Appendix 2
To the resolution of the Senate of the MUT No. 96/WAT/2023
dated June 22, 2023

WOJSKOWA AKADEMIA TECHNICZNA
MILITARY UNIVERSITY OF TECHNOLOGY

FACULTY OF MECHATRONICS, ARMAMENT AND AEROSPACE

CURRICULUM

Level of education: first cycle programme

Field of study: **MECHATRONICS**

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

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CURRICULUM
organisational arrangements

for the major of "MECHATRONICS"

Level of education: first cycle programme

Profile of study: general academic

Mode of study: full-time

Qualification and title conferred on graduates: inżynier [engineer]

Polish Qualification Framework level: 6

Field of study is assigned to:

Field of science **Scientific discipline**	engineering and technology mechanical engineering, 60% ECTS credits
Field of study **Scientific discipline**	engineering and technology automation, electronics, electrical engineering and space technology, 30% ECTS credits
Field of science **Scientific discipline**	engineering and technology technical computing and telecommunications, 10% ECTS credits

Leading discipline:[1] mechanical engineering

Language of instruction: Polish

Number of semesters: 7

Total number of hours

Robotics and industrial automation:	2326
Computer techniques in mechatronics:	2402

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:

Robotics and industrial automation:	106
Computer techniques in mechatronics:	107.5

- in the humanities and social sciences [2] 18

[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.*

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

As a part of an apprenticeship carried out after the 6th semester (credit is awarded in the 7th semester) in a didactic dimensions of 4 weeks, students should obtain 4 ECTS credits. The aim of an apprenticeship is to verify in practice the knowledge, skills and social competences acquired by students during their studies and to prepare them to carry out a final thesis. Students undertake an internship in national businesses. The apprenticeship in representative companies of the national economy, relevant to the field of study, takes place on the basis of a bilateral agreement on the student apprenticeship and the apprenticeship programme. An apprenticeship may also be completed in the form of an individual project of a student under the direction of an academic teacher during the course of studies. A didactic and educational supervision over apprenticeship is exercised by an apprentice supervisor or a project manager. To be awarded credit for the apprenticeship, it is necessary to document that the work carried out coincides with the student's field of study and that the student has achieved the expected learning outcomes set out in the apprenticeship programme by more than 50%.

CHARACTERISTICS OF THE FIELD OF STUDY

A degree in mechatronics provides the training of specialists who meet the needs of the changing labour market and are comprehensively prepared for the role of designer, manufacturer and operator of complex technical devices. The training is based on a thorough knowledge of mechanics, electronic control systems, selected branches of applied computer science and the mastery of computer-aided design tools in the design of products and manufacturing processes and their operation.

The degree programme enables the student to obtain an education that corresponds to international standards and requirements, as well as up-to-date engineering knowledge in the design, manufacture and operation of technical equipment and systems, characterised by a structure realised by mechanical, pneumatic, hydraulic, micromechanical, electromechanical, electrical and optical assemblies, together with a control system based on microprocessor technology.

The teaching process is organised in such a way that great importance is placed on teaching by example, while the classes are subordinated to the main goal of equipping the mechatronics engineer with the practical knowledge that will enable him or her to realise the design of a specific device and to carry it out as a team.

IMPLEMENTATION OF STUDIES

The Faculty of Mechatronics, Armament and Aerospace of the Military University of Technology is responsible for running the mechatronics degree programme, which has modern and comprehensively prepared teaching and research facilities, ensuring the possibility of organising attractive classes and conducting scientific research. The resources of the Faculty consist of the resources of the organisational units - 3 institutes

including the Institute of Missile Technology and Mechatronics and the Institute of Armament Technology, which jointly deliver most of the profile classes in the mechatronics faculty. The faculty also receives support from the workshops and laboratories of other organisational units of the University that are involved in the educational process of the faculty. The buildings where classes are held are located on campus within walking distance of each other. The experience of the academic staff gained in conducting and participating in such work naturally enriches the subject matter of the courses with the latest trends in the field of mechatronics, thus increasing the relevance and diversity of education, manifested in a wide range of elective content. The preparation of students for scientific work is carried out through projects and laboratory exercises, in which students carry out research tasks, both individually and in teams, tasks within the framework of their theses, some of which are incorporated into projects carried out at the Faculty. Students, active in research clubs, also have access to the apparatus base and can realise their own research ideas and apply for funding for ongoing projects. For students demonstrating particular aptitude in their field of study or specialisation and achieving good and very good academic results, the Faculty of Mechatronics, Armament and Aerspace organises studies according to an individual study programme. These studies satisfy students' aspirations to acquire expanded knowledge and prepare them for positions that require competences (including teaching) and skills that go beyond the curricula and study plans and are acquired through the development of personal interests. They are prepared to an extended extent to take up research and teaching jobs in higher education, scientific research institutes and research and development departments of companies.

PERSONAL AND PROFESSIONAL PROFILE OF THE GRADUATE

Graduates of the Mechatronics degree programme receive professional preparation for employment in all branches of industry, including: robotisation, automation, maintenance, database management. A graduate has a working knowledge of the design and operation of mechatronic systems and systems, computer aided design, manufacturing and operation systems, and has the ability to design and model automatic control systems using modern software. He or she is also skilled in the computer design of structural components of machinery and equipment using advanced CAx systems dedicated to geometry and structural modelling and programmed simulation of manufacturing processes.

Graduates (choosing subjects from the profile group in the area of robotics and industrial automation) have the following competences and skills:

- to independently carry out the engineering design of an industrial automation system using microcontrollers and computer networks,

- analysing and implementing programs in C, C++ and using: concurrency mechanisms, communication and process synchronisation, and the creation of database systems,

- the use of control algorithms to solve optimisation problems in discrete and continuous manufacturing processes,

- analysing the kinematics and dynamics of robots, handling, programming and operating industrial robots and PLCs

- the application of IT means for the acquisition of measurements, the control of technological processes, the design, commissioning, maintenance of autonomous systems and/or systems with information exchange via networks, based on standard data transmission protocols, the programming of controllers, operator stations, distributed process control systems with information exchange via networks.

The knowledge gained during the course of study allows graduates of the course to pursue career goals in:

- design and construction of industrial automation systems,

- design, construction, programming and operation of robotic manipulators,

- integration of robotic production workstations,

- carrying out research and development work in the fields of mechanical engineering and automation and robotics.

Graduates choosing subjects from the profile group in the area of computer techniques in mechatronics are prepared to take up professional work in, among others, design and technology offices of civil and defence industry companies as designers, technologists, specialists managing the production process and operation of mechatronic devices, coordination of all activities within mathematical and physical modelling. The key skills of a graduating student include the ability to take an analytical approach to solving problems that arise in the engineering projects they undertake using computer science. In addition, the graduate is equipped with knowledge and skills in the basics of entrepreneurship and a foreign language (at level B2 of the Common European Framework of Reference for Languages) including in the area of technical specialist language. The social and interpersonal competences developed during the course of study will significantly strengthen the professional potential of graduates in the areas of entrepreneurship, preparation for teamwork, awareness of qualification upgrading and their adaptation to the labour market.

The "Group of elective, specialised subjects in the area of computer technology in mechatronics" enables you to acquire knowledge in, among other things:

- computer-aided design process using universal design programmes and systems (AutoCAD, SolidEdge, SolidWorks, NX, CATIA, etc.);
- computer-aided manufacturing using: advanced manufacturing technologies (Rapid Prototyping, Rapid Tooling, Reverse Engineering) advanced manufacturing systems (MasterCAM, EdgeCAM) and CNC equipment - numerically controlled machine tools using modern construction materials;
- design of exploitation strategies together with the development of IT support systems for managing the exploitation of complex technical facilities, robotics and control.
- computer-aided management of projects and company resources,
- supporting mathematical and physical modelling, algorithmising the process, analysing the data obtained,
- the use of computer technology and information methods to support new and the operation of existing technologies, the realisation of an individual engineering project, the creation and operation of information systems, the realisation

and verification of information system components according to their specifications,

- self-development based on the knowledge and skills acquired.

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

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.

Explanation of designations:
- in a **symbol and outcome number** column:
  - K – field-related learning outcomes;
  - W, U, K (after the underscore) - category - respectively: knowledge (W), skills (U), social competence (K);
  - 01, 02, 03, …. – a number of learning outcome.
- in a code of description component column - X_P6 – a code of description component of the second-degree characteristics for qualification at level 6 of the Polish Qualification Framework

Symbol and outcome number	Description of the assumed learning outcomes	Code of description component
	KNOWLEDGE The graduate:	
K_W01	Has knowledge in mathematics including algebra, analysis, probability and elements of numerical methods necessary to: 1) description and analysis of the operation of mechatronic components, systems, devices and systems; 2) description and analysis of signal processing algorithms; 3) synthesis of mechatronic components, circuits, devices and systems.	P6S_WG
K_W02	Has knowledge of physics including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand basic physical phenomena occurring in and around mechatronic components and systems.	P6S_WG
K_W03	Has a structured and theoretically based knowledge of mechanics including: statics, fundamentals of material strength, kinematics, dynamics, fundamentals of vibration theory, fluid mechanics, allowing him to solve typical engineering problems in the design, manufacture and operation of mechatronic devices.	P6S_WG Inż._P6S_WG
K_W04	Has a structured and underpinned theoretical knowledge of electrical engineering, analogue and digital electronics to enable the integration of electrical and electronic components and circuits into a mechatronic system, device or system.	P6S_WG Inż._P6S_WG
K_W05	Has a structured knowledge of computer architecture, algorithmisation, programming methodology and technique, and database construction.	P6S_WG Inż._P6S_WG
K_W06	Has a basic knowledge of optoelectronic components and systems.	P6S_WG Inż._P6S_WG
K_W07	Has elementary knowledge of computer systems and networks architecture and operating systems, necessary to install, operate and maintain computer tools for the design, engineering calculations and manufacturing of mechatronic components, systems and systems.	P6S_WG Inż._P6S_WG
K_W08	Has a structured knowledge of automation with elements of robotics and control theory relating to mechatronic systems and systems.	P6S_WG Inż._P6S_WG
K_W09	Has a basic knowledge of materials structure and manufacturing engineering of mechanical components.	P6S_WG Inż._P6S_WG
K_W10	Has a basic knowledge of how to record the design of mechatronic systems and devices and simulate their operation using specialised software.	P6S_WG Inż._P6S_WG

K_W11	Has a basic knowledge of machine design used in mechatronic systems.	P6S_WG Inż._P6S_WG
K_W12	Has a structured knowledge of the areas of application of advanced tools to support the design, manufacturing and operational process.	P6S_WG Inż._P6S_WG
K_W13	Has a basic knowledge of the metrology of electrical and non-electrical quantities.	P6S_WG Inż._P6S_WG
K_W14	Has the basic knowledge necessary to understand the non-technical conditions of engineering activities, knows the basic principles of health and safety at work with mechatronic equipment.	P6S_WK Inż._P6S_WG
K_W15	Has elementary knowledge of the life cycle of mechatronic equipment and systems.	P6S_WG Inż._P6S_WG
K_W16	Has a basic knowledge of how to take into account at the design stage: basic quality indicators of mechatronic devices and systems such as reliability, durability, readiness and safety, and operating strategies.	P6S_WG Inż._P6S_WG
K_W17	Has elementary knowledge of management, including quality management and business management, and computer assisted management.	P6S_WK Inż._P6S_WK
K_W18	Has an elementary knowledge of intellectual property protection and patent law.	P6S_WK
K_W19	Is familiar with the general principles for the creation and development of forms of individual entrepreneurship using knowledge from mechatronics.	P6S_WK Inż._P6S_WK
K_W20	Knows and understands the nature, place and significance of the social sciences and humanities and their relationship to other sciences.	P6S_WG
	SKILLS **The graduate:**	
K_U01	Is able to obtain information from literature, databases and other sources; is able to integrate information obtained, interpret it, and draw conclusions and formulate and justify opinions.	P6S_UW
K_U02	Is able to work individually and as part of a team; able to estimate the time needed to complete a task; able to develop and implement a work schedule to ensure deadlines are met.	P6S_UO
K_U03	Is able to produce documentation on the completion of an engineering task and prepare a text discussing the results of the task.	P6S_UK
K_U04	Is able to prepare a note and give a short presentation on an engineering task.	P6S_UK
K_U05	Has the ability to self-educate and plan to improve professional competence.	P6S_UU

K_U06	Can speak a foreign language at level B2 of the Common European Framework of Reference for Languages, sufficiently to communicate and read technical texts with understanding.	P6S_UK
K_U07	Can apply mathematical apparatus appropriate to the scientific disciplines taught in the mechatronics major, can solve basic mathematical problems occurring in the process of designing mechatronic systems.	P6S_UW
K_U08	Can identify physical phenomena occurring in mechatronic systems.	P6S_UW Inż_P6S_UW
K_U09	Can carry out strength calculations of structural components and determine accelerations and speeds of machine components; can carry out measurements of basic strength properties of materials.	P6S_UW Inż_P6S_UW
K_U10	Can design and analyse electrical circuits.	P6S_UW Inż_P6S_UW
K_U11	Is able to design and analyse simple electronic circuits and systems, including simple digital signal processing systems.	P6S_UW Inż_P6S_UW
K_U12	Can formulate and solve simple engineering tasks in the field of control systems, can design and analyse simple automation systems.	P6S_UW Inż_P6S_UW
K_U13	Is able to develop an algorithm, use high- and low-level programming languages and appropriate computer tools to develop computer programmes to simulate the operation or control of mechatronic devices.	P6S_UW Inż_P6S_UW
K_U14	Knows how to select materials in the design, manufacture and operation of mechatronic equipment.	P6S_UW Inż_P6S_UW
K_U15	Can design elementary technological processes for the manufacture of mechatronic devices.	P6S_UW Inż_P6S_UW
K_U16	Knows how to plan an experiment, knows how to use instruments to measure basic mechanical and electrical quantities and how to select an instrument or measurement method according to a specific criterion, knows how to carry out a statistical analysis of the results of an experiment.	P6S_UW Inż_P6S_UW
K_U17	Is able to use data sheets, instructions written in Polish and foreign languages to select a suitable mechatronic component or system.	P6S_UW Inż_P6S_UW
K_U18	Is able to use appropriate programming environments, simulators and computer-aided design, manufacturing and operation tools for mechatronic equipment.	P6S_UW Inż_P6S_UW
K_U19	Can design a mechatronic system, device and system taking into account utility and economic criteria, using appropriate methods, techniques and tools.	P6S_UW Inż_P6S_UW

K_U20	Is able to carry out a performance analysis and critically evaluate the functioning of a component and plan the process of testing a component, a system, a simple system in order to establish their characteristics or detect errors.	P6S_UW Inż_P6S_UW
K_U21	Can plan and supervise the operation process of mechatronic equipment.	P6S_UW Inż_P6S_UW
K_U22	Is able to recognise system and non-technical aspects when formulating and solving engineering tasks.	P6S_UW Inż_P6S_UW
K_U23	Has a basic preparation for working in an industrial environment and is familiar with the associated health and safety rules.	P6S_UO
K_U24	Is able to identify and interpret basic social, humanistic and legal phenomena and processes within the scope of scientific disciplines relevant to the field of study.	P6S_UW
	SOCIAL COMPETENCES	**The graduate:**
K_K01	Is ready to critically evaluate his knowledge and recognise the importance of knowledge in solving cognitive and practical problems.	P6S_KK
K_K02	Is ready to fulfil social obligations, to co-organise activities for the public interest, to initiate action for the public interest and to think and act in an entrepreneurial manner.	P6S_KO
K_K03	Is ready to perform professional roles responsibly and, in particular, to observe professional ethics and to demand this of others and to care for the achievements and traditions of the profession.	P6S_KR

LIST OF COURSES

Groups of classes / subjects[3], 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)	No of ECTS credits	Discipline code	Reference to field-related outcomes
A	**Group of content of general education General subjects**	**21.0**		
A.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_W20 K_U24 K_K03
A.2	**Introduction to study:** *Methodology for modern study. Methods and techniques for effective learning. Modern techniques to support the study process.*	0.5	*NS*	K_U05 K_K01
A.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. Student activation lecture with simultaneous presentation of examples relating to best management and entrepreneurial practices.* *Exercises prepared in the form of: case studies, audiovisual presentations and solutions and presentations prepared by students.*	3.0	*NZJ*	K_W19 K_U23 K_K02
A.4	**Selected issues of law:** *Introductory issues. Individual acts and normative acts. The concept and process of law application. Sources of international law and European Union law. The concept of a legal relationship. Legal acts and other civil law events. Commercial law companies.*	1.5	*NP*	K_W18 K_W19 K_U24
A.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 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.*	3.0	*ITT*	K_W05 K_U13

[3] course information sheets shall be drawn up and made available 30 days before the beginning of the semester in which the course is taught

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
A.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.*		*NKF*	
A.7	**Foreign language:** *Structural-grammatical material: repetition, expansion and systematisation of the following topics: grammatical tenses/narrative tenses; active/passive voice; dependent speech; conditional mode; question formation; collocations; compound sentences; word order in a sentence; modal verbs; phrasal verbs. Conceptual-functional material: requests; suggestions; offers; advice; acquiescence/refusal; denials; agree/disagree; expressing opinion, cause/effect; reason/purpose; wish, apology; summary; choice of register/style.*	8.0	*J*	K_U06
A.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_W18
A.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.*			
	Socio-humanist subject elective			
A.10	**Polish history - selected aspects:** *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
A.11	**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*		*F*	K_W20

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	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 and basic problems. Main issues and fundamental problems of ontology. Main issues and fundamental problems of epistemology. Main issues and fundamental problems of axiology.			
A.12	**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.*			K_W20
B	**Content group of basic education Basic subjects**	**61.0**		
B.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_U18
B.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
B.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
B.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*	K_W10
B.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*	4.0	*M*	K_W01 K_U07

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	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.			
B.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 concepts 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.*	6.0	*NF*	K_W02 K_U01 K_U08
B.7	**Engineering Graphics:** *CAD/CAM/CAE systems - organisation and structure. Performing 2D drawings. Modelling solids based on primitives and NURBS curves. Modelling solid subassemblies 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*	K_W10
B.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_W07 K_U01 K_U13
B.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	*IM*	K_W09 K_U14
B.10	**Manufacturing Engineering:** *Basic knowledge of the cutting process. Materials used for cutting tools. Chip 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_W09 K_W12 K_U14 K_U23

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
B.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*	K_W13 K_U16
B.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_U01 K_U08
B.13	**Electrical Engineering and Electronics 1:** *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. Performing electrical measurements on electronic circuits and systems to determine parameters and characteristics. Produce appropriate reports on the measurements taken.*	6.0	*AEE*	K_W04 K_U10 K_U11; K_U16
B.14	**Engineering Mechanics:** *Reduction of force systems. Equilibrium of plane and spatial systems, determination of support quantities. Static analysis of beams, columns, frames and trusses. Selected issues of stress-strain state theory. Linear-elastic systems. Allowable stresses. Stress hypotheses. Strain analysis of machine components. Elements of kinematics and dynamics of a material point, a system of material points and a rigid body. Fundamentals of vibration theory of mechanical systems.*	6.0	*IM*	K_W03 K_U08 K_U09 K_U17 K_K03
B.15	**Strength and Materials Science Laboratory:** *Experimental determination of deformation and stresses in a selected section of a flexural beam. Experimental verification of the formula defining the line deflection of the flexural 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*	2.0	*IM*	K_U09 K_U14

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	strengthening of aluminium alloys. Density testing of porous materials and powders.			
C	**Content group of field-related education Field-related subjects**	**45.0**		
C.1	**Basics of Machine Constructions:** *Mastery of design skills for machine components and assemblies, fatigue strength issues for machine components and assemblies and tribology issues.*	4.0	*IM*	K_W11 K_W14 K_U15; K_U16 K_K02
C.2	**Computer science and mechanics laboratory:** *Execution in Matlab of applications using conditional, selection and iterative instructions. Constructing functions in Matlab, handling files, illustrating calculation results in graphs. Solving the task of preparing a logical data model. Verification and documentation of the model. Individual task to design and build a database. Development of user manual and database documentation. Statically loaded beam and space truss calculations using ANSYS Mechanical APDL software. Static calculation of planar and spatial element using ANSYS Workbench software.*	3.0	*IM/ITT*	K_W05 K_W07 K_U01 K_U04 K_U07 K_U09
C.3	**Manufacturing engineering and workshop measurement laboratory:** *Basic knowledge of casting design. Methods of producing castings. Knowledge of the influence of selected parameters of the powder pressing process, as well as the casting process, on selected properties of the manufactured product. Theoretical foundations of metal forming. Methods of manufacturing machine part components by means of plastic forming. Fundamentals of assembly organisation. Knowledge of basic workshop instruments. Ability to take measurements using basic workshop instruments. Basic knowledge of CMMs. Coordinate measurements. Knowledge of thread and gear measurements.*	3.0	*IM*	K_W09 K_W12 K_W13 K_U14
C.4	**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_W08 K_U12 K_U13

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
C.5	**Fundamentals of robotics:** *Robotics as a field of science. The laws of robotics. Classification of robots and manipulators. Basic components of robots and manipulators. Spatial description of robots and manipulators. Coordinate systems and their transformation. Simple and inverse task. Determination of velocities, accelerations, forces and moments of the manipulator. Robot effectors. Classification and characterisation.*	2.0	*AEE*	K_W08 K_U13
C.6	**Electrical Engineering and Electronics 2:** *Analysis of three-phase circuits and non-sinusoidal periodic currents. Fundamentals of electrical filters. Construction and principle of operation of DC and AC electrical machines. Knowledge of the effects of electricity on the human body and the principles of electric shock protection in electrical installations and equipment. Construction and principles of electronic components: unipolar transistors, complex electronic circuits: controlled rectifiers, switching power supplies, A/D and D/A converters. Construction, principle of operation of non-linear systems and their applications.*	5.0	*AEE*	K_W04 K_U10 K_U16
C.7	**Basics of Mechanical Engineering 2:** *Mastering the ability to design machine components and assemblies (also using CAD systems). Issues relating mainly to mechanical components and propulsion systems. Bearings, mechanical transmissions: gears, friction and linkage. Analysis of kinematic systems. Bearing selection, gearbox calculations.*	3.0	*IM*	K_W03 K_W10 K_W11 K_U09 K_U17
C.8	**Digital and microprocessor systems:** *Knowledge of digital information representation and Boolean algebra and basic digital combinatorial and sequential circuits. Architecture elements of processors, semiconductor memories and computers. The practice and tools for programming x51 controllers in assembler and basic digital serial transmission protocols are presented. Basic logic functors (gates) and flip-flops. Typical combinatorial and sequential systems. Classification and organisation of semiconductor memories.*	5.0	*AEE*	K_W04 K_U01 K_U11 K_U18 K_U20
C.9	**CAx basics:** *Design using freeform and parametric modelling systems. Basic information on mechatronic system design and construction notation using computer-aided design systems. An overview of topics related to reverse engineering, measurement and geometric representation of both free and parametric surfaces, computer aided engineering calculations CAE, computer aided manufacturing CAM, incremental manufacturing technology - rapid prototyping and characteristics of the basic methods used in so-called 3D printing.*	5.0	*IM*	K_W07 K_W10 K_W17 K_U18 K_U22
C.10	**Introduction to mechatronics:** *Essence of mechatronics, structures of mechatronic devices. Ways of describing the state of an object and its systems. Image sensors, sound sensors and motion*	4.0	*IM*	K_W04 K_W05 K_U11 K_U12

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	sensors. Signal synthesis systems in mechatronic devices. Sound processing methods. Modelling of image data processing systems. Processing of data from motion sensors, acceleration sensors. Study of algorithms and circuits for digital processing: audio, video. Signal synthesis in mechatronic devices.			
C.11	**Control in mechatronic systems 1:** *Issues related to the analysis, design, commissioning and control of mechatronic systems using pneumatic and hydraulic components. Method of selecting and combining appropriate components to build a given circuit, using theoretical knowledge and dedicated software tools. Mathematical modelling of multidimensional discrete and continuous control objects. Synthesis of linear couplings from the state vector for these objects, general and simplified gyroscope theory.*	3.0	*AEE/IM*	K_W08 K_U07 K_U12 K_U13
C.12	**Optoelectronics:** *Optical radiation spectrum. Basic optical phenomena. Optical radiation sources: LEDs and lasers, thermal and photon detectors, optical fibres, selected applications of optoelectronic techniques. Thermal detectors and their parameters. Night vision and thermal imaging. Thermal and photon detector research.*	4.0	*AEE*	K_W06 K_U10 K_U11
D	**Content group elective education elective subjects**			
	Robotics and industrial automation (RiAP)	**57.0**		
D.a.1	**Control in mechatronic systems 2:** *Issues related to the control of mechatronic systems. Control methods for electric drives and methods of determining parameters for PID and LQ state controllers used in a DC drive. Mathematical modelling of control objects. Control systems in mechatronic systems using electrical actuators.*	3.0	*AEE/IM*	K_W08 K_U07 K_U12 K_U13
D.a.2	**Reliability and operation of mechatronic equipment:** *Reliability indicators. Mathematical models of selected life distributions and time between component failures. Elements, structures, operating rules including prevention and diagnostics. Mechatronic equipment operations management.*	3.0	*IM*	K_W15 K_W16 K_U08 K_U20 K_U21
D.a.3	**Measurements:** *Problems of analogue and digital measuring instruments, computer-aided measurement processes, buses and system interfaces, structure, organisation and software of measuring systems, design methods for industrial measuring systems used in mechatronics.*	3.0	*AEE/IM*	K_W13 K_U16 K_U17
D.a.4	**Programming of mechatronic systems:** *Structured and object-oriented programming in C and C++. Control elements of automation components and basics of microcontroller programming.*	6.0	*ITT*	K_W05 K_U13
D.a.5	**Communication networks in automation:** *Knowledge of communication networks and systems, with particular emphasis on transmission protocols used in industrial automation and robotics. Elements of network performance and coverage calculations. Practice*	5.0	*ITT/AEE*	K_W07 K_U18

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	and tools for configuration and testing of wired and wireless networks.			
D.a.6	**Time management and work organisation:** *Fundamentals of management and work organisation theory. A systems approach in management. Quality management principles. Elements of organisational functioning. Application of the Lean Management approach. Occupational Health and Safety. Occupational risks. Environmental management elements. Standardisation activities*.	3.0	*IM*	K_W14 K_W17 K_W19 K_U17 K_U20 K_U21 K_U23
D.a.7	**Identification and diagnostic methods:** *Identification: definitions, classification, models, signals. Identification of mathematical models of dynamic systems using identification methods. Identification and diagnostic methods. Optimising the diagnosis process. Identification of static and dynamic system models. Use of the method of least squares in an identification task. Indicators of the quality of the diagnosis process*	5.0	*IM*	K_W15 K_U08 K_U12 K_U22
D.a.8	**Digital control systems:** *Design and implementation of digital control algorithms in mechatronic systems. Methods for the design of digital controllers and their implementation in electric robot drives and industrial process control systems.*	6.0	*AEE/IM*	K_W08 K_W12 K_U01 K_U12
D.a.9	**Elements of automation and robotics:** *Introduction to automation and robotics components. Methods of description and systematisation of elements. Controllers and control units used in automation and robotics. PLCs, microcontrollers. Operator panels. Industrial process control algorithms dedicated to the microcontroller platform: PID controller, fuzzy controller and predictive controller - application commissioning and testing. Sensory systems used in automation and robotics. Characteristics, installation and configuration. Industrial vision systems. Mechanisms, feeders, conveyors specialised systems in automation and robotics. Grippers, welding and painting heads used in robotics. Elements of safety systems in automation and robotics. Overview of integrator solutions.*	6.0	*IM*	K_W08 K_U12
D.a.10	**Drives in automation:** *Issues relating to the analysis, design and commissioning of DC and AC drives and electro-pneumatic and hydraulic drives in mechatronic systems. Methods of designing a drive for a specific application and engineering its fabrication, commissioning and testing based on direct examination of the physical model and dedicated software tools. Types of drives used in industrial manipulators and robots. Functional and design elements of linear, fluidic servo drives and actuators.*	3.0	*IM*	K_W10 K_W11 K_U02 K_U12 K_U17 K_U19
D.a.11	**Transition project:** *Issue of interim project topics and formal requirements for passing and editing the interim project. Discussion of issues to be resolved during the course of the project. Reference and discussion of project implementation*	3.0	*IM*	K_U02 K_U03 K_U05 K_U19 K_U21 K_K01

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	concepts. Analysis of the project implementation concept against the achievements presented in the literature on the subject. Referencing and discussion of project results to date. Reference and discussion of the entire interim draft.			
D.a.12	**Programmable controllers:** *Use and programming of freely programmable logic controllers (PLCs) in the programming languages described in IEC 61131-3:* *- in the ST structural language,* *- in the IL instruction list language,* *- in LD ladder language,* *- in the FBD functional block diagram language,* *- in the SFD scheme functional diagram language*	7.0	*AEE/IM*	K_W07 K_W16 K_U11
D.a.13	**Industrial robots:** *The concept of industrial robotics. Construction and classification of industrial robots, components of flexible production lines and the place of industrial robots in flexible production lines. Programming industrial robots in selected programming languages. Methods of programming robots, principles of developing control programmes and methods of testing them.*	4.0	*IM*	K_W08 K_U09
D.b	**Computer techniques in mechatronics (TKwM)**	**57.0**		
D.b.1	**Reliability, durability and operation of facilities:** *Basic concepts. Facilities characteristics. Basic sustainability issues. Basic reliability issues. Optimisation of the facility's reliability structure. Facility renewal. Operation of facilities. Impact of operating conditions on the reliability of facilities. Durability and reliability testing of facilities. Actively improving reliability. Systemic reliability design. The human factor in reliability analysis. Reliability and durability calculations. Reliability analysis design of a selected facility. Project to upgrade operations from a strategy according to planned prevention to a strategy according to technical condition.*	6.0	*IM*	K_W15 K_W16 K_U03 K_U04 K_U20 K_U24
D.b.2	**Object-oriented programming:** *Introduction to object-oriented programming. Arithmetic and logical operators. Objects. Variables and their types and range. Passing a variable by value and reference. Concepts of memory. Control instructions: loops and iterations. Functions: Object attributes. Arrays - declaring, storing and passing to functions. Multidimensional arrays. Ratios. Object classes. Constructor. Inheritance and polymorphism of objects.*	4.0	*ITT*	K_W05 K_W07 K_U13 K_U18
D.b.3	**Process design:** *Design of technological processes for the manufacture of machine parts with emphasis on machining methods. Concepts: rules for the assessment of the technological performance of machine parts, rules for the selection of machining technology, rules for the selection of tools and tooling used in the technological process, rules for the selection of technological parameters. Development of technology documentation in the form of technology sheets and instruction sheets.*	4.0	*IM*	K_W09 K_W15 K_U03 K_U15 K_U23
D.b.4	**Identification and diagnostic methods:**	4.0	*IM*	K_W15

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	Identification: definitions, classification, models, signals. Identification of mathematical models of dynamic systems using identification methods. Identification and diagnostic methods. Optimising the diagnosis process. Identification of static and dynamic system models. Use of the method of least squares in an identification task. Indicators of the quality of the diagnosis process			K_U22 K_U23
D.b.5	**Advanced manufacturing techniques:** *Familiarisation with methods of manufacturing machine parts using advanced manufacturing technologies and with the construction and operation of numerically controlled machine tools, as well as with the basics of their programming.*	5.0	*IM*	K_W09 K_W12 K_W17 K_U14 K_U15
D.b.6	**Design of mechatronic objects:** *Planning the design process for broadly defined mechatronic objects. Basic design management techniques in terms of mechatronic objects. Components of mechatronic objects. Typical processes in mechatronics. Collecting information about the process. Information analysis. Process control. Process modelling and optimisation criteria - process analysis. Functional structure of a mechatronic device. Fundamentals of conceptual design.*	3.0	*IM/AEE*	K_W12 K_W16
D.b.7	**Measurement automation:** *Introduction to issues of experiment automation: from observation to computerised measurement systems, basics of measurement system systematics, system controller and definition of virtual instruments, architecture and organisation of a measurement system, characteristics of basic buses and interfaces, place of measuring instruments and cards in the system, characterisation of the tasks of system components in the context of data processing, controller software, characterisation of programming packages for system tasks and construction of virtual instruments, basics of programming using the graphical programming language, system set-up, programming and start-up of simple control and measurement tasks.*	5.0	*IM/AEE*	K_W12 K_U17 K_U22 K_U23 K_K01
D.b.8	**Computer aided manufacturing:** *Introduction to methods of manual programming of numerically controlled machine tools using parametric programming, sub-programmes and fixed cycles. Designing the workpiece manufacturing process using CAM software.*	6.0	*IM*	K_W09 K_W12 K_U15 K_U18
D.b.9	**Computer aided design:** *Modelling of 3D parts using Solid Works basic and advanced functions. Modelling of welded parts and part assemblies. Development of 2D part and assembly documentation. Kinematic and strength analysis of structures.*	7.0	*IM*	K_W12 K_W15 K_W16 K_U02 K_U14 K_U18 K_U19
D.b.10	**Computer aided exploitation:** *Management support systems versus maintenance support systems in a manufacturing company. State forecasting methods in technology. In-service reliability*	5.0	*IM*	K_W05 K_W12 K_W16 K_W17 K_U04

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	monitoring and forecasting systems. Methods for assessing the durability of complex technical facilities and modifying their operating system. Elements of methodical design of an operations support information system. Design and development of exploitation database applications.			K_U18 K_U21
D.b.11	**Reverse engineering in the design process:** *Coordinate measuring technology for CAD systems. Contact and non-contact measurement methods. Analysis and processing of measurement data. Reverse engineering versus quality control systems. From triangle mesh to NURBS surface model. Modelling geometric objects with free surfaces. From triangle mesh to solid model. Modelling geometric objects with surfaces and parametric solids.*	4.0	*IM*	K_W13 K_W16 K_U16 K_U19
D.b.12	**Management, standardisation and quality systems:** *The essence of management process. The organisation and its place in the environment. The evolution of management science. Managerial roles and competencies. Planning in organisations. Corporate strategy. Decision making. Ethics and corporate social responsibility. Management support systems. Standardisation and its importance in the management of organisations. Quality schemes. Occupational Health and Safety. Risk assessment*	4.0	*IM*	K_W15 K_W17 K_W18 K_W19 K_W20 K_U24
E	**Diploma thesis**	**22.0**		
E.1	**Diploma Seminar:** *Thesis as an analytical-conceptual, design, experimental, review work. Sample thesis topics for all specialities. Ethics and elements of copyright law. The role and uses of technical literature in solving complex technical problems. The role of experimentation in scientific work. Stages of solving and performing a diploma task. Layout and content of the diploma thesis. Technique of writing and editing the diploma thesis. The essence and aims of self-presentation. Techniques for presentation and discussion of thesis results. Presentation and discussion of the ways in which the issues covered in the diploma task, the partial results and the overall engineering project are solved. Preparation for the thesis defence.*	2.0	*IM/AEE/ITT*	K_W18 K_U04 K_U05 K_K01
E.2	**Diploma Thesis:** *Development of an engineering thesis in the field of the chosen diploma specialisation. Presentation and discussion of the ways in which the issues covered in the thesis task, the partial results and the thesis as a whole are resolved. Preparation for the thesis defence.*	20.0	*IM/AEE/ITT*	K_U02 K_U03 K_U04 K_U05 K_U19 K_U21 K_K01
F	**Apprenticeship**	**4.0**		
F.1	**Apprenticeship:** *Practical familiarisation with the range of competences of a mechatronics engineer, carried out in an enterprise, plant, company in the electrical, electronic or mechanical industry. The primary aim of the apprenticeship is for students to acquire skills and experience in accordance*	4.0	*IM/AEE/ITT*	K_U02 K_K02 K_K03

No.	Name of class group Name of subject, short description (outline program)	No of ECTS credits	Discipline code	Reference to field-related outcomes
	with the requirements specified in the teaching standards for the course of study. This objective is achieved through: *1. Familiarising students with the company's operations, structure, production tasks and technical capabilities.* *2. Familiarising students with the equipment used for electronic, electrical and mechanical work.* *Acquisition of the ability to perform basic workshop work by students.*			
Total		**210.0**		

WAYS OF VERIFYING AND ASSESSING LEARNING OUTCOMES[4]

achieved by the student throughout the course of study:

The attainment of the expected outcomes in terms of knowledge and skills will be detailed in the subject information sheets. In general, verification of the achieved learning outcomes takes place taking into account the form of the course and the ways of verifying knowledge and skills adopted for a given form. The learning outcomes achieved by the student during classes requiring direct participation of academic staff and students as part of the core subjects, practical classes (including exercises, laboratory, seminar and project classes), as well as individual tasks and work carried out by the student without the participation of an academic staff member shall be verified.

Verification of the assumed learning outcomes takes place in the form of: examinations (oral and written), graded assessments, general assessments, ongoing answers to control questions, colloquia and tests, individual papers, interim projects.

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 good 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.

In the field of study "mechatronics", it is recommended that the following levels of achievement of the assumed learning outcomes are used when assessing the student:

- the grade of very good [bardzo dobry] is awarded to a student who has achieved the expected learning outcomes of 91-100%,
- the grade of good plus [plus dobry] is awarded to a student who has achieved the expected learning outcomes of 81-90%,
- the grade of good [dobry] is awarded to a student who has achieved the expected learning outcomes of 71-80%,
- the grade of very plus satisfactory [plus dostateczny] is awarded to a student who has achieved the expected learning outcomes of 61-70%,
- the grade of satisfactory [dostateczny] is awarded to a student who has achieved the expected learning outcomes of 51-60%,
- The failing grade [niedostateczny] is awarded to a student who has achieved the expected learning outcomes of 50% or less,

- the grade of general pass [zaliczenie] is awarded to a student who has achieved the expected learning outcomes higher than 50%.
- A general failing grade is awarded to a student who has achieved the expected learning outcomes at a level of 50% or less.

PLAN OF FULL-TIME PROGRAMME - in Appendix 1.

[4]general description - see details on course information sheets

Appendix 1. Plan of full-time programme

Wojskowa Akademia Techniczna

PLAN OF FULL-TIME FIRST-CYCLE STUDIES OF GENERAL ACADEMIC PROFILE

SCIENTIFIC DISCIPLINE (LEADING): MECHANICAL ENGINEERING

MAJOR: MECHATRONICS

Specialisation profiled with elective subjects: 1. Robotics and industrial automation 2. Computer techniques in mechatronics

beginning 2023

	GROUPS OF CLASSES / SUBJECTS	Scientific discipline	total hours/ ECTS		ECTS / shaping scientific skills	ECTS share	including hours:					number of hours/rigour/ ECTS per semester: I		II		III		IV		V		6		VII		administrative organisational unit responsible for the subject	Remarks
			No of hours	ECTS points			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**	**21,0**		**12,5**	**96**	**240**				**186**	**13,0**	**90**	**4,0**	**30**	**2,0**	**30**	**2,0**								
1	Occupational 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	NKF	60					60				30	Zo	30	Zo											SWF	
7	Foreign language	J	120	8,0		5,0		120				30	Zo 2	30	Zo 2	30	Zo 2	30	Zo 2							SJO	
	Foreign language - B2 level exam																		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													Occupational Safety and hygiene	
	Socio-humanities elective subject																										
10	Polish history	H																									
11	Philosophy	F	30	2,0		1,0	16	14						30	Zo 2											WLO	
12	Fundamentals of Music Education																										
	B. Content group of basic education		**688**	**61,0**	**24,0**	**29,0**	**340**	**268**	**80**			**190**	**17,0**	**284**	**26,0**	**214**	**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	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					80	E 6											WTC	
7	Engineering graphics	IM	30	3,0	3,0	1,5	12	18						30	Zo 3											WML/ITL	
8	Computer Science	ITT	30	3,0	2,0	1,5	14	16						30	Zo 3											WML/ITU	
9	Materials Science	IM	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	24	3,0	2,0	1,0	10		14					24	Zo 3											WML/ITR/ITU/ITL	
12	Physics 2	NF	60	4,0		2,0	30	20	10							60	E 4									WTC	
13	Electrical Engineering and Electronics 1	AEE	60	6,0	5,0	3,0	30	14	16							60	E 6									WML/ITR	
14	Technical mechanics	IM	68	6,0	5,0	3,0	34	34								68	E 6									WML/ITU	
15	Strength and Materials Science Laboratory	IM	26	2,0	1,5	1,5			26							26	Zo 2									WML/ITU	
	C. Content group of field-related education																										
	Common content group		**594**	**45,0**	**34,5**	**26,0**	**234**	**158**	**186**	**18**						**144**	**10**	**374**	**28**	**76**	**7**						
1	Basics of Machine Constructions	IM	60	4,0	4,0	2,5	28	32								60	E 4									WML/ITU	
2	Computer science and mechanics laboratory	IM/ITT	44	3,0	2,0	2,0			38	6						44	Zo 3									WML/ITU	
3	Manufacturing engineering and workshop measurement laboratory	IM	40	3,0	2,0	2,0	14		26							40	Zo 3									WML/ITU	
4	Basics of Automation	AEE	44	4,0	2,0	2,0	16	14	14									44	E 4							WML/ITL	
5	Fundamentals of Robotics	AEE	30	2,0	1,5	1,5	12	10	8									30	Zo 2							WML/ITR	
6	Electrical Engineering and Electronics 2	AEE	60	5,0	4,0	2,5	30	14	16									60	E 5							WML/ITR	
7	Basics of Machine Construction 2	IM	30	3,0	2,0	1,5	10	14		6								30	Zo 3							WML/ITU	
8	Digital and Microprocessor Systems	AEE	76	5,0	5,0	3,0	40	20	16									76	E 5							WML/ITR	
9	CAx basics	IM	74	5,0	4,0	3,0	24	24	26									74	Zo 5							WML/ITR	
10	Introduction to mechatronics	IM	60	4,0	3,0	2,5	24	16	14	6								60	E 4							WML/ITR	
11	Control in Mechatronic Systems 1	AEE/IM	30	3,0	2,0	1,5	14	12	4											30	Zo 3					WML/ITR	
12	Optoelectronics	AEE	46	4,0	3,0	2,0	22		24											46	Zo 4					IOE	
	D. Elective content group																										
	A group of elective content profiling in the area: "Robotics and industrial automation"		**678**	**57,0**	**43**	**29,5**	**330**	**162**	**150**	**32**	**4**									**294**	**23,0**	**314**	**30,0**	**70**	**4,0**		
1	Control in Mechatronic Systems 2	AEE/IM	38	3,0	2,5	2,0	16	12	10											38	E 3					WML/ITR	
2	Reliability and operation of mechatronic equipment	IM	46	3,0	2,0	2,0	22	16	8											46	Zo 3					WML/ITR	
3	Measurements	AEE/IM	44	3,0	2,0	2,0	26	10	8											44	Zo 3					WML/ITR	
4	Programming of mechatronic systems	ITT	60	6,0	5,0	2,5	30	12	18											60	E 6					WML/ITR	
5	Communication networks in automation	ITT/AEE	60	5,0	4,0	2,5	30	16	14											60	Zo 5					WML/ITR	
6	Time management and work organisation	IM	46	3,0	1,0	2,0	32	14												46	Zo 3					WML/ITR	
7	Identification and diagnostic methods	IM	60	5,0	3,0	2,5	32	12	16													60	Zo 5			WML/ITR	
8	Digital control systems	AEE/IM	60	6,0	5,0	2,5	26	18	16													60	E 6			WML/ITR	
9	Elements of automation and robotics	IM	68	6,0	5,0	2,5	34	14	10	10												68	E 6			WML/ITR	
10	Drives in automation	IM	30	3,0	2,0	1,5	12	6	12													30	Zo 3			WML/ITR	
11	Interim project	IM	16	3,0	3,0	1,5				16												16	Zo 3			WML/ITR	
12	Programmable controllers	AEE/IM	80	7,0	5,0	3,0	40	18	22													80	E 7			WML/ITR	
13	Industrial robots	IM	70	4,0	3,5	3,0	30	14	16	6	4													70	Zo 4	WML/ITR	
	A group of elective content profiling in the area: "Computer techniques in mechatronics"		**754**	**57,0**	**45,0**	**31**	**244**	**194**	**184**	**102**	**30**									**310**	**23,0**	**364**	**30,0**	**60**	**4,0**		
1	Reliability, durability and operation of objects	IM	90	6,0	5,0	4,0	20	24	20	16	10									90	E 6					WML/ITU	
2	Object-oriented programming	ITT	50	4,0	3,0	2,0	12	12	14	12										50	Zo 4					WML/ITU	
3	Technological process design	IM	60	4,0	4,0	2,5	24	10	18	8										60	Zo 4					WML/ITU	
4	Identification and diagnostic methods	IM	50	4,0	3,0	2,0	28	10	12											50	Zo 4					WML/ITR	
5	Advanced manufacturing techniques	IM	60	5,0	4,0	2,5	24	12	24											60	E 5					WML/ITU	
6	Design of mechatronic objects	IM/AEE	44	3,0	2,0	2,0	20	8		10	6											44	Zo 3			WML/ITU	
7	Measurement automation	IM/AEE	60	5,0	4,0	2,5	28	10	22													60	Zo 5			WML/ITL	
8	Computer aided manufacturing	IM	86	6,0	5,0	3,0	12	18	48	8												86	E 6			WML/ITU	
9	Computer aided design	IM	90	7,0	6,0	3,5	18	52		20												90	E 7			WML/ITU	
10	Computer aided exploitation	IM	60	5,0	4,0	2,5	30	8	14	8												60	E 5			WML/ITU	
11	Reverse engineering in the design process	IM	44	4,0	3,0	2,0	10	12	12	10												44	Zo 4			WML/ITU	
12	Management, standardisation and quality systems	IM	60	4,0	2,0	2,5	18	18		10	14													60	Zo 4	WML/ITU	
	E. Diploma thesis		**30**	**22,0**	**4,0**	**6,0**					**30**											**10**		**20**	**22**		
1	Diploma seminar	IM/AEE/ITT	30	2,0		2,0					30											10	Z	20	Zo 2	WML/ITU/ITR	
2	Diploma paper	IM/AEE/ITT		20,0	4,0	4,0																			Z 20	WML/ITU/ITR	
	F. Apprenticeship			**4,0**		**3,0**	**Completion date**																		**4**		
1	Apprenticeship - 4 weeks	IM/AEE/ITT		4,0		3,0	**after sem. VI.**																	60	Zo 4		
	TOTAL HOURS */ ECTS RiAP		**2326**	**210,0**	**105,5**	**106,0**	**1000**	**826**	**416**	**50**	**34**	**376**	**30,0**	**374**	**30,0**	**388**	**30,0**	**404**	**30,0**	**370**	**30,0**	**324**	**30,0**	**90**	**30,0**		
	TOTAL HOURS */ ECTS TKwM		**2402**	**210,0**	**107,5**	**107,5**	**914**	**858**	**450**	**120**	**60**	**376**	**30,0**	**374**	**30,0**	**388**	**30,0**	**404**	**30,0**	**386**	**30,0**	**394**	**30,0**	**80**	**30,0**		
	acceptable deficit of ECTS (**)											**15**		**18**		**17**		**17**		**15**		**13**		******			
	Types and number of rigours per semester:						number of examinations **E**					**2**		**3**		**4**		**5**		**2**		**3**					
							number of graded credits **Zo**					**10**		**7**		**4**		**4**		**6 / 5**		**3**		**3**			
							number of credits **Z**					**1**										**1**		**1**			
	** In accordance with the Dean's decision on norms and standards of the WML teaching process											Curriculum adopted by .Senat WAT on **„June 22, 2023**															
	Semesters V - VII - education including elective subjects																										
	An additional prerequisite for admission to the diploma examination is proof of skills in a foreign language at B2 level																										

Opinion of the Faculty Self-Government Council

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

OPINION

of the Faculty Education Council

Faculty of Mechatronics, Armament and Aerospace

Military University of Technology

named after Jarosław Dąbrowski

no 13/2023 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 *mechatronics* major valid from the academic year 2023/2024, developed in Polish and English.

Chairman of the meeting

mgr inż. Grzegorz NIKICIUK

(-) [illegible signature]