Ministry of Education and Science of the Republic of Kazakhstan
Kazakh National Research Technical University
named after K.I. Satpayev

MODULAR DIRECTORY

for an educational bachelor's program

Robotics and Mechatronics (Bachelor's degree)

Almaty, 2022

Robotics and Mechatronics (Bachelor's degree)

Module designation	Multilingual training module
Name of disciplines included in this module	*6 credits – (this block consists of the following elective disciplines: Beginner (A1); Elementary English (A1); General English 1 (A2); General English 2 (A2); Academic English (B1); Business English (B2))* *4 credits – (this block consists of the following elective disciplines: Basic Kazakh (Russian) language (A2); Academic Kazakh (Russian) language (B1); Business Kazakh language/Advanced Russian language (B2))* *6 credits – (this block consists of the following elective disciplines: Elementary English (A1); General English 1 (A2); General English 2 (A2); Academic English (B1); Business English (B2); Professional English (B2+)* *6 credits – (this block consists of the following elective disciplines: Academic Kazakh (Russian) language (B1); Business Kazakh language/Advanced Russian language (B2)* *6 credits – (this block consists of the following elective disciplines: General English 1 (A2); General English 2 (A2); Academic English (B1); Business English (B2); Professional English (B2+)* *6 credits – (this block consists of the following elective disciplines: General English 2 (A2); Academic English (B1); Business English (B2); Professional English (B2+)* *4 credits – (this block consists of the following elective disciplines: Business Kazakh language/Advanced Russian language (B2); Kazakh (Russian) language. Rhetoric (C1); Kazakh (Russian) language. Culture of business communication (C1)* *6 credits – (this block consists of the following elective disciplines: IELTS Preparation; Intercultural Communication; Technical Writing; Public speaking; Productivity skills; GRE preparation; Academic Writing)*
Semester(s) in which the module is taught	*Autumn, Spring (1,2,3,4)*
Person responsible for the module	*Ozhikenov Kassymbek Adilbekovich*
Language	*Kazakh, Russian, English*
Relation to curriculum	*Mandatory*
Teaching methods	*Practical exercises*
Workload (incl. contact hours, self-study hours)	*Total workload:* *1320 hours* *Practical 660* *IWS 660*
Credit points	*44*
Required and recommended prerequisites for joining the module	*Diagnostic Test, Beginner (A1), Beginner (A1), General English 1 (A2), General English 1 (A 2), Academic English (B1)*
Module objectives/intended learning outcomes	*The purpose of the module is to consolidate languages at the professional level of the specialty.* *The module develops 4 skills of teaching a foreign language: reading, listening, writing and speaking, introduces basic knowledge and the use of grammar and vocabulary, special emphasis is placed on independent study and critical thinking.* *Specific tasks of the module:* *1. The ability to draw conclusions about the main ideas and auxiliary details of various written and oral texts of the CEFR A2 level.* *2. The ability to conduct a conversation using appropriate grammatical structures and an active vocabulary (Glossary, lexical minimum -400 words, including technical terminology).* *3. Writing various types of text in the form of a logical and structured paragraph in the volume of 130-150 words.*

Module objectives/intended learning outcomes	*4. Knowledge of a number of grammatical structures with minor inconsistencies.* *The module allows students to practically master the basics of scientific style and develops the ability to perform structural and semantic analysis of the text.*
Content	*The description of the contents should clearly indicate focus areas and the level of difficulty.* *In this module, much attention is paid to completing tasks for simple texts and composing monologues and dialogues using the terminology of the specialty. The development of listening skills occurs to a greater extent through the performance of listening tasks during extracurricular hours and during online classes.* *The module also focuses on completing tasks using simple texts, as well as on creating short paragraphs, monologues and dialogues on various topics related to the specifics of the industry.*
Exams and assessment formats	*The module exams are conducted in the IELTS format. The examination ticket consists of 4 sections (Listening, Reading, Writing, Speaking), for each of which a certain amount of time and points are allocated at the discretion of the teacher, but the total time allocated to the student to provide an answer to the examination ticket should not exceed 120 minutes, and the maximum number of points is 40.*
Study and examination requirements	*Admission of students to the exam in the discipline is carried out automatically:* *- based on the assessment of the admission rating, determined by the results of the current and boundary control of academic performance (the total number of required semester points is at least 25 for two attestations);* *- those who have no outstanding tuition fees;* *- those who do not have more than 20% of skipping training sessions in the discipline;* *- not being on academic leave or academic break;* *those who do not have an overdue medical examination.* *The final assessment of the discipline includes assessments of current academic performance and final control. The assessment of the current academic performance (admission rating) is 60% of the final assessment of knowledge in the discipline, the assessment of the exam is 40% of the final assessment of knowledge in this discipline. Thus, the final score for each discipline is determined as the sum of the points scored by the student according to the results of the current and boundary performance controls (rating - a maximum of 60 points, a minimum of 25 points) and the exam (final control - a maximum of 40 points, a minimum of 20 points), which together makes a maximum of 100 points.*

Reading list	*1) Essential Grammar in Use. Murphy R. - Cambridge University Press: 2002* *2) Understanding and Using English Grammar, third edition. Betty Schrumpfer Azar – Longman: 1999* *3) Everyday Technical English. – Longman, 2003* *4) Engineering Workshop. – Oxford University Press, 2004* *5) Afanasyeva R. M. English. Development of oral speech skills based on thematic texts. Part I.: educational and methodological manual. - Moscow: Moscow State University of the Government of Moscow, 2012.* *6) Krylova I. P. Collection of exercises on English grammar / A Grammar of Present-day English: Practice Book. - Moscow: KDU, 2007.* *7) Antonia Clare, J.J. Wilson. Total English Intermediate Students' Book. Longman. 2006* *8) Abduova B. S., Asanova U. O. Kazak tili: Orys tildi toptarga arnalgan oku kuraly.- Astana, 2017. -282 b.* *9) Balabekov A. K., Bozbayeva-Hung A. T., Dosmambetova G. K., Salikhova B. O., Khazimova A. Zh.. Kazakh tili: ortadan zhogary degeige arnalgan okulyk. Ulttyk testileu ortalygy. - Astana: 2017* *10) Bozbayeva-Hung A. T., Balabekov A. K., Dosmambetova G. K., Salikhova B. O., Khazimova A. Zh. Kazak tili: orta degeige arnalgan okulyk. Ulttyk testileu ortalygy. - Astana: 2017.* *11) Anikina M. N. We are starting to learn Russian. Stairs: Textbook-book. - Moscow: Rus. yaz., 2002* *12) Dezochinnova T., Salagaeva L. Correction course of the Russian language: A textbook. - Almaty: Sanat, 1997.*

Module designation	*Module of social disciplines*
Name of disciplines included in this module	*6 credits – Contemporary History of Kazakhstan.* *6 credits – Phylosophy.* *8 credits – Social & Political Knowledge.*
Semester(s) in which the module is taught	*Autumn, Spring (1,4)*
Person responsible for the module	*Ozhikenov Kassymbek Adilbekovich*
Language	*Kazakh, Russian*
Relation to curriculum	*Mandatory*
Teaching methods	*Lectures and practical classes*
Workload (incl. contact hours, self-study hours)	*Total workload:* *600 hours* *Lectures 180* *Practical 120* *IWS 300*
Credit points	*20*
Required and recommended prerequisites for joining the module	*no*

Module objectives/intended learning outcomes	*The purpose of the module is to adapt students to changing social realities. He will master the culture and logic of thinking, is capable of critical generalization, analysis and perception of historical and socio-political information, uses the main provisions and methods of social and humanitarian sciences in solving social and professional problems, is able to analyse socially significant problems and processes. He is able to use regulatory legal documents in his activities.* *The module helps to identify and analyse the connections, correlation between natural science, technical and philosophical fields of knowledge, their mutual determination, place and role in culture.* *The module helps to identify the main problems of modern science and technology, the prospects for new discoveries, to outline ways out of the crisis of man-made civilization. The main goal is to study the foundations and boundaries of science and technology, the laws of their development, prospects and strategies for future existence with the help of a philosophical approach.*
Content	*To familiarize students with the history of the formation and development of science, technology, its conceptual basis; to present the foundations and structure of science, technology; to consider the features of the current stage of science development and its prospects; to substantiate the principles and laws of categorical thinking in the field of science; to analyse the methods and procedures of scientific knowledge; to present basic natural science theories within the boundaries of the mega -, macro -, microcosm; to determine the philosophical foundations and boundaries of technology; to demonstrate the variety of meanings of technology and ways of its implementation; to focus on the crisis dynamics of the development of science and technology, ways out of this situation. The proposed course also describes the issues of the formation of technical sciences, the features of technical knowledge.* *The module also studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan from ancient times to the present day. The sections of the discipline include: introduction to the history of Kazakhstan; the steppe empire of the Turks; early feudal states on the territory of Kazakhstan; Kazakhstan during the Mongol conquest (XIII century); medieval states in the XIV-XV centuries. The main stages of the formation of the Kazakh statehood are also considered: the era of the Kazakh Khanate of the XV-XVIII centuries. Kazakhstan as part of the Russian Empire; Kazakhstan during the period of civil confrontation and under the conditions of a totalitarian system;*

Content	*Kazakhstan during the Great Patriotic War; Kazakhstan during the formation of independence and at the present stage.*
Exams and assessment formats	*The module exams are conducted in writing. The exam ticket consists of 3 questions (calculations), each of which is allocated a certain amount of time and points at the discretion of the teacher, but the total time allocated to the student to provide an answer to the exam ticket should not exceed 120 minutes, and the maximum number of points is 40. The teacher also adheres to the following assessment criteria:* *1. Accuracy – 35%.* *2. Completeness of the solution of the problem – 35%.* *3. Creativity and originality – 30%.*

Study and examination requirements	*Admission of students to the exam in the discipline is carried out automatically:* *- based on the assessment of the admission rating, determined by the results of the current and boundary control of academic performance (the total number of required semester points is at least 25 for two attestations);* *- those who have no outstanding tuition fees;* *- those who do not have more than 20% of skipping training sessions in the discipline;* *- not being on academic leave or academic break;* *those who do not have an overdue medical examination.* *The final assessment of the discipline includes assessments of current academic performance and final control. The assessment of the current academic performance (admission rating) is 60% of the final assessment of knowledge in the discipline, the assessment of the exam is 40% of the final assessment of knowledge in this discipline. Thus, the final score for each discipline is determined as the sum of the points scored by the student according to the results of the current and boundary performance controls (rating - a maximum of 60 points, a minimum of 25 points) and the exam (final control - a maximum of 40 points, a minimum of 20 points), which together makes a maximum of 100 points.*
Reading list	*1) Nurysheva G. Zh. "Philosophy" - Almaty: Inzhu-marzhan, 2013.* *2) Nazarbayev N. A. " Mangilik El. Years equal to centuries. An Epoch equal to Centuries" - Astana: Business World Astana, 2014* *3) Johnston D."A Brief History of Philosophy: From Socrates to Derrida". –A&C Black, 2006. – 211 p. (JohnstonDi. "E brief history of philosophy: Frome Socrates tu Darrida".- A & C Black, 2006.* *4) Kenny A."New History of Western Philosophy". Volume 1-4. –Oxford University Press, 2006 - 2010. (Canny Hey. "New History of Western Philosophy". Volum 1-4-Oxford University Press, 2006-2010)* *5) Ayagan B. G., Abzhanov H. M., Seliverstov S. V., Bekenova M. S. Modern history of Kazakhstan. - Almaty, 2010* *6) Pankovskaya G. I., Fominykh V. V. History of Kazakhstan. Visual and graphic material to help students. - Ust-Kamenogorsk, 2011* *7) Pankovskaya G. I., Fominykh V. V. History of Kazakhstan. Chronological guide. - Ust-Kamenogorsk, 2011* *8) The history of Kazakhstan from ancient times to the present day in 4 (5) volumes-Almaty, 1996-2010* *9) Klyashtorny S. G., Sultanov T. I. States and peoples of the Eurasian steppes. Antiquity and the Middle Ages. - St. Petersburg, 2004* *10) N. A. Nazarbayev In the flow of history. Almaty, 2003.* *11) Nazarbayev N. A. Critical decade. Almaty, Atamura, 2003* *12) Bisembayev A. A. The main elements of political design in the Republic of Kazakhstan. Almaty, 2010.*

Module designation	*Module of physical and mathematical training and information 1*
Name of disciplines included in this module	*6 credits – (this block consists of the following elective disciplines: Physics Begin; Physics I)* *6 credits – (this block consists of the following elective disciplines: Algebra & introduction to calculus; Calculus I)* *6 credits – (this block consists of the following elective disciplines: Physics I; Physics II)* *6 credits – (this block consists of the following elective disciplines: Calculus I; Calculus II)* *6 credits – (this block consists of the following elective disciplines: Calculus II; Calculus III)* *6 credits – (this block consists of the following elective disciplines: Calculus III; Ordinary Differentiation Equations MatLab)*
Semester(s) in which the module is taught	*Autumn, Spring (1,2,3)*
Person responsible for the module	*Ozhikenov Kassymbek Adilbekovich*
Language	*Kazakh, Russian*
Relation to curriculum	*Mandatory*
Teaching methods	*lecture, laboratory work, practical work, calculations.*
Workload (incl. contact hours, self-study hours)	*Total workload:* *1080 hours* *Lectures 180* *Laboratory 60* *Practical 300* *IWS 540*
Credit points	*36*
Required and recommended prerequisites for joining the module	*Diagnostic Test, Physics I, Mathematics I, Physics II, Mathematics II.*
Module objectives/intended learning outcomes	*The purpose of the module is to deepen knowledge in the field of mathematics, physics with applied aspects in the field of information technology. Prepare the student to independently conduct the necessary research in their professional activities using the basic laws of mathematics and physics using methods of mathematical analysis and modeling.* *Develop the ability to apply the laws of physics for the formulation, formulation and solution of applied scientific and practical problems.*
Content	*The module covers the following sections: mechanics, dynamics of rotational motion of a solid body, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, transport phenomena, continuum mechanics, electrostatics, direct current, magnetic field, Maxwell's equations, laws of physics and ways of their application. The solution of generalized typical problems of physics in various fields (theoretical and experimental practical educational problems) for the formation of the foundations in solving professional problems, the assessment of the degree of accuracy of the results of experimental or theoretical research methods. As well as the study of mathematical analysis in the volume that allows you to study elementary functions and solve the simplest geometric, physical and other applied problems. The main attention is paid to differential and integral calculus. The sections of the module include differential calculus of functions of one variable, derivative and differentials, the study of the behavior of functions, complex numbers, polynomials. Indefinite integrals, their properties and methods of calculation. Definite integrals and their applications. Improper integrals. Elements of linear algebra and analytic geometry. Differential calculus of a function of several variables and its applications. Multiple integrals. Numerical, power series, Fourier series. Ordinary differential equations of the 1st order. Ordinary differential equations of higher orders. Systems of differential equations.*

Exams and assessment formats	*The module exams are conducted in writing. The examination ticket consists of 3 questions (calculations), each of which is allocated a certain amount of time and points at the discretion of the teacher, but the total time allocated to the student to provide an answer to the examination ticket should not exceed 120 minutes, and the maximum number of points is 40. The teacher also adheres to the following assessment criteria:* *1. Accuracy – 35%.* *2. Completeness of the solution of the problem – 35%.* *3. Creativity and originality – 30%.* *. Systems of differential equations.*
Study and examination requirements	*Admission of students to the exam in the discipline is carried out automatically:* *- based on the assessment of the admission rating, determined by the results of the current and boundary control of academic performance (the total number of required semester points is at least 25 for two attestations);* *- those who have no outstanding tuition fees;* *- those who do not have more than 20% of skipping training sessions in the discipline;* *- not being on academic leave or academic break;* *those who do not have an overdue medical examination.* *The final assessment of the discipline includes assessments of current academic performance and final control. The assessment of the current academic performance (admission rating) is 60% of the final assessment of knowledge in the discipline, the assessment of the exam is 40% of the final assessment of knowledge in this discipline. Thus, the final score for each discipline is determined as the sum of the points scored by the student according to the results of the current and boundary performance controls (rating - a maximum of 60 points, a minimum of 25 points) and the exam (final control - a maximum of 40 points, a minimum of 20 points), which together makes a maximum of 100 points.*
Reading list	*1) Suleeva L. B. Electronic textbook. Physics, part 1 " Mechanics. Molecular Physics and Thermodynamics " KazNTU Publishing House 2006* *2) Trofimova T. I. Physics:500 basic laws and formulas: A handbook for university students. Ed. 3rd-63 S. M.: Higher School, 1999* *3) Lungu K. N., Norin V. P. Collection of problems in higher mathematics, part 2, - Moscow: Iris-press, 2004.* *4) Danko P. E., Popov A. G., Kozhevnikov T. Ya. Higher mathematics in exercises and problems. In 2 h. Ch. I, 2: M.: Higher School,1999.* *5) Sobol B. V. Practicum on Higher Mathematics, Rostov n/A: Phoenix, 2006.* *6) Ryabushko A. P. Collection of individual tasks in higher mathematics. Ch. 1, 2, 3, Minsk.:Higher School, 2006* *7) Volkenstein V. S. Collection of problems on the general course of physics for students of technical universities, Ed. add., reprint-327 p. {Specialist} St. Petersburg: SpetsLit, 2002.* *8) Suleeva L. B. Mechanics and molecular physics. Physical practice. KazNTU Publishing House, 2003.*

Module designation	CHE452 Ecology sustainable development
Semester(s) in which this module is taught	3
The person responsible for the module	*Nurullayeva Gulzhan Zhagalbayevna*
Language	Russian
Attitude to the curriculum	Required component
Form of training	Basic discipline
Workload (incl. contact hours, hours of independent work)	1 cr: ecture-15h, SRS -15h.
Credit scores	1 cr: ecture-15h, SRS -15h.
Module objectives/expected learning outcomes	The key question is: what learning outcomes should students achieve within the module? As a result of mastering the discipline "Industrial Electronics", the student must: know: -the main patterns that determine the interaction of living organisms with the environment; - basic principles of nature protection and rational use of natural resources; - socio-ecological consequences of anthropogenic activities; - the concept, strategies, problems of sustainable development and practical approaches to their solution at the global, regional and local levels. be able to: – to identify and analyze natural and anthropogenic ecological processes and possible ways of their regulation; – to use the acquired knowledge about the laws of interaction between living organisms and the environment in practical activities to preserve sustainable development. possess skills: -definition of modern strategies for the sustainable development of mankind, aimed at the systematic change of traditional forms of management and lifestyle of people in order to preserve the stability of the biosphere and the development of society without catastrophic crises.
Content	Environment in the modern world; autecology, demoecology, synecology; biosphere and its sustainability; global environmental problems; the concept of sustainable development; natural resources and rational nature management; anthropogenic impacts on the atmosphere; atmospheric air protection; anthropogenic impacts on the hydrosphere; protection of water resources; soil protection; current environmental problems of sustainable development of the Republic of Kazakhstan.

Teaching methods	Various teaching methods and technologies are used in the classroom: student-centered learning, competence-oriented learning, role-playing games and educational discussions of various formats, case study (analysis of specific situations), project method (development and transformation of one's own experience and competence).
Examination forms	Exam tickets
Requirements for training and exams	- Availability of a computer and computer equipment; - Availability of an Internet channel with a speed of at least 0.5 Mbit/sec; - Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform; - Attendance of classes according to the schedule.
List of literature	1. Nikolaykin N. I. Ecology [text]: ucheb. / N. I. Nikolaykin, N. E. Nikolaykina, O. P. Melekhov. - 9-e nodded., pererab. and the ball. - Moscow: infra-Moscow, 2018. - 616 P.: Il. "Oh, dear. "no," she said. Bachelor's degree). - ISBN 978-5-16-012241 2. Alinov M. Sh. fundamentals of sustainable development: course lecture: ucheb. "I don't know," I said. - Almaty: Bastau, 2013. - 200 P. - ISBN 978-601-281-062- 3. Lukanin A.V. Engineering ecology: processes and apparatuses of gas and gas fields [text]: ucheb. "I don't know," he said. - Moscow: infra-Moscow, 2018. - 524 P.: Il. "Oh, dear. "no," she said. Bachelor's degree). - ISBN 978-5-16-012307- 4. Vetoshkin A. G. Technologies protecting the surrounding environment (theoretical foundations): ucheb. A. G. Vetoshkin, K. R. Tarantseva; Ed. A. G. Vetoshkina. - Moscow: infra-Moscow, 2015. - 362 P.: Il. "Oh, dear. "no," she said. Bachelor's degree). - ISBN 978-5-16-009259-1 5. Beisekova T. I. protection of water resources from industrial pollution: ucheb. the purpose of the event: Nats. techn. "no," I said. "I'm Sorry," She Said. - Almaty: Kazntu, 2013. - 174 P. 6. Yerubayeva G. K. ecological monitoring [text]: ucheb. "I don't know," she said. Nats. "no," I said. "I don't know," he said. - Almaty: Kazakh University, 2020. - 108 P. - ISBN 978-601-04-1332-0

Module designation	CHE451 Life safety
Semester(s) in which this module is taught	4
The person responsible for the module	*Shevtsova Vladlena Stepanovna*
Language	Russian
Attitude to the curriculum	Compulsory / elective / specialisation Names of other study programmes with which the module is shared
Form of training	Basic discipline
Workload (incl. contact hours, hours of independent work)	1 cr: Lecture-15h, SRS -15h.
Credit scores	1 cr: Lecture-15h, SRS -15h.
Module objectives/expected learning outcomes	The key question is: what learning outcomes should students achieve within the module? As a result of mastering the discipline "Ecology and sustainable development", the student must: know: - a culture of safety, awareness and risk assessment, in which security issues are considered as the most important priorities of human life; - a culture of professional safety, the ability to identify hazards and assess risks in the field of their professional activities; - readiness to apply professional knowledge to minimize negative production factors, ensure safety and improve working conditions in the field of their professional activities; - motivation and ability to independently increase the level of safety culture of life; - the ability to justify their decisions in a reasoned manner from the point of view of life safety. be able to: - logically and consistently identify the dangers that surround it and its habitat; - work with regulatory and legal documents in the field of life safety; - develop measures to reduce risks for personal and public safety, including industrial safety.
Content	Module "Life safety"; sections; Risk assessment analysis. Types and working conditions; Identification and human exposure to harmful and dangerous environmental factors; Physical factors (noise, vibrations, electromagnetic fields). Protection of humans and the environment from negative production factors; Providing comfortable conditions for human life and activity. Life safety management; Emergencies at radiation and chemically hazardous facilities. Ways to protect the population in emergency situations; Elimination of the consequences of emergency situations; Electrical safety. Fire safety; Responsibility for violation of the requirements of legislation in the field of life safety

Teaching methods	Various teaching methods and technologies are used in the classroom: student-centered learning, competence-oriented learning, role-playing games and educational discussions of various formats, case study (analysis of specific situations), project method (development and transformation of one's own experience and competence).
Examination forms	Exam tickets
Requirements for training and exams	- Availability of a computer and computer equipment; - Availability of an Internet channel with a speed of at least 0.5 Mbit/sec; - Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform; - Attendance of classes according to the schedule.
List of literature	1. Life safety: a short course of lectures/ Comp.: A.V. Khizov, I.I. Kuzmin // Saratov GAU. – Saratov, 2017. – 61 p. 2. The theory of activity safety: a textbook for bachelors of the direction 20.03.01 "Technosphere safety" / O. N. Rusak. – St. Petersburg: SPbGLTU, 2015. – 48 p. 3. Life safety [Electronic resource]: textbook. for universities / E. A. Arustamov [et al.]; Edited by E. A. Arustamov. - 10th ed., reprint. and additional - M.: Dashkov and K, 2006. - 476 p. - ISBN 5-94798-832-1. 4. Shevtsova V. S. Organizational and legal bases of life safety: Textbook. – Almaty: KazNITU, 2021. – 121 p.

Module designation	MNG487 Fundamentals of Entrepreneurship, leadership and anti-corruption culture
Semester(s) in which this module is taught	4
The person responsible for the module	Abenova M.H. (rus), Imankulova B.B. (kaz), Turegeldinova A.J. (Eng)
Language	Kazakh, Russian, English
Attitude to the curriculum	Required component
Form of training	Basic discipline
Workload (incl. contact hours, hours of independent work)	150 academic hours Lecture-15h, practical classes – 15. SIS (including SIST) – 105 hours
Credit scores	3 credits: contact – 3 (lecture – 1 credit, practice – 2 credits), contactless – 2 credits (SIST, SIS)

Module objectives/expected learning outcomes	The study of the general educational discipline "Fundamentals of entrepreneurship" is aimed at achieving the following goals: - familiarization of students with the theory and practice of entrepreneurship; - learning the basics of creating your own business; - formation of regulatory, economic and organizational knowledge and skills on the formation, organization and conduct of entrepreneurial activity. To form systematic knowledge about the basics of the organization of entrepreneurial activity. Develop organizational and managerial skills in conducting business. To form knowledge about the responsibility of business entities, the student must master aesthetic concepts and categories, the content and features of professional ethics in legal activity, possible ways (methods) of resolving moral conflict situations in the professional activity of a lawyer, the essence of professional and moral deformation and ways to prevent and overcome it, the features of lawyer etiquette, its basic norms and functions; be able to evaluate the facts and phenomena of professional activity from an ethical point of view, apply moral rules and norms of behavior in specific life situations. As a result of mastering the discipline, the student should know: - the typology of entrepreneurship; - the role of the environment in the development of entrepreneurship; - technology of making entrepreneurial decisions; - basic components of the internal environment of the company; - organizational and legal forms of entrepreneurial activity; - features of constituent documents; - the procedure for state registration and licensing of the enterprise; - mechanisms of functioning of the enterprise; - the essence of entrepreneurial risk and the main ways to reduce risk; - the main elements of the culture of entrepreneurship and corporate culture; - list of information subject to protection; - the nature and types of responsibility of entrepreneurs; - methods and tools of financial analysis; - basic provisions of accounting in small enterprises; - types of taxes; - a system of business performance indicators; - principles and methods of assessing the effectiveness of entrepreneurial activity;

	-ways to improve and control the efficiency of entrepreneurial activity. Be able to: characterize the types of entrepreneurial activity and the business environment; operate in practice with economic categories; develop a business plan; prepare a package of documents for opening a business; draw up documents for opening a bank account; determine the organizational and legal form of the enterprise; develop a strategy and tactics of the enterprise; comply with professional ethics, ethical codes of the company, generally accepted rules for doing business;
Content	The discipline is aimed at forming students' organizational and legal form of the enterprise based on the goals of the enterprise and the specifics of the organization and functioning of enterprises in various forms; to assess the effectiveness of entrepreneurial activity; to assess external and internal risks for the enterprise; to develop business plans taking into account regulatory, resource, administrative and other conditions. Set goals and formulate tasks related to the implementation of professional functions. Organize team interaction to solve management tasks. Diagnose organizational culture, identify its strengths and weaknesses, develop proposals for its improvement. Develop measures to motivate and stimulate the organization's staff. Tasks of the discipline: 1. To form systematic knowledge about the basics of the organization of entrepreneurial activity. 2. Develop organizational and managerial skills in conducting business. 3. To form knowledge about the responsibility of business entities. 4. As a result of mastering the discipline, the student must be able to: - to characterize the types of entrepreneurial activity and the business environment; - to operate in practical activities with economic categories; - develop a business plan; - prepare a package of documents for opening your own business; - to draw up documents for opening a current account in a bank; - determine the organizational and legal form of the enterprise; - develop the strategy and tactics of the company's activities; - comply with professional ethics, ethical codes of the company, generally accepted rules of business; - to characterize the mechanism of protection of business secrets; - distinguish the types of responsibility of entrepreneurs; - analyze the financial condition of the company; - carry out basic financial transactions; - calculate the profitability of entrepreneurial activity.

Teaching methods	Various teaching methods and technologies are used in the classroom: student-centered learning, competence-oriented learning, role-playing games and educational discussions of various formats, case study (analysis of specific situations), project method (development and transformation of one's own experience and competence).
Examination forms	Exam tickets
Requirements for training and exams	Timely delivery of calculations of practical work, full performance of all types of work (practical and independent) are required. A mandatory requirement of the course is to prepare for each lesson. It is necessary to review the specified sections of the textbook and additional material not only in preparation for practical classes, but also before attending the corresponding lecture. Final exam: consists of four tasks of different difficulty levels, three simple for 25 points and one difficult for 15 points. Skipping an exam for a disrespectful reason deprives you of the right to take it. If you miss the exam for a good reason, a special permit is issued and the date, time and place of the exam are assigned. Prompting and cheating during exams, passing the exam for another student are unacceptable. A student caught falsifying any course information will receive a final grade of "F". Mandatory use of electronic gadgets in the classroom, which is welcome, but it is unacceptable to use them in the exam. 4 Evaluation criteria Each work except tests is evaluated according to 4 criteria: - accuracy and accuracy (A) – 30% (how accurately and accurately the work is calculated) - creativity and creativity (T) – 30% (how and how the work is presented) - completeness and maturity (H) – 40% (how deeply, logically and structurally the work is solved) - originality(O) – a special coefficient of 1.0 is used; 0.5 or 0

List of literature	[1] E.V. Lysakovskaya. General characteristics and models of state regulation of small and medium-sized enterprises in developed countries// Law and Education, No. 5, 2011, pp. 261 - 266 [2] Civil Code of the Republic of Kazakhstan dated July 1, 1999 No. 409-I (Special Part) (with amendments and additions as of 06.03.2013) [3] Law of the Republic of Kazakhstan "On Private Entrepreneurship" (with amendments and additions as of 02.04.2010) [4] A. N. Asaul. Organization of entrepreneurial activity: textbook /. - St. Petersburg: ANO IPEV, 2009. 336s. [5] Koshanov A.K., Mukhamedzhanov B.G., Bektemisova S.T. Formation of private entrepreneurship in the conditions of transition to the market (on the example of the Republic of Kazakhstan). - Almaty: Institute of Economics, PAN RK, 2009. [6] Bocharov S.A., Ivanov A.A., Oleinikov S.Ya. FUNDAMENTALS OF BUSINESS: Study guide. -- M.: Publishing house of the center of the EAOI, 2007. - 447 p. [7] http://www.enbek.gov.kz/ [8] http://www.kapital.kz/ [9] http://headhunter.com.kz/

Module designation	CSE677 Information and communication technologies
Semester(s) in which this module is taught	3 semester
The person responsible for the module	Kalpeeva Zhuldyz Beishenalievna
Language	Russian
Attitude to the curriculum	Compulsory
Teaching methods	Lecture, laboratory classes, SIS
Workload (incl. contact hours, hours of independent work)	6cr: Lecture-30h, laboratory lesson – 30h, SIS -30h., SIST – 15h.
Credit scores	6cr: Lecture-2 cr, laboratory lesson – 2 cr, SIS -2 cr., SIST – 1 cr.
Necessary and recommended prerequisites for joining the module	The study of the discipline is based on the knowledge gained in secondary school on the basics of computer science, mathematics and physics.

Module objectives/expected learning outcomes	Training in the use of modern information technologies in the field of professional activity. The objectives of the course include: - To reveal the basic concepts of the architecture of computer systems; - To reveal the basic concepts of information and communication technologies and subject terminology; - Teach how to work with software interfaces of operating systems; - To teach how to work with data in various representations, both tabular structured and unstructured; - Teach to apply the basic principles of information security; - To reveal the concepts of data formats and multimedia content. To teach how to work with typical multimedia data processing applications. Use modern approaches of presentation of the material; - To reveal the concepts of modern social, cloud and mail platforms, and ways to work with them; - Teach to use algorithmization and programming methods to solve business process automation problems Students will know: - Computer device; - Architecture of computing systems; - Information and communication technology infrastructure; - Interfaces of modern operating systems; - Modern tools for working with data of various nature and purpose; - Types of threats to information security, principles, tools and methods of data protection; - Python programming language. Students will be able to: - Work with interfaces of modern operating systems; - Work with modern application software for working with data of various nature and purpose; - To use modern social, cloud, mail platforms for the organization of business processes; - Programming in an algorithmic programming language; - Analyze, model, design, implement, test and evaluate information and communication technology systems.

Content	The course contains a training program aimed at leveling the basic knowledge of students in the field of information and communication technologies. It contains a full range of topics, according to the Standard SSE Curriculum, with the predominance of educating practical skills in working with data, algorithmization and programming. The course is designed in such a way as to teach students not only the basic concepts of architecture and modern infrastructure of information and communication technologies, but also to teach them how to use these tools to solve problems of an applied nature. To teach how to optimize processes, apply adequate models and methods for solving practical problems using modern methods and tools of information technology, automate routine processes, be productive and efficient.
Examination forms	Exam tickets, test questions
Requirements for training and exams	- Availability of a computer and computer equipment;
List of literature	1. June J. Parsons and Dan Oja, New Perspectives on Computer Concepts 16th Edition - Comprehensive, Thomson Course Technology, a division of Thomson Learning, Inc Cambridge, MA, COPYRIGHT © 2014. 2. Lorenzo Cantoni (University of Lugano, Switzerland) James A. Danowski (University of Illinois at Chicago, IL, USA) Communication and Technology, 576 pages. 3. Craig Van Slyke Information Communication Technologies: Concepts, Methodologies, Tools, and Applications (6 Volumes). ISBN13: 9781599049496, 2008, Pages: 4288 4. Brynjolfsson, E. and A. Saunders (2010). Wired for Innovation: How Information Technology Is Reshaping the Economy. Cambridge, MA: MIT Press 5. Kretschmer, T. (2012), “Information and Communication Technologies and Productivity Growth: A Survey of the Literature'', OECD Digital Economy Papers, No. 195, OECD Publishing. Дополнительная: 6. Vijay K. Vaishnavi, Vijay K. Vaishnavi, William Kuechler Design Science Research Methods and Patterns: Innovating Information and Communication Technology, 2nd Edition 2015 by CRC Press 7. Hans J Schnoll E-Govemment: Information, Technology, and Transformation: Information, Technology, and Transformation (Routledge, Mar 12, 2015 - Political Science - 343 pages) 8. The Millennium Development Goals Report 2015, United Nations, New York, 2015 9. Maximizing Mobile //2012 Information and Communications for Development. World Bank, Washington D.C., 2012, 244 p. 10.Doing Business 2016 Measuring regulatory Quality and Efficiency / World bank Group Flagship Report, 2016

Module designation	ROB410 Fundamentals of Electromechanics and electronics
Semester(s) in which this module is taught	*3*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences, Associate Professor Aldiyarov N.U.* *Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-15h, laboratory lesson – 30h. practice – 15, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--1 cr, laboratory lesson – 2 cr. practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*
Module objectives/expected learning outcomes	*The key question is: what learning outcomes should students achieve within the module?* *As a result of mastering the discipline "Fundamentals of Electromechanics and Electronics", the student must:* *be able to:* *- read structural, installation and simple circuit diagrams;* *- calculate and measure the basic parameters of simple electrical, magnetic and electronic circuits;* *- use electrical measuring devices in work;* *- start and stop electric motors installed on the operated equipment;* *As a result of mastering the discipline, the student should know:* *- units of measurement of current, voltage, electric current power, resistance of conductors;* *- methods of calculation and measurement of basic parameters of simple electrical, magnetic and electronic circuits;* *- properties of direct and alternating electric current;* *- principles of serial and parallel connection of conductors and current sources;* *- electrical measuring devices (ammeter, voltmeter), their device, principle of operation and rules of inclusion in the electrical circuit;* *- properties of the magnetic field;* *- DC and AC motors, their design and principle of operation;* *- rules for starting and stopping electric motors installed on the operated equipment;* *- electric motor protection equipment.*

Content	*Modeling of power transformers, modeling of DC machines, modeling of asynchronous and synchronous machines, modeling of power lines, modeling of generalized loads, modeling of switching devices.*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*1. Fundamentals of the theory of circuits. G.V. Zeveke, P.A. Ionkin, A.V. Netushil Electrical Engineering. - Moscow: Energoatomizdat, 2008.* *2. Bessonov L. A. Theoretical foundations of electrical engineering. Moscow: Academy, 2010.* *3. Kozhaspaev N.K., Meshcheryakova T.Yu., Nadirov E.G., Electrical Engineering. Electrical circuits. Guidelines for laboratory work. Almaty KazNTU, 2012* *4. Nemtsov M.V. Electrical engineering and Electronics. Moscow: Academy, 2010* *5. Zhavoronkov M.A. Electrical engineering and electronics. M.: Academy, 2010* *6. Reg J. Industrial electronics [Electronic textbook]: Textbook / Reg J., 2011, DMK Press. - 1136 p.Access mode:http://iprbookshop.ru/7739*
Updating	annually

Module designation	ROB154 Electronics
Semester(s) in which this module is taught	*4*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences, Associate Professor Aldiyarov N.U.* *Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-15h, laboratory lesson – 30h. practice – 15, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--1 cr, laboratory lesson – 2 cr. practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*
Module objectives/expected learning outcomes	*After completing the course, the student must demonstrate the ability to analyze, synthesize and design circuits, as well as calculate costs.* *The student must be able to:* *− experimentally determine the parameters and characteristics of electronic devices and devices;* *At the end of the course, the student should know:* *− to measure electrical quantities in semiconductor devices.*
Content	*Introduction. Electrical conductivity of semiconductors. Semiconductor diodes.* *Bipolar transistors. General circuits of the transistor. Field-effect transistors with a control p-n junction. Thyristor. Thyristor switching circuits.* *Optoelectronic devices. Analog electronic devices. Operational amplifiers.* *Basic logical operations and logical elements. Combinational logic circuits* *Rectifying devices.*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	*1 Pryanishnikov V.A. Electronics: A complete course of lectures. – St. Petersburg. KORONA print, Binom Press, 2006. – 416s* *2 Functional electronics devices. Igumnov V.N., Bolshakov A.P. Publishing house: Yoshkar-Ola: PSTU, 2013.* *3 Demidenko D.A. Amateur radio measuring devices on transistors; Book on Demand - Moscow, 2012. - 127 p.* *4 Lachin V.I., Savelov N.S. Electronics: Textbook – Rostov n/A: Phoenix, 2009. – 704s.* *5 Opadchy Yu.F., Gludkin O.P., Gurov A.I. Analog and digital electronics: Textbook for universities. Edited by O.P. Gludkin. – M.: Hotline-Telecom. 2009, – 768c.* *5 Gusev V. G., Gusev Yu. M. Electronics and microprocessor technology: Textbook.for universities – M.: Higher School, 2006, – 800s.*
Updating	annually

Module designation	ROB506 Integrated and microprocessor circuitry
Semester(s) in which this module is taught	*5*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--2 cr, laboratory lesson – 2 cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, electronics*
Module objectives/expected learning outcomes	*At the end of the training, you should know:* *- the principle of operation of digital integrated elements, their classification, marking and conditional graphic images;* *-methods of combining and assembling complex devices;* *-the composition and purpose of microprocessor devices and methods of their programming;* *-digital nodes, including on the basis of microprocessor elements;* *-reading and understanding basic circuits;* *-reading, understanding and drawing functional circuits;* *- selecting the necessary chips and elements according to reference information for the implementation of circuits;* *-application of theoretical knowledge to solve problems related to the construction of digital and microprocessor systems and devices;* *-design of measuring instrument nodes based on integrated and microprocessor technology;* *Be competent:* *-be able to apply schemes in modern digital circuit engineering.*
Content	*Introduction. Logical functions and logical elements. The concept of the microclub series. Axiom of logic algebra, algebra of logic law. Combination logic devices. Demultiplek Sor, Multiplexer, code compatators. Serial logic schemes. Registers. Counters. Memory devices. Memory device management* *Microprocessor architecture. Microprocessor software support. Microprocessor systems. Automation methods in schematic design of electronic nodes*
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*1. Potekhin V.A. Circuit design of digital devices: textbook. manual for universities – Tomsk: V-Spectrum, 2012 – 250s.* *2. A.I. Belous, V.A. Emelyanov, A.S. Turtsevich Fundamentals of microelectronic devices circuitry. Moscow: Technosphere, 2012 - 472 p* *3.Fedorov, V.A. Electronics and microprocessor technology (for bachelors) / V.A. Fedorov, V.I. Moryakov, Yu. Shchetinov. - M.: KnoRus, 2013. - 800 p.* *4. Avanesyan, G.R. Digital integrated circuits / G.R. Avanesyan. - M.: Radio Engineering, 2015. - 915 p.* *5. Yu. S. Buzykova. "Fundamentals of circuit engineering" – Khabarovsk: Publishing House of the Pacific State University, 2015. – 44 p.* *6. Application of integrated circuits in electronic computing. Handbook. - M.: Radio and Communications, 2016. - 384 p.*
Updating	annually

Module designation	ROB510 Fundamentals of information and measurement technologies
Semester(s) in which this module is taught	*5*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--2 cr, laboratory lesson – 2 cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electronics, physics*
Module objectives/expected learning outcomes	*Brief description of the course: study of basic methods and measuring instruments of electrical, magnetic and non-electrical quantities, methods for assessing the accuracy of measurement results, familiarization of students with modern measuring technologies and their application in instrumentation.* *Knowledge gained during the course of the discipline:* *- the principle of operation and design of measuring instruments and transducers;* *- causes of occurrence and ways to exclude errors;* *- methods of building information and measurement systems.* *Skills and abilities (professional, managerial, communicative ...) acquired during the course of the discipline* *- to select a measuring device or sensor;* *- develop a mathematical model of measuring instruments;* *- calculate the accuracy of the information and measurement system.*
Content	*Introduction. Measuring channels Measuring signals. Measurement theories.* *Measurement data processing and forecasting. Measuring converters of electrical quantities. Measuring transducers of non-electrical quantities.*
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*1. Information and measurement technology and electronics. Converters of non-electrical quantities 2nd ed., ispr, and add. Textbook for universities. Viktor Vladimirovich Petrov. Moscow, 2016.* *2. Information and measuring equipment and technology. Textbook for universities / Edited by G.G. Ranneva. – M.: Higher School, 2012.* *3.Theoretical foundations of information and measurement systems. Babak V.P., 2014.* *4.Sergeev A.G., Krokhin V.V. Metrology, standardization and certification. – M.: Publishing House "Yurayt", 2011.* *5.Theoretical foundations of information and measuring technology. Textbook: G.A.Sadovsky. Moscow: High School, 2008.* *6.Information and measuring equipment and technologies. A.V. Yurchenko – Tomsk: Tomsk Polytechnic University Publishing House, 2012.* *7.Evtihiev N.N. Measurement of electrical and non-electrical quantities. – M.: Energoatomizdat, 2004.* *8. Klaassen K.B. Fundamentals of measurement theory. – M.: Postmarket, 2000.* *9.Nazarov N.G. Metrology. Basic concepts and mathematical models. – M.: Higher School, 2002.* *10.A. D. Nikitin. INFORMATION AND MEASURING EQUIPMENT. Laboratory workshop. — Yekaterinburg: Ural Publishing House. un-ta, 2017.*
Updating	annually

Module name and code	ROB 509 Physical basis for obtaining information
Responsible for module	Candidate of physical and mathematical sciences, Professor Kerimkulov Zh.K..
Module type	Basic, Elective module
Module level	BA
Amount of hours a week	3
Amount of credits	3 (6 ECTS)
Education form	full-time
Term	2
Quantity of the being trained	5
Module prerequisites	1. Physic.
Module content	**Lectures (30):** Electromagnetic field. Electrical properties of materials. Magnetic properties of materials. Basic equations of the electromagnetic field. Measuring transformations in electric fields. Measuring transformations in magnetic fields. Measuring transformations in the fields of eddy currents. Eddy current measurement transformation of local conductive objects. Measuring transformations in high-frequency electromagnetic fields. Sources and receivers of radio waves. Measuring transformations in acoustic fields. Measuring transformations in thermal fields. Measuring transformations in the fields of optical radiation. Measuring transformations in the fields of ionizing radiation. Measuring transformations in fields of elastic deformations. **Practical classes (15):** Characteristics of materials in an electric field. Maxwell's equations and characteristics of materials in a magnetic field. Electrocapacitive, electropotential, piezo-tensoelectric, electrochemical transformation. Induction, magneto-modulation, galvanomagnetic measuring conversion. Conversion of eddy current parameters into an electrical signal. Fields of application of eddy current measurement conversion. Polarization of radio waves. Areas of application of radio wave measuring conversion. Interference and diffraction of acoustic waves. Basic equation of thermal transformation. Sources and receivers of optical radiation. Sources and receivers of ionizing radiation. Functions for converting force, pressure, torque into deformation of an elastic body.
Education results	Master student: knows: – basic physical laws, effects, phenomena used to obtain measurement information; – theoretical material in the field of physical foundations for obtaining information, physical measurements, general theory of information, metrological support; principles for assessing the accuracy characteristics of various methods for measuring physical quantities the main measuring transducers and the physical effects used in them advantages and disadvantages of measuring transducers. can:

	– correctly choose the necessary transducer for measurements and justify his choice; – understand the principles of construction of various types of measuring transducers. competent: - in practical and theoretical use different converters in professional activity
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Attending a lecture; - performance the exercise of practical classes. - Exam
Продолжительность модуля	One term
Литература	[1] A.E. Goldstein. Physical basis for obtaining information / Moscow "Urayt", 2016 [2] Syzdykova Z.N. Mathematical physics tendeuleri - Almaty. – 2017. [3] Gasanov E.E. Intellectual systems, Theory of information storage and retrieval. - Almaty. – 2019. [4] Kupriyanov M.S., Matyushkin B.D. Digital signal processing: processors, algorithms, design tools. - St. Petersburg: Polytechnic. - 1999. - 592 p.
Updating	annually

Module name and code	ROB 526 Hydropneumatic drives of robots (professional)
Responsible for module	Master of tech. Sci., Aimukhanbetov Y.A.,
Module type	Basic, elective module
Module level	BA
Amount of hours a week	3
Amount of credits	3 (6 ECTS)
Education form	Full-time
Term	4
Quantity of the being trained	14
Module prerequisites	1.Computer science, 2.Physics, 3.Mathematics, 4.Electrical engineering.
Module content	Educational-methodical complex of the discipline Basic concepts of the drive. Robots based on hydraulic and pneumatic drives. Compressors, displacement compressors. dynamic compressors. Air preparation unit. Compressed air distribution unit. Block of executive engines. Pneumatic equipment. Control system (CS) for pneumatic drive. Fundamentals of hydraulics and hydraulic drive. Volumetric pumps. Characteristics of a volumetric pump. dynamic pumps. Characteristics of a dynamic pump. Hydraulic motors. Hydraulic equipment. Relay-contact control of hydropneumatic drive. Combined drives. Pneumohydraulic and hydropneumatic priods. **IWBT (60):** Gas Laws. Boyle's laws, Gay-Lussac. Pascal principles. Venturi principle. Pneumatic artificial muscles. air muscles. Water hammer. The main types of working fluids used in hydraulic drives. Model of a simple hydraulic system.
Education results	Bachelor:

	knows: - elements that are part of the hydropneumatic drive; - pneumatic drives of robots, their elements, static and dynamic characteristics; - hydraulic drives of robots and their main elements, static and dynamic characteristics; can: - draw up a generalized functional diagram of the hydraulic pneumatic drive of the robot - read schematic diagrams of drive control systems, as well as their installation and adjustment. - compose a mathematical description of the drives - visual modeling in the Automation studio environment.
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Attending a lecture; - Solving practical problems - Presentation of the abstract; - Fulfillment of tasks on the topics of the SIWT. - Performance of examinations. - Examination.
Module duration	One term
Literature	1. Hydraulics and hydraulic drive: practicum / [V. E. Shcherba, E. A. Pavlyuchenko, E. Y. Nosov, A.V. Grigoriev]; Ministry of Education and Science of Russia, OmSTU. – Omsk: Publishing house of OmSTU, 2020. – 187 p. 2. Weissman, N. M. Mechanics of liquid and gas. Hydraulics : studies. manual / N. M. Weisman, V. A. Golikov, A. A. Zharkovsky. – St. Petersburg : Publishing House of the Polytechnic University. un-ta, 2016. – 222 p. 3. Rachkov, M. Yu. Pneumatic automation systems: studies. manual for SPO / M. Y. Rachkov. — 3rd ed., ispr. and add. — M.: Yurayt Publishing House, 2019. — 264 p. — (Series: Vocational education). 4. Advances in Hydraulic and Pneumatic Drives and Control 2020 (Lecture Notes in Mechanical Engineering) 1st ed. 2021 Edition/ Jaroslaw Stryczek, Urszula Warzynski / published by Springer Nature Switzerland AG, 2021. – 792 p. 5. Pumps. Fans. Conditioners: Handbook/ E.M. Roslyakov, N. V. Kochenkov, I. V. Zolotukhin, etc.; Edited by E. M. Roslyakov. – St. Petersburg: Polytechnic, 2015. – 822 p.6. https://www.hydro-pnevmo.ru/
Updating	annually

Module name and code	ROB 517 Robot Drives (professional)
Responsible for module	Master of tech. Sci., Aimukhanbetov Y.A.,
Module type	Basic, elective module
Module level	MA
Amount of hours a week	4
Amount of credits	3 (6 ECTS)
Education form	Full-time

Term	7
Quantity of the being trained	21
Module prerequisites	1.Computer science, 2.Physics, 3.Mathematics, 4.Electrical engineering.
Module content	Educational-methodical complex of the discipline "Robot Drives" - ROB 5171 Lectures: Basic concepts of the drive. Electric drive. Types of electric drives. Features of the control system. Classification of electric drives. DC motors: control systems. Brushless motor and its control system. AC motors. Asynchronous motors and its control. Synchronous motors and its control. Stepper motors. universal motors. transmission mechanisms. features and disadvantages. Transfers by flexible connection Belt transfers. Chain transfers. Transfers by direct contact. Cylindrical gears. Bevel gears. Rack and pinion gears. Worm gears. Ball screw transmissions. IWBT: Calculation of direct current motors of parallel and series excitation. Piezo motors, principle of operation, features and disadvantages. Intelligent artificial muscles. Elastic nanotubes. Electroactive polymers. Planetary mechanisms. Automatic transmission. Differential. Coupling.
Education results	Bachelor: knows: - the main types of drives used in robotics: a generalized functional diagram of the robot drive and its components; - electric drives of devices based on DC motors, non-contact, synchronous, step motors; - electric drive control circuits, microprocessor control devices for robot drives; - methods for calculating, assembling and optimizing drive elements - various types of gear and friction gears, bearing supports, couplings, shafts and axles - Fundamentals and technology of assembly of drive elements of microelectromechanical systems; can: - read schematic diagrams of drive control systems, as well as their installation and adjustment. - compose a mathematical description of the drives - Visual modeling in the Solidworks environment.
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Attending a lecture; - Solving practical problems - Presentation of the abstract; - Fulfillment of tasks on the topics of the SIWT. - Performance of examinations. - Examination.
Module duration	One term

Literature	1. Vasiliev B.Yu. Electric drive. Electric drive power engineering. Textbook for universities. SOLON-Press Publishing House 2017 2. Uchaev P. N.' Emelyanov S. G.' Skhirtladze A. G.' Berezhnoy S. B.' Puntus A.V. Mechanical transmissions in examples and problems. TNT Publishing House 2020 3. Usoltsev A.A. Electric drive/Study guide. St. Petersburg: ITMO Research Institute, 2012, – 238 p. 4. Elements of the device drive: calculation, design, technology / ed. by Yu. M. Pleskachevsky. –Minsk: Belarus. navuka. - 2012. - 769 p. 5. Matthew Scarpino. Motors for Makers: A Guide to Steppers, Servos, and Other Electrical Machines 1st Edition/ Que Publishing – 800 East 96th Street Indianapolis, Indiana - November 30, 2015 – 320 pages. ISBN-10: 0134032837/ ISBN-13: 978-0134032832 6.Richard Crowder Electric Drives and Electromechanical Systems: Applications and Control 2nd Edition. Publisher: Butterworth-Heinemann; 2nd edition (November 5, 2019).Language: English. Paperback : 322 pages. ISBN-10: 0081028849. ISBN-13: 978-0081028841 7. S. R. Deb, Sankha Deb. Robotics Technology and Flexible Automation, 2nd Edition. ISBN: 9780070077911. Publication Date & Copyright: 2010 McGraw Hill Education (India) Private Limited
Updating	annually

Module name and code	ROB 144 Theory of learning machines and neural networks
Responsible for module	cand. of of physical and mathematical sciences., associate professor Baktybayev M.K.
Module type	Basic, compulsory module
Module level	MA
Amount of hours a week	2
Amount of credits	6 (ESTS 6)
Education form	Full-time
Term	6
Quantity of the being trained	17
Module prerequisites	the English language course bachelor program
Module content	**Practical classes (30h.):** Basic concepts of machine learning /ML/. Classification of machine learning tasks. Teaching with a teacher: setting the classification problem, regression. The concept of retraining and generalizing abilities. The standard machine learning library. Construction of a qualitative predictive model, uncertainty in the forecasts of the surrogate model. Non-standard machine learning tasks are either single-class classification, or an unbalanced classification task. Mathematical model of a neuron. The McCulloch-Pitts model as a linear classifier. Activation functions. The algorithm of back propagation of the error. Training based on incomplete data. The general formulation of the EM algorithm. EM algorithm as a sequential maximization of the lower likelihood limit. Estimation of parameters of a mixture of Gaussian distributions.

	Reinforcement Learning is based on negative and positive experiences. Training with a teacher. Batch Mode; Sequential Mode. Application of global optimization methods. Millions and billions of mathematical functions work together, and the better they are trained to do this, the stronger the system. TensorFlow is a free software released under the Apache 2.0 license, which is perfect for machine learning and for projects related to Deep Learning. This system would be flexible enough both for research and for implementation into products. It often happens that someone has a cool idea how to use machine learning to improve a product, but in order to implement it, you will have to rewrite everything from scratch. And this tool allows you to improve products without completely redoing everything. Dimension reduction. The method of the main components. Factor analysis. Linear discriminant analysis. Clustering. Statement of the clustering problem. The k-means algorithm. Hierarchical clustering. A model of a mixture of distributions for solving the clustering problem. Combination of models. Boosting, the AdaBoost algorithm. Bayesian averaging models. **IWMT (60h.):** The study of a unidirectional neural network. Training with incomplete data. The study of an expert management model using the experiment planning method. Probabilistic inference: approximate methods. Teaching without a teacher.
Education results	Students: knows: - training using a large number of levels of information representation to model the relationships of features (factors) in the data. In training, signs of higher levels are determined using signs of lower levels. Such a hierarchy of features is called "Deep Architecture"; - training on unmarked data ("without a teacher") or on a combination of unmarked and labeled data ("with partial involvement of a teacher"); - mathematical model of an artificial neuron; - sigmoidal activation functions; - single-layer perceptron; - WTA-type neurons; - basic operations when working with a neural network; - Kohonen networks; - networks of radial basis functions; - the method of support vectors; - Hopfield Network; - - Hamming network, Elman network. is able to: correctly apply the basic algorithms of mathematical modeling, use methods of computational mechanics and mathematical modeling in technical applications; - develop fuzzy process control systems, intelligent control systems based on neural networks;

	- apply the main tasks solved by neural networks- in matters of knowledge and understanding of modern problems
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Performance of examinations. - Translation of the original text in the specialty. - Annotation of articles in the specialty. - Written summarizing of articles in the specialty. - Performance of tasks of Rubezhnogo of control. - Examination.
Module duration	One term
Literature	1. Vorontsov K.V. Mathematical methods of teaching by precedents. 2012. http: //www.machinelearning.ru /wiki/index.php?titl=Machine learning. 2. Kruglov V.V., Borisov I.N. Artificial neural networks. Theory and practice. – M.: Hotline telecom, 2001, – 312 p. 3. Nazarov A.V., Loskutov A.I. Neural network algorithms for programming and system optimization – St. Petersburg: Science and Technology, 2003- 184 p . 4. Barseghyan A., Kupriyanov M., Kholod I., Tess M., Elizarov S. Data and process analysis. 3rd ed. // St. Petersburg: BHV-Petersburg, 2010, - 512 p. - Electronic edition. - ISBN 978-5-9775-0368-6. 5. Artificial intelligence: a modern approach - Artificial intelligence: a modern approach, - translated from English / Russell S., Norvig P. / 2nd edition - Moscow: Williams, 2007, – 1407 p.: ill.- Paral tit.l.: Eng.-Bibliogr.: p.1302-1372. -2000 copies-ISBN 978-5-8459-0887-2. 6. Gaskarov D.V. Intelligent information systems. – Moscow: Higher School, 2003, - 428 p. 7. Gavrilova T.A., Khoroshevsky V.F. Knowledge bases of intelligent systems. – St. Petersburg: Peter, 2000. – 348 p. 8. Hinton G. E., Salakhutdinov R. R. Reducing the Dimensionality of Data with Neural Networks // Science. — 2006, Vol. 313. — No. 5786. — P. 504-507. 9. Sukhanov V.I. Artificial Intelligence systems [Text]: Textbook. / V.I. Sukhanov. - Yekaterinburg: IPK USTU, 2004. - 124 p.
Updating	annually

Module name and code	ROB 169 Modeling of dynamic systems (professional)
Responsible for module	cand. of of physical and mathematical sciences., associate professor Baktybayev M.K.
Module type	Basic, compulsory module
Module level	MA
Amount of hours a week	2
Amount of credits	6 (ESTS 6)
Education form	Full-time
Term	6
Quantity of the being trained	17
Module prerequisites	the English language course bachelor program
Module content	Practical classes (30h.):

	Dynamic Hamilton equations (Hamiltonian). The total energy of the system. Dissipative system. Modeling of isolated continuous dynamical systems. Rayleigh equations. Newton's equations. Lagrange equations. Model transformation. The choice of a numerical method. Modeling of isolated hybrid systems. A behavior map with one state and with multiple states. Discrete dynamical systems. Modeling of multicomponent systems with inputs and outputs. "Physical modeling" in RMD. Formation of equations. Components with oriented links. Components with undirected connections. Bond graph: a method based on the flow of power between the elements of the system. Getting a parametric dependency. Parametric optimization. Stochastic experiment. The Monte Carlo method. Formation of an aggregate system of equations. IWMT (60h.): Linear oscillator. A classical dynamic system in the visual modeling environment of Rand Model Designer. Block diagram of the "Worm with two legs" device. Continuous behavior of the "pendulum" block. Model of the fan speed control system. A model of a simple hydraulic system. Probabilistic inference for discrete models. Turnstile model.
Education results	Students: knows: - the main provisions of the theory of modeling dynamic processes -Hamiltonian formalism and canonical perturbation theory. This approach allows us to apply the fundamental results of analytical dynamics to build effective algorithms for integrating differential equations and evaluating the convergence of the solutions obtained. is able to: - conduct computer experiments using modern visual modeling environments. The main one is the visual modeling environment of complex dynamic systems Rand Model Designer. competent: - in matters of knowledge and understanding of modern problems
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Performance of examinations. - Translation of the original text in the specialty. - Annotation of articles in the specialty. - Written summarizing of articles in the specialty. - Performance of tasks of Rubezhnogo of control. - Examination.
Module duration	One term
Literature	1. Efimov I.N., Morozov E.A., Selivanov K.M. Computer modeling of dynamic systems. - Izhevsk: Institute of Computer Research, 2014. 134s. 2. Kolesov Yu.B., Senichenkov Yu.B. Mathematical modeling of hybrid dynamic systems. Study guide. – St. Petersburg: Publishing House of the Polytechnic University. unita, 2014, - 236 p . 3. Barseghyan A., Kupriyanov M., Kholod I., Tess M., Elizarov S. Data and process analysis. 3rd ed. // St. Petersburg: BHV-

	Petersburg, 2010, - 512 p. - Electronic edition. - ISBN 978-5-9775-0368-6. 4. Wolfgang Borutzky. Bond Graph Methodology // Development and Analysis of Multidisciplinary Dynamic System Models. 2010. 5. Voronin A.V. Modeling of mechatronic systems: a textbook. Tomsk: Tomsk Polytechnic University Publishing House, 2008. 6. Dynamics course for Engineers: a unified approach to Newton-Euler mechanics and Lagrange Mechanics. - M.-Izhevsk: SIC "Regular and Chaotic Dynamics", Izhevsk Institute of Computer Research, 2011. - 504 p. 7. Efimov I.N., Morozov E.A. Computer modeling of physical processes. Study guide. Izhevsk: Publishing house "Mitra", 2012. – 134 p. 8. Hinton G. E., Salakhutdinov R. R. Reducing the Dimensionality of Data with Neural Networks // Science. — 2006, Vol. 313. No. 5786. P. 504. 9. Landau L.D., Lifshits E.M. Mechanics. – M.: Nauka, 1988. – 174 p. 10. Efimov I.N., Morozov E.A. Integral invariants of canonical integration of Hamiltonian systems. // Intelligent systems in production. - 2003. - No. 2 -pp. 59-79.
Updating	annually

Module name and code	ROB 145 Accuracy of measuring instruments (professional)
Responsible for module	cand. of physical and mathematical sciences., associate professor Baktybayev M.K.
Module type	Basic, compulsory module
Module level	BA
Amount of hours a week	2
Amount of credits	6 (ESTS 6)
Education form	Full-time
Term	6
Quantity of the being trained	17
Module prerequisites	the English language course bachelor program
Module content	**Practical classes (30h.):** Measuring channels and signals. Laws of distribution of measurement errors and determination of their characteristics. Measurement theories. Measurement data processing and forecasting. Measuring converters of electrical quantities. The method of parallel compensation in the measuring system. Modulation of measuring signals. Methods of matching the signal with the measuring channel. Decoding and recovery of the measuring signal. Accounting and calculation of the error when connecting a voltmeter or ammeter to the measuring. Measuring signal acquisition system with one measuring channel. Digitization of measurement signals. The theory of quantization of measuring signals. The laws of signal distribution in measuring channels. The theory of sampling of measuring signals in time. Multiplexing of measuring signals. Switching algorithms in a multiplexer. Mathematical model of measurements on the scale of

	relations. A mathematical model of measurements on a scale of order. The basic rules for determining the dimension of physical quantities. Quality indicators of measuring instruments. Indicators of reliability of measuring instruments. The structure of the compatibility of the measuring system links. **IWMT (60h.):** Calculation of parameters of models of measuring channels. Conducting direct multiple equal-precision measurements and processing the results. Determination of static errors of the measuring instrument. Determination of dynamic errors of the measuring instrument. Performing correction of systematic and component errors of the measuring instrument. Determination of the characteristics of converters.
Education results	Students: knows: - the principle of operation and design of measuring instruments and transducers; - causes of occurrence and ways to exclude errors; - methods of building information and measurement systems. is able to: - to select a measuring device or sensor; - develop a mathematical model of measuring instruments; - calculate the accuracy of the information and measurement system.
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Performance of examinations. - Translation of the original text in the specialty. - Annotation of articles in the specialty. - Written summarizing of articles in the specialty. - Performance of tasks of Rubezhnogo of control. - Examination.
Module duration	One term
Literature	1. Information and measurement technology and electronics. Converters of non-electrical quantities 2nd ed., ispr, and add. Textbook for universities. Viktor Vladimirovich Petrov. Moscow, 2016. 2. Information and measurement technology and technology. Textbook for universities / Edited by G.G. Ranneva. – M.: Higher School, 2012. 3.Theoretical foundations of information and measurement systems. Babak V.P., 2014. 4.Sergeev A.G., Krokhin V.V. Metrology, standardization and certification. – M.: Publishing House "Yurayt", 2011. 5.Theoretical foundations of information and measuring technology. Textbook: G.A.Sadovsky. Moscow: High School, 2008. 6.Information and measuring equipment and technologies. A.V. Yurchenko – Tomsk: Tomsk Polytechnic University Publishing House, 2012. 7.Evtiheev N.N. Measurement of electrical and non-electrical quantities. – M.: Energoatomizdat, 2004.

	8. Klaassen K.B. Fundamentals of measurement theory. – M.: Postmarket, 2000. 9. Nazarov N.G. Metrology. Basic concepts and mathematical models. – M.: Higher School, 2002. 10. A.D. Nikitin. Information and measuring equipment. Laboratory workshop. — Yekaterinburg : Ural Publishing House. un-ta, 2017.
Updating	annually

Module designation	ROB528 - Programming for engineers with MATLAB
Semester(s) in which this module is taught	7
The person responsible for the module	Ozhikenov Kassymbek Adilbekovich
Language	Russian, Kazakh
Attitude to the curriculum	Required component, profile discipline
Teaching methods	Lecture, laboratory, independent work
Workload (incl. contact hours, hours of independent work)	2 hours of lectures, 1 hour for a laboratory lesson and 1 hour for an office IWST per week (total contact 60 hours and 15 hours for an office IWST)
Credit scores	5
Necessary and recommended prerequisites for joining the module	None

Module objectives/expected learning outcomes	The purpose of studying the discipline "Programming for engineers with MATLAB" is to form students' theoretical knowledge about the principles of building simulation modeling systems, the ability to independently analyze the flow of physical processes of dynamic objects and their individual components by simulation modeling methods, to apply simulation models in control systems of mechatronic and robotic systems. The objectives of the discipline are the study of typical mathematical schemes for modeling systems, familiarization with the basic approaches of simulation modeling of systems, the study of modern methods of simulation of physical control processes in devices, automation equipment and technological processes in the MATLAB (Simulink). The final stage of the course is an exam. The student must be able to: - use MATLAB tools for dynamic systems analysis; - develop algorithms in the MATLAB environment. At the end of the course, the student should know: - basic principles of simulation modeling; - methodology for the study of dynamic systems in the environment in MATLAB; - methods of describing dynamic systems in the form of transfer functions; - synthesis of regulators for dynamic systems in a MATLAB environment; - methods for assessing the quality of the simulation process in MATLAB
Content	Introduction to MATLAB. The MATLAB environment. Work in team mode. Working with arrays. Formation of vectors and matrices. Solving systems of linear equations. Creating and using m-files: scripts and the simplest file functions. Debugging programs. Plotting graphs. Managing graphical windows. Programming. Loop, branch, and switch operators. Solving differential equations and their systems in MATLAB. Solving nonlinear equations and their systems. Solving differential equations and their systems in MATLAB. Solving nonlinear equations and their systems. General characteristics of Simulink. Creating a model. Components of the main Simulink library. Signals in Simulink and their attributes. White noise generator. The source of the time signal. A block for reading data from a file and workspace. Recording devices. The block for stopping the simulation. Analog blocks. Blocks of mathematical operations. Amplifiers. Slider control.
Examination forms	Written exam

Study and examination requirements	Mandatory participation in training sessions according to the schedule, which determines the readiness for the lesson. In case of absence from the lesson, the student is obliged to notify the teacher within a day and explain the plan for self-study of the lesson: - mandatory reading of the submitted materials before the lesson; - delivery of tasks at any time. There are penalties of -10% for late delivery; - 20% non-participation in the audience (for a good reason with supporting documents) - rating "F (Fail)"; - plagiarism and cheating during the execution of the task are not allowed; - mandatory use of electronic gadgets in the classroom, which is welcome, but it is unacceptable to use them in the exam.
Reading list	1. Ozhikenov K. A. Mathematical environment MATLAB: Textbook. – Almaty: Lantar Trade, 2021. – 159 p. 2. Ozhikenov K.A., Fundamentals of programming in the MATLAB environment. Electronic training manual. Almaty: 2016. http://doc.nlrk.kz/result/ebook_281/index.html#ps 3. Lazarev, Yu. Modeling of processes and systems in MatLab: a training course / Yu. Lazarev. – St. Petersburg: St. Petersburg; Kiev: BHV, 2018 4. Chernykh I.V. "Simulink: A tool for modeling dynamic systems" http://www.tspu.tula.ru/ivt/old_site/lcopy/Matlab_RU/simulink/book1/2.asp.htm
Updating	annually

Module designation	ROB503 Mechanics of robots
Semester(s) in which this module is taught	7
The person responsible for the module	Ozhikenov Kassymbek Adilbekovich
Language	Russian, Kazakh
Attitude to the curriculum	Required component, profile discipline
Teaching methods	lecture, practical classes, independent work
Workload (incl. contact hours, hours of independent work)	2 hours of lectures, 1 hour for a practical classes and 1 hour for an office IWST per week (total contact 60 hours and 15 hours for an office IWST)
Credit scores	5
Necessary and recommended prerequisites for joining the module	None

Module objectives/expected learning outcomes	The purpose of teaching the discipline "Mechanics of robots" is to study the basics of building kinematic and dynamic models of robots and motion control tasks, methods of constructing program trajectories of motion. Robots and manipulators have a number of specific characteristics that make it possible to distinguish them into a separate class of control objects and form requirements for control synthesis taking into account these features. Often, the synthesis of robot control cannot be separated from the kinematics and dynamics of its executive device. In this regard, an important and urgent task is to study the kinematics and dynamic properties of various actuators and use this information to obtain as simple and economical control as possible. In turn, the task of controlling the robot is inextricably linked with planning the trajectories of its movement. The student should be able to: - solve kinematics problems of manipulators; - build models of manipulator dynamics; - plan the trajectories of the manipulator movement in Cartesian space and in the space of generalized coordinates; - build and calculate robot execution systems; - control the movement of the robot. At the end of the course, the student should know: - features of executive systems as control objects; - methods for solving manipulator kinematics problems; - methods of constructing models of manipulator dynamics; methods of planning the trajectories of the manipulator movement in Cartesian space and in the space of generalized coordinates; - principles of construction and calculation of robot executive systems; - basic methods of controlling robot movement
Content	Introduction. Features of the robot as a control object. Manipulation mechanisms and executive systems of robots. Kinematics of manipulators. Kinematic parameters used to describe the angular and translational motion of a rigid body. Direct and inverse kinematics problems. Construction (planning) of program trajectories of the manipulator movement. Software control systems of robots. Planning the trajectories of the manipulator movement in Cartesian space. Simulation of the robot control system. Dynamics of manipulators. External force influences, masses and moments of inertia of the load, bringing to degrees of mobility of mechanisms. The mutual influence of degrees of mobility. Non-linearity of mechanical gears. Basic control principles implemented in robot drives. Control systems for robotics by a human operator. Group management systems. Tasks of controlling the robot's movement. Methods based on solving the inverse dynamics problem. Application of self-tuning methods in robot control.
Examination forms	Written exam

Study and examination requirements	Mandatory participation in training sessions according to the schedule, which determines the readiness for the lesson. In case of absence from the lesson, the student is obliged to notify the teacher within a day and explain the plan for self-study of the lesson: - mandatory reading of the submitted materials before the lesson; - delivery of tasks at any time. There are penalties of -10% for late delivery; - 20% non-participation in the audience (for a good reason with supporting documents) - rating "F (Fail)"; - plagiarism and cheating during the execution of the task are not allowed; - mandatory use of electronic gadgets in the classroom, which is welcome, but it is unacceptable to use them in the exam.
Reading list	1. Dynamics of robot control. Moscow: Nauka, 2017. 2. Control systems of manipulative robots / Medvedev V.S. et al. - Moscow:Nauka, 2018. 3.Shangin E.S. Control of robots and robotic systems. Lecture notes. Ufa, 2005. 4.Timofeev A.V. Adaptive robotic complexes. L.: Mechanical Engineering, 2016. 5.Mechanics of industrial robots: Edited by K.V. Frolov, E.I. Vorobyov. Book 1: Kinematics and dynamics / E.I. Vorobyov, S.A. Popov, G.I. Sheveleva. – M.: Higher School, 2015. – 304 p. 6. Korendyasev A.I. Theoretical foundations of robotics. Book 1. Moscow: Nauka, 2006.
Updating	annually

Module designation	ROB507 Fundamentals of biomechanics
Semester(s) in which this module is taught	*5*
The person responsible for the module	Ozhikenov Kassymbek Adilbekovich
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, practice – 15, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--2 cr, practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*

Module objectives/expected learning outcomes	The purpose of studying the discipline "Fundamentals of Biomechanics" is to form students' knowledge about the fundamental laws and principles of biomechanics, theoretical knowledge about the mechanical properties of biological tissues, systems and their substitutes, as well as the physical phenomena that occur in them in the process of life and movement of the body in space.
Content	Mechanical properties of biological tissues and fluids. External influences on the human body. Biomechanics of the heart. Biomechanics of the vascular system. Biomechanics of the respiratory tract. Biomechanics of the musculoskeletal system. Biomechanics of the eye. Biomechanics of hearing. Biomechanics of the vestibular apparatus. Biomechanics of speech formation. Biomechanics of the digestive system. Biomechanics of excretory organs. Mechanics of biological tissue substitutes. Biomechanics of artificial organs.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	1. Barankov I.V. Fundamentals of biomechanics. – M.: Publ. Mir, 2014. 2. Brankov G. Fundamentals of biomechanics / Trans. from Bulgarian - M.: Mir, 2017. - 254 p. 3. Physiology of movements. - L.:Publ. Nauka, 2014. - 375 p. 4. Formalsky A.M. Movement of anthropomorphic mechanisms. – M.: Publ. Nauka, 2015. – 368 p. 5. Biomechanics of blood circulation, respiration and biological tissues. - Riga: Zinatne, 2012. - 320 p.
Updating	annually

Module designation	ROB413 Biomechanics
Semester(s) in which this module is taught	*7*
The person responsible for the module	Ozhikenov Kassymbek Adilbekovich
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, practice – 15, SIS -30h., SIST – 15h.*

Credit scores	*6cr:* *Lecture-2 cr, practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*
Module objectives/expected learning outcomes	Studying the course "Biomechanics" is of great importance in the preparation of a graduate with a higher professional education, because it allows him, on the basis of a system-structural approach and using modern scientific methods of biomechanics, to analyze the motor activity of people. Course objectives - Formation of knowledge of the structure and functioning of the human biomechanical system; - Acquisition of knowledge of biomechanical research methods in the study of human motor activity; - The ability to solve particular problems of biomechanics in specific tasks of robotics.
Content	Scientific methods of biomechanics. Biomechanical characteristics of human movement. Biomechanical methods for studying human movements. Human motor apparatus as a biomechanical system. Biokinematic links, pairs and chains. Degrees of freedom of the human motor apparatus. Biomechanical model of the muscle. The effect of muscle action. Biomechanics of motor actions. Systems of human movements. Biomechanical foundations of human motor qualities. Biomechanics of different types of human movements. Biomechanical features of maintaining body balance.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	1. Begun P.I., Shukeilo Yu.A. Biomechanics Textbook for universities. - St. Petersburg: Polytechnic, 2020. - 463 p. 2. Popov G.I. Biomechanics. Textbook. Moscow. ACADEMA, 2015.-254 p. 3. Lisovsky A.F., Nepomnyashchaya N.N. Determination and comparative analysis of the moment of inertia of the human body by the swing method. Guidelines for laboratory work. - Tchaikovsky: CHIFK, 2021. 4. Donskoy D.D., Dmitriev S.V. Fundamentals of anthropocentric biomechanics. - N. Novgorod, 2016. - 146 p. 5. Traffic control. - L.: Nauka, 2013. - 190 p.
Updating	annually

Module designation	ROB416 Control and dynamic systems

Semester(s) in which this module is taught	*8*
The person responsible for the module	*Baiturganova Vinera*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, practice – 15, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture -2 cr, practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*

Module objectives/expected learning outcomes	The purpose of teaching the discipline "Control and dynamic systems" is to study the basics of building kinematic and dynamic models of robots and motion control tasks, methods for constructing program trajectories of motion. Robots and manipulators have a number of specific characteristics that make it possible to single them out as a separate class of control objects and form requirements for control synthesis, taking into account these features. Often, the synthesis of robot control cannot be separated from the kinematics and dynamics of its actuator. In this regard, an important and urgent task is to study the kinematics and dynamic properties of various actuators and use this information to obtain the simplest and most economical control possible. In turn, the task of controlling the robot is inextricably linked with planning the trajectory of its movement. - to solve problems of kinematics of manipulators; - to build models of dynamics of manipulators; - plan the trajectories of the manipulator in Cartesian space and in the space of generalized coordinates; - build and calculate the executive systems of robots; control the movement of the robot. At the end of the course, the student should know: - features of executive systems as objects of control; - methods for solving problems of kinematics of manipulators; - methods for constructing models of the dynamics of manipulators; - methods of planning the trajectories of the manipulator in Cartesian space and in the space of generalized coordinates; - principles of construction and calculation of executive systems of robots; - Basic methods of robot motion control
Content	Features of the robot as a control object. Manipulation mechanisms and executive systems of robots. Kinematics of manipulators. Kinematic parameters are used to describe the angular and translational motion of a rigid body. Direct and inverse problems of kinematics. Construction (planning) of program trajectories of the movement of the manipulator. Systems of program control robots. Planning the trajectories of the manipulator in Cartesian space. Modeling the control system of robots, dynamics of manipulators. External forces influence masses and moments of inertia of the load, reduction to degrees of mobility of mechanisms. System of adaptive control of robots. Mutual influence of degrees of mobility. Nonlinearity of mechanical transmissions. Basic principles of control are implemented in robot drives. Elastic deformations of structural elements and mechanical gears. Control systems for robotics by a human operator. Group control systems. Robot motion control tasks. Methods are based on solving the inverse problem of dynamics. Application of self-tuning methods in robot control. Features of the implementation of dynamic control algorithms using microprocessor control devices. Robot training.
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	1. Kuleshov V.S., Lakota N.A. Dynamics of manipulator control systems. - M.: Energy, 2015. 2. Remotely controlled robot and manipulators / S. Kuleshov et al.; Ed. E.P. Popov. - M.: Mashinostroenie, 2012. 3. Dynamics of robot control. M.: Nauka, 2017. 4. Control systems of manipulation robots / Medvedev V.S. and others - M.: Nauka, 2018. 5. Shangin E.S. Control of robots and robotic systems. Lecture notes. Ufa, 2014. 6. Zenkevich S.L., Yushchenko A.S. Fundamentals of manipulative robots control: A textbook for universities. - 2nd ed., corrected. and additional M.: Publishing house of MSTU im. N. E. Bauman, 2014. - 480 p.
Updating	annually

Module designation	ROB185 Industrial robotics
Semester(s) in which this module is taught	*3*
The person responsible for the module	*Tuleshov Yerkebulan Amandykovich*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, practice – 15, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--2 cr, practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*

Module objectives/expected learning outcomes	The purpose of teaching the discipline "Industrial Robotics" is to study by students' industrial manipulators of technological equipment, the design and calculation features of modern manipulator designs, their layout and structures, characteristics and requirements, conditions for the use of various types of manipulators in production. The main task is to obtain the necessary set of knowledge on the means of modern production automation, the ability to determine the rational combination of the main technical and economic indicators, the inculcation of practical skills necessary for the study, calculation and design of industrial robots and manipulators. As a result of studying the discipline, students should know: - Issues of design and calculation of the main parameters of industrial manipulators; - Various types and types of automation equipment, - Basic designs of industrial manipulators, - Conditions for the creation of flexible production complexes for modern industrial production; - be able to: - choose the optimal operating conditions for the complexes using various types of control, - To make calculations of the main parameters of industrial manipulators, - put forward and justify proposals for the modernization and design of these automation tools; -to achieve skills: - The use of methods and instruments for research of robots and manipulators in the conditions of current production.
Content	General characteristics of the designs of industrial robots. Classification of industrial robots. The principle of robot control. Rail and railless manipulators. Mechanisms of robotic manipulators and their calculation. Design features of automatic lines with robots and manipulators. The use of industrial robots for procurement and assembly operations. Flexible production systems.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	1. Belyanin P. N. Industrial robots and their application / / Robotics for mechanical engineering. M.: Mashinostroenie, 2013.312 p. 2. Belyanin P. N. Robotic systems for mechanical engineering. M.: Mashinostroenie, 2016. 256 p. 3. Kozyrev Yu. G. Industrial robots. M.: Mashinostroenie, 2013. 376 p. 4. Petrov B. A. Manipulators. L.: Mashinostroenie, 2014.238 p. 5. Rapoport G. N., Solin Yu. V. Application of industrial robots. M.: Mashinostroenie, 2015. 272 p. 6. Robotics and flexible automated production. In 9 books by M. Makarov. M.: Higher school, 2016. 7. Modern industrial robots. Catalog / Ed. Yu. G. Kozyreva. M.: Mashinostroenie, 2012. 152 p.
Updating	annually

Module designation	ROB429 Manipulator mechanics
Semester(s) in which this module is taught	*4*
The person responsible for the module	*Tuleshov Yerkebulan Amandykovich*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, practical classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-15h, practice – 15, SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--1 cr, practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electrical engineering, physics*

Module objectives/expected learning outcomes	The purpose of the discipline: The study of the general theory and fundamentals of designing the mechanisms of robots and manipulators and their application at the enterprises of the forest complex. The tasks of studying the discipline: To give knowledge about the structure of the main mechanisms of robots and manipulators, kinematic and dynamic parameters and optimization methods, the basic rules of operation in enterprises. The student must know: - Appointment of prospects for use and development trends; - Structure and classification of robots and manipulators; - Classification, main characteristics and scope of drives; - Purpose and types of sensor devices, control algorithms and control devices; - Fundamentals of designing manipulators, including industrial robots; - Features of the use and operation of robots and manipulators as means of automation and mechanization. The student must be able to: - Evaluate the production process with whole applications of industrial robots and manipulators; - To understand the structural, kinematic, pneumatic and hydraulic schemes of the manipulators of the complex of industrial robots; - Carry out kinematic, force and dynamic analysis of manipulation mechanical systems of robots and manipulator
Content	Subject and objectives of the course. Structure and classification of robots and manipulators. Stages of emergence, development. Main characteristics of robots: load capacity, system of coordinate movements, number of degrees of freedom; speed of movement and the magnitude of the stroke of each link, positioning error, method of installation at the workplace, working area of \u200b\u200bservice. Classification and principles of construction of robotic systems. Manipulation and gripping devices. Dynamic models of robots and manipulators. Features of the use of drives in robots and manipulators. Principles of development of dynamic models of robots and manipulators. Force calculation as the basis for choosing the strength parameters of the manipulator. Positioning errors and dynamic error calculation method. Characteristic features to consider when choosing the type of drive. Comparative evaluation of electro-hydraulic, pneumatic and electric drives of robots and forestry manipulators.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	1. Nazarov Kh.N. Robotic systems and complexes. Tutorial. - T .: TSTU, 2014 - 102 p. 2. Yurevich E.I. (ed.) Intelligent robots Textbook for universities / under the general editorship of E.I. Yurevich / I.A. Kalyaev, V.M. Lokhin, I.M. Makarov and others - M.: Mashinostroenie, 2017. - 360 p. 3. Yurevich E.I. Fundamentals of Robotics 2nd ed., revised. and additional - St. Petersburg: BHV Peterburg, 2015. - 416s, ill. 4. Lukinov, A. P. Design of mechatronic and robotic devices. / A. P. Lukinov. - St. Petersburg.: Lan, 2012. - 608 p.
Updating	annually

Module designation	ROB139 Sensor systems in robotics
Semester(s) in which this module is taught	*6*
The person responsible for the module	Ozhikenov Kassymbek Adilbekovich
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture--2 cr, laboratory lesson – 1 cr. practice – 1cr, SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Physics, Mathematics, Electronics*

Module objectives/expected learning outcomes	The purpose of the discipline "Sensor systems in robotics" is to study the principles of construction, technical and software implementation of the elements of sensor systems of complex mechatronic complexes. To achieve the goal in the discipline, the tasks of studying are solved: technical means of primary obtaining information on the current parameters of the functioning of the mechatronic complex; methods and means of converting signals from primary measuring transducers; methods for converting and transmitting information signals over communication lines; methods for improving the noise immunity of information systems under the influence of interference; interfaces and communication protocols in industrial information systems. The discipline studies the elements of industrial sensory and information-control systems and the principles of their functioning in mechatronic and robotic systems. The elements of information systems studied within the framework of the discipline include means of obtaining information about the state of a mechatronic object, converting and transmitting information over communication lines, as well as means of control.
Content	The main stages and trends in the development of robotics. Bionic aspects of information systems. Elements of information systems. Sensors and their characteristics. Measurement process. information model. Methods of compensation and accounting for errors. Resistive sensing elements. Electromagnetic sensitive elements. Hall transducers. Optical sensing elements. Piezoelectric sensing elements. Measuring schemes of sensors. General information. Parametric schemes of sensors. Generator measuring circuits. Measuring amplifiers. kinesthetic sensors. Measurement of speed and dynamic factors. Location information systems. Tactile sensing systems. Appointment of tactile sensors and their classification. Tactile matrices, general device, scope. Tactile matrices with high resolution. Vision systems. Video sensors. Image perception, preprocessing, recognition. Purpose of vision systems, principle of their operation, areas of application. Typical structure. Location sensing systems. Location sensors and their purpose. Classification, operating principle, generalized structure. Distributed information systems in mechatronics. Organization of the relationship of an information system with a distributed control system. Methods of interference suppression in communication lines. Organization of an information processing system. Composition and functional diagram of the system.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	1. Syryamkin V.I. Information devices and systems in robotics and mechatronics: textbook. allowance. (Series: Intelligent technical systems). -Tomsk: Publishing House Vol. un-ta, 2016. -524 p. 2. Vorotnikov S.A. Information devices of robotic systems: Proc. allowance. - M.: Ed. MSTU im. N.E. Bauman. 2015. - 384 p. 3. Claassen K.B. Fundamentals of measurements: sensors and electron. devices: textbook. allowance: per. from English. / K. B. Claassen. - 3rd ed. - Dolgoprudny: Intellect. 2018. - 350 p.: ill. schemes. - Item decree: p.336-344. - Bibliography: p. 345-346. 4. Friden. J. Modern sensors: reference: per. from English. / J. Frieden. - M.: Technosfera, 2016. - 588 p.: ill. - (World electronic.). - Bibliography. at the end of chapters. ISBN 5-94836-050-4 (in trans.). 5. Jackson R.G. The latest sensors: per. from English. / R. G. Jackson. - 2nd ed. add. - M.: Technosphere. 2018. - 399 p.: ill., tab. - (World electronic.).
Updating	annually

Module name and code	ROB 515 Basics of automation
Responsible for module	cand. of of physical and mathematical sciences., associate professor Baktybayev M.K.
Module type	Basic, compulsory module
Module level	BA
Amount of hours a week	2
Amount of credits	6 (ESTS 6)
Education form	Full-time
Term	6
Quantity of the being trained	17
Module prerequisites	the English language course bachelor program
Module content	TCMD «Basics of automation» «professional) » - ROB 515 Practical classes (30h.): Methods mathematical models of automatic control systems (ACS), Laplace transformations, transfer functions, evaluation of ACS functioning, ACS block diagrams, ACS stability, ACS synthesis methods, automation elements and their characteristics, electromagnetic devices. IWMT (60h.): Investigation of a linear dynamical system in Matlab. Typical dynamic links. Matlab environment for the study of automation systems. Development of a functional automation scheme using computer-aided design tools. Simulation of control systems in the SIMULINK package. Designing a regulator for a linear system.
Education results	Students: knows: - fundamentals of modeling using the Simulink library of the Matlab software product; - basic principles of regulation and management; - mathematical models of automatic control systems; - block diagrams of automatic control systems, amplifying link, aperiodic link of the first order, oscillatory link, integrating link, differentiating link, lagging link; - laws of regulation in linear continuous ACS;

	- methods of analysis for the stability of the system; is able to: correctly apply the basic algorithms of mathematical modeling, use methods of computational mechanics and mathematical modeling in technical applications; - to carry out sequential, parallel, feedback correction of linear automatic control systems.
Total control form	Examinaton: written examination – 120 min.
Conditions for receiving credits	- Performance of examinations. - Translation of the original text in the specialty. - Annotation of articles in the specialty. - Written summarizing of articles in the specialty. - Performance of tasks of Rubezhnogo of control. - Examination.
Module duration	One term
Literature	1. Shishmarev V.Yu. Automation. Moscow: Publishing Center "Academy", 205. 288 p. 2. Zimodro A.F., Skibenekiy G.L. Fundamentals of automation. L.: Energoatomizdat, 1984. 3. Kisarimov V.A. Practical automation: Reference book. M.: IP "Radiosoft", 2004.-192. 4. Shavrov A.V., Kolomets A.P. Automation. M.: Kolos, 1999. 5. Shishmarev V.Yu. Typical elements of automatic control systems. M.: Academy, 2004, 304 p. 6. Chernykh I.V. "Simulink: A tool for modeling dynamic systems". http://www.nsu.ru/matlab /MatLabRU/ simulink/book1/index.asp.htm 7. Besekersky V.A. Popov E.P. Theory of automatic control systems / V.A. Besekersky, E.P. Popov. -4th ed., reprint. and additional – St. Petersburg, Profession, 2007. 752 p. 8. Besekersky V.A. Collection of problems on the theory of automatic regulation and control. M.: Nauka, 1978. 512 p. 9. Vlasov K.P. Theory of automatic control: Textbook. Kh.: Humanitarian Center, 2007. 526 p. 10. Dorf R. Modern control systems / R. Dorf, R. Bishop: Translated from English by B.I. Kopylova. M.: Laboratory of Basic Knowledge, 2004. 832 p. 11. Shandrov B.V. Technical means of automation: Textbook for university students / B.V. Shandrov, A.D. Chudakov. -2nd ed., ster.- M.: Publishing center "Academy", 2010. 368 p.
Updating	annually

Module designation	ROB121 Optoelectronic technologies
Semester(s) in which this module is taught	*5*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6kr:* *Lecture-2 cr, laboratory lesson – 1 cr. SIS -2 kr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Electronics, physics*
Module objectives/expected learning outcomes	*The purpose of teaching the discipline" optoelectronic technologies " is the final stage of preparing students for an engineering project when studying semiconductor Optoelectronics.* *Knowledge: in design, you need to learn how to analyze technical tasks, build structural and functional schemes;* *It is necessary to be able to: get acquainted with the element base of electronic devices; to correctly fill out and create design documents, work with scientific and technical literature and learn.*
Content	*Fundamentals of optoelectronics. Fundamentals of optical Electronics Development. Radiation sources for optoelectronics. Fiber-optic communication lines (Vols). Optical multiplexers and demultiplexers. Classification of Vols (Vols). Optical methods of memorizing and storing information. Optical (laser) disks.Optical (laser) disks..Holographic information storage and processing systems.Information display systems.Liquid crystal indicators.Enabling a Color Image.Electroluminescent indicators.Information display systems based on semiconductor LEDs*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	*[1] Samokhvalov, M.K. Elements and devices of optoelectronics:strong postobie / M. K. Samokhvalov. - Ulyanovsk; UlSTU, 2015. – 223 P.* *[2] Ignatov, A. N. Optoelectronics and nanophotonics: educational postobie / A. N. Ignatov. - St. Petersburg.]: Lan, 2011. - 538 P.* *[3]Bugrov, V. Or. Optoelectronics of LEDs: a textbook/ V. Or. Bugrov, K. A. Vinogradova. - Saint Petersburg: NRU ITMO, 2013. – 174 P.* *[4] Ermakov, O. N. Optoelectronics. Step 1. Physical fundamentals of semiconductor optoelectronics. Coherent optoelectronics / O. N. Ermakov, A. N. Pihtin, Yu. Yu. Protasov, S. A. Tarasov. - Moscow: Janus-K, 2011. - 695 P.* *[5] Ignatov, A.N. Optoelectronic sawmills and installations: educational postobie / A. N. Ignatov-Moscow: Eco-Trend, 2006. – 269 p* *. [6] Yushin, A.M. Optoelectronic sawmills and their foreign analogues: In 5 vols. (Handbook). - Vol. 5. Catalog / A. M. Yushin. - Moscow: RadioSoft, 2005. - 511 p.*
Updating	annually

Module designation	ROB125 Reliability and quality of measuring instruments
Semester(s) in which this module is taught	*6*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6kr:* *Lecture-2 cr, laboratory lesson – 1 cr. SIS -2 kr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*physics, mathematics*

Module objectives/expected learning outcomes	*The purpose of teaching the discipline" reliability and quality of measuring instruments " is to teach students how to assess the reliability, safety, safety of measuring devices and how to improve their performance. This discipline is used in the development of information and electronic measuring devices to understand their basic parameters.* *When passing the discipline, the student must know:* *- know the basic concepts of reliability, safety theory, quantitative characteristics of reliability; methods of timely assessment of reliability, safety and safety of technical systems;* *- have the ability to assess the probability of failures, their frequency, intensity and feasibility of failures;* *- have the skills to assess the reliability, safety and safety of technical systems;* *- be competent in professional activities related to assessing the reliability and safety of technical systems..*
Content	*Introductory lecture.* *Introduction. Subject, purpose and tasks. Basic concepts of reliability. Classification of rejection.* *Dimensional reliability indicators. Basic definitions. Fundamentals of probability theory.* *The main indicators of reliability. The probability of working without giving up. Probability of rejection. The intensity of rejection.* *Relationship equation of reliability indicators. Quantitative characteristics of suppression.* *Mathematical models of reliability and failure.* *Distribution functions of the function before rejection, normal distribution function.* *The functions of the distribution before the rejection of the function are exponential, lognormal, and gamma-distribution.* *Reliability of the system, general concepts and definitions.Reliability of the main system.Reliability of recoverable objects and systems.* *Reliability of electronic devices. Reliability of integrated circuits.* *Reliability of semiconductor devices.* *Reliability of printed circuit boards* *Reliability of electronic passive elements.* *Reliability of Transformers. Reliability of capacitors.* *Reliability of resistors* *Quality indicators of measuring instruments. Instrument sensitivity* *Measurement accuracy* *Accuracy classes of measuring instruments*
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*1 Polovko A.M. Fundamentals of Reliability Theory Moscow, Nauka 2006* *2 V.S. Grubnik, Y.M. Krysin Reliability of electronic measuring instruments Penza 2001* *3 Rannev Georgiy Georgievich, Tarasenko Alexander Panteleevich Reliability and quality of measuring instruments. Textbook for students of higher education institutions Academy (Academia 2014).* *4 Korotkov V.P. "Fundamentals of metrology and theory of accuracy of measuring devices" M. Publishing House of Standards; 2011*
Updating	annually

Module designation	ROB189 Control and measuring devices
Semester(s) in which this module is taught	*6*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6kr:* *Lecture-2 cr, laboratory lesson – 1 cr. SIS -2 kr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*physics, electronics*

Module objectives/expected learning outcomes	*To give students the fundamental foundations of the construction of instruments and general methods of measuring technology, as well as the features of measurements of various non-electrical quantities.* *As a result of studying this course, students acquire the following skills and abilities:* *- basic metrological characteristics and classification of measurement means and errors;* *- the main components of measuring systems, issues of evaluation of measurement results;* *- main characteristics, switching schemes, classification of measuring transducers and errors of the conversion system;* *- the physical foundations of parametric and generator sensors, the device and the principle of their operation, the main metrological characteristics;* *- examples of the creation of multifunctional information and measurement systems based on microprocessor technology.*
Content	*The discipline "Control and measuring devices" occupies a leading place in the technological training of students, is the basis for studying the disciplines of the specialized disciplines of the specialty. Study with the basic principles and types of instruments and measuring systems used to measure physical quantities most commonly found in research and production.*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*1 Zaitsev S.A., Gribanov D.D., Tolstov A.N., Merkulov R.V. Control and measuring devices and tools Textbook for students. institutions sred. Prof. education. - 8th ed., ster. — M.: Academy, 2016. — 464 p.* *2 Buzulutskaya O.B., Arinova N.V., Dairbekova A.E., Kozhevnikova A.V. Bakylau-olsheu asaptaryn zhane bakylau kuraldaryn montazhdau Astana: Kasipkor, 2018.— 110 b.* *3 Afanasyev A.A., Koshimbayev Sh.K. Technological measurements and devices. Methodological guidelines for practical classes. - Almaty: KazNTU Publishing House, 2004.* *4 Rannev G.G., Tarasenko A.P. Methods and measuring instruments. Textbook for universities. 2nd ed.-Moscow: ASADEMA, 2004.*
Updating	annually

Module designation	ROB138 Sensor electronics, sensors
Semester(s) in which this module is taught	*6*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bigalieva Zh. S.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*basic*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6kr:* *Lecture-2 cr, laboratory lesson – 1 cr. SIS -2 kr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*physics, electronics*

Module objectives/expected learning outcomes	*formation of students' systematized knowledge in technical and scientific-technical fields and readiness to apply the knowledge gained at the university not only for the design of traditional electronic systems devices, but also for the collection and analysis of initial data for the calculation and design of electronic equipment.* *As a result of mastering the discipline, the student must:* *know* *- physical phenomena underlying the operation of sensors of various types;* *- physical phenomena underlying the operation of sensors;* *- physical processes of converting non-electrical quantities into electrical;* *- fundamentals of the theory of measurement of electrical and non-electrical quantities.* *be able to:* *- select and calculate sensors taking into account the specifics of the subject area and application conditions;* *- to make a reasonable choice of a measuring transducer when solving a specific practical problem;* *- to make the optimal choice of the measuring transducer when solving a specific practical problem;* *- to evaluate the conversion error when using sensors of various types;* *- to evaluate the conversion error when using sensors of various types.* *own:* *- skills of working with sensors of various types;* *- skills of a reasonable choice of a measuring transducer, taking into account the specifics of the subject area and application conditions;* *- is able to present a modern scientific picture of the world, identify the natural essence of problems, determine ways to solve them and evaluate the effectiveness of the choice made;* *- skills of working with measuring instruments.*
Content	*The discipline is aimed at acquiring students' knowledge about the principles of operation, basic parameters, designs of sensors, measuring transducers based on them and sensors for various purposes. Studies the basics of physical phenomena and processes underlying the principles of operation of sensors and measuring transducers. Students should have certain knowledge and skills when working with electrical devices and equipment, know its functional features.*
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*topilsky V.B. Circuit design of analog-to-digital converters. Educational publication. Moscow: TECHNOSPHERE, 2014. – 288 p.* *2 J. Frieden Modern sensors. Guide. Moscow: Technosphere, 2005. – 592 p.* *3 Intelligent sensor systems. Edited by J. K. M. Meijer. Moscow: Technosphere, 2011. - 464 p.* *4 Banks F.G. Chemical and biological sensors: fundamentals and applications. Consultant editor A. J. Fogg. Moscow: Technosphere, 2014. – 880 p.*
Updating	annually

Module designation	ROB523 Biomorphic and anthropomorphic robotics
Semester(s) in which this module is taught	*3*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Baiturganova V.K.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*5kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*3kr:* *Lecture-2 kr, practical lesson – 1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	After the course of study, the student is required to know: Principles of robot design, technical parameters and basic design requirements; calculation of kinematics, strength, accuracy and rigidity of robot structures.
Content	This course will expand the basic knowledge of the design of robotic systems and industrial manipulators.

Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1. Peter Mckinnen. Robotics and everything you need to know. CreateSpace Independent Publishing Platform. 2.M. Spong, S. Hutchinson, M. Vidyasagar, Robot modelling and control, Wiley press. Программируем на Python, Доусон Майкл, 2019г. Ussama Khatib, Handbook of robotics. Springer press. Second edition

Module designation	ROB504 Programming in high-level languages
Semester(s) in which this module is taught	*4*
The person responsible for the module	*Master of Technical Sciences, lecturer Bazarbay Lashyn* *Master of Technical Sciences, Senior lecturer Zhamuratova Mahabbat Musagazievna*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture -2cr , laboratory lesson – 1 cr. SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Studies the implementation of various computational models in Python and the formation of algorithmic thinking, the ability to implement technical calculations created independently or described in the literature, using various numerical schemes and modern programming languages when solving tasks.*

Module objectives/expected learning outcomes	*The key question is: what learning outcomes should students achieve within the module?* *As a result of mastering the discipline "Programming in high-level languages", the student must:* *know:* *- terminology and basic definitions regarding the discipline being studied;* *- principles of creating control programs in high-level languages and principles of processing program code in the controller;* *- principles of object-oriented programming;* *- basic static and dynamic data types;* *be able to:* *- set tasks and develop algorithms to solve them, use application programming systems, develop basic documents;* *- to carry out a competent statement of tasks arising in practice;* *- make programs in a high-level language;* *- perform debugging and testing of programs written in a high-level language* *to possess skills:* *- terminology of the academic discipline;* *- procedural and object-oriented programming languages;* *- skills in developing and debugging programs in at least one of the high-level algorithmic procedural programming languages.*
Content	*The study of the discipline is intended to form students' skills and knowledge on theoretical and practical issues arising in the implementation of various numerical methods and algorithms for solving problems of function interpolation, numerical differentiation and integration problems, approximation of functions. Objectives of the discipline: - study of the basic concepts and methods of interpolation, approximation of functions and numerical differentiation, integration, application of numerical methods for solving problems of interpolation and approximation of functions arising in economics and technology.*
Examination forms	*Exam tickets*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	1. *Fedorov D. Yu. Programming in a high-level Python language [Text]: textbook. the manual for the prikl. Bachelor's degree / D.Y. Fedorov. - 2nd ed., reprint. and additional - M.: Yurayt, 2019. - 161 p. - (Bachelor. Approx. course). - ISBN 978-5-534-10971-9.* 2. *Nikolay Prokhorenok. Python 3 and PyQt 5. Application development [Text] / N. Prokhorenok, V. Dronov. - 2nd ed., reprint. and additional - St. Petersburg: BHV-Petersburg, 2019. - 832 p. : ill. - ((Prof. programmer.). - ISBN 978-5-9775-3978-4* 3. *Dawson Michael. Programming in Python [Text]: textbook. manual: translated from English / M. Dawson. - 3rd ed. - St. Petersburg: St. Petersburg 2018. - 414 p.: ill. - ISBN 978-5-496-01071-9* 4. *Muller Andreas. Introduction to Machine Learning using Python. A guide for data specialists [Text] : translated from English / A. Muller, S. Guido. - St. Petersburg: Alfa-book LLC, 2018. - 480 p.: ill. - ISBN 978-5- 9908910-8-1*

Module designation	ROB162 Mechatronic systems software
Semester(s) in which this module is taught	*7*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Zhamuratova M.M. , Master of Technical Sciences, lecturer Kalmenov Ermukhamed*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30 h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture-2 cr , laboratory lesson – 1cr. SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	*When studying the discipline, the student must:* *Know: real-time system software; requirements for a computer on which PLC control software can be installed; user interface elements.* *Be able to: make algorithms for PLC control; work with PLC software; develop control applications for PLC;*

Content	*The course "Mechatronic Systems Software" describes modern technical systems, their properties and characteristics. Types and structure of technical systems. The basics of building a vehicle. Hardware and software. Types of software complexes for working with technical devices. Automated control systems of technical processes and principles of their construction. Technical support of computer networks.*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*1. Predko M. Robot control devices: circuitry and programming / Mike Predko; Translated from English. Zemskova Yu.V. – M.: DMK Press, 2004. – 416 p.: il – (to help an amateur radio operator).* *2. Petrov I.V. Programmable controllers. Standard languages and techniques of applied design / Ed. Prof. V.P. Dyakonova. – M.: SOLON – Press, 204. – 256 p.: ill. – (Series "Engineer's Library").* *3. G. Olson, J. Piani. Digital automation and control systems. St. Petersburg, 2015.* *4. D. M. Oslander, J. R. Ridgely, J. D. Ringgenberg. Control programs for mechanical systems. Moscow: BINOM 2016.*

Module designation	ROB 175 Robot software
Semester(s) in which this module is taught	*7*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Zhamuratova M.M.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory lesson – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, laboratory lesson – 1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*

Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	When studying the discipline, the student must: Know: the software of real-time systems; the requirements for a computer on which PLC control software can be installed; user interface elements. Be able to: create algorithms for PLC control; work with PLC software; develop control application programs for PLC;
Content	The course "Mechatronic Systems Software" describes modern technical systems, their properties and characteristics. Types and structure of technical systems. The basics of building a vehicle. Hardware and software. Types of software complexes for working with technical devices. Automated control systems of technical processes and principles of their construction. Technical support of computer networks.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	1. Predko M. Robot control devices: circuitry and programming / Mike Predko; Translated from English. Zemskova Yu.V. – M.: DMK Press, 2004. – 416 p.: il – (to help an amateur radio operator). 2. Petrov I.V. Programmable controllers. Standard languages and techniques of applied design / Ed. Prof. V.P. Dyakonova. – M.: SOLON – Press, 204. – 256 p.: ill. – (Series "Engineer's Library"). 3. G. Olson, J. Piani. Digital automation and control systems. St. Petersburg, 2015. 4. D. M. Oslander, J. R. Ridgely, J. D. Ringgenberg. Control programs for mechanical systems. Moscow: BINOM 2016.

Module designation	ROB109 Design of electronic circuits
Semester(s) in which this module is taught	*8*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Zhamuratova M.M.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory lesson – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*

Credit scores	*6kr:* *Lecture-21 kr, laboratory lesson – 1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Basics of Electronics, Integrated and microprocessor circuitry*
Module objectives/expected learning outcomes	When studying a discipline, a student should know: - basic methods and means of obtaining, storing, processing information, have computer skills as a means of information management; - methods for solving problems of analysis and calculation of characteristics of electrical circuits: Be able to: - to develop structural and functional circuits of radio-electronic means, as well as schematic diagrams of radio-electronic devices;
Content	The course "Designing electronic circuits" describes general information about the design process and CAD. The main types of CAD software. Mathematical models of RES at the level of automated functional and logical (system engineering) design (AFLC). Mathematical models of RES at the level of automated circuit design (ACcP).When studying a discipline, a student should know: - basic methods and means of obtaining, storing, processing information, have computer skills as a means of information management; - methods for solving problems of analysis and calculation of characteristics of electrical circuits: Be able to: - to develop structural and functional circuits of radio-electronic means, as well as schematic diagrams of radio-electronic devices;
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	1. Automation of design of radio-electronic means: A textbook for universities / O.V.Alekseev, A.A.Golovkov, I.Y.Pivovarov, etc.; Edited by O.V.Alekseev. – M.: Higher School, 2015. – 479 p. 2. Norenkov I.P. Fundamentals of computer–aided design: A textbook for universities. - M.: Publishing House of Bauman Moscow State Technical University, 2012. – 334 p. 3. Bogatyrev E.A., Grebenko Yu.A., Lishak M.Yu. Circuit modeling of radio-electronic devices. Laboratory work No. 1-7: textbook. – M.: Publishing House of MEI, 2016

Module designation	ROB428 Robotics and mechatronics
Semester(s) in which this module is taught	*2*
The person responsible for the module	Ozhikenov Kasymbek Adilbekovich, Professor
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson – 1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	
Module objectives/expected learning outcomes	When studying the discipline, the student should know: - areas of application of mechatronic and robotic systems; concepts of their construction and terminology in mechatronics and robotics. Be able to: - choose the necessary types of robotic and mechatronic systems; - define management methods and systems for them.
Content	The course "Robotics and Mechatronics" describes the main stages and trends in the development of robotics. Bionic aspects of information systems. General information about information systems. Typical devices and information systems in robotics and mechatronics. Elements of information systems. Tactile sensing systems. Tactile sensing systems. Vision systems.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	[1] Shahinpour M. Course of robotics. – Moscow: Mir, 1990. – 527 p. [2] Korendyasev A.I. Theoretical foundations of robotics. Book 1. Moscow: Nauka, 2006. [3] Syryamkin V.I. Information devices and systems in robotics and mechatronics: textbook. stipend. (Series: Intelligent Technical Systems). –Tomsk: Publishing House Vol. un-ta, 2016. -524 p. [4] Vorotnikov S.A. Information devices of robotic systems: Textbook. - M.: Publishing House of the Bauman Moscow State Technical University. 2005. - 384 p. [5] Mechanics of industrial robots: Edited by K.V. Frolov, E.I. Vorobyov. Book 1: Kinematics and dynamics / E.I. Vorobyov, S.A. Popov, G.I. Sheveleva. – M.: Higher School, 2015. – 304 p.

Module designation	ROB124 Microprocessor control devices of robots
Semester(s) in which this module is taught	*6*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bayanbai Nurlan*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture-2cr , laboratory lesson – 1cr. SIS -2 cr., SIST – 1 cr.*
Necessary and recommended prerequisites for joining the module	*Physics, Mathematics, Algorithmization and programming, Mechanics*
Module objectives/expected learning outcomes	*The discipline "Microprocessor control devices of robots" is a fundamental discipline for the study of microcontroller control of robots. The course is intended for students of mechatronics and robotics. Upon completion of this course, students should be able to program robots, be able to connect various sensors and devices, and also be able to calculate robot control algorithms.*

Content	*Introduction to microprocessor technology. Introduction to Arduino. LED programming and control basics. Engine control via Arduino. Arduino Sensors.Information output to the display. Arduino – communication port.Combined control system. LED matrix and cube.Wi-Fi and Bluetooth protocols in Arduino.RC Protocols in Arduino. Forward and reverse kinematics of sequential operation. Forward and reverse kinematics of a parallel robot*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*[1] Jeremy Blum. Exploring Arduino tools and techniques for engineering wizardly. Published by John Wiley and Sons.Inc.USA, 2012* *[2] Simon Monk. Hacking Electronics. The MeGraw-Hill companies, USA, 2013* *[3] D. Chablat, P. Wenger, J.Angeles. The kinematic design of 3-DOF hybrid manipulator. McGill University.817 Sherbrooke Str. West Montreal, Quebee, Canada* *[4] U. Thomas, I. Maciuszek and F. M. Wahl. A unified notation for serial, parallel and hybrid kinematic structures. Institute for Roborics and Process Control. Technical University of Braunschweig Muehlenpfordstrasse 23.38106, Braunschweig, Germany*

Module designation	ROB181 Embedded systems in robotics
Semester(s) in which this module is taught	*7*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bayanbai Nurlan*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6cr:* *Lecture-30h, laboratory lesson – 30h. SIS -30h., SIST – 15h.*
Credit scores	*6cr:* *Lecture-2cr , laboratory lesson – 1cr. SIS -2 cr., SIST – 1 cr.*

Necessary and recommended prerequisites for joining the module	*Physics, Mathematics, Algorithmization and programming, Mechanics, Microprocessor control devices of robots*
Module objectives/expected learning outcomes	*Teaching basic principles of robot control. The study of the basic principles of building information and measurement systems and control systems based on open microcontroller platforms, the formation of skills in the development of hardware and software for automated control systems and robot control.*
Content	*Introduction to Embedded Systems. Application of embedded systems for robot control. Overview of the Raspberry Pi Microcontroller family. First enabling and installing the OS on Raspberry Pi. Overview of the OS on Raspberry Pi. Examples of the board's operation. Projects using a board. Communication ports of the board. GPIO port Assignment. Internet connection, programs from the Pi Store and LibreOffice. Console, apt-get utility, screenshots, remote management. Working with GPIO, LED flashing, Python. RC protocols. Remote access to Raspberry Pi 3 via SSH and VNC protocols.Motion Detector and Alert system on Raspberry Pi*
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the person on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*
List of literature	*[1] Programming Embedded Systems, Second Edition with C and GNU Development Tools. Published by Michael Barr and Anthony Mossa, O'Reilly, 2012* *[2] Simon Monk. Hacking Electronics. The MeGraw-Hill companies, USA, 2013* *[3] Making Embedded Systems: Design Patterns for Great Software, Elecia White, O'Reilly* *[4] U. Thomas, I. Maciuszek and F. M. Wahl. A unified notation for serial, parallel and hybrid kinematic structures. Institute for Roborics and Process Control. Technical University of Braunschweig Muehlenpfordstrasse 23.38106, Braunschweig, Germany*

Module designation	ROB119 Computer modeling of mechatronic and robotic systems
Semester(s) in which this module is taught	*7*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Zhamuratova M.M.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory lesson – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, laboratory lesson – 1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	When studying a discipline, a student should know: - principles of drawing up calculation schemes and mathematical models of mechatronic and robotic systems - basic packages of computer mathematical modeling of mechanical, electromechanical, mechatronic systems; Be able to: - develop, test and use mathematical models of mechanical, electromechanical, mechatronic systems in the design; - to define and apply methods of calculation of mechanical systems in application to specific engineering tasks in professional activity.
Content	The course "Computer modeling of mechatronic and robotic systems" describes the main types of models and their properties. Principles of modeling. Review of modern computer packages and mathematical modeling programs. Examples of computer mathematical modeling of mechanical, electromechanical, mechatronic and robotic systems.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	1. Cherny A.A. Mathematical modeling: . Study guide. - Penza: Publishing House of PSU, 2015. - 256 p.[electronic resource]. http://window.edu.ru/ 2. Modeling and visualization of movements of mechanical systems in MATLAB: Textbook / V.S.Shcherbakov, M. S. Korytov, A.A. Ruppel, V.A. Glushets, S.A. Milyushenko. – Omsk: SibADI Publishing House, 2012. – 84c. 3. Modeling of mechatronic systems in MATLAB (Simulink/SimMechanics): textbook for higher educational institutions. – SPb:NIU ITMO, 2016. – 114 p.

Module designation	ROB148 Robot control
Semester(s) in which this module is taught	*8*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Baiturganova V.K.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory work, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory lesson – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, laboratory lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	After the course, the student must know -Special terms of industrial robotics; - Methods for calibration and alignment of industrial robots; - Principles of programming industrial robots be able to: 1. Find the necessary Internet resources on your own and study them to get started with various industrial robots. 2. Understand independently with IDE and development programs. 3. Independently deal with code fragments.
Content	This course will expand the basic knowledge of the control of robotic systems and industrial manipulators.

Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1. Peter Mckinnen. Robotics and everything you need to know. CreateSpace Independent Publishing Platform. 2. M. Spong, S. Hutchinson, M. Vidyasagar, Robot modelling and control, Wiley press. Программируем на Python, Доусон Майкл, 2019г. Ussama Khatib, Handbook of robotics. Springer press. Second edition J.J. Craig, Introduction to robotics, mechanics and control. Pearson education, Third edition.

Module designation	GEN177 Engineering and computer graphics
Semester(s) in which this module is taught	*1*
The person responsible for the module	*Shingisova R.K., senior lecturer* *Zharkimbayeva G.B., senior lecturer*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-15h, practical lesson – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-1 kr, practical lesson –2 kr., Independent work of students-1 kr., Independent work of students under the guidance of a supervisor – 2 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*

Module objectives/expected learning outcomes	This discipline will present basic knowledge and skills in the field of descriptive geometry, engineering and computer graphics, as well as methods for solving problems related to spatial forms and their relationships using graphical models. After completing the course, the student must demonstrate the ability to analyze, synthesize and design, as well as use the methods of projection drawing, geometric modeling, and drawing in axonometry. The student must be able to: - solve various positional and metric problems on complex drawing, axonometry; - be able to solve problems in the design of surfaces; - work with various drawing and measuring tools, instruments. At the end of the course, the student should know: - basic principles of discipline, basic requirements for the design process in practice; regulatory documents; - the main professional functions of an engineer, including the competent application of the theoretical foundations of descriptive geometry; - information computer technologies (ICT) used in the work; - basic methods and principles of axonometry and diagrams; – possess: - geometric techniques for solving positional and metric problems; - methods of image of spatial forms on the plane; -methods of graphical solution of various geometric problems related to the original; - skills to read and execute projection drawings of an object; - skills to create different geometric designs.
Content	Projection methods and properties. Kinds. Simple cuts. Cross section.Axonometric projections.Epure Monge. Drawing of a point, a straight line and a plane on a plot. Basic positional tasks.Types of connections (split connections). Polyhedra. Detailing. Metric tasks. Ways to transform the drawing. Curved lines. Surfaces.Surfaces of rotation.Intersection of a surface by a plane
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*

List of literature	[1] ESCD. General rules for the execution of drawings. – M.: Gosstandart, 1980. (changes 1998) [2] Zh. M. Esmukhan, K. A. Kuspekov, E. E. Masimbayev "Computer graphics theory of negizderi" Almaty.: ZHSHS "Almanac baspa uyi" 2019. – 166 b. [3] Chekmarev A.A. Descriptive geometry and drawing: textbook. for bachelors / A.A. Chekmarev ; Ministry of Education of the Russian Federation. - 4th ed., - M.: Yurayt, 2014. - 471 p . [4] Frolov S.A. Descriptive geometry. M. INFRA-M. 2013. [5] Nurmakhanov B.N., Abildabekova D.D. Computer graphics. Almaty. 2004. [6] Handbook of mechanical engineering drawing – M. 2002.

Module designation	ROB195 Programming for microcontrollers
Semester(s) in which this module is taught	*5*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bayanbai Nurlan*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory lesson – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, laboratory lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	At the end of the course, the student must be able to: - program the microcontroller in C, including hardware configuration and interrupt handling procedures, - manage parallel processes with different priorities without the help of the operating system, - explain the choice of data types and algorithms taking into account limited resources, - provide a detailed description of the limitations of the selected system project, - debug the microcontroller application in various ways.

Content	The structure of microcontrollers and internal peripherals, types of memory. Connection of analog and digital signals, including the basics of electronics. Serial communication. Hardware programming in C, device drivers, interrupt handling. Processing of parallel processes in the absence of an operating system, priority of processes, time analysis, finite automata. A set of instructions and registers, as well as addressing modes for this family of microcontrollers. Aspects of the effectiveness of various data types and program structures in C. Development and debugging tools.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1. Julien Bayle, "Programming in C for Arduino", published by Packt Publishing Ltd, 2013 links: 1. Raj Kamal, "Microcontroller Architecture, Programming, Interaction and System Design", 2nd edition, Pearson Education, 2005 2. Mazidi and Mazidi, "Microcontroller 8051 and embedded systems", 4th Impression, FI, 2000.

Module designation	ROB141 Statistical methods in engineering research
Semester(s) in which this module is taught	*7*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences, Associate Professor Baktybaev Murat Kyrgyzbaevich*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –15 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*

Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	Engineers in the research and creation of production processes, of necessity, deal with samples or part of all possible observations of the process, therefore it is recognized that statistical analysis of the collected data is appropriate; therefore, we must produce engineers who are literate not only verbally, but also quantitatively. Engineers in industry are increasingly required to develop effective experiments and conduct statistical analysis of the collected data. At the end of the course, the student should be able to: use a number of methods and techniques for visualizing data sets; calculate probabilities in simple cases; give an idea of the concept of a random variable and be able to use some common probability distributions; understand the meaning of the central limit theorem; use point and interval estimates for some typical statistical tasks; apply elementary regression to fit the measured data; give a report on some typical engineering applications of probability and statistics, for example. reliability and quality control.
Content	Descriptive statistics: location and variation measures, frequency tables, histograms, histograms, other charts and visualization tools. Introduction to Combinatorics and probability theory. Probability distributions: binomial, Poisson, normal, exponential. The central limit theorem. Point and interval estimation. Regression method. Engineering applications, selected examples.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1 Freud Jeff, Integrated Engineering Curriculum, These Materials, Session 1230. 2 Richards, Don E., New Engineering Curriculum for Sophomores - The Rose-Hulman Experience, these materials, session 1230. 3 Kinney, John J., The use of computer algebra systems in Probability courses and Statistics for engineers

Module designation	ROB126 Fuzzy logic and neural networks
Semester(s) in which this module is taught	*8*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences, Associate Professor Baktybaev Murat Kyrgyzbaevich*

Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*5kr:* *Lecture-30h, laboratory lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*3kr:* *Lecture-2 kr, laboratory lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	The purpose of mastering the discipline is to familiarize with control systems with fuzzy logic, fuzzy logic rule bases, output block. Fuzzy inference based on the composition rule, fuzzy inferences by: Mamdani, Larsen, Tsukamoto. To give a systematic review of models of modern biological and artificial neural networks, to study and master the ways of their application for information processing and pattern recognition. Comparison of classification and clustering tasks. The student should know and be able to: - develop fuzzy process control systems, intelligent control systems based on neural networks; - understand and formalize the task of data analysis; - organization of systems to support and fill the knowledge base. - acquire the skills to determine the quality of intelligent systems, to create expert intelligent control systems, control systems based on neural networks, as well as systems with fuzzy logic.
Content	This course examines neural network technologies of intelligent systems, technologies for building control systems with fuzzy logic, rules of fuzzy logic, technologies for creating knowledge base rules, approximation of functions, forecasting, clustering of data, management of dynamic objects, solving problems of associative storage, technologies of multilevel information processing, logical-dynamic models, problems of optimal mapping of structures intelligent control systems (ISU), logical-dynamic model, etc. This knowledge is necessary for further understanding of the principles of building robotic systems.
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	Number of E-mail address L1.1 Yakhyaeva G. E. - Fuzzy sets and neural networks: Textbook - Moscow: BINOM. Laboratory of Knowledge, Internet University of Information Technologies (INTUIT), 2008. http://www.iprbookshop 1 .ru/22414 L1. 2 Yakhyaeva G.E. - Fuzzy sets and neural networks: textbook - Moscow, Saratov: Internet University of Information Technologies (INTUIT), Higher Education, 2017. http://www.iprbookshop 1 .ru/67390.html

Module designation	ROB153 Fundamentals of engineering creativity
Semester(s) in which this module is taught	*6*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences, Associate Professor Baktybaev Murat Kyrgyzbaevich*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*

Module objectives/expected learning outcomes	"Fundamentals of Engineering Creativity" is a course of studying engineering at the secondary school level. The course introduces students to some of the basic concepts they will encounter in an engineering course after graduating from high school. Students have the opportunity to explore engineering and high-tech careers.ICU gives students the opportunity to develop skills and an understanding of course concepts through action-based learning, projects and challenges. Combined with a group approach, APB training encourages students to continually hone their interpersonal skills, creativity, and problem-solving skills based on engineering concepts. It also allows students to develop strategies to enable and guide their own learning, which is the ultimate goal of education.
Content	To succeed in ICU, students must simultaneously study at preparatory colleges in mathematics and natural sciences. Students will use engineering and scientific concepts in solving engineering design problems. Students will develop problem-solving skills and apply their knowledge in research and design to create solutions to various problems. Students will also learn how to document their work and communicate their decisions to their colleagues and members of the professional community.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1. Creative synthesis in design (series "Fundamentals of Engineering Design") Paperback - Import, January 1, 1964 Meigs Alger John Rogers (author) 2. Creativity in Engineering New solutions to complex problems Author: David Cropley

Module designation	ROB534 Mechanics of controlled machines
Semester(s) in which this module is taught	*5*
The person responsible for the module	*Tuleshov Yerkebulan Amandykovich*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Information and communication technologies*
Module objectives/expected learning outcomes	After completing the course, the student must demonstrate the ability to analyze, synthesize and design robot controls, as well as calculate costs. 2.3 The student should be able to: □ solve problems of kinematics of manipulators; □ build models of manipulator dynamics; □ plan the trajectories of the manipulator in Cartesian space and in the space of generalized coordinates; □ build and calculate robot execution systems; □ control the robot's movement. 1.4 At the end of the course, the student should know: □ features of executive systems as control objects; □ methods for solving manipulator kinematics problems; □ methods of constructing models of manipulator dynamics; methods of planning the trajectories of the manipulator movement in Cartesian space and in the space of generalized coordinates; □ principles of construction and calculation of robot executive systems; □ basic methods of controlling robot movement.

Content	Introduction. Features of the robot as a control object. Manipulation mechanisms and executive systems of robots. Kinematics of manipulators. Coordinate systems, selection and transformation. Kinematic parameters used to describe the angular and translational motion of a rigid body. Direct and inverse kinematics problems. Construction (planning) of program trajectories of the manipulator movement. General aspects of trajectory planning. Features of trajectory planning in the space of generalized coordinates. Types of trajectories. Acceptable trajectories of movement. Planning the trajectories of the manipulator in Cartesian space. External force influences, masses and moments of inertia of the load, bringing to the degrees of mobility of mechanisms. The mutual influence of degrees of mobility. Non-linearity of mechanical gears. Backlashes and moments of resistance to movement. Elastic deformations of structural elements and mechanical gears. Dynamics of manipulators. Methods for obtaining dynamics models. Dynamic model of a stationary robot. An example of obtaining differential equations of motion of a manipulator is the left parts of the equations. The right-hand sides of the dynamics equations. Tasks of controlling the robot's movement. Methods based on solving the inverse dynamics problem. Application of self-tuning methods in robot control. Features of the implementation of dynamic control algorithms using microprocessor control devices. Robot training.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*

List of literature	1. Kuleshov V.S., Lakota N.A. Dynamics of manipulator control systems. - M.: Energia, 2017. 2. Remotely controlled robots and manipulators / S. Kuleshov et al.; Edited by E.P. Popov. - M.: Mechanical Engineering, 2016. 3. Dynamics of robot control. M.: Science, 2017. 4. Control systems of manipulative robots / Medvedev V.S. et al. - M.:Nauka, 2018. 5. Shangin E.S. Control of robots and robotic systems. Lecture notes. Ufa, 2019. 6. Zenkevich S.L., Yushchenko A.S. Fundamentals of manipulative robot control: Textbook for universities. – 2nd ed., corrected. and additional M.: Publishing House of the Bauman Moscow State Technical University, 2017. – 480 p.

Module designation	ROB511 Autonomous mobile robots
Semester(s) in which this module is taught	*3*
The person responsible for the module	*senior lecturer Bayanbai Nurlan*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Robotics and mechatronics*

Module objectives/expected learning outcomes	Teaching basic principles of robot control. Acquisition of skills in controlling motors and devices controlled by microcontrollers. After completing the course, the student must demonstrate the ability to analyze, synthesize and design autonomous robotic systems, as well as calculate costs. The student must be able to: – Servo control − Control of DC motors − Stepper motor control − Work with the LCD display on the Arduino At the end of the course, the student should know: − Output of information from Arduino to various sources − Principles of construction of the LED matrix − LED management in LED matrix projects − Wireless communication protocols in Arduino
Content	LED programming and control basics. Engine control via Arduino. Arduino Sensors. Information output to the display. Arduino – communication port. Combined control system. LED matrix and cube Wi-Fi protocols and Bluetooth in Arduino. RC protocols in Arduino. Forward and reverse kinematics of sequential operation. Forward and reverse kinematics of a parallel robot.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	[1] Jeremy Blum. Exploring Arduino tools and techniques for engineering wizardly. Published by John Wiley and Sons.Inc.USA, 2012 [4] Jon Martinez Garcia, Inverse- Forward Kinematics of Delta Robot. JMG Fecha, 2010 [2] Simon Monk. Hacking Electronics. The MeGraw-Hill companies, USA, 2013 [5] F. Pierrot, C. Reynaud and A. Fournier. Delta simple and deficient parallel robot. Robotica Vol.8. Issue02 pp.105-109 [3] D. Chablat, P. Wenger, J.Angeles. The kinematic design of 3-DOF hybrid manipulator. McGill University.817 Sherbrooke Str. West Montreal, Quebee, Canada

Module designation	ROB519 Microcontroller control systems
Semester(s) in which this module is taught	6
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bayanbai Nurlan*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory classes, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory classes – 30h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, laboratory classes –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*Basics of Electronics*
Module objectives/expected learning outcomes	Teaching basic principles of robot control. Acquisition of skills in controlling motors and devices controlled by microcontrollers. Upon completion of this course, students should be able to program robots, be able to connect various sensors and devices, and also be able to calculate robot control algorithms. to know: the principles of construction and architecture of microcontrollers, the structure of hardware and software of microcontrollers, the main tasks solved with the help of microcontrollers; be able to: debug, diagnose and design microcontrollers, use standard terminology, definitions and designations; possess: skills of independent design of microcontroller software fragments
Content	Introduction to microprocessor technology. Introduction to Arduino. LED programming and control basics. Engine control via Arduino. Arduino Sensors. Information output to the display. Arduino – communication port.Combined control system. LED matrix and cube. Wi-Fi and Bluetooth protocols in Arduino. RC protocols in Arduino. Forward and reverse kinematics of sequential operation. Forward and reverse kinematics of a parallel robot.
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	[1] Jeremy Blum. Exploring Arduino toolsand techniques for engineering wizardly. Published by John Wiley and Sons.Inc.USA, 2012 [2] Simon Monk. Hacking Electronics. The MeGraw-Hill companies, USA, 2013 [3] D. Chablat, P. Wenger, J.Angeles. The kinematic design of 3-DOF hybrid manipulator. McGill University.817 Sherbrooke Str. West Montreal, Quebee, Canada [4] U. Thomas, I. Maciuszek and F. M. Wahl. A unified notation for serial, parallel and hybrid kinematic structures. Institute for Roborics and Process Control. Technical University of Braunschweig Muehlenpfordstrasse 23.38106, Braunschweig, Germany [5] Zoran P., Vladimir D., Comparison ofthe characteristics between serial and parallel robots. University "Sv.Kiril I Metodij". Faculty of Mechanical Engineering-Scopje. Karpos Ii B.B.P.O Box 464, Mk-1000. Skopje. Republic of Macedonia [6] Clavel R. Delta a fast robot with parallel geometry. In Proceedings of the 18 International Symposium on Industrial Robots. Lausanne, France. 26-28 April 1988, 91-100

Module designation	ROB421 Biotechnical systems
Semester(s) in which this module is taught	*4*
The person responsible for the module	Ozhikenov Kasymbek Adilbekovich, Professor
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –1kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*

Necessary and recommended prerequisites for joining the module	*biomedical engineering*
Module objectives/expected learning outcomes	As part of the course, the student will master the theoretical foundations and practical use of biotechnical systems and technology. The basic knowledge and skills in the field of biotechnical systems and technology, as well as the means of biotechnical systems and technology will be presented. Upon completion of the course, the student must demonstrate the ability to analyze, synthesize and design biotechnical systems and technologies, as well as assess their significance for biotechnology, biomedicine and medicine. The student should be able to: – analyze the results of using biotechnical systems and technology – solve problematic problems of biotechnical systems and technology At the end of the course, the student should know: – the theory of biotechnical systems and technologies – principles of operation of biotechnical systems and technologies
Content	Introduction to biotechnical systems and technologies Biotechnical systems and technologies in microbiology Biotechnical systems and technologies in cytology Biotechnical systems and technologies in hematology Biotechnical systems and technologies in biochemistry Biotechnical systems and technologies in endocrinology Biotechnical systems and technologies for circulatory organs Biotechnical systems and technologies for digestive organs Biotechnical systems and technologies for the musculoskeletal system Biotechnical systems and technologies for uronephrology Biotechnical systems and technologies for immunology and virology Biotechnical systems and technologies for the pharmaceutical industry-news Biotechnical systems and technologies based on optics Biotechnical systems and technologies based on ultrasonic radiation Biotechnical systems and technologies based on digital processing
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*

List of literature	Roitberg G.E., Strutynsky A.V. Internal diseases. Laboratory and instrumental diagnostics. 2021. 800s. MEDpress ISBN: 5000308581 ISBN-13(EAN): 9785000308585 Chernekhovskaya N.E., Fedchenko G.G., Andreev V.G., Radiography and endoscopy of respiratory organs Publishing house:BINOM 2020. ISBN: 9785951807038 / 5951807034 Microbiology, virology and immunology: textbook / edited by V.B. Sboychakov and M.M. Karapats. – M.: Geotar-Media, 2014. -. 320 p. Kishkun A. A. Clinical laboratory diagnostics: a textbook. — 2nd ed., reprint. Geotar-Media. 2019.1000p. ISBN: 5970448303 ISBN-13(EAN): 9785970448304 Boschenko A.A., Vrublevsky A.V., Karpov R.S. Transthoracic ultrasound examination of the main coronary arteries. 2015. 240c. ISBN: 9785936295409 / 5936295400 Ivashkin V.T., Mayev I.V., Trukhmanov A.S. Handbook of instrumental research and interventions in gastroenterology. Geotar-Media.2015. 560c. ISBN: 9785970430927 / 5970430927 Savushkin, A.V. Introduction to biotechnical systems and technologies in medicine: textbook for universities / A.V. Savushkin. — 2nd ed., ispr. and add. — Moscow: Yurayt Publishing House, 2021. - 142 p. — (Higher education). — ISBN 978-5-534-12879-6. — Text: electronic // Educational platform Yurayt [website]. — URL: https://urait.ru/bcode/476702 (accessed: 09/15/2021).

Module designation	ROB 411 Programming of embedded systems
Semester(s) in which this module is taught	*5*
The person responsible for the module	*Master of Technical Sciences, Senior lecturer Bayanbai Nurlan*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory lesson, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-15h, laboratory lesson – 15h. practical lesson – 15.Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-1 kr, laboratory lesson –1 kr., practical lesson- 1. Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*

Necessary and recommended prerequisites for joining the module	*Programming for microcontrollers*
Module objectives/expected learning outcomes	Teaching student's systematic ideas about hardware and software of modern embedded systems. - study of mathematical and algorithmic foundations of machine-oriented languages - familiarization with the capabilities of the architecture and command system of modern embedded systems - training in techniques and methods of algorithms and software development, their optimization for the target architecture of the embedded system Know: Principles of organization of hardware platforms for embedded systems, features of the process of integration and support of embedded systems as part of hardware and software complexes. be able to: Automate typical production processes, including those of an integrative nature. possess: the skills to support embedded systems using service software.
Content	1 Introduction to embedded control systems 2 Fundamentals of digital and analog circuitry 3 Analog-to-digital and digital-to-analog conversions 4 Classification of peripheral devices, Data output and visualization 5 Microcontroller operation, timers and interrupts 6 Pulse-width modulation, sound generation methods on microcontrollers 7 Working with electric motors, PID control on microcontrollers 8 Transmission of information via IR channel, etc. occupation, UART protocol 9 Special protocols, introduction to IteadMaple
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*- Availability of a computer and computer equipment;* *- Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* *- Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* *- Attendance of classes according to the schedule.*

List of literature	1) Introduction to the development of applications for embedded systems on the Intel Atom platform / O.N. Borichin. - 2nd ed., ispr. - Moscow: National Open University "INTUIT", 2016. - 165 p. - B. ts. - URL: http://biblioclub.ru/index.php?page=book&id=429016 / (accessed: 03/24/2020). - Access mode: EBS University Library ONLINE. - Text: electronic. 2) Borovsky, A. S. Programming of the Arduino microcontroller in information control systems: a textbook / A.S. Borovsky, M.Y. Schrader. - Orenburg: Orenburg State University, 2017. - 113 p.: ill. - Bibliogr. in the book - ISBN 978-5-7410-1853-8: B. C. - URL: http://biblioclub.ru/index.php?page=book&id=485434 / (accessed: 03/24/2020). - Access mode: EBS University Library ONLINE. - Text: electronic. 3) Goncharuk, S. V. Linux OS Administration / S.V. Goncharuk. - 2nd ed., ispr. - Moscow: National Open University "INTUIT", 2016. - 165 p. - B. ts. - URL: http://biblioclub.ru/index.php?page=book&id=429014 / (accessed: 03/24/2020). - Access mode: EBS University Library ONLINE. - Text: electronic.

Module designation	ROB508 Power sources
Semester(s) in which this module is taught	*6*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences, Associate Professor Baktybaev M.K.*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-15h, laboratory lesson – 15h, practical lesson –15h Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-1 kr, laboratory lesson –1 kr., practical lesson –1 kr Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*physics, electrical engineering*

Module objectives/expected learning outcomes	The purpose of the discipline "Power Supplies" is to study the principles of building systems of power supply devices and their structures, as well as the functioning of individual nodes that produce different voltage ratings for the power supply of electronic systems. The discipline studies power supply devices and systems, block diagrams, primary and secondary power sources, the principle of operation and devices of a transformer, rectifier devices, smoothing filters, stabilizing power sources with a transformer-free input, an inverter, a boost converter.
Content	Section 1. Transformers and chokes. Section 2. Rectifiers. Section 3. Smoothing filters. Section 4. Voltage and current stabilizers. Section 5. Voltage converters. Section 6. Improving the reliability and noise immunity of computers on the PVM power supply circuits. Section 7. PC power supplies. Section 8. Chemical power supplies.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	- *Availability of a computer and computer equipment;* - *Availability of an Internet channel with a speed of at least 0.5 Mbit/sec;* - *Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform;* - *Attendance of classes according to the schedule.*
List of literature	1 Kostikov V.G., Parfenov E.M. Power sources of electronic means. Circuit engineering and design – Moscow: Higher School, 2003, - 428 p. 2 I.M. Gottlieb - Power sources. Inverters. Converters. Linear and pulse stabilizers. From the Postmarket.2002. 3 Kashkarov A. P. K 31 Switching power supplies: circuit engineering and repair. – M.: DMK Press, 2012. – 184 p. 4 Hermann Schreiber. 300 power supply circuits 2000.

Module designation	*ROB514 Automation*
Semester(s) in which this module is taught	5
The person responsible for the module	Candidate of Technical Sciences Tuleshov Yerkebulan Amandykovich
Language	Russian, Kazakh
Attitude to the curriculum	elective
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –1kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	physics, electrical engineering

Module objectives/expected learning outcomes	-training of future specialists who are able to actively and competently use modern automation and control tools for conducting technological processes; - familiarity with the structures of modern automated process control systems, with the methods of selecting and using emergency control, alarm, blocking and protection systems; -to study the principles of building digital data processing tools, the features of organizing the work of microprocessor devices and the use of microprocessors in control systems of technical objects and technological processes, as well as the formation of skills in designing control systems based on microcontrollers and the development of their application software. As a result of mastering the discipline, the student should know: -classification, types, purpose and main characteristics of standard control and measuring devices, automatic and signaling devices at the place of their installation, device and principle of operation (electrical, electronic, pneumatic, hydraulic and combined sensors and actuators, interface, microprocessor and computer devices); -general information about automated control systems (ACS) and automatic control systems (ACS); -principles of construction of automated process control systems, typical systems of automatic regulation of technological processes; -automatic emergency protection system used in production; - state and prospects of development of automation of technological processes; -principles of measurement, regulation, control and automatic control of technological process parameters; -basic concepts of automated information processing; -fundamentals of measurement techniques. As a result of mastering the discipline, the student should be able to: -choose the type of control and measuring devices and automation tools for production tasks and justify your choice; -adjust the parameters of the technological process according to the indications of control and measuring devices and equipment (instrumentation and control equipment) manually and remotely using automation tools; -take readings of the instrumentation and assess the reliability of the information.

Content	Modern industrial production and automated control systems. Basic concepts of the system Processing of technological information. System states Technical means of automation of typical technological processes Connection of a computer with a technological object. Conversion of analog and digital signals Programmable Logic Controllers (PLCs) Functional schemes of measurement and automation systems. Graphic design of automation schemes Automated control systems technological processes. The structure of modern automated control system, its functions and main varieties. Automation schemes of typical technological processes Automation of continuous and discrete control systems. Static and dynamic characteristics. The differential equation of the SAR Experimental methods for determining the dynamic characteristics of control objects. Synthesis of automatic control systems Analysis of the quality of regulation. Example of calculating the CAP. Typical nodes of automatic control and control systems of technological processes. Digital and robotic control systems
Examination forms	Exam tickets, test questions.
Requirements for training and exams	- Availability of a computer and computer equipment; - Availability of an Internet channel with a speed of at least 0.5 Mbit/sec; - Personal account with a photo of the face on the avatar and corporate mail on the Microsoft 365 platform; - Attendance of classes according to the schedule.
List of literature	[1] Konyukh V.L. Computer automation of production. Novosibirsk, NSTU, 2006, Part 1-2. [2] David M. Harris and Sarah L. Harris. Digital Circuitry and Computer Architecture: Second Edition, Morgan Kaufman Publishing House © English Edition 2013, 2015 – 1684 p. [3] Serdobintsev S.P. Theory of automatic control. - Kaliningrad: KSTU, 2010 [4] Denisenko V.V. Computer control of technological process, experiment, equipment. - M.: Hotline-Telecom, 2009. - 608 p. [5] Petrov I. V. Programmable controllers: Standard languages and techniques of applied design / edited by V. P. Dyakonov. - Moscow: SOLON-Press, 2004, 266 p [6] Golubyatnikov V.A., Shuvalov V.V. Automation of production processes in the chemical industry. – Moscow: Chemistry, 2010.-736c. [7] Yugai V.Ya. Microprocessor technology in control systems. Part 1: Tutorial. – Taganrog: Publishing house of TTI SFU, 2010 [8] Ivanov Yu.I., Yugai V.Ya. Microprocessor technology in control systems. Part II: Study guide. – Taganrog: Publishing house of TTI SFU, 2009

Module designation	ROB109 Vibration of mechanical systems
Semester(s) in which this module is taught	*7*
The person responsible for the module	Candidate of Technical Sciences Tuleshov Yerkebulan Amandykovich
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, practical lesson, independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, practical lesson – 15h. Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, practical lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*mechanics of controlled machines*
Module objectives/expected learning outcomes	The aim is to provide students with the knowledge and skills to solve problems necessary in the design of machinery and equipment, as well as the theoretical foundations of vibration control and diagnostics of machinery and equipment, as well as methods for determining their vibration (dynamic) characteristics. In mechanical engineering, there is a steady trend - an increase in the parameters of the machine with a simultaneous decrease in the intensity of the metal, which is accompanied by an increase in their vibration activity. Vibration is an integral indicator of the quality of construction, manufacture and technical condition during the operation of machinery and equipment. Vibration protection is understood as a set of measures aimed at reducing the vibration of machines, equipment and structures during their design, manufacture and operation, and therefore to improve their quality and reliability.

Content	Introduction Dynamic effects and vibration of machinery and equipment. Classification, parameters, sources and causes. Vibration problems. The main sources of vibration. Classification of oscillatory processes. The basis of vibration measurement. The simplest harmonic oscillation. Oscillation equations. The concept of phase. Complex vibration. A brief summary of the amplitude units. Complex vibration. Energy and strength. Natural frequencies. Frequency analysis. Stationary signal. A deterministic signal. Non-stationary signal. Elementary parts of vibration systems. The number of degrees of freedom. Vibration analysis procedure. Spring elements. Nonlinear springs. Linearization of a nonlinear spring. Combination of springs. The spring constant associated with the restoring force due to gravity. Elements of mass or inertia. A combination of masses. The equivalent mass of the system. The mechanism of the cam follower. Damping elements. Construction Of Viscous Dampers. The damping constant of parallel plates separated by a viscous liquid. Piston cylinder. Linearization of a nonlinear damper. Combination of dampers. Equivalent spring and damping constants of the machine support. Harmonic motion. Harmonic Representation Complex algebra. Harmonic Operations Functions. Adding harmonic movements. Harmonic analysis. Extension of the Fourier series. Complex Fourier series. Frequency. Spectrum. Time and Frequency domain Representations. Even and odd functions. Decomposition. numerical Calculation of coefficients. Examples of Using MATLAB. Graphical representation of Fourier series using MATLAB. Graphical representation of rhythms. Numerical Fourier analysis using MATLAB. Free vibration of an undamped translational system. Equation of motion using Newton's Second Law of Motion. Equation of motion using other methods. Equation of motion of a spring-mass system in a vertical position. Harmonic motion. Free vibration of a continuous torsion system. The equation of motion. The reaction of systems of the first order and the time constant. Rayleigh's energy method. Free vibration with viscous damping. The equation of motion. Logarithmic decrement. The energy dissipated by viscous damping. Torsion systems with viscous damping.
Examination forms	*Exam tickets, test questions.*

Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1 Y.V. Kolosov V.V. Baranovskaya PROTECTION AGAINST VIBRATION AND NOISE IN PRODUCTION Textbook, St. Petersburg, 2011. 2 David Wong, Simon Neal Nonlinear vibration with control for flexible and adaptive structures, 1st edition: © Canopus Academic Publishing Limited 2010, © Springer International Publishing, Switzerland 2015. 3 Ashok Kumar Malik, Principles of Vibration Control, published by East-West Press Pvt. LLC, New Delhi. 4 Singiresu S. Rao in Miami Mechanical Vibrations, fifth Edition, 2011 5 Inman DJ (2007) Engineering Vibrations, 3rd ed. Pearson International Education (Prentice Hall), Upper Saddle River

Module designation	ROB 166 Designing robots
Semester(s) in which this module is taught	*8*
The person responsible for the module	*Candidate of Physical and Mathematical Sciences Sadykov Bakhtiar*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*6kr:* *Lecture-30h, laboratory lesson – 30h, Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*6kr:* *Lecture-2 kr, laboratory lesson –1 kr.Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*physics, electrical engineering, electronics*

Module objectives/expected learning outcomes	The purpose of the discipline "Robot Design" is to study algorithms for designing electronic and mechanical parts of a robotic device. "Robot Design" is a discipline covering the issues of robot design from the point of view of creating mechatronic systems including mechanical and electronic systems. The discipline gives an idea of the main stages of creating a robotic device.
Content	Fundamentals of robotics. The philosophy of robotics. Platforms for the development of robotic devices Robot power supplies. Lithium-ion battery. Battery charging modes. Alternative power sources in robotics. Robot drives. SHIM. Drive drivers. Data transfer between components in robotics. UART, I2C, SPI, RS 485, 1 WIRE, CAN, LINE, USB Technologies for increasing efficiency in robotics. Deep sleep. FLASH MEMORY. SRV. WI-FI. LAURA. GSM. bluetooth. android. Contact sensors of robotic devices Contactless sensors of robotic devices Robot control systems Layout development. The use of circuit boards when checking the operability of the circuit. Design of the printed circuit board. Production of printed circuit boards. Mounting of elements on a printed circuit board. Safety precautions when working with robotic systems. Existing norms and standards in robotics.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	[1] USP32. ReadtheDocs Template Documentation, Release 3.2. April 2019 [2] Predko M. 123 experiments in robotics. 2007 NT press Moscow [3] ESP 32 Technical Reference Manual. Version 4.0 Espressif Systems Copyright © 2018

Module designation	ROB168 Modeling of measuring systems
Semester(s) in which this module is taught	*7*
The person responsible for the module	*Lecturer Zhamuratova Mahabbat Musagazievna*
Language	*Russian, Kazakh*
Attitude to the curriculum	*elective*
Teaching methods	*lecture, laboratory lesson , independent work*
Workload (incl. contact hours, hours of independent work)	*5kr:* *Lecture-30h, laboratory lesson – 30h, Independent work of students -30h., Independent work of students under the guidance of a supervisor – 15h.*
Credit scores	*5kr:* *Lecture-2 kr, laboratory lesson –1 kr., Independent work of students-2 kr., Independent work of students under the guidance of a supervisor – 1 kr.*
Necessary and recommended prerequisites for joining the module	*physics, electronics*
Module objectives/expected learning outcomes	The purpose of studying the discipline is to form knowledge, skills and abilities in the field of building models of complex systems in future professional activity. In the process of studying this discipline, the student learns the following competence: - ability to use intelligent technologies in modeling and designing data and knowledge structures, robotic systems. - Study of the principles of building information models of complex systems, methods of formulating tasks on them and methods of their solution. - Formation of skills to use in practice the mathematical apparatus, principles and methods of computer solution of complex scientific and technical problems of obtaining, storing and processing information. - Formation of skills in the use of technology that allows describing complex systems and phenomena in nature and society in solving modern and promising tasks.

Content	Stages of circulation of measuring information. Measuring signals. Types and mathematical models of signals. Signal conversion in measuring systems. Modulation of sinusoidally varying signals. Modulation of pulse signals. Code pulse modulation. Discretization. Sampling with averaging. Recovery of a continuous signal from a sampled one. Interpolation methods of analog signal recovery. Optimal interpolation. "Physical" signal recovery. Recovery by the Lagrange polynomial. Step-by-step interpolation. Piecewise linear interpolation. General principles of modeling measuring systems. Physical implementation of measuring systems. Aggregate-modular principle of construction of measuring systems.
Examination forms	*Exam tickets, test questions.*
Requirements for training and exams	*The student should know the following disciplines: Mathematics, physics, descriptive geometry and engineering graphics, applied mechanics, electrical engineering, fundamentals of electronics, drives, fundamentals of automation, fundamentals of mechatronics and robotics.* *- Attendance of classes according to the schedule.*
List of literature	1 Tsapenko M.P. Measuring information systems: Textbook for universities. – 2nd ed., reprint. and additional - M.: Energoatomizdat, 1985. – 357 2 Vendrov, A.M. Case-technologies. Modern methods and means of designing information systems. Moscow: Finance and Statistics, 1998 3 Medyakova E. I. Information and measurement technology: textbook. - method. complex, inform. resources of the discipline, studies. manual / E. I. Medyakova. - - Publishing house of NWTU, 2008. - 41 p. 4 Parakhuda R. N. Information and measurement systems: written lectures / R. N. Parakhuda, B. Ya. Litvinov. - Publishing house of NWTU, 2002. - 74 p.