W10, K_W12, K_U01, K_U06, K_U10, K_U12,
Diploma thesis				
1	*Diploma Seminar:* *Principles and techniques of preparing seminar papers and techniques of presenting them. The process of self-education of students and its essential conditions. Methodology of knowledge acquisition and elements of technology of mental work. Internet and electronic sources of information acquisition. Library information systems. Types of theses and general requirements for diploma theses. Specificity of the diploma thesis of an engineer. Stages of solving and performing a diploma task. Layout and content of the diploma thesis. Technique of writing and editing the diploma thesis. Diploma thesis evaluation criteria. Ethics and research workshop of an engineer. Protecting and following the copyrights. Plagiarism and computer anti-plagiarism systems. Provisions of the rules of higher education and norms concerning diploma theses, diploma examination and graduation.*	2.0	IM/AEE	K_W15, K_W19, K_W20, K_U01, K_U02, K_U04, K_U05, K_U13, K_U14, K_K02,
2	*Diploma Thesis:* *Developing of the diploma project comprises knowledge, skills and competences within aerospace issues in the fields of avionics, aeroplanes and helicopters, and aircraft propulsion systems.* *It constitutes an independent study of a specific engineering topic with scientific elements covering knowledge, skills and competences related to aeronautical engineering.* *The thesis involves solving analytical and design tasks, designing, developing concepts, performing engineering and research tasks, presenting and discussing, and assessing the results obtained.*	20.0	IM/AEE	K_W09, K_W11, K_W12, K_W13, K_W14, K_W19, K_W20, K_U03, K_U04, K_U09, K_U10, K_U11, K_U12, K_U13, K_U17, K_U18, K_K01, K_K03, K_K04,
Apprenticeship				
1	*Apprenticeship:* *Students get acquainted with the rules and regulations of occupational health and safety. Students familiarize themselves with the organizational structure, activity profile, tasks and possibilities of the enterprise. Students familiarize themselves with technical, maintenance, repair and overhaul documentation, its circulation and quality control process. Inspecting the condition of equipment and taking diagnostic measurements using operating and measuring equipment (under the*	5.0	IM/AEE	K_W06, K_W09, K_W10, K_W11, K_W13, K_W17, K_W18, K_W19

No.	Name of class group Name of subject, short description (outline program) [7]	No of ECTS credits	Discipline code[8]	Reference to field-related outcomes
	direction of the instructor). Basic maintenance and workshop work at workstations (under the direction of the instructor). Use, installation and configuration of specialised or auxiliary computer software. Preparing and drawing up technical, technological, advertising and promotional documentation.			K_W20 K_U02, K_U04, K_U05, K_U06, K_U11, K_U12, K_U13, K_U11, K_U16, K_K01, K_K02, K_K03,
Total		**210**		

Methods of verifying and assessing the learning outcomes achieved by the student during the whole educational cycle:[9]

Verification of the intended learning outcomes shall be conducted systematically throughout the entire period of study. Passing each module with at least a satisfactory grade [ocena dostateczna] is the requirement for achieving of the intended learning outcomes. The intended learning outcomes are defined for each form of completion of the module (lectures, practical classes, laboratories, project, seminar) in the form of knowledge, skills and social competences, as well as methods and methods of their verification. Detailed methods of verification of the learning outcomes are included in the module information sheet.

Achievement of intended outcomes by a student in the category of social competence results from his/her attitude during the entire period of studies. Students from the second year should participate in the activities of Scientific Student Societies [Koło Naukowe Studentów - KNS] operating at the Military University of Technology. Performing the activities within KNS and participating in seminars will be a main indicator of achieving the intended outcomes in the category of social competence. Details concerning the activities of KNS are regulated by the rules and regulations of KNS and their tutors.

The final form of verification of the acquired knowledge and skills is a positive assessment of the diploma thesis and the final examination.

Plan of full-time programme - in Appendix 1.

[9] *general description - see details on course information sheets*

Appendix 1 - Plan of the full-time first degree programme

Wojskowa Akademia Techniczna

PLAN OF FULL-TIME FIRST-CYCLE STUDIES OF GENERAL ACADEMIC PROFILE
SCIENTIFIC DISCIPLINE (LEADING): MECHANICAL ENGINEERING
MAJOR: AERONAUTICS AND ASTRONAUTICS
Specialisation profiled with elective subjects: Avionics, Airframes and Propulsion Systems

beginning 2023

	GROUPS OF CLASSES / SUBJECTS	Scientific discipline	total hours/ ECTS		ECTS / allocating scientific skills	ECTS share	including hours:					number of hours/rigour/ ECTS per semester:														administrative organisational unit responsible for the subject	Remarks
												I		II		III		IV		V		VI		VII			
			HRS	ECTS			lect	Pr classes	Lab	Project	Seminar	hrs	ECTS	hrs	ECTS	hrs	ECTS	hrs	ECTS	hrs	ECTS	hrs	ECTS	hrs	ECTS		
	A. Content group of general education		**336**	**21**		**12,5**	**128**	**208**				**186**	**19,0**	**90**	**4,0**	**30**	**2,0**	**30**	**2,0**								
1	Professional ethics	NS	18	1,5		1,0	14	4				18 Zo	1,5													WLO	
2	Introduction to study	NS	6	0,5		0,5	6					6 Zo	0,5													Quality Officer	
3	Basics of management and entrepreneurship	NZJ	30	3,0		1,5	16	14				30 Zo	3													WLO	
4	Selected issues of law	NP	18	1,5		1,0	14	4				18 Zo	1,5													WLO	
5	Introduction to Computer Science	ITT	36	3,0		1,5	14	22				36 Zo	3													WML/ITR	
6	Physical Education		60					60				30 Zo		30 Zo												SWF	
7	Foreign language	J	120	6,0		6,0		120				30 Zo	2	30 Zo	2	30 Zo	2	30 Zo	2							SJO	
	Foreign Language - examination B2																	E								SJO	
8	Protection of Intellectual Property	NP	14	1,5		1,0	12	2				14 Zo	1,5													WLO	
9	Occupational Health and Safety		4				4					4 Z														BHP	
10	Socio-humanities module (elective content)																										
	a) Polish history	H					16	14																		WLO	
	b) Philosophy	F	30	2,0		1,0	16	14						30 Zo	2											WLO	
	c) Fundamentals of Music Education						16	14																		WLO	
	B. Content group of basic education		**708**	**61**	**23,0**	**32,0**	**350**	**274**	**84**			**190**	**17,0**	**284**	**26,0**	**234**	**18,0**										
1	Introduction to Metrology	AEE	24	2,0	1,0	1,0	12	12				24 Zo	2													WML/ITL	
2	Mathematics 1	M	68	6,0		3,0	30	38				68 E	6													WCY	
3	Mathematics 2	M	68	6,0		3,0	34	34				68 E	6													WCY	
4	Basics of Engineering Graphics	IM/AEE	30	3,0	2,0	1,5	12	18				30 Zo	3													WML/ITL	
5	Mathematics 3	M	46	4,0		2,0	22	20	4					46 E	4											WCY	
6	Physics 1	NF	80	6,0		3,0	40	30	10					60 E	6											WTC	
7	Engineering Graphics	IM/AEE	30	3,0	2,0	1,5	12	18						30 Zo	3											WML/ITL/ITU	
8	Computer Science	ITT	30	3,0	2,0	1,5	14	16						30 Zo	3											WML/ITU	
9	Materials Science	IMat	44	4,0		2,0	36	8						44 E	4											WML/ITU	
10	Manufacturing Engineering	IM	30	3,0	2,5	1,5	24	6						30 Zo	3											WML/ITU	
11	Metrology	IM/AEE	24	3,0	2,0	1,0	10		14					24 Zo	3											WML/ITL	
12	Physics 2	NF	60	4,0		2,0	30	20	10							60 E	4									WTC	
13	Electrical Engineering and Electronics	AEE	80	6,0	5,0	4,5	40	20	20							80 E	6									WML/ITL, WEL/IRE	
14	Technical mechanics	IM/AEE	68	6,0	6,0	3,0	34	34								68 E	6									WML/ITL	
15	Strength and Materials Science Laboratory	IM/IMat	26	2,0	1,5	1,5			26							26 Zo	2									WML/ITU	
	C. Content group of field-related education		**434**	**33**	**19,5**	**22,0**	**186**	**118**	**130**							**96**	**10,0**	**174**	**13,0**	**30**	**2,0**	**90**	**6,0**	**44**	**3,0**		
1	Mathematics 4	IM/AEE	50	6,0	3,5	2,5	24	10	16							50 Zo	6									WCY	
2	Human Factor	IM/AEE	16	2,0	1,0	1,0	16									16 Zo	2									WML/ITL	
3	Aviation Law and Regulations	NP.	30	2,0		1,5	24	6								30 Zo	2									WML/ITL	
4	Basics of Machine Constructions	IM/AEE	60	4,0	3,0	3,0	28	32										60 E	4							WML/ITU	
5	Basics of Automation	AEE	44	4,0	2,0	2,0	16	14	14									44 E	4							WML/ITL	
6	Digital and microprocessor systems	AEE	40	3,0	2,0	2,0	16	14	10									40 Zo	3							WML/ITL	
7	Basics of Modelling Physical Systems	IM/AEE	30	2,0	1,5	1,5		30										30 Zo	2							WML/ITL	
8	Aircraft Materials	IMat	30	2,0	1,5	1,0	18	12												30 Zo	2					WML/ITL	
9	Aircraft Integrated Laboratory	IM/AEE	90	5,0	3,0	5,0			90													90 Zo	5			WML/ITL	
10	Aircraft Maintenance Engineering	IM/AEE	44	3,0	2,0	2,5	44																	44 Zo	3	WML/ITL	
	D. Elective content group - AVIONICS		**910**	**68**	**56,5**	**47,0**	**256**	**208**	**110**	**46**	**6**							**224**	**15,0**	**342**	**28,0**	**284**	**20,0**	**60**	**5,0**		
1	**Fluid Mechanics and Aerodynamics:**	IM/AEE	**60**	**4,0**	**3,5**	**3,0**	**30**	**14**	**16**									**60 E**	**4**							**WML/ITL**	
2	**Propulsion Systems**	IM/AEE	**60**	**4,0**	**3,0**	**3,0**	**30**	**14**	**16**									**60 Zo**	**4**							**WML/ITL**	
3	**SP Construction and Installations**	IM/AEE	**90**	**7,0**	**6,0**	**6,0**	**44**	**46**										**60 Zo**	**4**	**30 Zo**	**3**					**WML/ITL**	
4	**Basics of Flight Mechanics**	IM/AEE	**30**	**3,0**	**2,5**	**1,5**	**16**	**10**	**4**											**30 E**	**3**					**WML/ITL**	
5	Aircraft Measurement Systems and Sensors	IM/AEE	44	3,0	2,0	1,5	18	6	20									44 Zo	3							WML/ITL	
6	Modelling of Avionic Systems	IM/AEE	44	4,0	3,0	2,5	14	30												44 Zo	4					WML/ITL	
7	Servoactuators and actuators	IM/AEE	44	3,0	2,5	2,5	14	14	16											44 Zo	3					WML/ITL	
8	Airborne Diagnostic Systems	IM/AEE	30	2,0	1,5	1,5	16	6	8											30 Zo	2					WML/ITL	
9	Control Theory	AEE	60	5,0	4,0	3,0	30	30												60 E	5					WML/ITL	
10	Aircraft Power Systems	IM/AEE	44	4,0	3,0	2,5	16	12	16											44 Zo	4					WML/ITL	
11	Basics of Mechatronics Devices Construction	IM/AEE	30	2,0	1,5	1,5	10			20										30 Zo	2					WML/ITL	
12	Avionics Modules and Systems Programming	AEE	90	6,0	5,0	5,0	28	50		12										30 Zo	2	60 Zo	4			WML/ITL	
13	Aircraft Radioelectronic Systems	AEE	44	3,0	2,5	2,5	20	8	16													44 Zo	3			WEL-IRE	
14	Aircraft Control Systems	IM/AEE	60	5,0	4,5	3,0	28	18	14													60 E	5			WML/ITL	
15	Aircraft Navigation Systems	IM/AEE	60	4,0	4,0	3,0	24	20	16													60 E	4			WML/ITL, WEL/IRE	
16	Aircraft Digital Systems and Computer Networks	AEE	60	4,0	4,0	3,0	30	8	8	14												60 E	4			WML/ITL	
17	On-board Visualization Systems and Simulators	AEE	60	5,0	4,0	3,0	28	12	16		6													60 E	5	WML/ITL	
	D. Elective content group - AIRFRAMES AND PROPULSION SYSTEMS		**990**	**68**	**57,0**	**49,0**	**318**	**226**	**100**	**16**								**210**	**15,0**	**360**	**28,0**	**330**	**20,0**	**90**	**5,0**		
1	**Fluid mechanics**	IM/AEE	**60**	**4,0**	**3,0**	**3,0**	**16**	**28**	**16**									**60 E**	**4**							**WML/ITL**	
2	**Thermodynamics**	IM/AEE	**60**	**4,0**	**3,0**	**3,0**	**30**	**14**	**16**									**60 Zo**	**4**							**WML/ITL**	
3	**Strength of Materials and Structures**	IM/AEE	**90**	**7,0**	**6,0**	**6,0**	**44**	**46**										**60 Zo**	**4**	**30 Zo**	**3**					**WML/ITL**	
4	**Aerodynamics**	IM/AEE	**30**	**3,0**	**2,0**	**1,5**	**20**		**10**											**30 E**	**3**					**WML/ITL**	
5	Avionic Systems	AEE	90	7,0	5,0	4,0	46	20	24									30 Zo	3	30 Zo	2	30 Zo	2			WML/ITL	
6	Heat Transfer	IM/AEE	30	2,0	1,0	1,5	14	16												30 Zo	2					WML/ITL	
7	Theory of Aircraft Engines	IM	60	5,0	4,0	3,0	40	20												60 E	5					WML/ITL	
8	Propellers and Rotors	IM	30	2,0	1,0	1,5	16	14												30 Zo	2					WML/ITL	
9	Manufacturing Techniques in Aeronautical Structures	IM	30	2,0	1,5	1,5	20		10											30 Zo	2					WML/ITL	
10	Aircraft Fuels and lubricants	IM	30	2,0	1,5	1,5	10	10	10											30 Zo	2					WML/ITL	
11	Strength of Aircraft Structures	IM	60	4,0	4,0	3,0	16	30	14											60 E	4					WML/ITL	
12	Hydropneumatic Systems	IM/AEE	60	5,0	4,0	3,0	36	8	16											30 Zo	3	30 Zo	2			WML/ITL	
13	Aeroelasticity	IM	30	2,0	2,0	1,5	14	16														30 Zo	2			WML/ITL	
14	Aircraft Propulsion Systems	IM/AEE	90	4,0	4,0	4,0	38	36	16													90 E	4			WML/ITL	
15	Flight Mechanics	IM/AEE	90	5,5	5,0	4,0	46	28	16													60 E	4	30 Zo	1,5	WML/ITL	
16	Aircraft construction	IM	90	6,0	7,0	5,0	38	36		16												60 E	4	30 E	2	WML/ITL	
17	Design and Manufacture of Airframes	IM/AEE	60	3,5	3,0	3,0	30	12	18													30 Zo	2	30 Zo	1,5	WML/ITL	
	E. Diploma thesis		**30**	**22**	**9,0**	**7,0**					**30**													**30**	**22**		
1	Diploma seminar	IM/AEE	30	2,0	1,0	2,0					30													30 Z	2		
2	Diploma thesis	IM/AEE		20,0	8,0	5,0																			20		
	F. Apprenticeship	number of weeks		5,0		4,0	**Completion date**															4	5				
1.	Apprenticeship			5,0		4,0	**after sem. VI.**															4 Z	5				
	TOTAL HOURS / ECTS - AVIONICS		2418	210,0	108	124,5	920	666	324	46	36	376	30,0	374	30,0	360	30,0	428	30,0	372	30,0	374	30,0	134	30,0		
	TAL HOURS / ECTS - AIRFRAMES AND PROPULSION SYSTE		2498	210,0	106,5	126,5	982	688	314	16	30	376	30,0	374	30,0	360	30,0	414	30,0	390	30,0	420	30,0	164	30,0		
	acceptable deficit of ECTS credits *											15		18		17		17		15		13		0			
	Types and number of rigours per semester:											number of examinations E		2 / 2		4 / 4		3 / 3		4 / 4		2 / 2		3 / 3		1 / 1		
												number of graded credits Zo		10 / 10		6 / 6		5 / 5		6 / 6		8 / 9		3 / 5		1 / 3		
												number of credits Z		1 / 1		/		/		/		/		/		1 / 1		
												number of interim projects		/		/		/		/		1 /		2 / 1		/		

Curriculum approved by the Faculty Education Council of the Faculty of Mechatronics, Armament and Aeronautics on 17.05.2023 (Opinion No. 11/2023 of 17 May 2023)

* In accordance with the Dean's decision on norms and standards of the WML teaching process

Appendix 2 - Opinion of the Faculty Education Council

OPINION

of the Faculty Education Council

Faculty of Mechatronics, Armament and Aerospace

Military University of Technology named after Jarosław Dąbrowski

no 11/2023 of 17 May 2023

on the development of a first degree programme project

The Faculty Education Council of the Faculty of Mechatronics, Armament and Aerospace of the Military University of Technology gives its positive opinion on the draft study programme/curriculum for the first degree programme for the *aeronautics and aerospace major* valid from the academic year 2023/2024, developed in Polish and English.

Chairman of the meeting

mgr inż. Grzegorz NIKICIUK

(-) [illegible signature]

Appendix 3 - Opinion of the Faculty Council of Student Self-Government

FACULTY SELF-GOVERNMENT COUNCIL

OF THE FACULTY OF MECHATRONICS, ARMAMENT AND AEROSPACE

MILITARY UNIVERSITY OF TECHNOLOGY

Warsaw, 16 May 2023

Chairman

of the Faculty Education Council

dr inż. Zdzisław ROCHALA

Subject: Opinion on study programmes/curriculum.

The Faculty Self-Government Council, having analysed the presented study programmes/curriculum, decided to give a positive opinion on the "Study programmes for engineering studies" with a general academic profile, starting from 1 October 2023 in the academic year 2023/2024

for the following majors:

-“AERONAUTICS AND ASTRONAUTICS";

- “MECHATRONICS”

- "SAFETY ENGINEERING";

- 'UNMANNED SYSTEMS ENGINEERING'.

For the Faculty Self-Government Council

Chairman

Marcelina Jedrzejewska

(-) Jędrzejewska Marcelina