ANNEX 5

Module Reference Book

Radio Engineering, Electronics and Telecommunications (Ma)

Table of Contents

Module Name:	**Module 1: Basics of Scientific and Research World View**
Code	M1REET(Ma)
Module Elements:	*Compulsory Subjects* Foreign Language (Professional) History and Philosophy of Science
Semester Number:	1
Person responsible for the module	O.M. Vasilyeva
Lecturer:	Foreign Language (Professional) - O.M. Vasilyeva History and Philosophy of Science - A.V. Nikiforov
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	1 semester: hours per week – 12 (lectures -1; workshops -3; independent work -8); hours per semester – 180.
Workload:	Teaching Load: 60 hours Extracurricular Classes: 120 hours Total: 180 hours
Credit Points:	6 ECTS
Conditions for Examinations:	For admission to the exam, the student must score at least 50 points out of 100 available for the subject
Recommended Conditions:	This module is based on the knowledge gained by students in previous undergraduate subjects of Philosophy and Foreign Language.
Expected Learning Outcomes:	**Know:** main philosophical trends in the development of technology and technical areas; technical foreign language in the field of electronics. **Be able to:** monitor trends in the influence of technical devices on human activity on the basis of modern philosophical works in the field of technology; work with technical documents and scientific works in a foreign language. **Possess the skills:** work with papers of philosophical technical nature and scientific works in a foreign language for research activities. **Demonstrate the ability to:** conduct research activities, based on the experience of foreign scientific works including those in the field of philosophy of technology
Intendend use/applicability	Module: Final Academic Assessment
Content:	*Foreign Language* Describing professional competence; personal and professional challenges; professional image of contemporary electric engineers; the importance to be skilled; decision-making process; business meetings and correspondence. Grammar review. Listening and speaking. Modal auxiliary verbs. *History and Philosophy of Science* Science in culture and civilization Origin of science. Main stages of the historical development of science. Science in Antiquity and the Middle Ages. Modern science. Classical science and its features. Features of non-classical science period. Post-non-classical science. Structure of scientific knowledge. Laws of development of science. Concepts of K. Popper, T. Kuhn, I. Lakatos and P. Feyerabend. Science as a social institution. Philosophical problems of natural sciences. Philosophical problems of social and humanitarian sciences.
Examination Form, module mark:	*Foreign Language (Professional)* – computer-based testing; *History and Philosophy of Science* – written control examination. Module mark: the result of the exam *History and Philosophy of*

	Science
Technical/Multimedia Facilities:	Multimedia system
Study Materials:	1. Vocabulary: - Social and Domestic Communication: Family in modern society, Housing and accommodation; - Social and Cultural Communication: Kazakhstan, Country studies (English speaking countries: culture, geography, economy), Leisure, Traveling; - Educational and Professional Communication: Education, My University, Jobs and Professions, My future profession, Professional competence, Advantages and disadvantages of different professions; - Social and Cultural Communication: Health and Healthy Life Style, Law, Human Rights, Environment and environmental problems, Mass Media 2. Grammar: - Tenses (Present, Past, Future – Simple, Continuous, Perfect); - Conditional sentences; - Reflexive, Possessive and Relative Pronouns; - The passive Voice; - Modal verbs (might, could, might, can); - Reported Speech; - Connectors (although, however,thus…); - Quantifiers (a few, a little etc.); - Adverbs of frequency; - Degrees of comparison (adjectives and adverbs) 3.D.E. Zemach, L.A.Rumisek. Academic Writing. MacMillan Press, 2006. 2.Key Concepts in Information and Communication Technology (Palgrave) by Roger I. Cartwright.3.Holy Roddick Business Writing Makeovers, AST, Astrel, 2004. 4. P. V. Alekseyev, A.V. Panin. Philosophy: Textbook. M.: Prospect, 2003 5. V. D. Gubin. Philosophy: Textbook. M.: Omega, 2006 6. A. G. Spirkin. Philosophy: Textbook. M.: Gardariki, 2004 7. Philosophy: Textbook/Comp. T. H. Gabitov, Almaty, 2003.
Date of last amendment	20.01.2023

Module Name:	**Module 2: Psychological and Pedagogical Education**
Code	M2EPE(Ma)
Module Elements:	*Compulsory Subjects* Psychology Pedagogics Methods of teaching technical disciplines in higher education
Semester Number:	1, 2
Person responsible for the module	*G.I. Chemodanova*
Lecturer:	Psychology – *L.A. Bogunov* Pedagogics - *G.I. Chemodanova* Methods of teaching technical disciplines in higher education- E.V.Kuharenko
Language:	Russian, Kazakh
Curriculum relation:	Electrical Power Engineering (Ma)
Type of teaching / number of hours per week and per semester :	1 semester: hours per week – 12 (lectures -2; workshops -2; independent work -8); hours per semester – 180. 2 semester: hours per week – 6 (lectures -1; workshops -1; independent work -4); hours per semester – 90.
Workload:	Teaching Load: 90 hours Extracurricular Classes: 180 hours Total: 270 hours
Credit Points:	9 ECTS
Conditions for Examinations:	For admission to the exam, the student must score at least 50 points out of 100 available for each subject of the module
Recommended Conditions:	This module is based on the knowledge obtained from the previous module of the bachelor degree: Social and Humanitarian Knowledge
Expected Learning Outcomes:	**Know:** social and psychological nature of pedagogical activity; properties of mental and cognitive processes included in cognitive activity; content and specifics of psychological and pedagogical influence; psychology of cognitive activity of students in the learning process; main directions and trends of higher education development; general problems of higher school pedagogy, methodological and theoretical bases of higher school pedagogy; **Be able to:** apply psychological methods and means to improve the effectiveness and quality of training; **Possess the skills:** professional communication and intercultural communication; **Demonstrate the ability to:** apply psychological methods and means to improve the effectiveness and quality of training; a holistic view of the factors and laws of the pedagogical process of higher education. build and implement promising lines of intellectual, cultural, moral, physical and professional self-development and self-improvement; follow ethical and legal standards; social adaptation.
Intendend use/applicability	Module: Teaching Practice
Content:	*Psychology* Education as a global object of the psychology of the higher school. Psychological education in high school. Psychological structure of the learning process. Psychology of cognitive activity. Psychological methods and means of improving the efficiency and quality of education in modern conditions. Psychology of

	personality and student group. Problems of education in high school Education and formation of professional consciousness. Psychodiagnostics in high school. Psychological characteristics of pedagogical activity of the teacher of higher school. Management of the learning process. Student as a subject of educational activities. Psychological and pedagogical communication. Psychology of pedagogical influence. The main psychological problems in teaching. *Pedagogics* Main directions and trends of higher education in Kazakhstan. The concept of continuous pedagogical education of the teacher of new formation of the Republic of Kazakhstan. Pedagogical process of higher school. Key competences are the main factor of training competitive specialists. Organization of the learning process in higher education. Forms and methods of teaching in higher school. Educational technology. The concept of pedagogical technology. *Methods of teaching technical disciplines in higher education.* Distance learning technologies. Environments for creating educational materials. Platforms and support tools. Internet multimedia facilities. multimedia projects.
Examination Form, module mark:	Comprehensive examination including: *Psychology* - Written examination *Pedagogics* - Computer-based testing Methods of teaching technical disciplines in higher education - Written examination Module mark: the result of the exam Methods of teaching technical disciplines in higher education
Technical/Multimedia Facilities:	Modern multimedia systems.
Study Materials:	1. L. A. Bogunov Psychology of Training and Education in Higher Education: Textbook. – Petropavlovsk: NKSU named after M. Kozybayev, 2011. – 99 p. 2. V. V. Davydov. Problems of Developmental Education. – M: Publishing center Akademiya, 2004. – 288 p. 3. S. M. Dzhakupov. Psychological Structure of Teaching Process. Almaty: Kazak universitety, 2004. – 311 p. 4. S. M. Dzhakupov. Management of Cognitive Activity of Students in the Teaching Process. Almaty, 2002. – 117 p. 5. I. A. Zimnaya. Pedagogical Psychology. – M.: Logos, 2002. – 384 p. 6. S. D. Smirnov. Pedagogy and Psychology of Higher Education: from Activity to Personality. – M., 2001. – 304 p. 7. Reference Materials in Pedagogical Psychology / ed.-comp. B. R. Mandel. – Rostov-on-Don: Phoenix, 2008. – 384 p. 8. R. L. Hon. Pedagogical Psychology. – M: Academic Project: Culture, 2005. – 376 p. 9. Organization of independent work of students in the conditions of development of distance learning technology / DV Lepeshev. - Omsk: NOU VPO OmGA, 2014. - 112 p. 10. Kleynosova, N.P. Distance learning in the Moodle environment / N.P. Kleynosova, E.A. Kadyrova, I.A. Telkov, O.M. Baskakova, R.V. Khrunichev -, 2011. - 28 p.
Date of last amendment	20.01.2023

Module Name:	**Module 3: Current Problems of Technical Sciences**
Code	M3REET(Ma)
Module Elements:	*Compulsory subjects* Scientific and Technical Problems of Radio Engineering, Electronics and Telecommunications Current State of Radio Engineering, Electronics and Telecommunications
Semester Number:	1, 2
Person responsible for the module	Y.V. Gerasimova
Lecturer:	Scientific and Technical Problems of Radio Engineering, Electronics and Telecommunications – Y.V. Gerasimova Current State of Radio Engineering, Electronics and Telecommunications – *Y.V. Gerasimova*
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	1 semester: hours per week – 6 (lectures -1; workshops -1; independent work -4); hours per semester – 90. 2 semester: hours per week – 10 (lectures -2; workshops -2; independent work -6); hours per semester – 150.
Workload:	Teaching Load: 90 hours Extracurricular Classes: 150 hours Total: 240 hours
Credit Points:	8 ECTS
Conditions for Examinations:	For admission to the exam, the student must score at least 50 points out of 100 available for each subject of the module
Recommended Conditions:	The module is based on the knowledge gained in the course of undergraduate study modules: Digital Control Systems, Radio Engineering Systems.
Expected Learning Outcomes:	**Know:** prospects for the development of modern information transmission systems and telecommunication networks; possible ways of further development of radio-electronic and telecommunication equipment. **Be able to:** solve scientific and technical problems of introduction of communication systems, radio broadcasting, radio systems, television technologies, antenna-feeder, radio transmitting and radio receiving devices. **Possess the skills:** evaluation of complex, computational, design and test methods regarding their importance and effectiveness. **Demonstrate the ability:** in the issue of solving modern problems in the field of electronics and telecommunications.
Intendend use/applicability	Module: Modern Signal Processing and Transmission Systems
Content:	*Scientific and Technical Problems of Radio Engineering, Electronics and Telecommunications.* Modern trends in development of radio and telecommunication systems, scientific and technical problems in the field of radio engineering and electronics, modern methods of measurement in telecommunications. *Current State of Radio Engineering, Electronics and Telecommunications* The discipline is aimed at studying modern trends in the development of telecommunication and radio engineering systems, the possibilities of using new technologies for communication networks, the prospects for the development of electronics and microelectronics, and the problems of

	nanoelectronics.
Examination Form, module mark:	*Scientific and Technical Problems of Radio Engineering, Electronics and Telecommunications*- Computer-based testing *Current State of Radio Engineering, Electronics and Telecommunications* - written examination Module mark: the result of the exam *Current State of Radio Engineering, Electronics and Telecommunications*
Technical/Multimedia Facilities:	Multimedia projector, interactive whiteboard, computers.
Study Materials:	1. B. S. Goldstein, N. A. Sokolov, G. G. Yanovskiy. Communication Networks. –SPb.: BHV-Petersburg, 2010. – 400 p. 2. N. S. Marder. Modern Telecommunications. — M.: IRIAS, 2006. — 384 p. 3. M. S. Nemirovsky, O. A. Shorin, A. I. Babin, A. L. Sartakov. Wireless Technologies from the Last Mile to the Last Inch. – M: Eko-Trends, 2009. – 400 p. 4. V. O. Tikhvinskiy, S. V. Terentyev, A. B. Yurchuk. Networks of LTE Mobile Communication: Technology and Architecture. – M: Eko-Trends, 2010. – 284 p. 5. A. M. Somov, S. F. Kornev. Satellite Communication Systems. –M: Goryachaya liniya-Telekom, 2012, - 244 p. 6. I. V. Shakhnovich. Modern Technologies of Wireless Communication. – M.: Tekhnosfera, 2006, - 288 p. 7. I. Richardson. Video Coding. H.264 and MPEG-4 – New Generation Standards. - M.: Tekhnosfera, 2005, -369 p. 8. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008. 9. V. V. Velichko, G. P. Katunin, V. P. Shuvalov. Basics of Information and Communication Technologies. Textbook for universities. – M: Goryachaya liniya-Telekom, 2009, - 712 p. 10. N.S. Marder. Modern Telecommunications. – M.: IRIAS, 2006. – 384 p.
Date of last amendment	20.01.2023

Module Name:	**Module 4: Scientific Research 1**
Code	M4REET(Ma)
Module Elements:	*Compulsory Subjects* Scientific Research
Semester Number:	1
Person responsible for the module	V.P. Ivel
Lecturer:	Scientific Research– V.P. Ivel
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	1 semester: hours per week – 14; hours per semester – 210. Scientific Research – 210 hours.
Workload:	Extracurricular Classes: 210 hours. Total:210 hours
Credit Points:	7 ECTS
Conditions for Examinations:	For admission to the report defense, the master's student must score at least 50 points out of 100 available for scientific research
Recommended Conditions:	-
Expected Learning Outcomes:	**Know:** main methods of optimization and control of radio-electronic and telecommunication systems; basics of logic and technology of research; modern control systems of radio systems; the introduction of intelligent technologies. **Be able to:** plan and conduct experiments in radio engineering and telecommunication networks and systems. **Possess the skills:** logical and analytical thinking in solving problems and their proper documentation; use of modern systems of processing and data collection during the technical experiment; mathematical modeling in the study of electronic and telecommunication systems. **Demonstrate the ability to:** set experiment in devices and systems of radio engineering, electronics and telecommunications; design of digital control systems.
Intendend use/applicability	Modules: Scientific Research 2, Final Academic Assessment
Content:	*Scientific Research 1* Formulation of the goals and objectives of the study. Generalization of the scientific problem. Proposed methods for its solution. Analysis of scientific papers on the subject of research. Synthesis of the methodology for solving the problem.
Examination Form, module mark:	*Scientific Research 1* – scientific research report defense
Technical/Multimedia Facilities:	Control and measuring equipment and devices of specialized laboratories, as well as modern multimedia systems.
Study Materials:	1. Scientific and Technical Text: Rules of Performance and Registration / T. Y. Teplitskaya. - Rostov-on-don : Phoenix, 2007. 2. Rules of Performance of Test Documents in Educational Process: Methodical Instructions on Registration of Abstracts, Standard Calculations, Term Papers for Students of Engineering Specialties – Petropavlovsk, 2002. 3. V. Y. Shishmarev. Units and Elements of Automatic Control Systems. - M: Akademiya, 2005. 4. L. A. Stankevich. Intelligent Systems and Technologies. Textbook and Practical Course for Undergraduate and Graduate Programs. M.: Yurayt, 2016. 5. V. A. Vorona, V. A. Tikhonov. Access Control and

	Management Systems. M.: Goryachaya liniya Telekom, 2013 6. E. F. Khamadulin. Methods and Means of Measurements in Telecommunication Systems. M.: Yurayt, 2014. 7. Y. M. Kelim. Typical Elements of Automatic Control Systems. M., INFRA-M, 2004. 8. V. V. Velichko, G. P. Katunin, V. P. Shuvalov. Basics of Information and Communication Technologies. Textbook for universities. – M: Goryachaya liniya-Telekom, 2009, - 712 p. 9. I. V. Shakhnovich Modern Technologies of Wireless Communication. – M.: Tekhnosfera, 2006, - 288 p. 10. V. I. Nefedov. Basics of Radio Electronics and Communication.- M: Vysshaya shkola, 2009. 11. Digital and Analog Transmission Systems/Ed. V. I. Ivanov.- M.: Goryachaya liniya - Telekom, 2005 12. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008 13. Advanced Telecommunication Technologies. Potential Opportunities/ ed. by L. D. Reiman.- M.,2001 14. B. Sklyar. Digital Communication. Theoretical Basics and Practical Application. Translated from English.- M.: Publishing House Williams, 2003. 15. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001.
Date of last amendment	20.01.2023

Module Name:	**Module 5: Scientific Research 2**
Code	M5REET(Ma)
Module Elements:	*Compulsory Subjects* Scientific Research
Semester Number:	2
Person responsible for the module	V.P. Ivel
Lecturer:	Scientific Research– V.P. Ivel
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	2 semester: hours per week – 14; hours per semester – 210. Scientific Research – 210 hours.
Workload:	Extracurricular Classes: 210 hours. Total:210 hours
Credit Points:	7 ECTS
Conditions for Examinations:	For admission to the report defense, the master's student must score at least 50 points out of 100 available for scientific research
Recommended Conditions:	Module: Scientific Research 1, Organizing of Scientific Research
Expected Learning Outcomes:	**Know:** main methods of optimization and control of radio-electronic and telecommunication systems; basics of logic and technology of research; modern control systems of radio systems; the introduction of intelligent technologies. **Be able to:** plan and conduct experiments in radio engineering and telecommunication networks and systems. **Possess the skills:** logical and analytical thinking in solving problems and their proper documentation; use of modern systems of processing and data collection during the technical experiment; mathematical modeling in the study of electronic and telecommunication systems. **Demonstrate the ability to:** set experiment in devices and systems of radio engineering, electronics and telecommunications; design of digital control systems.
Intendend use/applicability	Modules: Scientific Research 3, Final Academic Assessment
Content:	*Scientific Research 2* Formation of research base for the solution of scientific problems. Creation of a methodology for sequential decision problems. Carrying out the initial experiment. Confirmation of the hypothesis. Correction of scientific experiment.
Examination Form, module mark:	*Scientific Research 2* – scientific research report defense
Technical/Multimedia Facilities:	Control and measuring equipment and devices of specialized laboratories, as well as modern multimedia systems.
Study Materials:	16. Scientific and Technical Text: Rules of Performance and Registration / T. Y. Teplitskaya. - Rostov-on-don : Phoenix, 2007. 17. Rules of Performance of Test Documents in Educational Process: Methodical Instructions on Registration of Abstracts, Standard Calculations, Term Papers for Students of Engineering Specialties – Petropavlovsk, 2002. 18. V. Y. Shishmarev. Units and Elements of Automatic Control Systems. - M: Akademiya, 2005. 19. L. A. Stankevich. Intelligent Systems and Technologies. Textbook and Practical Course for Undergraduate and Graduate Programs. M.: Yurayt, 2016. 20. V. A. Vorona, V. A. Tikhonov. Access Control and

	Management Systems. M.: Goryachaya liniya Telekom, 2013 21. E. F. Khamadulin. Methods and Means of Measurements in Telecommunication Systems. M.: Yurayt, 2014. 22. Y. M. Kelim. Typical Elements of Automatic Control Systems. M., INFRA-M, 2004. 23. V. V. Velichko, G. P. Katunin, V. P. Shuvalov. Basics of Information and Communication Technologies. Textbook for universities. – M: Goryachaya liniya-Telekom, 2009, - 712 p. 24. I. V. Shakhnovich Modern Technologies of Wireless Communication. – M.: Tekhnosfera, 2006, - 288 p. 25. V. I. Nefedov. Basics of Radio Electronics and Communication.- M: Vysshaya shkola, 2009. 26. Digital and Analog Transmission Systems/Ed. V. I. Ivanov.- M.: Goryachaya liniya - Telekom, 2005 27. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008 28. Advanced Telecommunication Technologies. Potential Opportunities/ ed. by L. D. Reiman.- M.,2001 29. B. Sklyar. Digital Communication. Theoretical Basics and Practical Application. Translated from English.- M.: Publishing House Williams, 2003. 30. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001.
Date of last amendment	20.01.2023

Module Name:	**Module 6: Scientific Research 3**
Code	M6REET(Ma)
Module Elements:	*Compulsory Subjects* Scientific Research
Semester Number:	3
Person responsible for the module	V.P. Ivel
Lecturer:	*Scientific Research*– V.P. Ivel
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	3 semester: hours per week – 14; hours per semester – 210. Scientific Research – 210 hours.
Workload:	Extracurricular Classes: 210 hours. Total:210 hours
Credit Points:	7 ECTS
Conditions for Examinations:	For admission to the report defense, the master's student must score at least 50 points out of 100 available for scientific research
Recommended Conditions:	Module: Scientific Research 2, Organizing of Scientific Research
Expected Learning Outcomes:	**Know:** main methods of optimization and control of radio-electronic and telecommunication systems; basics of logic and technology of research; modern control systems of radio systems; the introduction of intelligent technologies. **Be able to:** plan and conduct experiments in radio engineering and telecommunication networks and systems. **Possess the skills:** logical and analytical thinking in solving problems and their proper documentation; use of modern systems of processing and data collection during the technical experiment; mathematical modeling in the study of electronic and telecommunication systems. **Demonstrate the ability to:** set experiment in devices and systems of radio engineering, electronics and telecommunications; design of digital control systems.
Intendend use/applicability	Modules: Scientific Research 4, Final Academic Assessment
Content:	*Scientific Research 3* Conducting a secondary experiment. Verification of compliance of the obtained data with the objectives of the study. Simulation based on an adjusted methodology of the study. Preparation of scientific publications on the basis of experiments. The final adjustment of the methods of solving the scientific problem.
Examination Form, module mark:	*Scientific Research 3* – scientific research report defense
Technical/Multimedia Facilities:	Control and measuring equipment and devices of specialized laboratories, as well as modern multimedia systems.
Study Materials:	1. Scientific and Technical Text: Rules of Performance and Registration / T. Y. Teplitskaya. - Rostov-on-don: Phoenix, 2007. 2. Rules of Performance of Test Documents in Educational Process: Methodical Instructions on Registration of Abstracts, Standard Calculations, Term Papers for Students of Engineering Specialties – Petropavlovsk, 2002. 3. V. Y. Shishmarev. Units and Elements of Automatic Control Systems. - M: Akademiya, 2005. 4. L. A. Stankevich. Intelligent Systems and Technologies.

	Textbook and Practical Course for Undergraduate and Graduate Programs. M.: Yurayt, 2016. 5. V. A. Vorona, V. A. Tikhonov. Access Control and Management Systems. M.: Goryachaya liniya Telekom, 2013 6. E. F. Khamadulin. Methods and Means of Measurements in Telecommunication Systems. M.: Yurayt, 2014. 7. Y. M. Kelim. Typical Elements of Automatic Control Systems. M., INFRA-M, 2004. 8. V. V. Velichko, G. P. Katunin, V. P. Shuvalov. Basics of Information and Communication Technologies. Textbook for universities. – M: Goryachaya liniya-Telekom, 2009, - 712 p. 9. I. V. Shakhnovich Modern Technologies of Wireless Communication. – M.: Tekhnosfera, 2006, - 288 p. 10. V. I. Nefedov. Basics of Radio Electronics and Communication.- M: Vysshaya shkola, 2009. 11. Digital and Analog Transmission Systems/Ed. V. I. Ivanov.- M.: Goryachaya liniya - Telekom, 2005 12. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008 13. Advanced Telecommunication Technologies. Potential Opportunities/ ed. by L. D. Reiman.- M.,2001 14. B. Sklyar. Digital Communication. Theoretical Basics and Practical Application. Translated from English.- M.: Publishing House Williams, 2003. 15. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001.
Date of last amendment	20.01.2023

Module Name:	**Module 7: Teaching Practice**
Code	M7REET(Ma)
Module Elements:	*Compulsory Subjects* Teaching Practice
Semester Number:	3
Person responsible for the module	V.P. Ivel
Lecturer:	Teaching Practice – V.P. Ivel
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	3 semester: hours per week –6; hours per semester – 90. Teaching Practice – 90 hours.
Workload:	Extracurricular Classes: 90 hours. Total:90 hours
Credit Points:	3 ECTS
Conditions for Examinations:	For admission to the report defense, the master's student must score at least 50 points out of 100 available for teaching practice.
Recommended Conditions:	Module: Psychological and Pedagogical Education
Expected Learning Outcomes:	**Know:** methods and techniques of teaching activities, including those of innovative nature. **Be able to:** apply knowledge of pedagogy and psychology of higher education in teaching activities; apply interactive teaching methods; critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena; integrate knowledge gained in different subjects to solve research problems in new unfamiliar conditions. **Possess the skills:** implementation of educational and pedagogical activity on credit technology of training; methods of teaching professional disciplines; use of modern information technologies in the educational process; professional communication and intercultural communication; public speaking, correct and logical design of one's own thoughts in oral and written form. **Demonstrate the ability to:** implementation of educational activities, including those of innovative nature.
Intendend use/applicability	Module: Final Academic Assessment
Content:	*Teaching Practice* Introduction to scientific and pedagogical activity. Implementation of pedagogical activity. Familiarization with the material technical base. Work with regulatory documents.
Examination Form, module mark:	*Teaching Practice* – Practice report defense
Technical/Multimedia Facilities:	Control and measuring equipment and devices of specialized laboratories.
Study Materials:	1. Scientific and Technical Text: Rules of Performance and Registration / T. Y. Teplitskaya. - Rostov-on-don : Phoenix, 2007. 2. Rules of Performance of Test Documents in Educational Process: Methodical Instructions on Registration of Abstracts, Standard Calculations, Term Papers for Students of Engineering Specialties – Petropavlovsk, 2002. 3. Edited by A. A. Okin, Technical Operation of Electric Power Plants and Networks, M, 2001

	4. V. V. Davydov. Problems of Developmental Education. – M: Publishing center Akademiya, 2004. – 288 p. 5. S. M. Dzhakupov. Psychological Structure of Teaching Process. Almaty: Kazak universitety, 2004. – 311 p. 6. S. M. Dzhakupov. Management of Cognitive Activity of Students in the Teaching Process. Almaty, 2002. – 117 p. 7. I.A. Zimnaya. Pedagogical Psychology. – M.: Logos, 2002. – 384 p. 8. S. D. Smirnov. Pedagogy and Psychology of Higher Education: from Activity to Personality. – M., 2001. – 304 p.
Date of last amendment	20.01.2023

Module Name:	**Module 8: Scientific Research 4**
Code	M8REET(Ma)
Module Elements:	*Compulsory Subjects* Scientific Research
Semester Number:	4
Person responsible for the module	V.P. Ivel
Lecturer:	Scientific Research – V.P. Ivel
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	4 semester: hours per week – 14; hours per semester – 210. Scientific Research – 210 hours.
Workload:	Extracurricular Classes: 210 hours. Total: 210 hours
Credit Points:	7 ECTS
Conditions for Examinations:	For admission to the report defense, the master's student must score at least 50 points out of 100 available for scientific research
Recommended Conditions:	Modules: Scientific Research 3, Organizing of Scientific Research
Expected Learning Outcomes:	**Know:** main methods of optimization and control of radio-electronic and telecommunication systems; basics of logic and technology of research; modern control systems of radio systems; the introduction of intelligent technologies. **Be able to:** plan and conduct experiments in radio engineering and telecommunication networks and systems. **Possess the skills:** logical and analytical thinking in solving problems and their proper documentation; use of modern systems of processing and data collection during the technical experiment; mathematical modeling in the study of electronic and telecommunication systems. **Demonstrate the ability to:** set experiment in devices and systems of radio engineering, electronics and telecommunications; design of digital control systems.
Intendend use/applicability	Module: Final Academic Assessment
Content:	*Scientific Research 4* Description and structuring of the final methodology of the scientific experiment on the scientific problem. Generalizations of adjusted models. Publication of the results of the study. Formalization of scientific research in a logical structure.
Examination Form, module mark:	*Scientific Research 4* – Scientific Research Report Defense
Technical/Multimedia Facilities:	Control and measuring equipment and devices of specialized laboratories, as well as modern multimedia systems.
Study Materials:	1. Scientific and Technical Text: Rules of Performance and Registration / T. Y. Teplitskaya. - Rostov-on-don : Phoenix, 2007. 2. Rules of Performance of Test Documents in Educational Process: Methodical Instructions on Registration of Abstracts, Standard Calculations, Term Papers for Students of Engineering Specialties – Petropavlovsk, 2002. 3. V. Y. Shishmarev. Units and Elements of Automatic Control Systems. - M: Akademiya, 2005. 4. L. A. Stankevich. Intelligent Systems and Technologies. Textbook and Practical Course for Undergraduate and Graduate Programs. M.: Yurayt, 2016.

	5. V. A. Vorona, V. A. Tikhonov. Access Control and Management Systems. M.: Goryachaya liniya Telekom, 2013 6. E. F. Khamadulin. Methods and Means of Measurements in Telecommunication Systems. M.: Yurayt, 2014. 7. Y. M. Kelim. Typical Elements of Automatic Control Systems. M., INFRA-M, 2004. 8. V. V. Velichko, G. P. Katunin, V. P. Shuvalov. Basics of Information and Communication Technologies. Textbook for universities. – M: Goryachaya liniya-Telekom, 2009, - 712 p. 9. I. V. Shakhnovich Modern Technologies of Wireless Communication. – M.: Tekhnosfera, 2006, - 288 p. 10. V. I. Nefedov. Basics of Radio Electronics and Communication.- M: Vysshaya shkola, 2009. 11. Digital and Analog Transmission Systems/Ed. V. I. Ivanov.- M.: Goryachaya liniya - Telekom, 2005 12. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008 13. Advanced Telecommunication Technologies. Potential Opportunities/ ed. by L. D. Reiman.- M.,2001 14. B. Sklyar. Digital Communication. Theoretical Basics and Practical Application. Translated from English.- M.: Publishing House Williams, 2003. 15. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001.
Date of last amendment	20.01.2023

Module Name:	**Module 9: Research Scientific Training**
Code	M9REET(Ma)
Module Elements:	*Compulsory Subjects* Research Scientific Training
Semester Number:	4
Person responsible for the module	V.P. Ivel
Lecturer:	Research Scientific Training – V.P. Ivel
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	4 semester: hours per week – 16; hours per semester – 240. Research Scientific Training – 240 hours.
Workload:	Extracurricular Classes: 240 hours. Total: 240 hours
Credit Points:	8 ECTS
Conditions for Examinations:	For admission to the report defense, the master's student must score at least 50 points out of 100 available for the training
Recommended Conditions:	Completion of theoretical training on the degree programme
Expected Learning Outcomes:	**Know:** conditions of creation and operation of systems, processes and equipment in different areas of radio electronics and telecommunications systems. **Be able to:** plan and conduct research/experimental research activities in the specialty. **Possess the skills:** professional implementation of research and management activities. **Demonstrate the ability to:** conduct research activities in the field of electronics and telecommunications.
Intendend use/applicability	Module: Final Academic Assessment
Content:	*Research Scientific Training* Studying the material technical base. Work with regulatory documents. Collection of materials on the research topic. Organization of work on the development and creation of electronic devices and systems. Processing of the collected material on the research topic.
Examination Form, module mark:	*Research Scientific Training* – Training report defense
Technical/Multimedia Facilities:	Control and measuring equipment, electrical tools, instruments and systems of specialized laboratories, as well as modern multimedia systems.
Study Materials:	1. I. N. Kuznetsov. Scientific Research: Methods and Design. – M: Publishing and Trading Corporation Dashkov i K^0, 2008. 2. I. S. Kozlova. Reference Book of Radio Engineering / I. S. Kozlova, Y. V. Shcherbakova. – Rostov-on-Don: Phoenix, 2008. 3. , V. Y. Galchuk, A. P. Solovyev. Techniques of a Scientific Experiment. – L. Sudostroyeniye, 2002. 4. Reference Book of Digital Information Processing Devices/ N. A. Vinogradov, V. N. Yakovlev, V. V. Voskresenskiy et al. – - K.: Tekhnika, 2003. 5. B. V. Dvoryashin. Metrology and Radio Measurements. – M.: Akademiya, 2005. 6. Metrology and Radio Measurements: Textbook for higher educational institutions under the editorship of V. I. Nefedov. - M.: Vysshaya shkola, 2006. 7. Metrology and Radio Measurements: Collection of tasks under the editorship of V. L. Skachkov. – M: MPEI, 2010.
Date of last amendment	20.01.2023

Module Name:	**Module 10: Final Academic Assessment**
Code	M10REET(Ma)
Module Elements:	*Compulsory Subjects* Comprehensive examination Development and Defense of Master's Thesis
Semester Number:	4
Person responsible for the module	*K.T. Koshekov*
Lecturer:	Comprehensive examination - *K.T. Koshekov* Development and Defense of Master's Thesis - *K.T. Koshekov*
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	8 semester: hours per semester – 450.
Workload:	Extracurricular Classes: 450 hours. Total: 450 hours
Credit Points:	15 ECTS
Conditions for Examinations:	Completion of the degree programme.
Recommended Conditions:	Successful completion of all previous master's degree modules.
Expected Learning Outcomes:	**Know:** the basic requirements for the content and rules of the thesis. **Be able to:** integrate the knowledge gained in different subjects, use them to solve analytical and management problems in new unfamiliar conditions; summarize the results of research and analytical work in the form of a thesis, scientific article, report, analytical note, etc. **Possess the skills** of public speaking, correct and logical design of one's thoughts in oral and written form. **Demonstrate the ability to:** analyze and summarize information, use it to solve problems.
Intendend use/applicability	Professional activity
Content:	*Comprehensive examination* To demonstrate the knowledge and skills gained in the study of the following disciplines: Modern Microcontrollers and Communication Microprocessors, Computer-Aided Design and Basics of CAD, Current State of Radio Engineering, Electronics and Telecommunications, Scientific and Technical Problems of Radio Engineering, Electronics and Telecommunications *Development and Defense of Master's Thesis* An independent scientific research containing theoretical and/or practical developments of an actual problem in the field of the chosen specialty, basing on modern theoretical, methodical and technological achievements of science.
Examination Form, module mark:	*Comprehensive examination* - Oral examination *Development and Defense of Master's Thesis* – Thesis Defense
Technical/Multimedia Facilities:	Control and measuring equipment and devices of specialized laboratories, as well as modern multimedia systems.
Study Materials:	1. Scientific and Technical Text: Rules of Performance and Registration / T. Y. Teplitskaya. - Rostov-on-don : Phoenix, 2007. 2. Rules of Performance of Test Documents in Educational Process: Methodical Instructions on Registration of Abstracts, Standard Calculations, Term Papers for Students of Engineering Specialties – Petropavlovsk, 2002.

	3. V. Y. Shishmarev. Units and Elements of Automatic Control Systems. - M: Akademiya, 2005. 4. L. A. Stankevich. Intelligent Systems and Technologies. Textbook and Practical Course for Undergraduate and Graduate Programs. M.: Yurayt, 2016. 5. V. A. Vorona, V. A. Tikhonov. Access Control and Management Systems. M.: Goryachaya liniya Telekom, 2013 6. E. F. Khamadulin. Methods and Means of Measurements in Telecommunication Systems. M.: Yurayt, 2014. 7. Y. M. Kelim. Typical Elements of Automatic Control Systems. M., INFRA-M, 2004. 8. V. V. Velichko, G. P. Katunin, V. P. Shuvalov. Basics of Information and Communication Technologies. Textbook for universities. – M: Goryachaya liniya-Telekom, 2009, - 712 p. 9. I. V. Shakhnovich Modern Technologies of Wireless Communication. – M.: Tekhnosfera, 2006, - 288 p. 10. V. I. Nefedov. Basics of Radio Electronics and Communication.- M: Vysshaya shkola, 2009. 11. Digital and Analog Transmission Systems/Ed. V. I. Ivanov.- M.: Goryachaya liniya - Telekom, 2005 12. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008 13. Advanced Telecommunication Technologies. Potential Opportunities/ ed. by L. D. Reiman.- M.,2001 14. B. Sklyar. Digital Communication. Theoretical Basics and Practical Application. Translated from English.- M.: Publishing House Williams, 2003. 15. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001.
Date of last amendment	20.01.2023

Module Name:	**Module 11: Organizing of Scientific Research**
Code	M11REET(Ma)
Module Elements:	*Electice Subjects* Research Management Commercialization of Scientific Projects Methods of Organizing of Scientific Research Methods of Organization of Work with Scientific Texts (in Kazakh)
Semester Number:	1
Person responsible for the module	Y.V. Gerasimova
Lecturer:	Research Management - Y.V. Gerasimova Commercialization of Scientific Projects – V.P. Ivel Methods of Organization of Scientific Research – Y.V. Gerasimova Methods of Organization of Work with Scientific Texts (in Kazakh) – S.S. Moldakhmetov
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	1 semester: hours per week – 16 (lectures -3; workshops -3; independent work -10); hours per semester – 240.
Workload:	Teaching Load: 90 hours Extracurricular Classes: 150 hours Total: 240 hours
Credit Points:	8 ECTS
Conditions for Examinations:	For admission to the exam, the student must score at least 50 points out of 100 available for each subject of the module
Recommended Conditions:	The module is based on the knowledge gained in the course of undergraduate study modules: Philosophy, Technologies of Technogenic Risk Management.
Expected Learning Outcomes:	**Know:** modern methodology, methods of scientific research; types of research projects and the basic principles of their management; methods of setting goals and objectives of scientific project research; the legislative framework for the management of science and its organizational structure; methods of obtaining, processing and storage of scientific information; ways of commercialization of objects of intellectual property; possible ways of further development of radioelectronic and telecommunication equipment. **Be able to:** perform the functions of a manager in the management of a scientific project; solve scientific and technical problems of introduction of communication systems, radio broadcasting, radio systems, television technologies, antenna-feeder, radio transmitting and radio receiving devices; systematize domestic and foreign experience in the field of research; apply scientific methods of knowledge in professional activity; creative thinking and creative approach to solving new problems and situations; competently present the results of research and project activities. **Possess the skills:** research, preparation of reports and publications on research topics, development of individual research issues; solving problems related to the management of scientific research; application of new technologies of communication networks; search and analysis of modern scientific and technical information. **Demonstrate the ability:** to scientific activity and to further

	independent management of scientific research; formulate and solve problems arising in the course of research activities; draw up the results of research work in various forms of scientific products; conduct a scientific discussion using the evidence base.
Intendend use/applicability	Modules: Scientific Research 2, Scientific Research 3, Scientific Research 4, Research Scientific Training
Content:	*Research Management* Basic concepts related to research in general, main goals and approaches of scientific research. In addition, the following functions of research management are considered: planning, organization, motivation and control, as well as the legislative framework of science management. *Commercialization of Scientific Projects* Basic concepts related to research in general, main goals and approaches of scientific research. In addition, the following functions of research management are considered: planning, organization, motivation and control, as well as the legislative framework of science management. *Methods of Organization of Scientific Research* Main stages and deadlines of research. Structural elements of the thesis (theme, relevance, problem, contradiction, object, subject, purpose, tasks, hypothesis). Structural elements of the thesis (methods, scientific novelty, theoretical and practical significance). Methodology and methods of scientific research. Experiment as a research method. Statistical research methods (basics). Statistical research methods (research data analysis). Work with scientific literature. Language and style of scientific speech. Publication of research results. The logic of science. Organization of defense of master's thesis. Modern development of science in Kazakhstan. *Methods of Organization of Work with Scientific Texts (in Kazakh)* This discipline is aimed at the formation of skills of writing scientific texts (annotation, reference paper, abstract, report, essay, comment, etc.) and skills of working with scientific literature in the Kazakh language.
Examination Form, module mark:	*Research Managemen* - computer-based testing *Commercialization of Scientific Projects* - written examination *Modern Methods of Measurement in Radio Engineering and Telecommunication Networks* - computer-based testing *Methods of Organization of Work with Scientific Texts (in Kazakh)* - written examination Module mark: written examination *Elective Subject*
Technical/Multimedia Facilities:	Multimedia projector, interactive whiteboard, computers.
Study Materials:	1. A. M. Novikov. Methodology of Scientific Research: Textbook. -M: LIBROKOM, 2010. 280 p. 2. A.V. Pavlov. Logic and Methodology of Science. Modern Humanitarian Knowledge and its Prospects. - M.:Flinta: Nauka, 2010.- 344 p. 3. Law of the Republic of Kazakhstan on Copyright and Related Rights. 4. Law of the Republic of Kazakhstan on Innovations. 5. Patent Law of the Republic of Kazakhstan. 6. Law of the Republic of Kazakhstan on Science". 7. A. Zakharova, T. Zakharova. How to Write and Defend a Thesis. SPb.: Piter, 2007. -160 p.

	8. M. F. Shklyar. Basics of Scientific Research: Textbook .-M: Dashkov i K, 2008.-244 p. 9. A. N. Dzhurinskiy. Development of Education in the Modern World: Textbook.-2nd ed. - M:VLADOS, 2003.-240 p. 10. A. F. Anufriyev, Scientific Study. Course papers, Theses and Dissertations. - 3rd ed.- M. : Os-89, 2007. - 112 p.
Date of last amendment	20.01.2023

Module Name:	**Module 12: Simulation Tools for Radio Engineering Systems**
Code	M12REET(Ma)
Module Elements:	*Electice Subjects* Elements of Artificial Intelligence in Technical Systems System Simulation Databases Systems of Computer Mathematics Visual Simulation Systems Automated Data Collection Systems Modern Methods of Measurement in Radio Engineering and Telecommunication Networks Information Technologies in Radio Engineering and Telecommunications Network Technologies. Computer-Aided Design and Basics of CAD Modern CAD Systems Wavelet Theory Theory of Simulation and Scientific Experiment
Semester Number:	2
Person responsible for the module	Elements of Artificial Intelligence in Technical Systems – Y.V. Gerasimova System Simulation – Y.V. Gerasimova Databases – A.A. Savostin Visual Simulation Systems – V.P. Ivel Automated Data Collection Systems – V.P. Ivel Modern Methods of Measurement in Radio Engineering and Telecommunication Networks - *D.V. Ritter* Information Technologies in Radio Engineering and Telecommunications – Y.V. Gerasimova Network Technologies – D.V. Ritter Computer-Aided Design and Basics of CAD – D.V. Ritter Modern CAD Systems – V.P. Ivel Wavelet Theory – S.S. Moldakhmetov Theory of Simulation and Scientific Experiment – S.S. Moldakhmetov
Lecturer:	Y.V. Gerasimova
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	2 semester: hours per week – 30 (lectures -6; workshops -6; independent work -18); hours per semester – 300.
Workload:	Teaching Load: 180 hours Extracurricular Classes: 270 hours Total: 450 hours
Credit Points:	15 ECTS
Conditions for Examinations:	For admission to the exam, the student must score at least 50 points out of 100 available for each subject of the module
Recommended Conditions:	The module is based on the knowledge gained in the course of undergraduate study module Modern Communication Systems.
Expected Learning Outcomes:	**Know:** theoretical basics of processing and filtering of digital signals; principles of calculation of digital automatic control systems; basics of data collection, processing and analysis on the example of LabVIEW and MATLAB software environments, basics of data collection and processing using automated systems, basics of telecommunication system simulation in MATLAB software environment; methods of experimental and

	computational and theoretical research. **Be able to:** conduct analysis and synthesis of digital systems, to calculate the digital filters and the use of systems for computer mathematics simulation of digital devices and systems; practically apply knowledge for data collection and processing during the research work; enter, analyze and process data sets in software environments; organize research and production work. **Possess the skills:** methodology of digital signal filtering, methods of analysis and synthesis of digital systems; practical implementation of data input-output, processing and analysis of information using I/o interface cards; extension and deepening of knowledge required for everyday professional activity and further education in doctoral studies. **Demonstrate ability:** in construction of digital filters and digital automatic control systems; apply knowledge to research and design automated systems; design and simulation of telecommunication systems in software environments, execution of their analysis.
Intendend use/applicability	Modules: Research Scientific Training, Final Academic Assessment
Content:	*Elements of Artificial Intelligence in Technical Systems* Philosophical aspects of AIS problem. The history of the AIS development. Issues of AIS simulation. Intelligent control. Expert system as a type of AIS. Models of knowledge representation. Models of decisions output and communication in AIS. Fuzzy sets. Fuzzy and linguistic variables. *System Simulation* Basic concepts of simulation theory, current state and general properties of the system simulation. Simulation as a method of scientific knowledge. Principles of system approach in system simulation. Classification of types of systems simulations. Capabilities and efficiency of the simulation systems on a computer. Sensitivity analysis, model identification. Methods for assessing the adequacy and accuracy of models. Automatic and graph models. The concept of Petri networks and features of models based on them. Stochastic networks. Aggregate models. Analytical models of queuing systems. Simulation model. Methods of event and step-by-step time management in simulation models. View of the status in simulation models. Organization of statistical simulation. Pseudo-random number and the procedures of their native generation. Check the quality of the pseudo-random number sequence. Methods of producing random effects, variables, sequences, processes and threads. Features of statistical processing of simulation results. System modeling tools. Planning of machine experiments. *Databases* Main directions and methods used in the field of artificial intelligence both at the stage of analysis and at the stage of development and implementation of intelligent systems. *Visual Simulation Systems* System of computer mathematics MathCAD, system of circuit design Micro-CAP, integrated environment of end-to-end design OrCAD, simulation programs of electric power systems. *Automated Data Collection Systems* Methods of mathematical calculations, simulation, principles of algorithm development, data analysis and visualization in the software environment, the stages of designing electronic systems

	with the help of modern systems of computer mathematics and automated data collection systems. *Modern Methods of Measurement in Radio Engineering and Telecommunication Networks* Features of application of cryptographic methods. Indicators and standards of service quality in secondary telecommunication networks. Properties of the quality of primary networks functioning. Assessment of service quality in IP networks. Implementation of amplitude modulation. Frequency and phase modulation. Pulse modulation methods. Communication channel. Interference in communication channels. Classification of switches of 3rd generations systems. Re-configurable networks. Non-blocking networks. ATM. Switching with minimum-depth of blocked networks. Basics of VoIP. Voice over IP networks. IP telephony networks and scenarios. IP telephony network as recommended by H323. SIP and SIP-t Protocol basics. *Information Technologies in Radio Engineering and Telecommunications* Measurement of physical quantities, time characteristics, data collection systems, signal matching systems, signal connection, digital signal processing, introduction to LabVIEW, creation of virtual instruments and virtual instruments subroutines, cycles and other structures in virtual instruments, arrays, clusters, lines, I/o files, instrumentation control. *Network Technologies* Measurement of physical quantities, time characteristics, data collection systems, signal matching systems, signal connection, digital signal processing, introduction to LabVIEW, creation of virtual instruments and virtual instruments subroutines, cycles and other structures in virtual instruments, arrays, clusters, lines, I/o files, instrumentation control. *Computer-Aided Design and Basics of CAD* Methods of mathematical calculations, simulation, principles of algorithm development, data analysis and visualization in the software environment, the stages of designing electronic systems with the help of modern systems of computer mathematics and automated data collection systems. *Modern CAD Systems* Methods of mathematical calculations, simulation, principles of algorithm development, data analysis and visualization in the software environment, the stages of designing electronic systems with the help of modern systems of computer mathematics and automated data collection systems. Two-dimensional CAD design. *Wavelet Theory* Methods of mathematical calculations, simulation, principles of algorithm development, data analysis and visualization in the software environment, the stages of designing electronic systems with the help of modern computer mathematics and automated data collection systems. *Theory of Simulation and Scientific Experiment* Classification, types and objectives of the experiment, single-factor and multifactorial experiment, experimental technique. Measurement methods, absolute and relative errors, single and multiple measurements. Mathematical statistics, tasks and main sections of mathematical statistics, general and sample population, sampling, sample representativeness, sample parameterization,

	application of built-in Excel tools for statistical data processing. Investigation of experimental data on the reliability and reproducibility of the experimental results.
Examination Form, module mark:	Comprehensive examination of the module including: *Elements of Artificial Intelligence in Technical Systems* - written examination *Databases* - written examination *System Simulation* - written examination *Systems of Computer Mathematics* - Computer-based testing *Visual Simulation Systems* - Computer-based testing *Automated Data Collection Systems* - Computer-based testing *Methods of Organizing of Scientific Research* - written examination *Information Technologies in Radio Engineering and Telecommunications* – written examination; *Network Technologies* – written examination; *Computer-Aided Design and Basics of CAD* – Computer-based testing *Modern CAD Systems* – Computer-based testing *Wavelet Theory* – Computer-based testing *Theory of Simulation and Scientific Experiment* - written examination Module mark: written examination *Elective Subject*
Technical/Multimedia Facilities:	Laboratories of Computer Mathematics and Electronic Simulation, Digital Devices and Microprocessors, NI ELVIS complex, interface boards NIPCI 6621, GPIB, NI Simulator, NI SCXI, coordinator-milling machine ProtoMat S42, hardware platforms of Arduino Nano, Uno, Mega, Duemilanove.
Study Materials:	1. M. P. Tumanov Theory of Management. Theory of Linear Automatic Control Systems: Textbook. — M: MGIEM., 2005. 2. Ronald J. Tocci, Neal S Widmer. Digital Systems. Theory and Practice. – M.: Williams, 2004 – 1024 p. 3. A. I. Solonina et al. Basics of Digital Signal Processing: a course of lectures. - SPb: BHV - Petersburg, 2003. - 608 p. 4. V. Tomashevskiy, Y. Zhdanov. Simulation Modeling in GPSS Environment. M: Bestseller, 2003. 5. A. B. Sergiyenko. Digital Signal Processing. - SPb: Piter, 2002. -608 p. 6. I. M. Ibragimov Basics of Computer-Based Simulation of Nanosystems.-SPb., 2010. 7. V.I. Boyko, A. N. Gurzhiy, V. Y. Zhuykov, et al. Circuitry of Electronic Devices. Microprocessors and Microcontrollers - SPb - BHV-Petersburg, 2004.-464 p. 8. L. Foster, Nanotechnology. Science, Innovation and Opportunities.-M., 2008. 9. J. Martinez-Duart. Nanotechnology for Micro- and Optoelectronics. - M., 2007 10. Advanced Telecommunication Technologies. Potential Opportunities/ ed. by L. D. Reiman.- M., 2001 11. V. G. Kartashevskiy. Networks of Mobile Communication. - M: Eko-Trends, 2001. 12. B. Sklyar. Digital Communication. Theoretical Basics and Practical Application. Translated from English.- M.: Publishing House Williams, 2003. 13. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001. 14. I. P. Norenkov, V. A. Trudonoshin. Telecommunication

	Technologies and Networks.- M.: Bauman MGTU, 2000. 15. V. P. Dyakonov. Wavelets. From Theory to Practice. – 2nd ed., 2004. 16. I. M. Dremin, O. V. Ivanov, V. A. Nechitailo. Wavelets and Their Application. // UFN, t. 171. – 2001. – No. 5. – P. 465-501. 17. V. P. Dyakonov. Computer mathematics. Theory and Practice. – M.: Nolidzh, 2001. – 1296 p. 18. V. P. Dyakonov., A. A. Penkov. MatLab and Simulink for Radio Engineers. – M: DMK-Press, 2008. – 784 p. 19. A. V. Kuropatkin. Seven Lessons on CAD 2001. Goryachaya liniya – Telekom, 2001. 20. EDA. Practice of Computer-Aided Design of Electronic Devices: V. B. Steshenko – Moscow, Publisher S. V. Molgacheva, Nolidzh, 2002 - 768 p. 21. Introduction to Modern CAD: Vladimir Malyukh– Moscow, DMK Press, 2010 22. Y. A. Kurbatova MATLAB 7. Teach-Yourself Book. Publisher: Williams. Year of publication: 2005. 256 p. 23. N. K. Smolentsev. Basics of Wavelet Theory. Wavelets in Matlab. Publishing House DMK 2005. 304 p. 24. A. Krivilev. Basics of Computer Mathematics using MATLAB. Leks-Kniga, 2005. 25. K. Cheng, P. Giblin, A. Irving. MATLAB in Mathematical Research. Mir. 2001. 26. V. Dyakonov, V. Kruglov. MATLAB. System Analysis, Identification and Simulation. Special reference book. Piter. 2001. 27. R. S. Zagidullin. LabView in Research and Development. M.: Goryachaya liniya – Telekom, 2005. 28. L. I. Peych, D. A. Tochilin, B. P. Pollak. LabView for Beginners and Professionals. M.: Goryachaya liniya - Telekom, 2004 29. A. Y. Suranov. LabView 7: Function Reference Book. M.: DMK Press, 2005. 30. A. Y.Grishentsev. Theory and Practice of Technical and Technological Experiment. - SPb.: SPbSU ITMO, 2010. 102 p/
Date of last amendment	20.01.2023

Module Name:	**Module 13: Modern Signal Processing and Transmission Systems**
Code	M13REET(Ma)
Module Elements:	*Electice Subjects* Digital Systems Simulation Analysis of Object Remote Control Systems Analysis of Television Signal Transmission Technologies Modern Microcontrollers and Communication Microprocessors Microcontrollers and Microprocessors in Control Systems Design of Radio Electronic Devices Based on Microcontrollers Complex Types of Modulation and Coding in Multichannel Telecommunication Systems Analysis and Development of Switching Systems of the Third Generation IP-Telephhony Telepresence Modern Cryptographic Methods of Information Protection Analysis of Technologies and Technical Means of Information Protection in Telecommunications Service Quality in Telecommunication Networks Computer vision in real-time systems NI Technologies in Data Acquisition Systems Electronic nanosensors Robotic systems Modern wireless technologies
Semester Number:	3
Person responsible for the module	D.V. Ritter
Lecturer:	Digital Systems Simulation – Y.V. Gerasimova Analysis of Object Remote Control Systems – V.P. Ivel Analysis of Television Signal Transmission Technologies – .D.V. Ritter Modern Microcontrollers and Communication Microprocessors – V.P. Ivel Microcontrollers and Microprocessors in Control Systems – P.A. Petrov Design of Radio Electronic Devices Based on Microcontrollers – A.A. Savostin Complex Types of Modulation and Coding in Multichannel Telecommunication Systems – Y.V. Gerasimova Analysis and Development of Switching Systems of the Third Generation– V.P. Ivel IP-Telephhony Telepresence – Y.V. Gerasimova Modern Cryptographic Methods of Information Protection – V.P. Ivel Analysis of Technologies and Technical Means of Information Protection in Telecommunications – D.V. Ritter Service Quality in Telecommunication Networks S.S. Moldakhmetov Computer vision in real-time systems - A.A. Savostin NI Technologies in Data Acquisition Systems - A.A. Savostin Electronic nanosensors - G.V. Savostina Robotic systems - P.A. Petrov Modern wireless technologies – P.A. Petrov
Language:	Russian, Kazakh
Curriculum relation:	Radio Engineering, Electronics and Telecommunications (Ma)
Type of teaching / number of hours per week and per semester :	3 semester: hours per week – 40 (lectures -7; workshops -7; independent work -26);

	hours per semester – 600.
Workload:	Teaching Load: 210 hours Extracurricular Classes: 390 hours Total: 600 hours
Credit Points:	20 ECTS
Conditions for Examinations:	For admission to the exam, the student must score at least 50 points out of 100 available for each subject of the module
Recommended Conditions:	Module: Current Problems of Technical Sciences
Expected Learning Outcomes:	**Know:** the theory of discrete and digital signals and systems; theoretical basics of construction and practical use of microprocessor systems of various functional complexity; physical nature of the phenomena occurring in the transmission of messages using multi-channel transmission systems, their mathematical interpretation; principles of operation of technical devices used in transmission systems; signal conversion and processing methods; transfer system equipment; principles of the primary network; organization of technical operation of transmission systems; types of modern microcontrollers and hardware platforms, as well as the principles of building microprocessor systems for various purposes; principles of operation of nanoelectronic components; principles of operation of hardware and software components of data acquisition systems built on the National Instruments platform; fundamentals of computer vision and its application in real-time systems; image processing methods; pattern recognition algorithms; principles of organizing wireless communication in the high-frequency range of radio waves. **Be able to:** apply digital processing algorithms, analyze discrete and digital signals and systems in the time and frequency domains; apply basic technologies of construction of microprocessor systems in practice; use methods of algorithms and programs in the creation of microprocessor systems; understand circuitry and electrical circuits in the development of various microprocessor systems; use literature and reference books, carry out the design of transmission systems in different parts of the primary network; draw up technical documentation for design and measurements; execute calculations of parameters of the equipment for transmission systems and its separate units; design and simulate electronic nanosensors based on knowledge of nanomaterials and nanoelectronics; select and configure hardware components for data acquisition systems; process images and conduct object detection in real time; develop pattern recognition algorithms, including machine learning and neural networks; programming in Python; program microprocessors for organizing wireless communications. **Possess the skills**; designing and debugging hardware and software; simulation and experimental research of digital signal processing devices, design of digital signal processing devices; work with various instruments and equipment used to measure the parameters of nanosensors and nanomaterials; use of hardware and software components of data acquisition systems and NI LabVIEW; design and implementation of real-time computer vision systems, including the selection of a hardware platform, the development of algorithms and the implementation of software; building and programming wireless communication systems based on microprocessors.

	Demonstrate the ability to: apply computerized signal processing; in the design of various radio and telecommunication systems based on microcontrollers and microprocessors; development and adjustment of multichannel telecommunication systems; analyze the practical possibilities of improving the noise immunity of modern multi-channel telecommunication systems; compose algorithms and programs for microprocessor equipment; analyze and evaluate scientific articles and studies related to electronic nanosensors; process and analyze data using NI LabVIEW software; work with libraries and tools for image processing and computer vision; use various pattern recognition algorithms and choose the most suitable for a particular task; program in Python and use it to develop real-time computer vision systems; analyze the performance of computer vision systems in real time and optimize their performance; design and establish local wireless networks.
Intendend use/applicability	Modules: Scientific Research 4, Research Scientific Training, Final Academic Assessment
Content:	*Digital Systems Simulation* Mathematical models and results of analysis of digital systems of different classes using analytical, numerical and simulation research methods *Analysis of Object Remote Control Systems* Methods and means of information transmission, structure, software and metrological support of remote monitoring and control systems *Analysis of Television Signal Transmission Technologies.* Discrete signals and their spectra. Discrete systems and methods of their description: transfer function, direct and canonical block diagrams, difference equations, impulse and transient characteristics of the discrete filter. Design of digital filters: IIR filters for a given analog-prototype method of generalized bilinear conversion, IIR filters with linear PFC method of "weighing", automation of digital filters design using specialized software products. Effects caused by the finite bit depth of digital filters. *Modern Microcontrollers and Communication Microprocessors* The discipline studies the following sections: architecture and classification of microcontrollers/microprocessors. Computer language. Tools for development and debugging of microcontrollers. Design stages of radio electronic devices based on microcontrollers/microprocessors *Microcontrollers and Microprocessors in Control Systems* New 16-bit family of microcontrollers from Microchip (part one and two), new 16-bit microcontrollers dsPIC33F with DSP core, service modules, peripheral module. *Design of Radio Electronic Devices Based on Microcontrollers* Classification of microcontrollers. Harvard architecture. RISC architecture. General description of AVR microcontrollers. Description of ATmega microcontroller. Periphery. Programming of microcontrollers. Description of AVR assembler. Working with AVR Studio package. Overview of hardware and software of Arduino platform, the advantages of Arduino, history of Arduino, main (basic) platforms of Arduino. *Complex Types of Modulation and Coding in Multichannel Telecommunication Systems* Modern types of modulation and coding, as well as acquisition of

	skills of practical application of knowledge in the design of multi-channel telecommunications systems. *Analysis and Development of Switching Systems of the Third Generation* Basics of construction of multi-channel transmission systems. Communication channel. Interference and distortion. Coding and modulation. Principles of formation of multichannel signals with frequency division of channels. Features of two-way signal transmission. Interference in telecommunication channels. Construction of modern transmission systems. Basics of construction of transmission systems with time division of channels. Linear path. *IP-Telephhony Telepresence*. Linear codes of digital transmission systems. Regeneration of the digital signal form. Standardization of digital transmission systems. Temporary merging of digital streams. The temporary grouping of asynchronous digital streams. Transmission of commands, coordination of speeds. *Modern Cryptographic Methods of Information Protection* Study of the following sections: History of cryptography. Basic concept. Mathematical foundations of cryptography. Reliability of the codes. Basics of Shannon's theory. Hash functions. Introduction to cryptographic methods of information security. Symmetric encryption systems. Asymmetric encryption systems. Electronic digital signature. Public distribution of keys. Cryptographic methods of information security in telecommunication networks. *Analysis of Technologies and Technical Means of Information Protection in Telecommunications* The discipline aims to acquaint undergraduates with common problems and tasks of technical protection of information in telecommunication systems. gives an idea of the tasks, structure and capabilities of technical intelligence, the main stages and processes of obtaining information; of the physical processes in the technical means and systems that contribute to the leakage of protected information; of the properties of used and promising technical means of obtaining and protecting information; of the state system of information protection and its main documents *Service Quality in Telecommunication Networks* The discipline aims to acquaint undergraduates with common problems and tasks of technical protection of information in telecommunication systems. gives an idea of the tasks, structure and capabilities of technical intelligence, the main stages and processes of obtaining information; of the physical processes in the technical means and systems that contribute to the leakage of protected information; of the properties of used and promising technical means of obtaining and protecting information; of the state system of information protection and its main documents *Robotic systems* The device of robots. Robot drives. Robot control system. Mathematical representation of the control object. Synthesis of the controller: PID controller. Digital control systems. Identification of systems. Engines. Identification of model parameters. Mechatronic systems. Wheeled mobile robots. Systems with nonholonomous constraints. Systems with a lack of control actions

	Electronic nanosensors Principles of operation of electronic nanosensors, nanomaterials and nanostructures. Principles of operation of nanoelectronic components. Application of nanoelectronics in electronic nanosensors. Chemical nanosensors. Principles of operation of biomedical nanosensors. *NI Technologies in Data Acquisition Systems* NI hardware components: data capture cards, I/O modules, programmable controllers, power supplies. NI Software: A NI software package including LabVIEW, SignalExpress, DAQmx and other tools. Design of data collection systems on the NI platform. Integration of data collection systems into scientific and industrial applications. *Computer vision in real-time systems* Real-time image processing; machine learning and its application in real-time computer vision systems; hardware and software acceleration of real-time image processing, including the use of graphics processors (GPUs) and microcontrollers; development and implementation of real-time computer vision systems; evaluation of the performance and quality of real-time computer vision systems; computer vision applications in real-time systems. *Modern wireless technologies.* Wireless data transmission systems. Classification of wireless communication networks. Frequency ranges of wireless communication systems. Organization of cellular communication services. Wireless local area networks. Multi-station access methods. Multiple access systems based on temporary channel separation. Cellular communication of GSM standard. The functioning of the cellular system. Corporate wireless networks. Technologies used in wireless local area networks. Wireless data transmission in robotic systems. Standard 802.15.4. Graphical programming environments. Arduino. Communication via wireless interfaces. Automated ZigBee technology. A system of commands used in ZigBee technology. Wi-fi modules for low-speed data transmission.
Examination Form, module mark:	*Digital Systems Simulation* - written examination *Analysis of Object Remote Control Systems* - written examination *Analysis of Television Signal Transmission Technologies.* - written examination *Modern Microcontrollers and Communication Microprocessors* - written examination *Microcontrollers and Microprocessors in Control Systems* - written examination *Design of Radio Electronic Devices Based on Microcontrollers.* - written examination *Complex Types of Modulation and Coding in Multichannel Telecommunication Systems* - computer-based testing *Analysis and Development of Switching Systems of the Third Generation* - computer-based testing *IP-Telephhony Telepresence* - computer-based testing *Modern Cryptographic Methods of Information Protection* - written examination *Analysis of Technologies and Technical Means of Information Protection in Telecommunications* - written examination *Service Quality in Telecommunication Networks* - written

	examination *Computer vision in real-time systems* - free-form examination *NI Technologies in Data Acquisition Systems* - free-form examination *Electronic nanosensors* - computer-based testing *Robotic systems* - free-form examination *Modern wireless technologies* - free-form examination Module mark: free-form examination *Elective Subject.*
Technical/Multimedia Facilities:	Laboratories of Computer Mathematics and Electronic Simulation, Microcontrollers and Special Microprocessors based on MK at 89S51, Microcontrollers and Special Microprocessors based on MK at 90S8535, Digital Devices and Microprocessors, complex NI ELVIS, interface cards NIPCI 6621, GPIB, NI Simulator, NI SCXI, hardware platforms of Arduino Nano, Uno, Mega, Duemilanove, coordinator-milling machine ProtoMat S42.
Study Materials:	1. A. B. Sergiyenko. Digital Signal Processing: Textbook for universities. 2nd ed. SPb.: Piter, 2007' 751 p.: with pictures. 2. V. P. Vasilyev. Basics of the theory and calculation of digital filters: Textbook for higher schools/ B. P. Vasilyev, E. L., Muro, S.M. Smolskiy; ed S.M. Smolskiy. M.: Publishing Center Akademiya, 2007. 272 p. 3. Y. A. Grebenko. Methods of Digital Signal Processing in Radio-Receiving Devices: textbook on the courses of Methods and Devices for Digital Signal Processing and Radio Receivers / Y. A. Grebenko. M.: Publishing House of MPEI, 2006. 48 p. 4. G. I. Pukhalskiy. Design of Microprocessor Systems. Textbook for universities. SPb.: Politekhnika, 2001. 5. A. I. Solonina et al. Algorithms and Processors for Digital Signals Processing - SPb: BHV - Peterburg, 2001. - 464 p. 6. M. S. Kupriyanov, B. D. Matyushkin. Digital Signal Processing: Processors, Algorithms, Design Tools. - St. Petersburg: Politekhnika, 1999. -592 p. 7. A. I. Solonina et al. Basics of Digital Signal Processing: a course of lectures. - SPb: BHV - Petersburg, 2003. - 608 p. 8. A.V. Belov Tutorial on Microprocessor Technology. SPb.: Nauka i tekhnika, 2003. 9. B. Y. Sovetov, S. A. Yakovlev. System Simulation. - M.: Vysshaya shkola, 1998. 10. Jeremy Blum. Exploring Arduino: Tools and Techniques for Engineering Wizardry. 1st Edition, 2015. – 336 p. 11. Introduction to Microcontrollers by Gunther Gridling and Bettina Weiss, 2006. 12. Microcontroller Projects Using The Basic Stamp by Al Williams, 2010. 13. PIC microcontrollers by Milan Verle, 2008. 14. Programming Arduino Getting Started with Sketches by Simon Monk, 2011. 15. Programming Arduino - Next Steps by Simon Monk, 2013. Microcontroller Systems by Daniel Ernst, 2007. 16. V. N. Gordiyenko. Multichannel Telecommunication Systems. -M: Goryachaya liniya-Telekom, 2005, 2007. 17. V. I. Ivanov, V. N. Gordiyenko et al. Digital and Analog Transmission Systems: Textbook for high schools/ Under the editorship of V. I. Ivanov. – 2nd ed. – M.: Goryachaya liniya – Telekom, 2005. – 232 p. 18. Design and Technical Operation of Digital Telecommunication Systems and Networks. /under the editorship

	of V. N. Gordiyenko. -M., 2008, 2012. 19. N. N. Slepov Modern Digital Technologies of Global Communication Networks. -M.: Astra Polygraphiya, 2011. 20. I. Richardson. Video Coding. H.264 and MPEG-4 – New Generation Standards. - M.: Tekhnosfera, 2005, -369 p. 21. V. V. Krukhmalev, V. N. Gordiyenko, Basics of Construction of Telecommunication Networks and Systems. Textbook for universities. M.: Goryachaya liniya – Telekom, 2003.-232 p. 22. M. V. Garanin. Systems and Networks of Information Transmission.- M: Radio i svyaz, 2001. – 336 p. 23. Yurevich E.I. Fundamentals of robotics. --- St. Petersburg. BCHV-Petersburg, 2015. – 328 p. 24. Visilter V.Yu., Zheltov S.Yu., Knyaz V.A. Processing and analysis of digital images with examples on LabVIEW and IMAQ Vision, Moscow 2011. 25. J.-L. Laurier, Artificial Intelligence Systems, M. Mir, 2011. 26. E.Hunt. Artificial Intelligence, Moscow, 2000. 27. A.I.Gusev "Nanomaterials, nanostructures, nanotechnologies" — Moscow: FIZMATLIT, 2005. — 416 p. 28. M.Y. Dolomatov Physical foundations of nanoelectronics. Study guide. – Ufa : RSCI Bash. GU-2015, 206s. 29. Chaplygin Yu.A. Nanotechnologies in electronics Publishing House:Technosphere - 2015 30. Ch. Poole, F. Owens. Nanotechnology. The world of materials and technologies. Technosphere, Moscow, 2005 31. National Instruments. LabVIEW and CompactRIO: Fundamentals of Application Development. – National Instruments, 2018 32. V.K.Batovrin, A.S.Bessonov, V.V.Moshkin, V.F.Papulovsky. LabVIEW workshop on the basics of measurement technologies. – Moscow: DMK Press, 2017 33. National Instruments. Creating applications using CompactRIO and LabVIEW. – National Instruments, 2019 34. Yu. Evdokimov. LabVIEW for a radio engineer: From a virtual model to a real device. – Moscow: DMK Press, 2007 35. Shapiro L. Computer vision / L. Shapiro, J. Stockman — M. : BINOM, 2013. — 752 p. 36. Jan Eric Solem Programming computer vision in Python. / translated from English. Slinkin A. A. M.: DM K Press, 2016. 312 p.: ill. 37. Reinhard Klette Computer vision. Theory and Algorithms / translated from English by A. A. Slinkin. - M.: DMK Press, 2019. - 506 with: il. 38. Bishop, Christopher M. Pattern recognition and machine learning. : Translated from English - St. Petersburg : Dialectics LLC, 2020. - 960 p. 39. Jeremy Blum. Exploring Arduino: Tools and Techniques for Engineering Wizardry. 1st Edition, 2015. – 336 p. 40. Gepko I.A., Oleinik V.F., Chaika Yu.D., Bondarenko A.V. Modern wireless networks: state and prospects of development. -- EKSMO, 2009. - 672 p 41. Petin V.A. Projects using the Arduino controller. – St. Petersburg: BHV-Petersburg, 2017. – 464 p. 42. Ratynsky M.V. "Fundamentals of cellular communication"/ edited by D.E.Zimin – M.: Radio and Communications, 2005.
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