Wojskowa Akademia Techniczna

Uchwała
Senatu Wojskowej Akademii Technicznej
im. Jarosława Dąbrowskiego

nr 34/WAT/ 2021 z dnia 27 maja 2021 r.

w sprawie ustalenia programów studiów pierwszego stopnia dla kierunków studiów: „lotnictwo i kosmonautyka", „mechatronika", „inżynieria bezpieczeństwa", „inżynieria systemów bezzałogowych"

Na podstawie art. 28 ust. 1 pkt. 11 Ustawy z dnia 20 lipca 2018 r. - Prawo o szkolnictwie wyższym i nauce (Dz. U. z 2021 r., poz. 478, z późn. zm.), oraz § 21ust. 1 pkt 21 i § 81 ust 10 i 11 Statutu WAT stanowiącego załącznik do uchwały Senatu WAT nr 16/WAT/ 2019 z dnia 25 kwietnia 2019 r., w sprawie uchwalenia Statutu Wojskowej Akademii technicznej im. Jarosława Dąbrowskiego (tj. obwieszczenie Rektora WAT nr 2/WAT/2019 z dnia 9 października 2019 r.), po zasięgnięciu opinii samorządu studenckiego uchwala się, co następuje:

§ 1

Ustala się programy studiów pierwszego stopnia o profilu ogólnoakademickim , rozpoczynających się od roku akademickiego 2021/2022, dla następujących kierunków studiów:

1) „lotnictwo i kosmonautyka" – w języku polskim i angielskim stanowiący załącznik nr 1 do uchwały;
2) „mechatronika" – w języku polskim i angielskim stanowiący załącznik nr 2 do uchwały;
3) „inżynieria bezpieczeństwa" – stanowiący załącznik nr 3 do uchwały;
4) „inżynieria systemów bezzałogowych"- stanowiący załącznik nr 4 do uchwały.

§ 2

Uchwała wchodzi w życie z dniem podjęcia.

Przewodniczący Senatu

(-) płk prof. dr hab. inż. Przemysław WACHULAK

Annex 1
To the Resolution of the Senate of the MUT
No. 34/WAT/2021
Dated: 27 maja 2021

MILITARY UNIVERSITY OF TECHNOLOGY named after Jarosław Dąbrowski

CURRICULUM

Level of education: a first-cycle programme

Field of study: Mechatronics

Resolution of the Senate of the Military University of Technology named after Jarosław Dąbrowski No. 34/WAT/2021 of. 27 maja 2021 r. on the establishment of the curriculum for the field of study "Mechatronics"

Effective from the academic year 2021/2022

Warsaw

2021

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CURRICULUM

for the field of study "Mechatronics"

Level of education: first-cycle programme

Profile of study: general academic

Mode(s) of study: full-time programme

Qualification and title conferred on graduates: engineer

Polish Qualification Framework level: 6

Field of study assigned to:

Field of science	engineering and technology
Scientific discipline	mechanical engineering, 60% ECTS credits
Field of science	engineering and technology
Scientific discipline	automation, electronics and electrical engineering, 30% ECTS credits
Field of science	engineering and technology
Scientific discipline	information and communication technology, 10% ECTS credits

Leading discipline: mechanical engineering

Language of instruction: English

Number of semesters: 7

Total number of hours:

Robotics and industrial automation	2322
Computer techniques in mechatronics	2392

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:	105.5.
Computer techniques in mechatronics:	107.0

- in the humanities and social sciences: 18

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 complete their apprenticeship in national economy enterprises. Apprenticeship in representative and appropriate for a given field of study national economy enterprises is carried out on based on a bilateral agreement on student apprenticeships and apprenticeships 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.

Description of the intended 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 term 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, skills, social competence;
  - 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, where X means elaboration of the description for the field of education:
  a) **T** – in the scope of technical sciences,
  b) **Inż** - engineering competence,
  c) no **X** - reference to characteristics without elaboration of the description for the field of study.

Symbol and outcome number	Description of intended learning outcomes	Code of description component
	KNOWLEDGE The graduate:	
K_W01	has knowledge of mathematics encompassing algebra, analysis, probability theory and elements of numerical methods necessary to: 4) describe and analyse the operation of mechatronic components, circuits, devices and systems; 5) describe and analyse the signal processing algorithms; 6) synthesize the mechatronic components, circuits, devices and systems	P6S_WG
K_W02	has knowledge of physics encompassing mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including knowledge necessary to understand basic physical phenomena occurring in mechatronic components and systems and in their environment	P6S_WG
K_W03	has well-structured and theoretically grounded knowledge of mechanics encompassing: statics, fundamentals of materials strength, kinematics, dynamics, fundamentals of vibration theory, fluid mechanics, allowing for solving typical engineering problems when designing, manufacturing and operating mechatronic devices	P6S_WG Eng._P6S_WG
K_W04	has well-structured and theoretically grounded knowledge of electrical engineering, analogue and digital electronics, allowing for incorporation of electrical and electronic components and circuits into a mechatronic circuit, device or system	P6S_WG Eng._P6S_WG
K_W05	has well-structured knowledge of computer architecture, algorithmisation, programming methodology and techniques, and database construction	P6S_WG Eng._P6S_WG
K_W06	has basic knowledge of optoelectronic components and circuits	P6S_WG

		Eng._P6S_WG
K_W07	has elementary knowledge of system architecture and computer networks and operating systems, necessary to install, operate and maintain IT tools for designing, engineering calculations and manufacturing mechatronic components, circuits and systems	P6S_WG Eng._P6S_WG
K_W08	has well-structured knowledge of automation with elements of robotics and control theory related to mechatronic circuits and systems	P6S_WG Eng._P6S_WG
K_W09	has basic knowledge of material structure and engineering of manufacturing of mechanical components	P6S_WG Eng._P6S_WG
K_W10	has basic knowledge concerning the design notation of mechatronic systems and devices as well as simulation of their operation using specialised software	P6S_WG Eng._P6S_WG
K_W11	has basic knowledge of the machinery construction used in mechatronic systems	P6S_WG Eng._P6S_WG
K_W12	has a well-structured knowledge of the application areas of advanced tools supporting the design, manufacturing and operational process	P6S_WG Eng._P6S_WG
K_W13	has basic knowledge of metrology of electrical and non-electrical quantities	P6S_WG Eng._P6S_WG
K_W14	has basic knowledge necessary to understand non-technical conditions of engineering activity, knows basic health and safety rules at work with mechatronic devices	P6S_WK Eng._P6S_WG
K_W15	has elementary knowledge of the life cycle of mechatronic devices and systems	P6S_WG Eng._P6S_WG
K_W16	has basic knowledge of the methods of taking into account at the design stage: basic quality indicators of devices and mechatronic systems such as reliability, durability, readiness and safety as well as operation strategies	P6S_WG Eng._P6S_WG
K_W17	has elementary knowledge of management, including quality management and business management, as well as computer-aided management	P6S_WK Eng._P6S_WK
K_W18	has elementary knowledge of protection of intellectual property and patent law	P6S_WK
K_W19	knows the general principles of creation and development of forms of individual entrepreneurship using knowledge from mechatronics	P6S_WK Eng._P6S_WK

K_W20	knows and understands the nature, place and importance of the social sciences and humanities and their relation 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, as well as formulate and justify opinions	P6S_UW
K_U02	is able to work independently or in a team; can estimate time required for task completion; is able to develop and implement a work schedule to meet deadlines	P6S_UO
K_U03	is able to prepare documentation for an engineering task and prepare a text discussing the results of an engineering task	P6S_UK
K_U04	is able to prepare a note and give a short presentation on an engineering task	P6S_UK
K_U05	is able to self-educate and plan to improve professional competences	P6S_UU
K_U06	is able to use a foreign language at B2 level of the Common European Framework of Reference for Languages, sufficiently enough to communicate and read technical texts with comprehension	P6S_UK
K_U07	Is able to apply a mathematical apparatus appropriate to the disciplines of science taught within the mechatronics field, can solve basic mathematical problems occurring in the process of designing mechatronic circuits	P6S_UW
K_U08	is able to identify physical phenomena occurring in mechatronic circuits	P6S_UW Eng_P6S_UW
K_U09	is able to make strength calculations for structural elements and determine acceleration and speed of machine elements; can perform measurements of basic strength properties of materials	P6S_UW Eng_P6S_UW
K_U10	is able to design and analyse electrical circuits	P6S_UW Eng_P6S_UW
K_U11	is able to design and analyse simple electronic circuits and systems, including simple digital signal processing systems	P6S_UW Eng_P6S_UW
K_U12	is able to formulate and solve simple engineering tasks related to control systems, can design and analyse simple automation systems	P6S_UW Eng_P6S_UW
K_U13	is able to develop an algorithm, use high and low level programming languages and appropriate IT tools to develop computer	P6S_UW

	software to simulate the operation or control of mechatronic devices	Eng_P6S_UW
K_U14	is able to select materials at designing, manufacturing and operating of mechatronic devices	P6S_UW Eng_P6S_UW
K_U15	is able to design elementary technological processes of manufacturing of mechatronic devices	P6S_UW Eng_P6S_UW
K_U16	is able to plan an experiment, knows how to use instruments to measure basic mechanical and electrical quantities and how to choose an instrument or measurement method according to a specific criterion, knows how to carry out a statistical analysis of the experiment's results	P6S_UW Eng_P6S_UW
K_U17	is able to use data sheets, instructions written in Polish and foreign languages in order to select an appropriate mechatronic component or circuit	P6S_UW Eng_P6S_UW
K_U18	is able to use appropriate programming environments, simulators and tools for computer aided design, manufacture and operation of mechatronic devices	P6S_UW Eng_P6S_UW
K_U19	is able to design a mechatronic circuit, device and system taking into account utilisation and economic criteria, using appropriate methods, techniques and tools	P6S_UW Eng_P6S_UW
K_U20	is able to carry out performance analysis and critically evaluate the functioning of a component and plan the testing process of an element, circuit, simple system in order to determine its characteristics or detect errors	P6S_UW Eng_P6S_UW
K_U21	is able to plan and supervise the operation of mechatronic devices	P6S_UW Eng_P6S_UW
K_U22	is able to perceive system and non-technical aspects in formulating and solving engineering tasks	P6S_UW Eng_P6S_UW
K_U23	has basic preparation for work in an industrial environment and knows the occupational health and safety rules related to this work	P6S_UO
K_U24	is able to identify and interpret the 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/her knowledge and recognise the importance of knowledge in solving cognitive and practical problems	P6S_KK

K_K02	is ready to fulfil social obligations, co-organise activities in the public interest, initiate action in the public interest and think and act in an entrepreneurial way	P6S_KO
K_K03	is ready to fulfil professional roles responsibly, in particular to comply with the rules of professional ethics and to require others to do so, as well as to care for the achievements and traditions of the profession.	P6S_KR

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 the class group Name of subject: short description (outline program)	No. of ECTS credits	Discipline code	Reference to field-related outcomes
A	**Content group 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 of modern studying. Methods and techniques of effective learning. Modern techniques supporting the process of studying.*	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. A lecture activating students with simultaneous presentation of examples referring to the best practices of management and entrepreneurship. Exercises prepared in the form of: case studies, audiovisual presentations, solutions and presentations prepared by students.*	3.0	*SNF*	K_W19 K_U23 K_K02
A.4	**Selected issues of law:** *Introductory issues. Individual acts and normative acts. The notion and course of the law application process. The sources of international law and European Union law. The concept of legal relationship. Legal acts and other civil law acts. 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.*	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

	Standards, formats and 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 languages.			
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: revision, expansion and systematisation of the following topics: grammatical tenses/ tenses of narration; active/passive voice; dependent speech; conditionals; question formation; collocations; compound sentences; word order in a sentence; modal verbs; phrasal verbs. Conceptual-functional material: requests; suggestions; offers; advice; consent/refusal; negations; agree/disagree; expressing opinion, cause/effect; reason/purpose; wishes, apology; summary; choice of register/style.*	8.0	*J*	K_U05
A. 8	**Poland 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 monarchs, the era of partitions, regaining independence in 1918 and the history of the Polish state in the inter-war period, World War II and afterwards.*	2.0	*H*	K_W20
A. 9	**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. 10	**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.*			
B	**Content group of basic education core subjects**	**60.0**		
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*	2.0	*AEE*	K_W04 K_U18

	of basic measurement methods. The structure and purpose of basic standards and measurement instruments of physical quantities. Errors and uncertainty of measurement			
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 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
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 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*	K_W10

B. 8	**Computer Science:** *Basic concepts of computer science. Algorithmisation of data processing tasks. Fundamentals of programming in a high-level language. Management support software using databases. Database functions. Database 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 a 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_W09 K_W12 K_U14 K_U23
B. 11	**Metrology:** *Digital measurement technology - introduction. Analogue and digital instruments for measuring electrical quantities. Analog vs. digital oscilloscope. Measurements of electrical quantities. Geometric measurements. Measurement of non-electrical quantities by electrical methods. Measuring transducers in mechatronic systems. Digital measurement 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:** *Electrical circuits of direct and alternating current. Methods of analysis and design and determination of basic parameters and characteristics. Principle of operation of selected DC and AC machines. Basic electronic components and systems, their parameters and characteristics. Performing electrical measurements in*	6.0	*AEE*	K_W04 K_U10 K_U11 K_U16

	electronic circuits and systems to determine the parameters and characteristics. Drawing up appropriate reports on the conducted measurements.			
B.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.*	5.0	*IM*	K_W03 K_U08 K_U09 K_U17 K_K03
B.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 compressing 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*	K_U09 K_U14
C	**Content group of field-related education field-related subjects**	**46.0**		
C. 1	**Fundamentals of Machine Design:** *Mastering the skills of designing elements and structural assemblies of machines, issues related to fatigue strength of components and structural assemblies of machines and tribology issues*	5.0	*IM*	K_W11 K_W14 K_U15 K_U16 K_K02
C. 2	**Computer science and mechanics laboratory:** *Developing applications in Matlab using conditional, selection and iterative instructions. Constructing the functions in Matlab, using files, illustrating calculation results on graphs. Solving tasks of preparing a logical model of data. Verifying and documenting a model. Individual task of designing and building a database. Developing the user manual and documentation of a database. Calculating statically loaded beam and spatial truss using ANSYS Mechanical APDL software. Statically loaded planar and spatial element calculations using ANSYS Workbench software.*	3.0	*IM/ITT*	K_W05 K_W07 K_U01 K_U04 K_U07 K_U09

C. 3	**Laboratory of manufacturing engineering and workshop measurements:** *Basic knowledge of the casting design. Methods of castings manufacturing. Knowledge of effect of selected parameters of the powder pressing process as well as the casting making process on selected properties of the manufactured product. Theoretical basis of plastic processing. Methods of producing machine parts by plastic forming. Basics of assembly organisation. Knowledge of basic workshop instruments. Ability to take measurements using basic workshop instruments. Basic knowledge of coordinate measuring machines. 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
C.5	**Fundamentals of Robotics:** *Robotics as a field of science. Laws of robotics. Classification of robots and manipulators. Basic elements 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 a manipulator. Robot effectors. Classification and characteristic.*	2.0	*AEE*	K_W08 K_U13
C.6	**Electrical Engineering and Electronics 2:** *Analysis of three-phase circuits and non-sinusoidal periodic currents. Basics of electrical filters. Construction and principles of operation of electrical machines of direct and alternating current. Knowledge of the effects of electric current on the human body and the principles of protection against electric shock in electric installations and equipment. Construction and principles of operation of electronic components: unipolar transistors, complex electronic circuits: controlled rectifiers, switch mode power supplies, A/C and D/A converters. Construction, principle of operation of non-linear circuits and their application.*	5.0	*AEE*	K_W04 K_U10 K_U16
C.7	**Fundamentals of Machine Design 2:** *Mastering the skills of designing the elements and constructional assemblies of machines (also using CAD systems). Issues related mainly to mechanical components and power units. Bearings, mechanical transmissions: gears, friction, flexible-connection. Analysis of*	3.0	*IM*	K_W03 K_W10 K_W11 K_U09 K_U17

	kinematic systems. Analysis of kinematic systems. Selection of bearings, transmission calculations.			
C. 8	**Digital and Microprocessor Circuits:** *Knowledge of digital information representation and Boolean algebra and basic digital combinatorial and sequential circuits. Elements of architecture of processors, memories of semiconductor and computers. Presenting practice and tools for programming x51 controllers in assembler and basic protocols of digital serial transmission. Basic logic functors (gates) and flip-flops. Typical combinational and sequential circuits. Classification and organisation of semiconductor memories.*	5.0	*AEE*	K_W04 K_U01 K_U11 K_U18 K_U20
C. 9	**Fundamentals of Cax:** *Designing using free and parametric modelling systems. Basic information on mechatronic systems design and construction notation using computer-aided design systems. Overview of issues 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 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. Methods of describing the state of an object and its systems. Image sensors, sound sensors and motion sensors. Signal synthesis systems in mechatronic devices. Sound processing methods. Modelling of image data processing systems. Processing of data from motion sensors, acceleration sensors. Research of algorithms and systems of digital processing: sound, image. Signal synthesis in mechatronic devices.*	4.0	*IM*	K_W04 K_W05 K_U11 K_U12
C. 11	**Control in Mechatronic Systems:** *Issues related to the analysis, design, activating and control of mechatronic systems using pneumatic and hydraulic components. Selecting and combining appropriate elements to build a given system, using theoretical knowledge and dedicated software tools. Mathematical modelling of discrete and continuous multidimensional 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:** *Spectrum of optical radiation. Basic optical phenomena. Sources of optical radiation: LEDs and lasers, thermal and photon detectors, optical fibres, selected applications of optoelectronic techniques. Thermal detectors and their parameters. Noctovision and thermovision. Research on thermal and photon detectors.*	4.0	*AEE*	K_W06 K_U10 K_U11
D	**Content group of elective subjects Elective subjects**			
	Robotics and industrial automation	**57.0**		
D.a.1	**Control in Mechatronic Systems 2:** *Issues related to the control of mechatronic systems. Methods of controlling electric drives and methods of determining parameters for PID and LQ state controllers used in in DC drives. Mathematical modelling of control*	3,0	*AEE/IM*	K_W08 K_U07 K_U12 K_U13

	objects. Control systems in mechatronic systems using electric actuators.			
D.a.2	**Reliability and operation of mechatronic devices:** *Reliability indicators. Mathematical models of selected distributions of durability and time between failures of an element. Elements, structures, operation rules including prevention and diagnostics. Management of mechatronic devices operation.*	3.0	*IM*	K_W15 K_W16 K_U08 K_U20 K_U21
D.a.3	**Surveying:** *Issues related to analogue and digital measuring instruments, computer aided measuring processes, system buses and 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:** *Structural and object-oriented programming in C and C++ language. 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 calculation of network parameters and ranges. Practices and tools for configuration and testing of wired and wireless networks.*	5.0	*ITT/AEE*	K_W07 K_U18
D.a.6	**Management and occupational organization:** *Fundamentals of management theory and work organisation. Systemic approach in management. Principles of quality management. Elements of organisation functioning. Application of Lean Management approach. Health and Safety at work. Occupational risk. Elements of environmental management. Standardization activities*.	3.0	*IM*	K_W14 K_W17 K_W19 K_U17 K_U20 K_U21 K_U23
D.a. 7	**Methods of identification and diagnostics:** *Identification: definitions, classification, models, signals. Identification of mathematical models of dynamic systems using identification methods. Identification and diagnostic methods. Optimisation of the diagnostic process. Identification of static and dynamic systems models. Using of least squares method in identification task. Quality indicators of the diagnostic 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 of designing digital controllers and their implementation in electric drives of robots and in control systems of industrial process.*	6,0	*AEE/IM*	K_W08 K_W12 K_U01 K_U12
D.a.9	**Elements of automation and robotics:** *Introduction to elements of automation and robotics. Methods of description and systematics of elements. Controllers and control units used in automation and robotics. PLC controllers, microcontrollers. Operator panels. Algorithms of regulation of industrial processes dedicated to microcontroller platform: PID controller, fuzzy and predictive controller - starting and testing an application. Sensor 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.*	6.0	*IM*	K_W08 K_U12

	Safety systems elements in automation and robotics. Overview of integrator solutions.			
D.a.10	**Drives in automatic:** *Issues related to the analysis, design and starting of DC and AC drives and electro-pneumatic and hydraulic drives in mechatronic systems. Methods of drive design for a specific application and its engineering, starting and testing based on direct examination of the physical model and dedicated tool programmes. Types of drives used in industrial manipulators and robots. Functional and design elements of servo drives and linear and fluid drives.*	3.0	*IM*	K_W10 K_W11 K_U02 K_U12 K_U17 K_U19
D.a.11	**Interim project:** *Providing topics for interim projects and formal requirements for passing and editing the interim project. Discussing the issues to be resolved while carrying out the project. Referring to and discussing of concepts of project execution. Analysing the project concept against the background of the achievements presented in the literature on the subject. Referring to and discussing the results of the project execution to date. Referring to and discussing the results of the entire project.*	3.0	*IM*	K_U02 K_U03 K_U05 K_U19 K_U21 K_K01
D.a.12	**Programmable Logic Controllers:** *Using and programming of freely programmable logic controllers (PLC) in the programming languages described in IEC 61131-3:* *- in the structural language ST,* *- in the IL instruction list language,* *- in the LD ladder language,* *- in FBD functional block diagram language,* *- in the SDF sequential block 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 place of industrial robots in flexible production lines. Programming of industrial robots in selected programming languages. Methods of robot programming, principles of developing the control programs and methods of their testing.*	4.0	*IM*	K_W08 K_U09
D.b	**Computer technology in mechatronics**	**57.0**		
D.b.1	**Reliability, durability and maintenance of objects:** *Basic concepts. Characteristics of objects. Basic durability issues. Basic reliability issues. Optimisation of reliability structure of an object. Renewal of objects. Operation of objects. Effects of operation conditions on reliability of objects. Testing of durability and reliability of objects. Active reliability improvement. Systemic development of reliability. Human factor in reliability analysis. Reliability and durability calculations. Reliability analysis design of a selected object. Design of modernization of operation from the strategy according to planned prevention to the 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 scope. Passing a variable by value and reference. Concepts of memory. Control instructions: loops and iterations. Functions. Attributes of objects. Arrays - declaring, storing and passing to functions.*	4.0	*ITT*	K_W05 K_W07 K_U13 K_U18

	Multidimensional arrays. Pointers. Object classes. Constructor. Inheritance and polymorphism of objects.			
D.b.3	**Designing of technological processes:** *Designing of technological processes for the manufacture of machine parts with emphasis on removal machining methods. Concepts: principles of the assessment of the technological performance of machine parts, principles of the selection of machining technologies, principles of selection of tools and instrumentation used in the technological process, rules of selection of technological parameters. Developing of technological documentation in the form of technological sheets and instruction sheets.*	4.0	*IM*	K_W09 K_W15 K_U03 K_U15 K_U23
D.b.4	**Methods of identification and diagnostics:** *Identification: definitions, classification, models, signals. Identification of mathematical models of dynamic systems using identification methods. Identification and diagnostic methods. Optimisation of the diagnostic process. Identification of static and dynamic system models. Using of least squares method in identification task. Quality indicators of the diagnostic process.*	4.0	*IM*	K_W15 K_U22 K_U23
D.b.5	**Advanced manufacturing techniques:** *Learning the methods of manufacturing the machine parts using advanced manufacturing technologies and the construction and operation of numerically controlled machine tools, as well as 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 designing process for broadly understood mechatronic objects. Basic techniques of project management related to mechatronic objects. Components of mechatronic objects. Typical processes in mechatronics. Collecting information about the process. Information analysis. Process control. Process modelling and optimization criteria - process analysis. Functional structure of 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 systems systematics, system controller and virtual instruments definition, system architecture and organisation of the measurement system, characteristics of the basic buses and interfaces, place of instruments and measurement cards in the system, characteristics of the tasks of the system elements in the context of data processing, controller software, characteristics of the system task programming packages and construction of virtual instruments, basics of programming using the graphical programming language, system configuration, programming and starting 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:** *Learning the methods of manual programming of numerically controlled machine tools using parametric programming, subroutines and fixed cycles. Designing the manufacturing process of a workpiece using CAM software.*	6.0	*IM*	K_W09 K_W12 K_U15 K_U18
D.b.9	**Computer aided design:**	7.0	*IM*	K_W12 K_W15

	Modelling of 3D parts using Solid Works basic and advanced functions. Modelling of welded parts and assemblies of parts. Developing of 2D documentation of parts and assemblies. Kinematical and strength analysis of the structure.			K_W16 K_U02 K_U14 K_U18 K_U19
D.b.10	**Computerised maintenance management system:** *Management support systems vs. maintenance management systems in a manufacturing company. Methods of condition forecasting in technology. Systems of monitoring and predicting reliability in operation. Methods of assessing durability of complex technical objects and modification of their operation system. Elements of methodical design of computer system supporting operation. Design and development of operation database applications.*	5.0	*IM*	K_W05 K_W12 K_W16 K_W17 K_U04 K_U18 K_U21
D.b.11	**Reverse engineering in design process:** *Coordinate measuring technology for CAD systems. Contact and non-contact measuring methods. Analysis and processing of measurement data. Reverse engineering and quality control systems. From triangle meshes to NURBS surface models. Modelling of geometrical objects with free surfaces. From triangle meshes to solid models. Modelling of geometric objects with parametric surfaces and solids.*	4.0	*IM*	K_W13 K_W16 K_U16 K_U19
D.b.12	**Management, standardization and quality systems:** *Essence of the management process. Organisation and its place in environment. Evolution of management sciences. Roles and competences of managers. Planning in organization. Corporate strategy. Decision making. Ethics and social responsibility of business. Management support systems. Standardization and its meaning in organizations management. Quality systems. Health and safety at work. 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:** *Diploma thesis as an analytical and conceptual, design, experimental and review work. Sample topics for diploma theses for all specialties. Ethics and elements of copyright law. The role and methods of using technical literature in solving complex technical issues. The role of experiment 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. Essence and purposes of self-presentation. Techniques of presentation and discussion of thesis results. Presentation and discussion of solutions to issues included in the diploma task, partial results and the entire engineering project. Preparing for the diploma thesis defense.*	2.0	*IM/AEE/ITT*	K_W18 K_U04 K_U05 K_K01
E.2	**Diploma Thesis:** *Developing an engineering thesis in the field of the chosen diploma specialization. Presenting and discussing the manners of solving the issues included in the diploma task, partial results and the entire diploma thesis. Preparing for the defense of the diploma thesis.*	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:**	4.0	*IM/AEE/ITT*	K_U02 K_K02

	Practical learning of the competences of a mechatronics engineer, carried out in an enterprise, plant, company in the field of electrical, electronic or mechanical engineering *The main goal of the apprenticeship is for students to gain skills and experience in accordance with the requirements set out in the teaching standards for the field of study. This objective is achieved through:* *3. Familiarising students with the activities of the company, its structure, production objectives and technical capabilities.* *4. Familiarising students with the equipment used for electronic, electrical and mechanical work.* *Acquiring by students the skills to perform basic workshop work.*			K_K03
Total		**210.0**		

Methods of verification and assessment of learning outcomes[4] achieved by the student during the entire cycle of education:

Achievement of intended outcomes in the category of knowledge and skills will be specified in detail in the course information sheets. In general, verification of the achieved learning outcomes is carried out taking into account the form of the course and the methods of knowledge and skills verification adopted for a given form. 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.

Plan of a full-time programme - in Appendix 1.

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

Wojskowa Akademia Techniczna

PLAN OF FULL-TIME AND FIRST CYCLE "ENGINEERING" STUDIES OF GENERAL ACADEMIC PROFILE

SCIENTIFIC DISCIPLINE (LEADING) MECHANICAL ENGINEERING

FIELD OF STUDY – MECHATRONICS

Specialisations profiled by elective subjects: 1. robotics and industrial automation 2. computer techniques in mechatronics

beginning of 2021

	GROUPS OF CLASSES / SUBJECTS		Scientific discipline	Hours total/ ECTS		ECTS / scientific skills	ECTS udział NA	including hours:					Number of hours/regime/ECTS in semester														the organisational unit of administration responsible for the subject	Notes
													I		II		III		IV		V		VI		VII			
				Hours	ECTS			lecture	practical class.	lab.	project	semin.	hours	ECTS	hours	ECTS	hours	ECTS	hours	ECTS	hours	ECTS	hours	ECTS	hours	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	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													Pełnomocnik ds. Jakości	
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	8.0		5.0		120				30	Zo 2	30	Zo 2	30	Zo 2	30	Zo 2							SJO	
	Foreign language - Examination B2																			E							SJO	
8	Poland History		H	30	2.0		1.0	16	14						30	Zo 2											WLO	
9	Protection of intellectual property		NP	14	1.5		1.0	12	2				14	Zo 1.5													WLO	
10	Occupational health and safety			4				4					4	Z													BHP	
	B. Content group of general education			**684**	**61.0**	**24.0**	**29.0**	**346**	**272**	**66**			**190**	**17.0**	**280**	**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		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 1		AEE	20	3.0	2.0	1.0	16	4						20	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	60	6.0	5.0	3.0	30	14	16							60	E 6									WML/ITR	
14	Engineering 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																											
	Group of common content			**594**	**45.0**	**34.5**	**26.0**	**230**	**156**	**190**	**18**						**144**	**10**	**374**	**28**	**76**	**7**						
1	Fundamentals of Machine Design		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	Laboratory of manufacturing engineering and workshop measurements		IM	40	3.0	2.0	2.0	10		30							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	Fundamentals of Machine Design 2		IM	30	3.0	2.0	1.5	10	14		6								30	Zo 3							WML/ITU	
8	Digital and Microprocessor Circuits		AEE	76	5.0	5.0	3.0	40	20	16									76	E 5							WML/ITR	
9	Fundamentals of Cax		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		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																											
	Content group for the specialization "Robotics and Industrial Automation"			**678**	**57.0**	**42**	**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 devices		IM	46	3.0	2.0	2.0	22	16	8											46	Zo 3					WML/ITR	
3	Surveying		AEE/IM	44	3.0	2.0	2.0	26	10	8											44	Zo 3					WML/ITR	
4	Programing of mechatronics system		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	Management and occupational organization		IM	46	3.0		2.0	32	14												46	Zo 3					WML/ITR	
7	Methods of identyfication and diagnostics		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	Drivers in automatic		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 Logic 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	
	Content group for the specialization"Computer techniques in mechatronics"			**748**	**57.0**	**45.0**	**31**	**268**	**180**	**184**	**86**	**30**									**310**	**23.0**	**378**	**30.0**	**60**	**4.0**		
1	Reliability, durability and maintenance objects		IM	90	6.0	5.0	4.0	26	24	20	10	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	Designing of technological proceses		IM	60	4.0	4.0	2.5	24	10	18	8										60	Zo 4					WML/ITU	
4	Methods of identyfication and diagnostics		IM	50	4.0	3.0	2.0	28	10	12											50	Zo 4					WML/ITR	
5	Advanced manufacturig 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	80	6.0	5.0	3.0	16	8	48	8												80	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	Computerised maintenance management system		IM	60	5.0	4.0	2.5	30	8	14	8												60	E 5			WML/ITU	
11	Reverse engineering in design process	Reverse e	IM	44	4.0	3.0	2.0	10	12	12	10												44	Zo 4			WML/ITU	
12	Management, standardization and quality systems		IM	60	4.0	2.0	2.5	32	14			14													60	Zo 4	WML/ITU	
	E. Dploma 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 THESIS		IM/AEE/ITT		20.0	4.0	4.0																			Z 20	WML/ITU/ITR	
	F. Apprenticeship				**4.0**		**3.0**																				**4**	
1	Apprenticeship - 4 weeks		IM/AEE/ITT		4.0		3.0																			Zo 4		
	TOTAL HOURS * / ECTS RiAP			**2322**	**210.0**	**104.5**	**106.0**	**1002**	**830**	**406**	**50**	**34**	**376**	**30.0**	**370**	**30.0**	**388**	**30.0**	**404**	**30.0**	**370**	**30.0**	**324**	**30.0**	**90**	**30.0**		
	TOTAL HOURS * / ECTS TKwM			**2392**	**210.0**	**107.5**	**107.5**	**940**	**848**	**440**	**104**	**60**	**376**	**30.0**	**370**	**30.0**	**388**	**30.0**	**404**	**30.0**	**386**	**30.0**	**388**	**30.0**	**80**	**30.0**		
	admissible deficit of ECTS credits (**)												**11**		**		**		**		**		**		**			
	Types and number of assessments in semester:								number of exams **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			
	ance with the decision of the WML Dean concerning the norms and standards of the didac												**Curriculum adopted by Senat WAT date 27 maja 2021 r.**															
	Semesters V - VII - education including elective subjects																											
	Additional condition for admission to the diploma examination is confrmed knowledge of a foreign language at B2 level.																											

I hereby certify the compliance of the above translation with the original document in Polish. ----------

Monika Janik, a certified translator of the English language, entered onto the List of Certified Translators held by the Minister of Justice, entry No TP 139/13 ----------

Rep. No ---------- 162/2021

Warsaw, 18 May 2021----------

(STRONA CELOWO POZOSTAWIONA PUSTA)

WYDZIAŁOWA RADA
SAMORZĄDU WYDZIAŁU
MECHATRONIKI UZBROJENIA I
LOTNICTWA WAT

Warszawa, 15 kwietnia 2021 r.

Przewodniczący

Wydziałowej Rady ds. Kształcenia

Dr inż. Zdzisław ROCHALA

Dotyczy: zaopiniowania programów studiów.

Wydziałowa Rada Samorządu, po dokonaniu analizy przedstawionych programów studiów, postanowiła pozytywnie zaopiniować „Programy studiów inżynierskich" o profilu ogólnoakademickim, rozpoczynających się od 1 października roku akademickiego 2021/2022

nw. kierunków studiów:

- „lotnictwo i kosmonautyka";
- „mechatronika";
- „inżynieria bezpieczeństwa";
- „inżynieria systemów bezzałogowych".

Za Samorząd WBS WML
Przewodnicząca

Aneta Misiak

Aneta MISIAK

OPINIA

Wydziałowej Rady ds. Kształcenia
Wydziału Mechatroniki, Uzbrojenia i Lotnictwa
Wojskowej Akademii Technicznej
im. Jarosława Dąbrowskiego

nr 13/2021 z dnia 28 kwietnia 2021 r.

w sprawie opracowania projektu programu studiów I stopnia

Wydziałowa Rada ds. Kształcenia Wydziału Mechatroniki, Uzbrojenia i Lotnictwa Wojskowej Akademii Technicznej pozytywnie opiniuje projekt programu studiów I stopnia dla kierunku *mechatronika* obowiązujący od roku akademickiego 2020/2021, opracowany w języku polskim i języku angielskim.

Przewodniczący

dr inż. Zdzisław ROCHALA, prof. WAT

Wojskowa
Akademia
Techniczna

Uchwała
Rady Dyscypliny Naukowej „Inżynieria Mechaniczna"
Wojskowej Akademii Technicznej
im. Jarosława Dąbrowskiego

nr 18/RDN IM/2021 z dnia 19 maja 2021 r.

w sprawie zaopiniowania projektu programu studiów I stopnia na kierunku „mechatronika", opracowany w języku polskim i w języku angielskim

Na podstawie § 25 ust. 1 pkt 13 Statutu WAT, stanowiącego załącznik do uchwały Senatu WAT nr 16/WAT/2019 z dnia 25 kwietnia 2019 r. w sprawie uchwalenia Statutu Wojskowej Akademii Technicznej im. Jarosława Dąbrowskiego (tj. obwieszczenie Rektora WAT nr 2/WAT/2019 z dnia 9 października 2019 r.), uchwala, co następuje:

§ 1

Rada Dyscypliny Naukowej „Inżynieria Mechaniczna" pozytywnie opiniuje projekt programu studiów I stopnia na kierunku „mechatronika" opracowany w języku polskim i w języku angielskim, obowiązujący od roku akademickiego 2021/2022 na Wydziale Mechatroniki, Uzbrojenia i Lotnictwa.

§ 2

Uchwała wchodzi w życie z dniem podjęcia.

Przewodniczący

prof. dr hab. inż. Jerzy MAŁACHOWSKI