Description of individual educational component (module)	
Управление проектами *Project management*	
Магистратура *Master of Sciens*	
CU7	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	2nd semester
Number of ECTS credits allocated	3
Total hours	108
Contact hours	32
Self-study hours	76
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. A.Kulmukhametova
Prerequisites and co-requisites	None
Course contents	Concept of project management. Standards in project management. Project participants, conflict of interest. Advantages and disadvantages of the functional, project and matrix structures. Principles of formation of the project team. Project Management Processes. Initiation processes Planning processes. Execution processes Monitoring and management processes. The final processes. The main subsystems of project management: Managing the content and organization of the project. Project duration management. Project risk management. Project Resource Management. Project cost management. Project quality management Software in project activities
Recommended or required reading and other learning resources/tools	1. Kudryavtsev, E.M. Methods of network planning and project management. [Electronic resource] - Electron. Dan. - M.: DMK Press, 2008. - 238 p. 2. Osetrova, I.S. Project management in Microsoft Project 2010. [Electronic resource] - Electron. Dan. - SPb. : NRU ITMO, 2013. - 69 p. 3. Topuzov, N. K. Project Management Text text. a guide for control students personnel N. K. Topuzov, A. E. Schelkonogov; South-Ural. state Univ, Intern. Fak., Center add. prof. education; SUSU. - Chelyabinsk: Publishing Center SUSU, 2009. - 173, [1] p. 4. Newton, R. Project Management from A to Z. [Electronic resource] - Electron. Dan. - M.: Alpina Publisher, 2013. - 180 p. 5. Bunova, E. V. Management of information systems design using software products: Project Expert and Microsoft Project Textbook. allowance for universities in the direction 080000 "Economics and Management." E. V. Bunova; South-Ural. state University, Kaf. Inform. systems; SUSU. - Chelya-Binsk: SUSU Publishing Center, 2011. - 104, [1] p. 6. Gelrud, Ya. D. Project Management: methods, models, systems Text monograph Ya. D. Gelrud, OV Loginovskiy; by ed. A.L. Shestakova; South-Ural. state un-t; YUr-GU. - Chelyabinsk: Publishing Center SUSU, 2015. - 329, [1] p. 7. Moroz, O. A. Project Management in ProjectLibre Text text.-practical. manual O. A. Moroz. - Rostov n / a: Phoenix, 2015. - 253, [1] p. 8. Nikiforova, M. V. Project Management Text Method. instructions on the direction of "State and municipality" M. V. Nikiforova; South-Ural. state University, Kaf. Econ. theory, world and region. the economy; SUSU. - Chelyabinsk: Publishing Center SUSU, 2014. - 25, [1] p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO7

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria
Oral exam, project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO7: Use the main types and elements of projects; major principles, sources, forms and principles of organization of project financing. Manage to calculate the performance indicators of various project options and choose the best option. Possess planning, cost management and project control skills; project risk management skills.	1. Demonstrate knowledge about features of the feasibility study of projects to create specialized systems, their subsystems and individual modules 2. Demonstrate ability to prepare the necessary initial data for the correct calculation of the feasibility study of the project 3. Work actively within the multinational team with a specific role and demonstrate reflective practice.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of project management.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Техносферная безопасность Technosphere safety	
Магистратура *Master of Sciens*	
CU13	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3d semester
Number of ECTS credits allocated	4
Total hours	144
Contact hours	48
Self-study hours	96
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	None
Course contents	Legal aspects of technosphere safety. Labor protection management system. Safety of production processes; safety of production equipment.
Recommended or required reading and other learning resources/tools	1. Life Safety [Text] Studies. manual for universities ed. A.I. Sidorov; SUSU. - 2nd ed., Pererab. and add. - M .: KnoRus, 2012 2. Belov, S. V. Life Safety and Environmental Protection (Technosphere Safety) [Text] textbook for high schools in the discipline "Life Safety" for bachelors S. V. Belov. - 4th ed., Pererab. and add. - M .: Yurayt, 2013. - 681, [1] p. Il., tab. 3. Occupational safety in industry (mass scientific journal of a wide profile, Federal Service for Ecological, Technological and Atomic Supervision (Rostechnadzor)). 4. Safety in the technosphere (scientific method and infor. Journal. CJSC "Publishing House" Rus. Journal. "). 5. Life safety (scientific, practical, and educational. - method. Journal. LLC "Publishing House" New Technologies "). 6. Zanko, N.G. Life Safety. [Electronic resource] / N.G. Zanko, K.P. Malayan, O.N. Hare. - Electron. Dan. - SPb. : Lan, 2012. - 672 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO8

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Laboratory reports, oral exam. For assessment criteria please, see **table "Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO8: Use the main requirements of regulatory legal acts to production processes, rooms, machines, equipment in terms of ensuring technospheric safety. Manage to use the main methods of protecting production personnel and the public from the possible consequences of accidents, catastrophes, natural disasters. Possess the skills of an informed choice of well-known devices, systems and methods for ensuring technospheric safety.	1. Demonstrate knowledge about regulatory legal acts in the field of ensuring technosphere safety. 2. Demonstrate ability to evaluate the production process and production equipment in terms of safety for humans and the environment. 3. Work actively to align the production process and equipment with the state regulatory requirements of labor protection.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Laboratory reports	Laboratory reports are issued in accordance with the standard. Calculations performed correctly. The report contains all the necessary graphs and tables. The analysis of the obtained results. When protecting the report, the student answered correctly more than 85% of the questions asked.	Laboratory reports are issued in accordance with the standard. The calculations are performed mostly correctly. The report contains all the necessary graphs and tables. When defending a report, a student correctly answered more than 70% of the questions asked.	Laboratory reports are issued with deviations from the standard. The calculations are performed mostly correctly. The report does not contain all the necessary graphs and tables. When defending the report, the student answered correctly more than 50% of the questions asked.	Laboratory reports are issued with deviations from the standard. Calculations are not performed correctly. The report does not contain all the necessary graphs and tables. When defending a report, a student answered correctly less than 50% of the questions asked.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of technosphere safety.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Защита интеллектуальной собственности Intellectual property protection	
Магистратура *Master of Sciens*	
CU1	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	1st semester
Number of ECTS credits allocated	3
Total hours	108
Contact hours	32
Self-study hours	76
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. L.Radionova
Prerequisites and co-requisites	None
Course contents	The issues of copyright protection, related rights, legal protection of computer programmes and databases, intellectual property rights of industrial property, the main provisions of the international patent system, the conduct of patent search, analysis of inventions and identification of their protectability, as well as the rules for drafting applications are considered for inventions, utility models, industrial designs and trademarks. Questions are being studied on protection against unfair competition.
Recommended or required reading and other learning resources/tools	1. Batuev, V. A. Intellectual Property Protection Text Textbook. manual in areas 151900.68 "Construct.-tekhnol provision of machine building. pr-in" and 221400.68 "Quality management" V. A. Batuev, O. V. Kolotilova; South-Ural. state University, Kaf. Engineering technology; SUSU. - Chelyabinsk: Publishing Center SUSU, 2013. - 59, [1] p. 2. Gulbin, Yu. T. Legal Protection and Protection of Intellectual Property Yu. T. Gulbin. - M .: Vershina, 2006. - 441 p. 3. Patenting and intellectual property protection Textbook. allowance for additional. prof. the formations of V. P. Seredkin, I. V. Chumanov, S. N. Trofimova, M. M. Lukyanov; M-energy Ros. Federation. - Chelyabinsk: Book, 2002. - 204, [1] p. 4. Karpukhina, S.I. Intellectual Property Protection and Patenting Studies. S.I. Karpukhin. - M .: Center for Eco-nomics and Marketing, 2002. - 349 p. 5. Rednikov, S.N. Protection of Intellectual Property Text lecture notes S.N. Rednikov; South-Ural. state University, Kaf. Hydraulics and hydropneumatic systems; SUSU. - Chelya-Binsk: SUSU Publishing Center, 2010. - 43, [1] p. 6. Chumanov, I. V. Patenting and intellectual property protection. Training. manual for educat. institutions add. prof. formations I. V. Chumanov, S. N. Trofimova, M. M. Lukyanov; South-Ural. state University, Chrysostom. Fil., Kaf. Electrical equipment and automation production. processes; SUSU. - Chelyabinsk: SUSU Publishing House, 2002. - 190, [1] p. 7. Prakhov, B. G. Invention and Patenting. - 2nd ed., Pererab. and add. - Kiev: Tekhnika, 1988. - 255 p. 8. Patenting Studies. for technical colleges Artemyev E. I., Boguslavsky M. M., Yesterday R. P., and others; Ed. V.A. Ryasentseva. - 3rd ed., Pererab. and add. - M .: Mashinostroenie, 1984. - 351 p. 9. Radionova L.V. Intellectual property protection: a training manual. -

	Novotroitsk: NF NITU "MISiS", 2015.- 130 p. 10. Gulbin, Yu.T. Exclusive rights to the means of individualization of goods - trademarks, service marks, appellations of origin of goods: Civil aspect. [Electronic resource]: monogr. - Electron. Dan. - M.: STATUTE, 2007. - 284 p. 11. Ton, V.V. Basics of patent science: guidelines for practical exercises. [Electronic resource]: method. decree. - Electron. Dan. - M.: MISIS, 2016. - 78 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO6

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria
Oral exam. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO6: Apply principles of patent research; analyse the current state of the main areas and branches of mechanical engineering; basics of collecting information on research topics. Evaluate patent and other research related to intellectual property. Possess skills in compiling reports on patent and other research in the field of intellectual property.	1. Demonstrate knowledge about the main provisions of the legislation of the Russian Federation in the field of intellectual property protection. 2. Demonstrate ability to make applications for objects of intellectual property and licensing agreements. 3. To carry out a legal assessment of actions of subjects of legal relations in the field of intellectual property protection.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of Intellectual property protection.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Теория эксперимента Theory of the experiment	
Магистратура *Master of Sciens*	
CU2	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	1st semester
Number of ECTS credits allocated	2
Total hours	72
Contact hours	32
Self-study hours	40
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. L. Radionova
Prerequisites and co-requisites	None
Course contents	General ideas about the design of experiments and the processing of experimental data. Fundamentals of mathematical statistics: random variables, their average values. Moments of the distribution of random variables. Dispersion and standard deviation. Covariance matrix. Normal probability distribution. Calculation of probabilities at normal distribution. Confidence intervals, their calculation for the center and the standard of normal distribution. Pearson and Student Distributions. Fundamentals of dispersion analysis. Correlation analysis. Full factorial experiment. Fractional factorial experiment.
Recommended or required reading and other learning resources/tools	1. Golovanov, A.N. Planning an experiment. Tutorial. [Electronic resource] - Electron. Dan. - Tomsk: TSU, 2011. - 76 p. 2. Polyakova, N.S. Mathematical modeling and planning of the experiment. [Electronic resource] / N.S. Polyakova, G.S. Deryabina, Kh.R. Fedorchuk. - Electron. Dan. - M.: MSTU. N.E. Bauman, 2010. - 33 p. 3. Grishentsev, A.Yu. Theory and practice of technical and technological experiment. [Electronic resource] - Electron. Dan. - SPb. : NRU ITMO, 2010. - 102 p. 4. Ryabov, A. Century. Processing of experimental data on the computer Textbook. allowance A. V. Ryabov, I. V. Chumanov; South-Ural. state University, Chrysostom. Phil.; SUSU. - Chelyabinsk: SUSU Publishing House, 2000. - 35 p. 5. Yerdakov, I. N. Organization and methodical planning of an experiment Text text. manual in the direction of 150400 "Metallurgy" I. N. Erdakov; South-Ural. state University, Kaf. Metallurgy and foundry pr-in; SUSU. - Chelyabinsk: Publishing Center SUSU, 2014. - 87, [1] p. 6. Johnson, N. Statistics and Experiment Planning in Engineering and Science: Experiment Planning Methods. Trans. from Russian, English Ed.: E. K. Letsky, E. V. Markova. - M .: Mir, 1981. - 520 p. 7. Krasovsky, GI. Planning an experiment. - Minsk: The Belarusian State University, 1982. - 302 p. 8. Spiridonov, A. A. Planning of the experiment in the study of technological processes. - M .: Mashinostroenie, 1981. - 184 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO2

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Oral exam. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO2: Apply the basic physical and mathematical laws of the functioning of mechatronic complexes and their elements. Use methods of synthesis and research of intelligent control systems, modern scientific methodology, new research methods. Use methods of mathematical modeling of complex mechatronic systems.	1. Demonstrate knowledge about methodology for conducting full and fractional factor experiments. 2. Demonstrate ability to make a plan of an industrial experiment in the conditions of existing production. 3. Possess the skills to organizing a technological experiment in a laboratory and workshop

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of the experiment theory.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Информационные системы в мехатронике и робототехнике *Information systems in mechatronics and robotics*	
Магистратура *Master of Sciens*	
CU3	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	1st semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. S. Andreev
Prerequisites and co-requisites	None
Course contents	The elements of industrial information and information control systems and the principles of their operation 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, transformation and transmission of information via communication lines, as well as means of control.
Recommended or required reading and other learning resources/tools	1. Mechanical engineering: network electronic scientific journal 2. Automation in industry: a monthly scientific, technical and production journal. - M .: Publishing house "InfoAutomation" 3. Modern automation technology: scientific and technical journal. - M .: LLC "STA-PRESS" 4. Mechatronics, automation, management: a monthly scientific, technical and industrial journal. - M .: Publishing house "New technologies"
Language of instruction	Russian, English

Learning outcomes of the course unit
Please, see table “**Mapping Programme Key Learning Outcomes to Module Learning Outcomes” below**

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Oral exam. For assessment criteria please, see **table** “**Assessment criteria table” below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO3: Use methods of application of intelligent systems in the field of building control systems for mechatronic and robotic devices in agromechatronics. Design and implement intellectual control system according to specified criteria of functioning. Possess the skills of	1. Demonstrate knowledge about the development of algorithmic support for the operation of digital elements of information systems, model the operation of digital subsystems using standard software. 2. Demonstrate ability to design, implement and research

designing information systems and their elements; skills of organization, management and communication with colleagues in the implementation of production and research activities. LO5: Use the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, principles of construction and methods for implementing mechatronic systems based on industrial controllers. Apply the principles of building information systems and their elements, principles of building industrial SCADA-systems.	the work of information systems of mechatronic complexes using modern design tools and information technologies. 3. Possess the skills of designing information systems and their elements. 4. Demonstrate knowledge of the principles of building information systems and their elements, their structure and design stages

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of the Information systems in mechatronics and robotics.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Системы автоматизированного проектирования *CAD systems*	
Магистратура *Master of Sciens*	
CU4	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	1st semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. A. Maklakov
Prerequisites and co-requisites	None
Course contents	The study of the discipline is aimed at mastering the necessary theoretical foundations of computer-aided design (CAD) systems and obtaining practical knowledge for solving design and engineering problems of electrical CAD design in the field of industrial mechatronics.
Recommended or required reading and other learning resources/tools	1. Malukh, V.N. Introduction to modern CAD: Course of lectures. [Electronic resource] - Electron. Dan. - M.: DMK Press, 2010. - 192 p. 2. Norenkov, I.P. Fundamentals of Computer Aided Design Ucheb. for universities in the direction of "Informatics and computing technology." - M .: MSTU. N. E. Bauman, 2000. - 359 p. 3. Avetisyan, DA Fundamentals of computer-aided design of electromechanical transducers Textbook. manual for electrical engineering. specialties of technical colleges. - M .: Higher School, 1988. - 270 p. 4. Fundamentals of calculation and design of automatic control systems in mechanical engineering Text text. allowance for universities in the direction of "Design-Technol. Provision of machine-building. Ave. Il., tab. 5. Lukinov, A.P. Designing mechatronic and robotic devices Text textbook. manual for bachelors and magi-str in the direction of "Mechatronics and Robotics" A. P. Lukinov. - SPb. et al .: Lan, 2012. - 608 p. Ushakov, D.M. Introduction to the mathematical foundations of CAD: a course of lectures. [Electronic resource] - Electron. Dan. - M.: DMK Press, 2011. - 208 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO5

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria

Oral exam, project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO5: Use the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, principles of construction and methods for implementing mechatronic systems based on industrial controllers. Apply the principles of building information systems and their elements, principles of building industrial SCADA-systems.	1. Demonstrate knowledge about modern basics of automated design of technical objects, computer graphics tools. 2. Demonstrate ability to adjust the drawing parameters, apply the commands for editing and modifying the created graphic objects 3. Possess the skills of using computer equipment in modeling and design of mechatronic systems. 4. Demonstrate knowledge of the stages and procedures of the design process, features of the design procedures for the pre-design stage of developing models of mechatronic modules, basic design principles, structure and types of CAD, components of CAD systems CAD, CAM, CAE. 5. Possess the skills to apply CAD software products when designing mechatronic systems.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of CAD systems.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Геополитика *Geopolitics*	
Магистратура *Master of Sciens*	
CU8	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	2nd semester
Number of ECTS credits allocated	2
Total hours	72
Contact hours	32
Self-study hours	40
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	None
Course contents	The course is a study of the theoretical and methodological foundations of geopolitics, based on the foundation of knowledge, laid down at the previous stages of education.
Recommended or required reading and other learning resources/tools	1. Gadzhiev, KS Introduction to Geopolitics Studies. for universities in the specialties and areas of "Political Science", "International Relations", "Jurisprudence", "History", "Sociology" KS Gadzhiev. - 2nd ed., Pererab. and add. - M .: Logos, 2002. - 428, [1] p. 2. Nartov, N. A. Geopolitics Text textbook. for universities on econ. specialties N. A. Nartov, V. N. Nartov; by ed. V.I. Staroverova. - 4th ed., Pererab. and add. - M .: UNITY-DANA: Unity, 2007. - 527 p. 3. Dugin, A. G. Foundations of Geopolitics: Russia's Geopolitical Future; Thinking by space A. G. Dugin. - 4th ed. - M .: Arktogeya Center, 2000. - 924, [1] p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO1

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria
Oral exam. For assessment criteria please, see **table** “**Assessment criteria table” below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO1: Manage to improve their intellectual and general cultural level. Possess the ability to improve thinking skills in accordance with the laws and requirements of logic.	1. Demonstrate knowledge ways to improve and develop their intellectual and general cultural level. 2. Demonstrate the ability to improve thinking skills in

	accordance with the laws and requirements of logic.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of Geopolitics.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Программное обеспечение и системные функции контроллеров *Software and system functions of controllers*	
Магистратура *Master of Sciens*	
CU9	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	2nd semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	Technical equipment for automation and control of mechatronic systems
Course contents	Basic concepts and definitions of industrial controllers, microprocessor systems and their use in mechatronic systems, the architecture of controllers, the principles of operation of controllers and systems. Programming based on industrial logic controllers.
Recommended or required reading and other learning resources/tools	1. Petrov, I.V. Programmemable controllers. Standard languages and techniques of applied design. [Electronic resource] - Electron. Dan. - M.: SOLON-Press, 2004. - 256 p. 2. Polish, V.A. The study of control methods of AC electric drive based on programmemable logic controllers: method. instructions for the course "Electric Robots". [Electronic resource]: studies. Method. manual / V.A. Polish, A.V. Vanin. - Electron. Dan. - M.: MSTU. N.E. Bauman, 2010. - 35 p. 3. Kangin, V.V. Industrial controllers in the systems of automatization of technological processes Text text. manual for universities in the direction of "Automation of technological processes and pr-in" V. V. Kangin. - Stary Oskol: Thin high technology, 2013. - 407 p. 4. Medvedev, M. Yu. Programmeming industrial controllers Text text. manual for masters of engineering and technology of universities in the direction of "Electrical Engineering, Electromechanical and Electrical Engineering" M.Yu. Medvedev, V.H. Pshikho-pov. - SPb. et al .: Lan, 2011. - 288 p. 5. Shishov, OV. Programmemable controllers in industrial automation systems: a textbook. - M .: INFRA-M, 2017. - 363, [2] p. 6. Michel, J. Programmemable Controllers. Trans. with fr. A.P. Sizov. - M .: Mashinostroenie, 1986. - 172 p. 7. Michel, J. Programmemable Controllers Architecture and Application Trans. with fr. I.V. Fedotova; Ed. B. I. Lytky-on. - Pererab. and add. ed. - M .: Mashinostroenie, 1992. - 318, [2] p. 8. Petrov, I.V. Programmemable Controllers. Standard Languages and Applied Design Techniques I. V. Petrov; Ed. V.P. Dyakonov. - M .: Solon-Press, 2004. - 253 p. 9. Kangin, V. V. Hardware and software management systems. Industrial networks and controllers [Text] studies. manual for universities in the direction of training 150400 - "Tech-nol. Machines and Equipment" V. V. Kangin, V. N. Kozlov. - M .: Binom. Laboratory of Knowledge, 2010. - 418 p. Il., tab.

Language of instruction	Russian, English

Learning outcomes of the course unit
Please, see table "**Mapping Programme Key Learning Outcomes to Module Learning Outcomes" below**

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria
Oral exam. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO5: Use the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, principles of construction and methods for implementing mechatronic systems based on industrial controllers. Apply the principles of building information systems and their elements, principles of building industrial SCADA-systems.	1. Demonstrate knowledge about the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, algorithms for performing cyclic programmes, programmes for arithmetic data processing, principles of construction and methods for implementing mechatronic systems based on industrial controllers. 2. Demonstrate ability to programming industrial controllers. 3. Possess the skills of using programming techniques, troubleshooting hardware and software of industrial controllers in automated manufacturing.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of software and system functions of controllers.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
SCADA системы в автоматизированном производстве *SCADA systems in automated production*	
Магистратура *Master of Sciens*	
CU14	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3d semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. S. Voronin
Prerequisites and co-requisites	Software and system functions of controllers
Course contents	Principles of operation of SCADA-systems, controllers and actuating devices operating under the control of SCADA-systems.
Recommended or required reading and other learning resources/tools	1. Bashmakov, A.I. Intelligent Information Technology Text-textbook. manual for universities in the direction of "Informatics and computational techniques" A. I. Bashmakov, I. A. Bashma-kov. - M .: Publishing House MSTU. N.E. Bauman, 2005. - 302 p. 2. Lukinov, A.P. Designing mechatronic and robotic devices Text textbook. manual for bachelors and magi-str in the direction of "Mechatronics and Robotics" A. P. Lukinov. - SPb. et al .: Lan, 2012. - 608 p. 3. Karnaukhov, N. F. Electromechanical and mechatronic systems Textbook. manual on specialties 190206, 220401, 220402 N. F. Karnaukhov. - Rostov n / a: Phoenix, 2006. - 319 p. 4. Moskvichev, A. A. Gripping devices of industrial robots and manipulators Textbooks. manual for universities in the following directions: 03/15/04 "Automation of technological processes and pr-in", 03/15/2006 "Mechatronics and Robotics" A. A. Moskvi-chev, A. R. Kvartals, B. V. Ustinov. - M .: Forum: INFRA-M, 2017. - 175 p. 5. Firas A. Rahim. Methods of building intelligent systems for planning and controlling the movement of a robotic arm in an unknown environment. Aut. dis. Cand. tech. Sciences: Specialty 05.02.05 - Robots, mechatronics and robotic systems Firas A. Rahim; scientific hands A. G. Bulgakov; South-Russian state tech. un-t - Novocher Kask, 2009. - 23 p. 6. Gerasimov, A.V. Designing a process control system using SCADA-systems: a tutorial. [Electronic resource]: studies. allowance / A.V. Gerasimov, A.S. Titovtsev. - Electron. Dan. - Kazan: KNITU, 2014. - 128 p. 7. Pyavchenko, T.A. Automated information and control systems using TRACE MODE SCADA systems. [Electronic resource]: studies. allowance - Electron. Dan. - SPb. : Lan, 2015. - 336 p.
Language of instruction	Russian, English
Learning outcomes of the course unit	
LO5	

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria
Oral exam, project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO5: Use the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, principles of construction and methods for implementing mechatronic systems based on industrial controllers. Apply the principles of building information systems and their elements, principles of building industrial SCADA-systems.	1. Demonstrate knowledge about main principles of building industrial SCADA-systems.. 2. Demonstrate ability to organize and manage the development of industrial management systems based on SCADA-systems. 3. Possess the skills of adequate formulation of tasks solved by the methods set out in the course. 4. Demonstrate knowledge about industrial interfaces and controllers operating under the control of SCADA-systems. 5. Demonstrate ability to design SCADA-systems for automatic and automated control, using modern built-in development tools and programming languages for SCADA-systems. 6. Possess the basic skills when working with the main interfaces of the SCADA system.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of SCADA systems.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Методы искусственного интеллекта в мехатронике *Methods of artificial intelligence in mechatronic*	
Магистратура *Master of Sciens*	
CU10	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	2nd semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. S. Andreev
Prerequisites and co-requisites	Information systems in mechatronics and robotics
Course contents	The discipline studies the issues of synthesis and modeling of intellectual control systems of various types, as well as algorithms of intellectual inference and their programme implementation. The use of artificial intelligence, fuzzy and formal logic, adaptive and self-adjusting systems, artificial neural networks in the synthesis of an intelligent control system for a mechatronic object is considered.
Recommended or required reading and other learning resources/tools	1. Shestakov, A. L. Distributed intelligent automated process control systems-text Textbook. manual for universities in the preparation 200100 "Instrument Engineering" and others. A. L. Shestakov, M. N. Bizyaev, I. V. Sainsky; South-Ural. state un-t; SUSU. - 2nd ed., Corr. and add. - Chelyabinsk: Publishing Center SUSU, 2011. - 495 p. silt 2. Uskov, A. A. Intellectual management technologies. Artificial neural networks and fuzzy logic A. A. Uskov, A. V. Kuzmin. - M .: Hotline - Telecom, 2004 3. Alekseev, E.R. Scilab: Solving engineering and mathematical problems Text E.R. Alekseev, O.V. Chesnokova, E.A. Rudchenko. - M .: ALT Linux: BINOM. Laboratory of Knowledge, 2008. - 257, [2] p. 4. Dolbenkov, V.I. Simulink in problems of automatic control systems Textbook. allowance V. I. Dolbenkov; South-Ural. state University, Kaf. Control systems; SUSU. - Chelyabinsk: Publishing of SUSU, 2005. - 101, [2] p. 5. Industrial automation: a monthly scientific, technical and production journal. - Moscow: Publishing House "InfoAutomation" Publishing House 6. Problems of theory and practice of management: an international journal. - M .: International Media Group LLC 7. Mechatronics, automation, management: a monthly scientific, technical and industrial journal. - M .: Publishing house "New technologies" 8. Information technology: a monthly theoretical and applied scientific and technical journal. - M .: Publishing house "New technologies" 9. Korablev, Yu.A. Intellectual technologies in control systems and diagnostics: a training manual. [Electronic resource] / Yu.A. Korablev, M.Yu. Shestopalov, M.I. Khalikov. - Electron. Dan. - SPb. : SPbGLTU, 2012. - 112 p. 10. Smolin, D.V. Introduction to artificial intelligence: lecture notes. [Electronic resource] - Electron. Dan. http://e.lanbook.com/book/2325

	- Moscow: Fizmatlit, 2007. - 264 p. 11. Kharakhan, O.G. Artificial Intelligence Systems. Practicum for laboratory work. [Electronic resource]: studies. allowance - Electron. Dan. - M.: Mining Book, 2006. - 80 p. 12. Dyakonov, V.P. MATLAB 6.5 SP1 / 7/7 SP1 / 7 SP2 + Simulink 5/6. Tools of artificial intelligence and bioinformatics. [Electronic resource]: studies. manual / V.P. Dyakonov, V.V. Kruglov. - Electron. Dan. - M.: SOLON-Press, 2009. - 456 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
Please, see table "**Mapping Programme Key Learning Outcomes to Module Learning Outcomes" below**

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Oral exam, project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO4: Use methods of application of intelligent systems in the field of building control systems for mechatronic and robotic devices in agromechatronics. Design and implement intellectual control system according to specified criteria of functioning. Possess the skills of designing information systems and their elements; skills of organization, management and communication with colleagues in the implementation of production and research activities. LO4: Apply methods of formal, fuzzy and combinatorial logic; mathematical methods for the construction and training of neural networks, adaptive and self-adjusting systems. Manage to implement intelligent control algorithms using numerical methods of solution; correctly and efficiently choose different types of drives for specific industrial mechatronic systems, use microprocessor control devices in typical drives. Possess the skills to build mathematical models of intelligent systems and their implementation using typical software.	1. Demonstrate knowledge about the application of intelligent systems in the field of building control systems for mechatronic and robotic devices in various areas of industrial production. 2. Demonstrate ability to make a choice of the type of intellectual control system according to specified criteria of functioning, develop algorithmic and software of intelligent control systems of various types of mechatronic systems. 3. Possess the skills of analyzing technical and scientific information about the principles of synthesis and analysis of the application of various types of intelligent systems in control systems for mechatronic systems. 4. Demonstrate knowledge about methods of formal, fuzzy and combinatorial logic; mathematical methods used for the construction and training of neural networks, adaptive and self-adjusting systems. 5. Demonstrate ability to implement intelligent control algorithms using numerical methods of solution. 6. Possess the basic skills to build mathematical models of intelligent systems and their implementation using typical software.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of

		were very good.	the report were good.	the report fell short of a passing grade.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of artificial intelligence in mechatronic.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Управление промышленными мехатронными системами *Management of industrial mechatronic systems*	
Магистратура *Master of Sciens*	
CU15	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3d semester
Number of ECTS credits allocated	6
Total hours	216
Contact hours	80
Self-study hours	136
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Prof. V. Khramshin
Prerequisites and co-requisites	Methods of artificial intelligence in mechatronics
Course contents	The course of this discipline covers the main prospects for the development of mechatronic systems, the purpose and composition of mechatronic systems, the classification and features of executive drives and technological sensors of mechatronic systems, the principles of construction and calculation of industrial systems regulators, the principles of operation and the main characteristics of industrial mechatronic control systems.
Recommended or required reading and other learning resources/tools	1. Poduraev, Yu.V. Mechatronics: principles, methods, application: studies. manual for university students. [Electronic resource] - Electron. Dan. - M.: Mashinostroenie, 2007. - 256 p. 2. Izotkina, N.Yu. Innovative control technologies in mechatronics and robotics: studies. allowance. [Electronic resource] / N.YU. Izotkina, Yu.M. Osipov, V.I. Syryamkin. - Electron. Dan. - Tomsk: TSU, 2015. - 220 p. 3. Storozhev, V.V. Systems engineering and mechatronics of technological machines and equipment: a monograph. [Electronic resource] / V.V. Storozhev, N.A. Feoktistov. - Electron. Dan. - M.: Dashkov and K, 2016. - 412 p. 4. Melnikov, N. V. Electromechanical and Mechatronic Information-Controlled Specialized Systems Text monograph N. V. Melnikov. - M .: Forum, 2010. - 416 p. 5. Smirnov, Yu. S. Electromechatronic converters Text Part 1 monograph Yu. S. Smirnov; by ed. A.L. Shestakova; South-Ural. state un-t; SUSU. - Chelyabinsk: Publishing Center SUSU, 2013. - 360, [1] p. Il., fot. 6. Eliseev, S. V. Mechatronic approaches in the dynamics of mechanical oscillatory systems Text monograph by S. V. Eliseev, Yu. N. Reznik, A. P. Khomenko; rep. ed. P.A. Lontsikh, A.V. Lukyanov; Irkut. state un-t ways reported; Zabaykal. state un-t - Novosibirsk: Science, 2011. - 382, [1] p. 7. Karnaukhov, N. F. Electromechanical and mechatronic systems Textbook. manual on specialties 190206, 220401, 220402 N. F. Karnaukhov. - Rostov n / a: Phoenix, 2006. - 319 p. 8. Gafiyatullin, R. Kh. Guidelines for teaching and research work of students of specialty O 628 "Electric drive and automation of industrial installations" Chelyab. Polytechnic Inst them. Lenin Komsomol, Kaf. Electric drive and automation of industrial installations; YUr-GU. - Chelyabinsk: Publishing house CPI, 1983. - 18 p. 9. Borisov, A. M. A collection of schemes for the course "Integrated Automation of Industrial Installations and Processes" PRPI them.

	Leninsky Komsomol, Kaf. Electric drive and automation prom. installations; SUSU. - Chelyabinsk, 1975. - 18 p. 10. Ishii, T. Mehatronika Per. with jap S. L. Maslennikova; Ed. V.V. Vasilkov. - M .: Mir, 1988. - 314 p. silt 11. Gorbenko, T.I. Fundamentals of mechatronics and robotics. [Electronic resource] / T.I. Gorbenko, M.V. Gorbenko. - Electron. Dan. - Tomsk: TSU, 2012. - 126 p. 12. Gorbatsevich, E.D. Mechatronic devices of locator antennas: Proc. manual for the course "Fundamentals of Mechatronics" and "Fundamentals of Robotics". [Electronic resource] - Electron. Dan. - M.: MSTU. N.E. Bauman, 2007. - 24 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO4

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Oral exam, project work. For assessment criteria please, see **table "Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO4: Apply methods of formal, fuzzy and combinatorial logic; mathematical methods for the construction and training of neural networks, adaptive and self-adjusting systems. Manage to implement intelligent control algorithms using numerical methods of solution; correctly and efficiently choose different types of drives for specific industrial mechatronic systems, use microprocessor control devices in typical drives. Possess the skills to build mathematical models of intelligent systems and their implementation using typical software.	1. Demonstrate knowledge about the composition and principles of operation of drives of modern industrial mechatronic and electro-technical devices based on engines of various types. 2. Demonstrate ability to correctly and efficiently choose different types of drives for specific industrial mechatronic systems, taking into account the purpose and conditions of operation, as well as the advantages and disadvantages of drives of various types 3. Possess the skills of hardware and software implementation of drives for electromechanical and mechatronic systems; skills of using microprocessors in mechatronic and robotic systems drives.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content	The student must answer 75-84% of the questions asked, disclose the content of the material in the	The student must answer 60-74% of the questions asked, master the main content of the	The student answered less than 59% of the questions asked, could not show knowledge at the

	of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of management in industrial mechatronic systems.	scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Суперкомпьютерное моделирование мехатронных систем *Supercomputer modeling of mechatronic systems*	
Магистратура *Master of Sciens*	
CU16	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3d semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. S. Ivanov
Prerequisites and co-requisites	Information systems in mechatronics and robotics
Course contents	Calculations on the supercomputer using specialized software packages. Models, their types. The nature of the models. Modeling. Objectives of modeling. Stages of modeling. CAE / CAD system. The basic concepts. The history of CAE / CAD systems. Examples of CAE / CAD systems. Capabilities of CAE / CAD systems. Sharing files between a supercomputer and a personal computer, setting a problem for a solution on a supercomputer. Tasks for supercomputer. Applications that use supercomputer computing. Methods used to solve problems on supercomputers in specialized software packages. Finite element method. Finite volume method. The advantages and disadvantages of the methods. Convergence and accuracy. General principles for constructing software packages that implement the finite element method and the finite volume method. Basic concepts of parallel computing. Necessity and importance of parallel computing. Task execution modes: sequential, pseudo-parallel, parallel. Types of parallelism: multiprocessing, pipelining, vector processing. Ways to achieve parallel computing. Supercomputers: performance lists Top500, Top50. Classification of parallel systems: Flynn systematics. Clusters Topology of interconnection networks of multicomputers. Evaluation of the effectiveness of parallel computing: acceleration, efficiency, cost. Amdal's law. Gustafson's law.
Recommended or required reading and other learning resources/tools	1. Kaplun, E.M. Morozov, M.A. Olferyeva; foreword A.S. Shadsky. - Izd.ster. - M .: URSS: LIBROCOM, 2014. - 269 p. silt 2. Basov, KA. ANSYS Text Ref. User K. A. Basov. - 2nd ed., Sr. - M .: DMK-Press, 2012. - 639 p. silt 3. Gergel, V.P. High performance computing for 4. multiprocessor multi-core systems Text textbook for university students enrolled on the VPO 010400 "Applied Mathematics and Information" and 010300 "Fundamental Informatics and Information Technologies" V. P. Gergel; B-ka Nizhegor. state un-that them. N. I. Lobachevsky; Supercomputer consortium of universities of Russia. - Moscow: Fizmatlit, 2010. - 539, [4] p. silt 25 cm 5. Workshop on methods of parallel computing Textbook text for universities in the areas of HPE 010400 "Applied mathematics and computer science" and 010300 "Fundamental informatics and information technologies" A. Starchenko and others; by ed. A. V. Starchenko; Tom. state un-t -M .: Production of Moscow University, 2010. - 199 p. silt 21 cm

	6. Supercomputer technologies in science, education and 7. Industry Text Vol. 3 almanac ed. V.A. Sa-dovniche and others; Mosk. state un-t them. MV Lomonosov et al. - M .: Publishing House of Moscow State University, 2012. -229, [2] p. silt 8. Voevodin, V.V. Parallel Computations. manual for universities in the direction 510200 "Applied Mathematics and Informatics" V.V. Voevodin, Vl. V. Voevodin. - SPb .: BHV-Petersburg, 2004. - 599 p. 9. Basov, K.A. Graphic interface of the ANSYS complex K.A. Basov. - M .: DMK-Press, 2006. - 247 p. 10. Chernyavsky, AO. Practical application of the finite element method in tests of strength calculation. Textbook. A.O. Chernyavsky's congregation; South-Ural. state University, Kaf. Butt. mechanics, dynamics and durability of machines; SUSU. - Chelyabinsk: Publishing house SUSU, 2001. - 89 p. silt 11. Chigarev, A.V. ANSYS for Engineers Ref. allowance A.V. Chigarev, A.S. Kravchuk, A.F. Smalluk. - M .: Machine building: Mashinostroenie-1, 2004. - 511 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO2

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, case study.

Assessment methods and criteria
Oral exam. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO2: Apply the basic physical and mathematical laws of the functioning of mechatronic complexes and their elements. Use methods of synthesis and research of intelligent control systems, modern scientific methodology, new research methods. Use methods of mathematical modeling of complex mechatronic systems.	1. Demonstrate knowledge about the basic concepts of parallel computing. 2. Demonstrate ability to solve problems on parallel computing systems using specialized software packages. 3. Possess the skills of the modern high-performance computing. 4. Demonstrate ability to work with the queue of tasks on a supercomputer. 5. Possess the skills of solving tasks on a supercomputer in specialized software.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of supercomputer	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering,

	modeling of mechatronic systems.	sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.		gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Технические средства автоматизации и управления мехатронных систем *Technical equipment for automation and control of mechatronic systems*	
Магистратура *Master of Sciens*	
CU5	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	1st semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. S. Andreev
Prerequisites and co-requisites	None
Course contents	Methods and means of measuring process parameters; methods and methods for processing and converting information about the value of monitored parameters; purpose, principles of construction and use of technical means of control and actuating devices; the structure of modern microprocessor aggregate complexes of technical means, the principles of their customization and programming.
Recommended or required reading and other learning resources/tools	1. Lukinov, A.P. Design mechatronic and robotic devices + CD. [Electronic resource] - Electron. Dan. - SPb. : Lan, 2012. - 608 p. 2. Smirnov, Yu.A. Technical means of automation and control. [Electronic resource] - Electron. Dan. - SPb. : Lan, 2017. - 456 p. 3. Shandrov, B. V. Technical means of automation Textbook textbook on the specialty "Automation of machine building processes and pr-in (mechanical engineering)" directions "Automatics. Technologies and pr-va" B. V. Shandrov, A. D. Chudakov. - M .: Academy, 2007. - 360, [1] p. 4. Technical means of automation and control: studies. com / O.V. Shishov. - M.: INFRA-M, 2017. - 396 p. 5. Rannev, G. G. Methods and measuring instruments Text textbook for universities in the direction of 653700 "Instrument Engineering" specialty 190900 "Inform.metr. Engineering and technology" G. G. Rannev, A. P. Tarasenko. - 6th ed., Sr. - M .: Academy, 2010. - 330 p. 6. Borisov, A. M. Programmemable automation devices Text textbook. manual on the specialty 140604 "Electric drive and automation of industrial installations and technological complexes" A. M. Borisov, A. S. Nesterov, N. A. Loginova; South-Ural. state University, Kaf. Electric drive and automation prom. installations; SUSU. - Chelyabinsk: Publishing Center SUSU, 2010. - 185p. 7. Shishov, OV. Technical means of automation and control [Text] studies. manual for universities on tehn. directions O. V. Shishov. - M .: INFRA-M, 2012. - 395 p. 8. Modern automation technology [Text]: scientific and technical journal. - M .: LLC "STA-PRESS" 9. Devices + automation [Text]: industry scientific, technical and production journal. - M .: SOO “International NTO of instrument-makers and metrologists
Language of instruction	Russian, English

Learning outcomes of the course unit
LO5

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Laboratory reports, oral exam. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO5: Use the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, principles of construction and methods for implementing mechatronic systems based on industrial controllers. Apply the principles of building information systems and their elements, principles of building industrial SCADA-systems.	1. Demonstrate knowledge about the device of the main types of technical means for automatization and control, the design and calculation methods of individual blocks and control devices for mechatronic and robotic systems and the order of research of their work. 2. Demonstrate ability to select and coordinate the work of standard measuring and computing equipment in order to design automatic control systems for mechanical and robotic systems. 3. Possess the skills of installation and adjustment of automation and control systems, as well as research of their work.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Laboratory reports	Laboratory reports are issued in accordance with the standard. Calculations performed correctly. The report contains all the necessary graphs and tables. The analysis of the obtained results. When protecting the report, the student answered correctly more than 85% of the questions asked.	Laboratory reports are issued in accordance with the standard. The calculations are performed mostly correctly. The report contains all the necessary graphs and tables. When defending a report, a student correctly answered more than 70% of the questions asked.	Laboratory reports are issued with deviations from the standard. The calculations are performed mostly correctly. The report does not contain all the necessary graphs and tables. When defending the report, the student answered correctly more than 50% of the questions asked.	Laboratory reports are issued with deviations from the standard. Calculations are not performed correctly. The report does not contain all the necessary graphs and tables. When defending a report, a student answered correctly less than 50% of the questions asked.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide evidence, show skills in solving standard problems of technical equipment for automation and control of mechatronic systems.	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not clearly given, mistakes are made in the conclusions, practical skills are weak.	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Проектирование мехатронных систем *Design of mechatronic systems*	
Магистратура *Master of Sciens*	
CU11	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	2nd semester
Number of ECTS credits allocated	5
Total hours	180
Contact hours	64
Self-study hours	116
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. A. Maklakov
Prerequisites and co-requisites	Project management
Course contents	The issues of information support of the process of designing mechatronic devices and systems (a systematic approach to design, design procedure and principles, CAD, design features of mechatronic modules and systems).
Recommended or required reading and other learning resources/tools	1. Lukinov, A.P. Design mechatronic and robotic devices + CD. [Electronic resource] - Electron. Dan. - SPb. : Lan, 2012. - 608 p. 2. Boshlyakov, A.A. Designing algorithmic and software support for mechatronic systems: Proc. allowance. [Electronic resource] / A.A. Boshlyakov, S.V. Ovsyannikov. - Electron. Dan. - M.: MSTU. N.E. Bauman, 2007. - 56 p. 3. Andreikin, P.V. Theory of design of mechatronic devices. Part 2. [Electronic resource] / P.V. Andreikin, A.V. Zezekalo, I.Sh. Isaev. - Electron. Dan. - M.: MSTU. N.E. Bauman, 2014. - 104 p. 4. Avetisyan, D. A. Fundamentals of automated design of electromechanical converters Textbook. manual for electrical engineering. specialties of technical colleges. - M .: Higher School, 1988. - 270 p. 5. Intelligent integrated CAD REA and BIS Sat. scientific tr. Ed. ed. B.V. Bunkin, V.N. Gridin; Acad. sciences USSR, Institute of design automation. - M .: Science, 1990. - 124 p. 6. Yurevich, EI Basics of Robotics. Textbook. allowance for high school in direction 652000 "Mechatronics and Robotics" E. I. Yurevich. - 2nd ed., Pererab. and add. - SPb .: BHV-Petersburg, 2005. - 401 p. 7. Kozyrev, Yu. G. Industrial robots: the main types and technical characteristics Text text. manual for universities in the areas of "Automation. Technology and production", "Mechatronic and robotics" Yu. G. Kozyrev. - M .: KnoRus, 2015 8. Ishii, T. Mehatronika Per. with jap S. L. Maslennikova; Ed. V.V. Vasilkov. - M .: Mir, 1988. - 314 p. 9. Intellectual robots Text of studies. manual for universities in the direction of training. 220400.65 "Mechatronics and Robotics" I. A. Kalyaev, V. M. Lokhin, I. M. Makarov and others; under total ed. E. I. Yurevich. - M .: Mashinostroenie, 2007. - 360 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO3, LO7

Planned learning activities and teaching methods
Lectures, presentation, individual work, group work, experiment, case study.

Assessment methods and criteria
Oral exam, project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO3: Use methods of application of intelligent systems in the field of building control systems for mechatronic and robotic devices in agromechatronics. Design and implement intellectual control system according to specified criteria of functioning. Possess the skills of designing information systems and their elements; skills of organization, management and communication with colleagues in the implementation of production and research activities. LO7: Use the main types and elements of projects; major principles, sources, forms and principles of organization of project financing. Manage to calculate the performance indicators of various project options and choose the best option. Possess planning, cost management and project control skills; project risk management skills.	1. Demonstrate knowledge about the basics of designing mechatronic systems; principles of operation of industrial robotic systems; the procedure and principles of building CAD; sequence and design features of mechatronic modules and systems. 2. Demonstrate ability to conduct an analysis of technological processes in various industries in order to develop recommendations for their automation; determine the requirements and develop technical specifications for individual subsystems of the mechatronic system, including mechanical devices, electronic, electromechanical, hydraulic and microprocessor devices. 3. Possess the skills of methods and tools of computer design of mechatronic modules, computer methods of calculation and modeling of modern mechatronic systems; engineering techniques for designing technical solutions for mechatronic objects. 4. Demonstrate knowledge about the design methods that ensure the development of rational designs of mechatronic modules, based on the specified technical requirements, working conditions and production and economic opportunities

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.
Oral exam	The student must answer more than 84% of the questions asked, most fully disclose the content of the material in the scope of the program of the discipline, clearly and correctly give the necessary definitions, provide	The student must answer 75-84% of the questions asked, disclose the content of the material in the scope of the program of the discipline, basically correctly give the basic definitions and concepts of the	The student must answer 60-74% of the questions asked, master the main content of the material in the scope of the program of the discipline. When answering, the definitions and concepts are not	The student answered less than 59% of the questions asked, could not show knowledge at the level of playing and explaining information, could not show intellectual skills of solving simple problems, the main

	evidence, show skills in solving standard problems of mechatronic systems.	subject. When answering, inaccuracies, irregularities in the sequence of presentation may be made, and there may also be slight inaccuracies in the conclusions and use of terms, practical skills are not firm.	clearly given, mistakes are made in the conclusions, practical skills are weak.	content of the educational material was not disclosed. When answering, gross errors were made in the definitions, no answers were given to the teacher's additional questions.

Description of individual educational component (module)	
Учебная (ознакомительная) практика Intership	
Магистратура *Master of Sciens*	
CU6	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	1st semester
Number of ECTS credits allocated	10
Total hours	360
Contact hours	64
Self-study hours	296
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	None
Course contents	Intership is one of the types of educational process, during which a direct connection of theoretical training with the future practical activity of a specialist is carried out. During the first intership, students study the general organization of production at the plant, technological processes in individual workshops, methods for controlling the technological process and product quality, and basic technical and economic indicators.
Recommended or required reading and other learning resources/tools	1. Kapustin, N. M. Automation of mechanical engineering Textbook. for universities in the areas of "Technology, equipment and automation of machine-building. Ave.", "Automation and Control." N. M. Kapustin, N. P. D'yakonov, P. M. Kuznetsov; Ed. N. M. Kapustin. - M .: Higher School, 2002. - 222, [1] p. 2. Automation of production processes in the machine-building. Training. for universities in the areas of preparation of bachelors and masters "Technology, equipment and automation of the Mashinostr. Ave." and diploma. specialists "Designer.-technol. software engineering. pr-in" and "Automation. technology and pr-va" N. M. Kapustin, P. M. Kuznetsov, A. G. Shirtladze and others; Ed. N. M. Kapustin. - M .: Higher School, 2004. - 414, [1] p. 3. Ivanov, N. I. Automation of production processes in ferrous metallurgy. Training. manual for metallurgist. specialist. universities. - M .: Metallurgy, 1980. - 303 p. silt 4. Frantsenyuk, I. V. Modern metallurgical production I. V. Frantsenyuk, L. I. Frantsenyuk. - 2nd ed. - M .: Moscow, 2000. - 528 p. 5. Zyuzin, V.I. Mechanical equipment of metallurgical shops [Text] manual for designers and mechanics V.I. Zyuzin. - M .: Metallurgizdat, 1960. - 335 p. 6. Hydraulic equipment of metallurgical shops [Text] A. M. Ioffe, O. N. Kukushkin, F. A. Naumchuk, etc. - Moscow: Metallurgy, 1989. - 248 p. 7. Polukhin, PI. Rolling production Textbook for universities for the special. "Metal. Pressure." - 3rd ed., Pererab. and add. - M .: Metallurgy, 1982. - 696 p. 8. Voronenko, V.P. Machine-Building Production. Textbook. for nouns special studies. institutions V. P. Voronenko, A. G. Skhirtladze, V. N. Bryukhanov; Ed. Yu. M. Solomentsev. - Moscow: High School: Academy, 2001
Language of instruction	Russian, English

Learning outcomes of the course unit
LO1, LO6

Planned learning activities and teaching methods
individual work, group work, case study

Assessment methods and criteria
Project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO1: Manage to improve their intellectual and general cultural level. Possess the ability to improve thinking skills in accordance with the laws and requirements of logic. LO6: Apply principles of patent research; analyse the current state of the main areas and branches of mechanical engineering; basics of collecting information on research topics. Evaluate patent and other research related to intellectual property. Possess skills in compiling reports on patent and other research in the field of intellectual property.	1. Demonstrate knowledge about basic world and domestic cultural achievements. 2. Demonstrate ability to consistently develop and improve the completeness, accuracy, depth, speed of perception of information; consistently perceive and evaluate various aspects and properties of objects. 3. Possess the skills of thinking in accordance with the laws and requirements of logic. 4. Demonstrate knowledge about the current state of the main areas and branches of mechanical engineering; basics of collecting information on research topics. 5. Demonstrate ability to work with scientific and technical information, collect, process, analyze and systematize the information obtained and apply it in the analysis and processing of its research results.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.

Description of individual educational component (module)	
Производственная практика Intership	
Магистратура *Master of Sciens*	
CU12	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	2nd semester
Number of ECTS credits allocated	10
Total hours	360
Contact hours	64
Self-study hours	296
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	None
Course contents	The purpose of the intership is to familiarize with the profile industrial and engineering enterprises of the region, to form the professional position of the future specialist, his motivation for professional and personal self-improvement, general familiarization of students with the equipment of industrial enterprises, its operation and maintenance conditions of modern enterprises of the industry. The main attention is paid to the study of the main components and mechanisms of technological equipment, automation systems of the technological process; the use of tools, templates, instruments for setting up and adjusting equipment components and process control systems, equipment operating conditions, modes of its operation, production organization and machine repair. A student visits a workshop or a site in an enterprise, where they get acquainted with a workplace, equipment, and technological process. With the help of a consultant from the enterprise, he studies equipment and technology according to an individual assignment. Collects material for further work on coursework and final qualifying work. Based on materials collected in practice, prepares a report that protects the assessment.
Recommended or required reading and other learning resources/tools	1. Kapustin, N. M. Automation of mechanical engineering Textbook. for universities in the areas of "Technology, equipment and automation of machine-building. pr-in", "Automation and Control." N. M. Kapustin, N. P. D'yakonov, P. M. Kuznetsov; Ed. N. M. Kapustin. - M .: Higher School, 2002. - 222, [1] p. 2. Automation of production processes in mechanical engineering Textbook. for universities in the areas of training of bachelors and masters "Technology, equipment and automation of machine building. pr-in" and diploma. specialists "Designer.-technol. software engineering. pr-in" and "Automation. technology and pr-va" N. M. Kapustin, P. M. Kuznetsov, A. G. Shirtladze and others; Ed. N. M. Kapustin. - M .: Higher School, 2004. - 414p. 3. Belov, M.P. Automated electric drive of typical production mechanisms and technological complexes Manual. for universities in the specialty "Electric drive and automation of industrial installations and technological complexes" M. P. Belov, V. A. Novikov, L. N. Rassudov. - 2nd ed., Sr. - M .: Academy, 2004. - 574p. 4. Bashta, T. M. Hydraulic drive and hydropneumatic automation Training. for the specialty "Hydropneumatics and hydraulic actuators" T. M. Basta. - M .: Mashinostroenie, 1972. - 320 p. 5. Kondakov, L. A. Mashinostroitelnyy hydraulic actuator Ed. V. N.

	Prokofiev. - M .: Mashinostroenie, 1978. - 495 p. 6. Voronenko, V.P. Machine-Building Production. Textbook. for nouns special studies. institutions V. P. Voronenko, A. G. Skhirtladze, V. N. Bryukhanov; Ed. Yu. M. Solomentsev. - Moscow: High School: Academy, 2001 7. Frantsenyuk, I. V. Modern metallurgical production I. V. Frantsenyuk, L. I. Frantsenyuk. - 2nd ed. - M .: Metallurgy, 2000. - 528 p. 8. Moskalenko, V. V. Automated electric drive Textbook V. V. Moskalenko. - M .: Energoatomizdat, 1986. - 416 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO2, LO5

Planned learning activities and teaching methods
individual work, group work, case study

Assessment methods and criteria
Project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO2: Apply the basic physical and mathematical laws of the functioning of mechatronic complexes and their elements. Use methods of synthesis and research of intelligent control systems, modern scientific methodology, new research methods. Use methods of mathematical modeling of complex mechatronic systems. LO5: Use the basic concepts, definitions, characteristics and classification of controllers, interfaces; system of commands, principles of construction and methods for implementing mechatronic systems based on industrial controllers. Apply the principles of building information systems and their elements, principles of building industrial SCADA-systems.	1. Demonstrate knowledge about modern scientific methodology, new research methods. 2. Demonstrate ability to change the scientific and industrial production profile of professional activity. 3. Demonstrate ability to change the socio-cultural and social conditions of activity. 4. Demonstrate knowledge about the basics of creating mechatronic and robotic systems, their subsystems and individual modules. 5. Possess the skills to prepare a feasibility study of projects.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.

Description of individual educational component (module)	
Производственная практика (научно-исследовательская работа) Intership *(research work)*	
Магистратура *Master of Sciens*	
CU17	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3d semester
Number of ECTS credits allocated	10
Total hours	360
Contact hours	64
Self-study hours	296
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	None
Course contents	The purpose of this intership is to familiarize with the profile industrial and engineering enterprises of the region, to form the professional position of the future specialist, his motivation for professional and personal self-improvement, general familiarization of students with the equipment of industrial enterprises, its operation and maintenance conditions of modern enterprises of the industry. The main attention is paid to the study of the main components and mechanisms of technological equipment, automation systems of the technological process; the use of tools, templates, instruments for setting up and adjusting equipment components and process control systems, equipment operating conditions, modes of its operation, production organization and machine repair. A student visits a workshop or a site in an enterprise, where they get acquainted with a workplace, equipment, and technological process. With the help of a consultant from the enterprise, he studies equipment and technology according to an individual assignment. Collects material for further work on coursework and final qualifying work. Based on materials collected in practice, prepares a report that protects the assessment.
Recommended or required reading and other learning resources/tools	1. Kapustin, N. M. Automation of mechanical engineering Textbook. for universities in the areas of "Technology, equipment and automation of machine-building. Ave.", "Automation and Control." N. M. Kapustin, N. P. D'yakonov, P. M. Kuznetsov; Ed. N. M. Kapustin. - M .: Higher School, 2002. - 222 p. 2. Automation of production processes in the machine-building. Training. for universities in the areas of preparation of bachelors and masters "Technology, equipment and automation of the Mashinostr. Ave." and diploma. specialists "Designer.-technol. software engineering. pr-in" and "Automation. technology and pr-va" N. M. Kapustin, P. M. Kuznetsov, A. G. Shirtladze and others; Ed. N. M. Kapustin. - M .: Higher School, 2004. - 414p. 3. Belov, M.P. Automated electric drive of typical production mechanisms and technological complexes Manual. for universities in the specialty "Electric drive and automation of industrial installations and technological complexes" M. P. Belov, V. A. Novikov, L. N. Rassudov. - 2nd ed., Sr. - M .: Academy, 2004. - 574, [1] p. 4. Krasovsky, GI. Planning an experiment. - Minsk: The Belarusian State University, 1982. - 302 p. 5. Bashta, T. M. Hydraulic drive and hydropneumatic automation Training. for the specialty "Hydropneumatics and hydraulic actuators" T. M. Basta.

	- M .: Mashinostroenie, 1972. - 320 p. 6. Kondakov, L. A. Mashinostroitelnyy hydraulic actuator Ed. V. N. Prokofiev. - M .: Mashinostroenie, 1978. - 495 p. 7. Voronenko, V.P. Machine-Building Production. Textbook. for nouns special studies. institutions V. P. Voronenko, A. G. Skhirtladze, V. N. Bryukhanov; Ed. Yu. M. Solomentsev. - Moscow: High School: Academy, 2001 8. Frantsenyuk, I. V. Modern metallurgical production I. V. Frantsenyuk, L. I. Frantsenyuk. - 2nd ed. - M .: Moscow, 2000. - 528 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO2

Planned learning activities and teaching methods
individual work, group work, case study

Assessment methods and criteria
Project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO2: Apply the basic physical and mathematical laws of the functioning of mechatronic complexes and their elements. Use methods of synthesis and research of intelligent control systems, modern scientific methodology, new research methods. Use methods of mathematical modeling of complex mechatronic systems.	1. Demonstrate knowledge about methods of conducting a literary review of modern achievements in the studied area using modern information and communication technologies; principles of analysis of modern achievements and the identification of scientific problems in the studied area, as well as in interdisciplinary areas using modern information and communication technologies. 2. Demonstrate ability to conduct a literary review of modern achievements in the studied area using modern information and communication technologies; analyze current achievements and identify scientific problems in the studied area, as well as in interdisciplinary areas using modern information and communication technologies. 3. Demonstrate ability to independently analyze current achievements and identify scientific problems in the area under study; skills of organizing scientific work, assessing the scientific activities of researchers, analyzing their level of knowledge.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.

Description of individual educational component (module)	
Преддипломная практика Undergraduate practice	
Магистратура *Master of Sciens*	
CU18	
Organisation	South Ural State University
Faculty	Mechanical and Technology Faculty
Department	Mechatronics and Automation
Responsible person	Professor A. Radionov
Type of course unit	Compulsory elective
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	4th semester
Number of ECTS credits allocated	24
Total hours	864
Contact hours	64
Self-study hours	800
Mode of delivery	Face-to-face
Maximum attendance	15
Name of lecturer(s)	Dr. V. Gasiyarov
Prerequisites and co-requisites	None
Course contents	The implementation of the program of undergraduate practice ensures the verification of theoretical knowledge obtained during the period of study at the university, their expansion, and also contributes to the consolidation of the practical skills acquired by students during the course of undergraduate practice. A student visits a shop or site at an enterprise, studies the main process equipment of the ACS, automation systems, and process control algorithms. Collects material for further work on final qualification work. Based on materials collected in practice, prepares a report that protects the assessment.
Recommended or required reading and other learning resources/tools	1. Kapustin, N. M. Automation of mechanical engineering Textbook. for universities in the areas of "Technology, equipment and automation of machine-building. pr-in", "Automation and Control." N. M. Kapustin, N. P. D'yakonov, P. M. Kuznetsov; Ed. N. M. Kapustin. - M .: Higher School, 2002. - 222, [1] p. 2. Automation of production processes in machine building Textbook. for universities in the areas of preparation of bachelors and masters "Technology, equipment and automation of machine building. pr-in" and diploma. specialists "Design-tor.-tekhnol. software engineering. pr-in" and "Automat-zir. technology and pr-va" N. M. Kapustin, P. M. Kuznetsov, A. G. Shirtladze and others; Ed. N. M. Kapustin. - M .: Higher School, 2004. - 414, [1] p. 3. Belov, M. p. Automated electric drive of standard production mechanisms and technological complexes, Textbook. for universities in the specialty "Electro-water and automation of industrial plants and technological complexes" M. P. Belov, V. A. Novikov, L. N. Rassudov. - 2nd ed., Sr. - M .: Academy, 2004. - 574, [1] p. 4. Krasovsky, GI. Planning an experiment. - Minsk: Publishing house BSU, 1982. - 302 p. 5. Bashta, T. M. Hydraulic drive and hydropneumatic automation Proc. for the specialty "Hydropneumatics and hydro-drive" T. M. Basta. - M .: Mashinostroenie, 1972. - 320 p. 6. Kondakov, L. A. Mashinostroitelnyi hydraulic actuator Ed. V. N. Prokofiev. - M .: Mashinostroenie, 1978. - 495 p.
Language of instruction	Russian, English

Learning outcomes of the course unit
LO3

Planned learning activities and teaching methods
individual work, group work, case study

Assessment methods and criteria
Project work. For assessment criteria please, see **table** "**Assessment criteria table" below**

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
LO3: Use methods of application of intelligent systems in the field of building control systems for mechatronic and robotic devices in agromechatronics. Design and implement intellectual control system according to specified criteria of functioning. Possess the skills of designing information systems and their elements; skills of organization, management and communication with colleagues in the implementation of production and research activities.	1. Demonstrate knowledge about the main features of the implementation of the results of research carried out individually and as part of the group of executors and ensuring the protection of rights to objects of intellectual property. 2. Demonstrate ability to prepare documentation for the implementation of the results of research carried out individually and as part of a group of performers; to assess the protection of intellectual property rights. 3. Demonstrate ability the main features of the implementation of the results of research carried out individually and as part of a group of performers and ensuring the protection of rights to intellectual property. 4. Possess the skills to skills of organization, management and communication with colleagues in the implementation of production and research activities.

Assessment criteria table				
Type of assessment	**5 (Excellent)**	**4 (Good)**	**3 (Satisfactory)**	**2 / Insufficient**
Project work	The content of the work was at high standard. The literature library assembled by the student was outstanding with no serious missing articles. The style and clarity of the report was excellent.	The content of the work was a high standard but with some weaknesses regarding evidence. The literature library assembled by the student was very good with only a few missing key articles. The style and/or clarity of the report were very good.	The content of the work was of a good standard but with several weaknesses regarding evidence and/or some lack of clarity. The literature library assembled had a number of missing key articles and lacked breadth. The style and/or clarity of the report were good.	The content of the work fell short of that required to pass due to lack of evidence base/or very poor clarity. The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade. The style and/or clarity of the report fell short of a passing grade.