Ministry of Agriculture of the Republic of Kazakhstan
Kazakh Agrotechnical University named after S.Seifullin

Considered at the meeting
of the Academic Council
of the University
Protocol №15 from «30» 05 2019 y.

CONFIRM
Chairman of the JSC "S.Seifullin
Kazakh Agrotechnical University"
A.Kurishbayev
"05" 05 2019 y.

EDUCATIONAL PROGRAM
«Precision agriculture»

Code and classification of the field of education:
7M08 Agriculture and bioresources
Code and classification of training areas:
7M085- Agroengineering
Code in the International Standard Classification of Education:
7M08

Qualification: Master of Agricultural Sciences in the educational program «Precision Agriculture»
Duration of study: 2 years

Nur-Sultan, 2019

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The team of authors was approved by the order of JSC «KATU named after S.Seifullin»
№ _____ from _____

The educational program «Precision agriculture»
considered at the meeting of the Department «Agricultural machinery and Technology» protocol №7 from «27» 01 2019 y.,

approved by the Council of the Technical Faculty
protocol № 9 «28» 02 2019 y.

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Content

1 Passport of the educational program

1.1 Purpose of the educational program:

The purpose of the educational program «Precision Agriculture» is to prepare masters for the introduction of precision farming technologies, who are qualified by advanced theoretical and practical knowledge on the use of technological and technical solutions of differentiated impact on the soil-plant system and are ready to take on consulting and guidance on the implementation, application of digital technologies, as well as use the acquired professional knowledge in scientific-research work and scientific-pedagogical activity.

Objectives of the educational program:

- training of specialists who are able to work with scientific and technical information and documentation on the practical application of digital technologies in agriculture, who are able to use advanced domestic and foreign experience in the use of precision farming technologies, systematize and summarize the information received;
- in—depth individual theoretical and practical training in mastering the basic elements of precision farming - information collection systems, information analysis and decision-making and decision-making - conducting agrotechnological operations;
- formation of practical skills of independent work with GIS technologies, data processing of remote sensing of the earth, ground-based studies of soils and plants, development of prescriptive maps for technical means for differentiated effects on the soil-plant system, analysis of the economic efficiency of precision farming technologies.

2 General characteristics of the educational program

For the fastest introduction of precision farming systems into agricultural turnover of the Republic of Kazakhstan, it is necessary to train personnel who have the skills to apply the basic elements of precision farming - information collection systems, information analysis and decision—making and decision-making - conducting agrotechnological operations.

The program is characterized by practical orientation and a high level of independent work of undergraduates. It was developed jointly with teachers with practical experience in implementing the basic elements of precision farming as part of the digitalization of agriculture in Kazakhstan in 2018, agricultural producers from 9 pilot farms in North Kazakhstan, Kostanay, Akmola and Karaganda regions, US scientists and is focused on the strengths of agricultural education in the USA and Kazakhstan. In the course of training, the main focus is on interactive forms (seminars, presentations, practices) and practical content (real

research) in order to eventually get versatile qualified graduates who meet modern professional requirements.

For the implementation of the educational program at S.Seifullin KATU, for the first time in Kazakhstan, created:

- «Scientific and Educational Center of Geographical Information Systems and Technologies (GIS)»;
- Kazakh-German Precision Farming Center «Glass»;
- Kazakh-American Precision Farming Center «John Deer».

An agreement has been signed with the Minsk Tractor Plant on the establishment of the MTZ Precision Farming Center.

Also, on the basis of KATU, the professional infrastructure (educational resources) necessary for the implementation of the EP has been created:

- Scientific and experimental campus of the University (with an area of 1200 hectares)
- Kazakh-Belarusian Personnel Training and Retraining Center;
- Kazakh-Chinese Agricultural Mechanization Center;
- laboratory of 3-D visualization and modeling;
- pavilions of agricultural machinery;
- design bureau;
- robotics laboratory, etc.

Teachers and professors from the University of California at Davis (USA); well-known agricultural scientists; practical managers with extensive experience in the implementation of elements of precision agriculture are involved in the implementation of the educational program for the preparation of masters.

3 Competence model (portrait) graduate

3.1 Areas of professional activity:

- enterprises of the agricultural sector, as the main specialists in the production of agricultural crops;
- structures in which graduates are entrepreneurs who create and develop their own business for the production of agricultural crops;
- research organizations;
- institutions of higher and additional professional education.

3.2 Types of professional activity:

- *organizational and managerial*: management of organizations and enterprises, divisions, projects; development of strategies for the development of organizations and their individual divisions;
- *production and technological*: the use of modern digital technologies in the production of agricultural crops;

- *analytical*: search, analysis and evaluation of information for making optimal management decisions; development and justification of proposals for making optimal tactical and strategic management decisions on differentiated effects on the soil-plant system;

- *research:* development of research programs in the precision farming system, search, collection, processing, analysis and systematization of information on the research topic; development of methods and tools for conducting research and analyzing their results;; preparation of reviews, reports and scientific publications;

- *pedagogical*: teaching disciplines on precision farming; conducting seminars on the introduction of precision farming elements; developing recommendations, educational programs and teaching materials.

3.3 Basic competencies:

- knowledge of the basic provisions of agro-soil science, the basics of plant nutrition management and phytosanitary safety of agricultural crops;

- knowledge of methods for solving planned technological and operational tasks for managing the production process of agricultural crops;

- the ability to compare, formulate conclusions, build their own arguments, express their position on the main issues of precision farming;

- the ability to bring to the producers of agricultural crops the prospects for the development and introduction of precision agriculture in Kazakhstan;

- the ability to model and analyze the state of development of precision agriculture, to determine and solve planned technological and operational tasks for managing the production process of agricultural crops.

possess: skills in organization and training necessary for the independent continuation of further improvement of precision farming systems; skills in organizing research, scientific and industrial work with the use of precision technologies.

3.5 Professional competencies

- knowledge of the basic provisions of the system of agriculture and crop production, digital technologies in the management of the production process of agricultural crops;

- to know and master various methods of conducting scientific research and developing academic writing in the field of digitalization of the agro-industrial complex, to understand the importance of the principles and culture of academic integrity and use them in their scientific, educational and practical activities

- knowledge of methods for solving tactical tasks for managing the production process of agricultural crops, the ability to develop cartograms of the

distribution of nutrients, weeds and diseases, prescriptive maps for technical means for differentiated effects on the soil-plant system in the precision farming system;

- the ability to analyze information about the farm, field, culture, formulate and argue optimal solutions for conducting agrotechnological operations in the precision farming system;

- the ability to bring to crop producers the relevance and necessity of using smart farming technologies to maximize profits with minimal environmental impact;

- the ability to model and analyze production issues to obtain a potentially possible yield of cultivated crops, conduct research to improve technological and technical solutions for the implementation of precision farming systems.

4 The base of passing professional practices

The pedagogical practice of undergraduates is a mandatory part of the educational program of higher professional education and is conducted in accordance with the approved working curricula and the schedule of the educational process. The goal is to develop undergraduates' skills in developing a training course, independently conducting seminars and practical training sessions, as well as gaining experience in organizational and educational work.

Research practice is a form of professional training of undergraduates for scientific, pedagogical and scientific activities, which is a type of practical activity of undergraduates related to conducting scientific research within the chosen topic of research work.

The objects of the Master's research practice are agricultural enterprises, research organizations, as well as higher educational institutions. The University has signed contracts with enterprises for undergraduates to practice. The main bases of practice for undergraduates of the educational program Precision «agriculture» in pedagogical practice is KATU named after S. Seifullina, on research - research institutes and centers of the National Agrarian Scientific and Educational Center (NANOC), leading agricultural enterprises «Baiserke Agro», «Atameken-Agro», «Rodina», «Naydorovskoy», «Shakhterskoye», «Troyana», representatives of leading foreign companies «Eurasia Group", «ST Agro», «Navstar Asia» and others.

5 Structure of the Master's degree program in the scientific and pedagogical direction

№ n/a	Name of cycles of disciplines and types of activities	Total labor intensity	
		in academic hours	in academic credits
1	2	3	4
1.	Theoretical training	1920	64
1.1	Cycle of basic disciplines (BD)	1050	35
	University Component (UC):	600	20
	including:		
	History and philosophy of science	150	5
1)	Foreign language (professional)	300	10
	Pedagogy and psychology of higher education	90	3
	Pedagogical practice	60	2
	Component of choice (CC)	450	15
	including:		
	Agro-soil science	150	5
	Physics and chemistry of soil		
	Fundamentals of Plant nutrition Management	150	5
2)	Optimization of mineral nutrition of agricultural crops		
	Phytosanitary technologies of cultivation of agricultural crops	150	5
	Phytosanitary monitoring of harmful organisms		
1.2	Cycle of profile disciplines (PD)	1470	49
	University Component (UC):	1050	35
	including:		
	Farming systems and crop production	150	5
	GIS and remote sensing technologies in agriculture	150	5
	Technical support of technological processes in the precision farming system	270	9
1)	Management and decision-making in precision agriculture	90	3
	Theoretical foundations of agricultural production mechanization	150	5
	Digital technologies in crop production	120	4
	Advanced biometeorology	120	4

2)	Component of choice (CC)	150	5
	including:		
	Fundamentals of scientific research and experimental planning	150	5
	The methodology of the experimental case		
3)	Research practice	270	9
2	Research work	720	24
1)	Research work of a master's student, including internship and completion of a master's thesis (NIRM)	720	24
3	Additional types of training (DVO)		
4	Final certification (GIA)	360	12
1)	Registration and defense of a master's thesis (RaDMT)	360	12
	Total	3600	120

Appendix 1. Academic Calendar***

Appendix 2 Working Curriculum

Appendix 3 Description of the disciplines of the university component

1. Basic information about the discipline:	
Name of the discipline	**History and philosophy of science**
2. Number of credits	5
3. Prerequisites:	Philosophy (Bachelor's degree course), Religious Studies (Bachelor's degree course), Sociology (Bachelor's degree course)
4. Post-requirements:	Pedagogical practice, dissertation
5. Competencies:	They must have an idea about (about) the subject of professional activity and about the ways of self-determination and self-analysis, about the basics of theories of speech communication. Know the correct presentation of their thoughts orally and in writing; formulation of conclusions. Be able to: design the educational process; form speech and communicative competence. Have skills in means and technologies of unsupervised learning; evaluation of achieved results; organization and management of students' activities; use of argumentation theory, logic. Be competent in the field of scientific and scientific-pedagogical activity in higher educational institutions; in matters of modern educational technologies; in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.
6. Author of the course	Abdina A.K.
7. Basic literature	1. Abdina A.K. «Philosophy», 2008; 2. Ibraeva K.J. "Organization and planning of scientific research in professional pedagogy", 2008; 3. Trofimova N.M., Pushkina T.F., Kozina N.V. «Age psychology», 2009.
8. The content of the discipline. Analysis of philosophical and ideological, epistemological, logical and methodological issues. Skills and abilities of research activity. Structure and functions of scientific knowledge. Methods of science. Philosophical views on science. Worldview. History of science. Methods of scientific cognition. Systematic understanding in the field of study and mastering the skills and methods of research in a particular field. Actual methodological and philosophical problems of science.	

1. Basic information about the discipline:	
Name of the discipline	Pedagogy and psychology of higher education
2. Number of credits	3
3. Prerequisites:	Philosophy, psychology, history, cultural studies, sociology;
4. Post-requirements:	Passing of pedagogical practice
5. Competencies:	As a result of studying the discipline , a master 's student - will learn: actual problems of pedagogical science; the essence of pedagogical activity of a university teacher; - master the ability to: isolate pedagogical facts, phenomena, events from the surrounding reality and describe them in the language of pedagogical science, based on the laws of pedagogical theories, explanations, forecasting and development; constructing the educational process based on new concepts of teaching and upbringing. Will be competent: in solving problems of higher pedagogical education and prospects for its further development; in the application of effective university teaching technologies; solutions to topical psychological and pedagogical problems, evaluation of the results achieved. As a result of studying the discipline, a master's student will understand the psychophysiological features of work; the basics of personality psychology; know the psychological foundations of managerial activity and cognitive processes; to know and understand the mechanisms of human perception by man and the mechanisms of people's influence on each other, psych technologies of influence, psychology of leadership; to know the psychological features of the formation of the labor collective and interpersonal relations in it and to be able to regulate interpersonal relations in the team, including effectively resolving conflict situations; apply psychological patterns of managerial decision-making and be able to take into account the psychological factors of managerial activity in general; apply psychological techniques to overcome professional stress and prevent professional burnout
6. Author of the course	Sagalieva J.K., Midzhshev B.A. Ibraeva K.J., Ul. Sarbasova.A. Seilkhan G.I. Bekbaeva J.S. Shakhmatova D.S., Zhusupova A.A.
7. Basic literature	Akhmetova G.K., Isaeva Z.A. Pedagogy: Textbook for Master's degree of universities. - Almaty: Kazak University!, 2006. - 328 p. Bashirova Zh.R. Development of university education in the aspect of higher school teacher training. Monograph. - Almaty: ATU named after Abai, 2003. - 160 p. Mynbayeva A.K. Fundamentals of Higher school pedagogy: A textbook. - Almaty, 2013. - 190 p. The credit system of education at the university. - Almaty: Kazak University!, 2006. - 180c. Pionova R. Pedagogy of higher school. - Minsk: Universitetskoe, 2002. Pedagogy and psychology of higher education. - Rostov n/A: Phoenix, 2002. - 544 p. A.A. Urbanovich "Psychology of management" Minsk -2005 G. L.D. Stolyarenko "Psychology of management" Rostov-on-Don 2005
8.The content of the discipline. Fundamentals of higher school pedagogy. The subject and tasks of higher school pedagogy. Methodology and methods of pedagogical research in higher education. Didactics of higher education. The pedagogical process in higher education. Laws, patterns and principles of learning. Methods, forms and means of teaching in higher education. The current state of higher education in the Republic of	

Kazakhstan. Professional formation of a high school teacher. The process of education in higher education. The purpose of education as a pedagogical problem. Educational staff as a form of functioning of an integral pedagogical process. Introduction to Management psychology. Conceptual apparatus of management psychology. The manager and the team. Conflicts in the labor collective. Managerial communication. Decision-making technology. The concept of the subject and the object of management. The leader and the leader. Psychology of the order. Personality as a subject and object of management. Democratic leadership style and its features. Psychology of criticism. Psychotypes of communication subjects. Psychological technique of persuasive influence. Psychological problems of the selection of senior personnel. Psychological problems of training and retraining of senior personnel. Recruitment and placement of personnel. Rotation of personnel. Certification and staff turnover.

1. Basic information about the discipline:	
Name of the discipline	**Foreign language (professional)**
2. Number of credits	**5 (2)**
3. Prerequisites:	Foreign language (Bachelor's degree) English for special purposes Professionally-oriented foreign language
4. Post-requirements:	Disciplines in the specialty in English**, English for academic purposes**
5. Competencies:	As a result of studying the discipline, the master's student will know the functional and stylistic characteristics of the scientific presentation of the material in the studied foreign language, general scientific terminology and terminological sublanguage of the corresponding specialty in a foreign language, the basics of business correspondence within the framework of international cooperation. As a result of the training, the undergraduate will be able to freely read, translate original literature on his chosen specialty with subsequent analysis, interpretation and evaluation of the extracted information, explicate scientific information in writing (abstract, abstract, summary), participate in professional discussions, scientific debates, debates, round-table discussions, make a presentation of scientific research (at seminars, conferences, symposiums, forums), listen to and understand public speeches in direct and indirect communication (lectures, reports, tele- and internet programs);
6. Author of the course	Department of Foreign Language
7. Basic literature	1 Белоусова А.Р., Мельчина О.П. Английский язык для студентов сельскохозяйственных вузов, 2010. 2.Принципы управления, Авторы: Манон Карпентер, Талия Бауэр, Беррин Эрдоган и Джереми Шорт, Версия: 2.0 Дата публикации: март 2013 3.Команда команд: Новые правила взаимодействия в сложном мире в твердом переплете – 12 мая 2015 г.

8. Content of the discipline:

1. What is agriculture?
2. Knowledge of the subject
3. Tools and equipment
4. Functions
5. What should I read?
6. Bank of authentic materials
7. Work skills
8. Identification of the culture of the place of work
9. Identification of target events
10. Organizational structure

11. Job descriptions 12. Job Interview 13. To-do lists 14. Organization of fairs and conferences 15. Job change

1. Basic information about the discipline:	
Name of the discipline	**Farming systems and crop production**
2. Number of credits	5
3. Prerequisites:	Basic and profile Bachelor's degree disciplines
4. Post-requirements:	Specialized disciplines. Professional activity.
5. Competencies:	*have an idea*: about the theoretical provisions and features of farming systems, technologies for growing crops; *be able to:* use agricultural techniques when growing agricultural crops *to have skills:*- on the application of methods of rational and efficient use of land, increasing soil fertility and increasing crop productivity; *be competent:* in the zonal features of agricultural techniques that contribute to the preservation and increase of soil fertility, protect the soil from erosion and allow increasing the yield of agricultural crops in various soil-climatic zones.
6. Author of the course	Zhumagulov Iglik Imangalievich
7. Basic literature	1. Agriculture. Edited by A.I. Puponin. - M.: 2004. – 552 p. 2. Kashtanov A.N. et al. Scientific foundations of modern farming systems.-M.: 1988.P.256. 3. Ivannikov A.V., Shramko N.V., Mukazhanov K. M. Agriculture of Northern Kazakhstan – Astana, 2001- 295 p. 4. Soil protection system of agriculture. – Alma-Ata: Kainar, 1985- 200 p.
8. The content of the discipline. History of development and classification of farming systems and crop production, scientific foundations of zonal farming systems. The main links of zonal (modern) farming systems, the principles of modern zonal farming systems and crop production, Modern farming systems: Precision, biological and adaptive landscape, resource–saving agriculture and their features. Soil protection agriculture and its theoretical foundations and practical techniques. Scientific foundations of tillage, principles of minimization of tillage; soil erosion and measures to combat it. Features of crop rotations in various modern farming systems; weeds and measures to combat them in the soil protection system of agriculture.	

1. Basic information about the discipline:	
Name of the discipline	**GIS technologies and Remote sensing of the Earth**
2. Number of credits	5
3. Prerequisites:	Fundamentals of Geography, Fundamentals of Mathematics, Coordinate Systems, Fundamentals of Scientific Research, Fundamentals of Information Technology. Fundamentals of physics.
4. Post-requirements:	Master's thesis
5. Competencies:	Have knowledge in the field of computer science and modern geoinformation technologies, possess skills in using software and working in computer networks, be able to create databases and use Internet resources, possess GIS technologies, be able to work with information from various sources to solve professional problems, have an idea of the

	current state of the remote sensing data market, their features and characteristics, to know the theoretical foundations and methodology of digital image processing for the purposes of mapping and monitoring of agriculture, be able to work in specialized software packages for processing and analyzing remote sensing data, be able to classify remote sensing data and extract information about the state of crops and their diseases.
6. Author of the course	Ermakov F.K.
7. Basic literature	1. Thenkabail, P.S., Knox, J.W., Ozdogan, M., Gumma, M.K., Congalton, R.G., Wu, Z., Milesi, C., Finkral, A., Marshall, M., Mariotto, I., You, S. Giri, C. and Nagler, P. 2012. Assessing future risks to agricultural productivity, water resources and food security: how can remote sensing help?. Photogrammetric Engineering and Remote Sensing, August 2012 Special Issue on Global Croplands: Highlight Article. 78(8):773–782. IP-035587. 2. Russell G. Congalton, Kass Green. 2019. Assessing the Accuracy of Remotely Sensed Data: Principles and Practices, Third Edition. Reference - 328 Pages - 19 Color & 37 B/W Illustrations . ISBN 9781498776660 - CAT# K29742. 3. Prasad S. Thenkabail, John G. Lyon, Alfredo Huete. Fundamentals, Sensor Systems, Spectral Libraries, and Data Mining for Vegetation. 2018. Reference - 449 Pages - 118 Color & 57 B/W Illustrations ISBN 9781138058545 - CAT# K33293 4. Prasad S. Thenkabail, John G. Lyon, Alfredo Huete. Hyperspectral Indices and Image Classifications for Agriculture and Vegetation. 2018. Reference - 296 Pages - 85 Color & 21 B/W Illustrations ISBN 9781138066038 - CAT# K33412 5. Prasad S. Thenkabail, John G. Lyon, Alfredo Huete. Hyperspectral Remote Sensing of Vegetation, Second Edition, Four Volume Set. Reference - 1478 Pages - 414 Color & 204 B/W Illustrations ISBN 9781138066250 - CAT# K33423 6. Jensen, John R. Remote sensing of the environment: an earth resource perspective. 2nd ed. 2007. 550.28 – dc22. ISBN 0-13-188950-8
8. The content of the discipline. Fundamentals of GIS and remote sensing: Coordinate systems. Positioning systems. Cartographic projections. Electronic maps, layers. Digital image. Multispectral image. Hyperspectral image. Remote sensing of the earth. Satellites.GIS and remote sensing: Spatial data collection. Creating a spatial database. Features of the organization of data storage. Digitization of data. Photogrammetry. Correction of remote sensing data. Remote sensing data processing.Data analysis: Spatial analysis. Classification approaches. Types of classified data. Identification of types of crops according to remote sensing data. Identification of diseases of crops according to remote sensing data. Identification of the main properties of soils according to remote sensing data.	

1. Basic information about the discipline:	
Name of the discipline	**Technical support of technological processes in the precision farming system**
2. Number of credits	9
3. Prerequisites:	Agro-soil science. Fundamentals of plant nutrition management.
4. Post-requirements:	Master's thesis
5. Competencies:	**A**. Knowledge and understanding of the basic provisions of the differentiated impact on the «soil-plant» system; knowledge of the principles of operation of

	technical means to ensure technological processes of cultivation of agricultural crops in the precision farming system **B.** Knowledge of methods for solving planned technological and operational tasks for managing the production process of agricultural crops; the ability to develop electronic prescriptions for performing technological operations. **C.** The ability to compare, formulate conclusions, build their own arguments, express their position on the main issues of precision agriculture. **D.** The ability to bring to the producers of grain crops the prospects for the development and introduction of precision agriculture into agriculture in Kazakhstan. **E.** The ability to model and analyze the state of development of precision agriculture. Determine and solve planned technological and operational tasks for managing the production process of agricultural crops.
6. Author of the course	Nukeshev S.O.
7. Basic literature	1. Shpaar D., Zakharenko A.V., Yakushev V.P. Precision agriculture. – St. Petersburg-Pushkin, 2009. – 397 p. 2. Yakushev V.P. On the way to precision farming. – St. Petersburg: Publishing House of the Russian Academy of Sciences. 2001. – 458 p. 3. Mikhailenko I.M. Management of precision farming systems. – St. Petersburg: Publishing House of St. Petersburg University, 2005. – 234 p. 4. Nukeshev S.O. Scientific bases of intra-soil differentiated application of mineral fertilizers in the system of precision agriculture: monogr. M-in the rural household of the Republic of Kazakhstan. - Astana: S. Seifullin KATU, 2011. - 358 p. 5. Fertilizers and their Efficient Use Harold F. Reetz, Jr. First edition, IFA, Paris, France, May 2016. Copyright 2016 IFA., - 114 p.
8. The content of the discipline. Positioning systems. Local sampling in the coordinate system. Parallel driving system. Creating prescriptive maps. Differentiated tillage. Differentiated seeding. Differentiated application of fertilizers. Differentiated application of pesticides. Yield monitoring. Sensorics. Compilation of yield and electrical conductivity maps. Robotic systems in agriculture.	

1. Basic information about the discipline:	
Name of the discipline	**Theoretical foundations of agricultural production mechanization**
2. Number of credits	5
3. Prerequisites:	Agricultural machines (bachelor's degree course), agrotechnological machines of animal husbandry (bachelor's degree course), mechanization of animal husbandry (bachelor's degree course).
4. Post-requirements:	Farming systems and crop production. , Fundamentals of Scientific Research and Experimental Planning, Master's thesis
5. Competencies:	**A.** Knowledge and understanding of machines and tools for performing basic technological processes and operations of the agricultural process; devices, workflow and adjustments of modern agricultural production machines. **B**. Knowledge of methods of theoretical justification of the processes of mechanization of agricultural production, setting machines to a given operating mode; energy saving of technological processes of post-harvest processing and storage of agricultural products. **C.** The ability to correctly calculate the parameters of machines and tools, evaluate the quality of work and the effectiveness of the use of modern agrotechnological machines; compare, formulate conclusions, build their

	own argumentation, express their position on the main issues of the technological process, formulate conclusions about the use of specific equipment, build their own argumentation; compile and prepare machines and tools for work and select for them necessary energy resources. **D**. The ability to master modern designs and technological processes of agrotechnological machines. **E.** The ability to analyze key issues on the justification of the basic parameters and modes of operation of working bodies, mechanisms of agrotechnological machines and their design.
6. Author of the course	Aduov M.A.
7. Basic literature	1 Klenin N.I. Agricultural machines: textbook for students. universities, training. for example, "Agroengineering" / N.I. Klenin, S.N. Kiselyov, A.G. Levshin; [ed. Yu.A. Chichov].-Moscow : KolosS, 2008. - 816 p. : ill. 2 Aduov M.A. Mechanization of sowing seeds of grain crops and application of mineral fertilizers. Monograph, S. Seifullin KATU, Astana, 2008. - 209 p. 3 Aduov M.A., Kapov S.N., Nukusheva S.A. Seeders with combined coulters for direct sowing of grain crops. Monograph, KATU named after S.Seifullin.-Astana: 2017. -142 c. 4 Shilo I.N., Romanyuk N.N., Kitun A.V., Kolonchuk V.M., Kolonchuk M.V., Abdyrov A.M., Nukeshev S.O., Zaichko G.A. Manual for solving engineering problems and production situations on technical support and service of animal husbandry. Astana, S. Seifullin KATU, Astana, 2017. - 223 p. 5 Kolga D.F., Kazarovets N.V., Simanovich V.S., etc. Technical support of processes in animal husbandry: a textbook. - Minsk: IVC of the Ministry of Finance, 2012. - 576 p. 6 Novikov A.V., Shilo I.N., Ketsko V.N. Diagnostics and maintenance of machines for agriculture: study guide. - 2nd ed. - Minsk: BGATU, 2010. - 404 p. 7 Torekhanov A.A. Scientific achievements in the field of animal husbandry: inform. sb. about scientific achievements in the region of animal husbandry / M-vo rural household of the Republic of Kazakhstan. - Almaty: Kazniizhik, 2011. - 184 p.
8. The content of the discipline. Theory and calculation of modern machines and implements for tillage. Theoretical foundations of mechanical tillage. Tillage machines and tools for tillage. Energy assessment of plows, huskers, harrows and milling cutters. Technological process of machines and calculation of the main parameters of machines for applying organic and mineral fertilizers.. The energy intensity of the fertilizer application process. Modern sowing and planting machines. Machines for protecting plants from pests, diseases and weeds. Technological process and justification of the mode of operation of machines. Calculation of the main working bodies and operating modes of forage harvesting, harvesting, grain cleaning and sorting machines. The purpose of the device, workflow and adjustments of modern livestock farming machines. Fundamentals of the theory of the processes of grinding, dosing, mixing, pressing, moisture-thermal and chemical processing of feed, milking and primary processing of milk, cleaning and removal of manure. Theories of animal husbandry mechanization processes, setting up machines for a given operating mode. The quality of work and the efficiency of the use of modern agrotechnological machines. Modern designs and technological processes of agrotechnological machines. Key questions on the justification of the main parameters and modes of operation of working bodies, mechanisms of agrotechnological machines and their design.	

1. Basic information about the discipline:	
Name of the discipline	**Management and management decision-making in precision agriculture**
2. Number of credits	3
3. Prerequisites:	Production Management (Bachelor's degree course).
4. Post-requirements:	Systems of agriculture and production of crop products, Phytosanitary technologies of cultivation of agricultural crops
5. Competencies:	As a result of studying this discipline, students should: To know: the basics of production management in the formation of the socio-economic system; production management in the enterprise management system; the content and structure of the production management system; market strategy in production management. - to be qualified: product strategy; content and objectives of the process of tactical production management; current plans of the production enterprise; organization of production processes; organization of auxiliary processes and provision of services. - be competent: organization of production management processes; motivation to achieve the goal; fundamentals of operational production management; production control and ways of regulating production. To know and understand: Knowledge of the principles of the organization of production activities, basic methods and tools for managing production activities and understanding the basic concepts and methods of organizing production activities. Be able (descriptor B): To use in practice the ability to plan the production activities of the organization, to develop corporate, competitive and functional strategies for the development of the organization. Possess: Possess the methodology of forecasting promising ways to solve problems; economic justification of effective projects. c. The ability to set goals and formulate tasks related to the implementation of professional functions. d. Be able to organize the work of performers for the implementation of specific projects, activities, works. E. Be able to analyze the relationship between the functional strategies of companies in order to prepare balanced management decisions. Systematize and obtain the necessary data to analyze the activities of the industry enterprise.
6. Author of the course	
7. Basic literature	1. Belyaev, A.M. Production management: Textbook for bachelors / I.N. Ivanov, A.M. Belyaev, V.V. Lobachev; Edited by I.N. Ivanov. - M.: Yurayt, 2013. - 574 p. 2. Sitnikov, S.G. Production management at telecommunication enterprises: A textbook for universities / S.G. Sitnikov. - M.: Gor. liniya-Telecom, 2013. - 276 p. 3. Shemyakina, T.Y. Production management: quality management (in construction): Textbook / T.Y. Shemyakina, M.Y. Selivokhin. - M.: Alfa-M, SIC INFRA-M, 2013. - 272 p. 4. Alexandrova, A.V. Strategic management: Textbook / N.A. Kazakova, A.V. Alexandrova, S.A. Kurashova, N.N. Kondrashova. - M.: SIC INFRA-

	M, 2013. - 320 p. 5. Production management: a textbook / E. M. Gainutdinov, L. I. Podderegina. – Minsk: Higher School, 2010. – 319, p . 6.Production management: textbook / E. M. Karpenko, S. Y. Komkov. – Gomel: GSTU, 2010. – 519 p.
8. Content of the discipline. Introduction to production management. Designing a new product. Management of innovative projects. Types of production processes. Production cycle. Production capacity. Placement of enterprises. The production structure of the enterprise. Organization of production by in-line methods. Organization of production maintenance. Product quality strategy. Production inventory management. Production planning and organization of product sales. Formation of production programs. Operational production management.	

1. Basic information about the discipline:	
Name of the discipline	**Digital technologies in crop production**
2. Number of credits	4
3. Prerequisites:	Basic and profile Bachelor's degree disciplines
4. Post-requirements:	Crop production, agriculture.
5. Competencies:	have an idea: - on the methods of rational and efficient use of land, increasing soil fertility, increasing crop productivity and the principle of operation of modern geoinformation systems for satellite monitoring and monitoring of agricultural machinery, growth and development of crops; know: information technologies to reduce costs and minimize the impact on the environment; - electronic field maps; - regulation of the production process of plants by microperiods of organogenesis using self-adjusting automated means based on electronic control systems; be able to: use new modern information technologies in crop production; - determination of yield during harvesting using yield counters; have skills:work with electronic maps of the economy in GIS; - maintaining databases of personnel, customers, farm fields, mobile energy facilities, agricultural machinery, management strategy that uses information technology; - assessment of spatial heterogeneity of soil cover and crops. be competent:- solving standard tasks of professional activity with the use of information and communication technologies.
6. Author of the course	Amantaev Bekzat Omirzakovich,
7. Basic literature	1. Lichman G.I., Marchenko N.M., Drincha V.M. Basic principles and prospects for the application of precision agriculture. M., Russian Agricultural Academy, 2004, 80c. 2.Yakushev V.P. et al. What is precision farming? St. Petersburg, AFI, 2004, 18c. 3.Mikhailenko I.M., Management of precision farming systems. - St. Petersburg: Publishing House of St. Petersburg University, 2005. - 234 p. 4. V.P. Yakushev, V.V. Yakushev. Information support of precision agriculture. - St. Petersburg: Publishing House of the Russian Academy of Sciences. 2007. - p. 384.
8. The content of the discipline. Features of GIS application in crop production, main functions and examples of geoinformation systems. Technological approaches to the introduction of precision agriculture in the production of crop products. Database of personnel, customers, farm fields, mobile energy facilities,	

agricultural machines Mapping of fields in the precision farming system. Normalized vegetation Index NDVI (Normalized Difference Vegetation Index). The use of ICT in the production of crop production. The agronomist's tablet.

1. Basic information about the discipline:	
Name of the discipline	**Advanced biometeorology**
2. Number of credits	4
3. Prerequisites:	Basic and profile Bachelor's degree disciplines
4. Post-requirements:	Specialized disciplines. Professional activity.
5. Competencies:	*have an idea of:* meteorological factors and physical processes occurring in the atmosphere; climate classifications, climate changes. *be able to:* carry out meteorological observations, with the help of meteorological instruments, possess methods of forecasting adverse meteorological phenomena. *have skills:*- work with modern meteorological instruments and their use in meteorological observations and measurements and when performing work in agriculture; *be competent:* in methods of forecasting adverse meteorological phenomena, in measures for anthropogenic climate regulation.
6. Author of the course	Zhumagulov Iglik Imangalievich
7. Basic literature	1. IPCC, 2007: Climate Change, 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 2007. - 104 p. 2. Karol I.L. Introduction to the dynamics of the Earth's climate. L.: Hydrometeoizdat, 1988. - 215 p. 3. Poltaraus B.V., Kisloe A.V. Climatology. M.; Moscow Publishing House. Un-ta, 1986. - 144 p. 4. Glantz M.H. Climate affairs: a primer. National Center for Atmospheric Research. Island Press, 2003, 292 p. 5. Controlling vehicular emissions in Beijing during the last decade. Hao Jiming. Hu Jingnan. Transp. Res. A. 2006. 40, №8, pp. 639-651.
8. The content of the discipline. Atmosphere, weather, climate. World Climate Observation Service: ground and space observation systems, global communication system, global data processing system. Weather forecast. Weather service. Climate formation. Fundamentals of limiting anthropogenic greenhouse gas emissions. The UN Framework Convention on Climate Change. Kyoto Protocol to the UN Framework Convention on Climate Change.Fundamentals of limiting anthropogenic greenhouse gas emissions. The UN Framework Convention on Climate Change. Kyoto Protocol to the UN Framework Convention on Climate Change.	

1. Basic information about the discipline:	
Name of the discipline	**Agro-soil science**
2. Number of credits	5
3. Prerequisites:	Chemistry, Fundamentals of Soil Science, Biology
4. Post-requirements:	Agriculture, Crop production, Feed production
5. Competencies:	**they must know and understand (descriptor A):** factors of soil formation, composition, agrophysical and physico-chemical properties of

	soils; production and genetic classification of soils; classifications of micro- and mesostructures of soil cover; heterogeneity of soils; features of changes in soil cover and soils as a result of agricultural use; features of the application of GIS technologies in soil science. **Be able (descriptor B):** to determine the physical properties of soils; to evaluate the physico-chemical, agrochemical indicators of soil fertility in terms of suitability for cultivation of various crops; to regulate soil conditions. **Possess (Descriptor C):** methods for assessing the agronomic properties and regimes of soils in order to regulate them; methods for compiling electronic soil maps; techniques for compiling and implementing in practice a system of agrotechnical and measures to increase soil fertility and crop yields. **Have communication skills (Descriptor D)** to discuss the state of the soil cover and ways to increase soil fertility. **To acquire practical skills (descriptor E)** of working with GIS technologies, to search, analyze and evaluate professional information, data from scientific reports, special literature.
6. Author of the course	Mukhametkarimov K.M.
7. Basic literature	1. Mukha V.D. et al. Agro–soil science. - M.: Kolos, 1994. 2.Faizov K.Sh. Soils of the Republic of Kazakhstan. Almaty, Aleyron Publishing House, 2001 – 328 p. 3. Valkov V. F., Kazeev K. Sh., Kolesnikov S. I. Soil science. Yurayt - Moscow, 2013. - 528 p. 4.Aparin B. F. Soil Science. Academy-Moscow, 2012. - 272 p. 5. Agroecological assessment of lands, design of adaptive landscape systems of agriculture and agrotechnologies (edited by V.I.Kiryushin). Moscow: Rosinformagrotech, 2005. -784 p.
8. Content of the discipline Factors of soil formation, composition and properties of soils. Agronomic assessment of soils of the main natural zones of the Republic of Kazakhstan and their agricultural use. Reclamation assessment of soils, improvement techniques and use. Soil change as a result of agricultural use. Soil bonitization and agroecological land typification. Basics of mapping. GIS systems in soil cartography, creation of a database in geoinformation systems. Creating an electronic card.	

1. Basic information about the discipline:	
Name of the discipline	**Physics and chemistry of soil**
2. Number of credits	5
3. Prerequisites:	Biology, Chemistry, geology, fundamentals of soil science
4. Post-requirements:	Digital technologies in crop production, GIS and remote sensing technologies in agriculture, farming systems and crop production
5. Competencies:	**A.** Knowledge and understanding of physical and chemical processes to solve the problems of optimization of agrophysical and agrochemical properties, soil bonification, development of recommendations for improving the physical condition of soils and the use of fertilizers and reclamation activities. **B.** Use theoretical and applied knowledge in practice; present and critically analyze basic information in the field of physics and chemistry of soils. **C.** The ability to formulate conclusions based on the results of the

	obtained physico-chemical properties of soils. To give an agronomic assessment of the main water, physical and chemical properties of the soil. **D.** In the field of communication - to form feelings of tolerance, responsible attitude to the environment; **E.** To apply modern experimental methods of soil research in field and laboratory conditions.
6. Author of the course	Kenzhegulova S.O.
7. Basic literature	1 Revut I.B. Soil Physics. – M., 1972. 2 Kachinsky N.A. Soil Physics, parts 1 and 2. – M., 1970. 3 Vozbutskaya A.E. Soil Chemistry. – M., 1968. 4 Orlov D.S. Soil Chemistry. – M., 1985. 5 Kononova M.M. Organic soil substance. – M., 1963. 6 Agrophysical methods of soil research. – M., 1976. 7 Kaurichev I.S. Soil science. – M., 1985. 8 Workshop on soil science. – Almaty, 1975, 2004. 9 Dimo V.N., Rode A.A. Thermal and water regime of soils of the USSR. – M., 1968. 10 Gedroits K.K. The doctrine of absorption capacity. Izb. soc. T 1. 1959.
8. Content of the discipline	Subject, purpose and objectives of the course "Physics and chemistry of soils". Granulometric and microaggregate composition of soils. Processes of soil structure formation. Specific and volumetric mass of soils. Soil air and research methods. Water and thermal regimes of soils. Modern ideas about humus formation. Soil colloids. Absorption of cations by the soil. The composition of the soil solution and methods of their study. Trace elements. The biological cycle of mineral substances, and its importance in the formation of soil types and soil fertility.

1. Basic information about the discipline:	
Name of the discipline	**Fundamentals of Plant nutrition Management**
2. Number of credits	5
3. Prerequisites:	Biology, Chemistry, Soil science
4. Post-requirements:	Digital technologies in crop production, GIS and remote sensing technologies in agriculture, farming systems and crop production
5. Competencies:	**To know and understand (Descriptor A):** the essence of plant nutrition, methods of its regulation; properties and features of the use of fertilizers; agrochemical properties of the main types of soils; the value of agrochemical examination. **Be able to (Descriptor B):** correctly determine the forms and types of fertilizers depending on the biological characteristics of crops and soil properties, calculate fertilizer rates, determine the timing, methods of their application, read agrochemical cartograms. **Possess (Descriptor C):** skills in using the results of agrochemical analyses, the results of field experiments of the Research Institute in calculating optimal fertilizer rates; skills in compiling electronic agrochemical cartograms and their application in the precision farming system. **Have communication skills (Descriptor D):** to analyze and substantiate

	conclusions on the use of fertilizers in precision farming systems. **To acquire practical skills (Descriptor E)** of using the results of agrochemical analyses to create optimal nutrition levels of agricultural crops.
6. Author of the course	Kashkarov A.A.
7. Basic literature	1 Yagodin B.A., Zhukov Yu.P., Kobzarenko V.I. Agrochemistry.-M., 2003. 2 Chernenok V.G. Nitrogen regime of soils of Northern Kazakhstan and the use of nitrogen fertilizers. - Akmola, 1997. 3 McGrath J.M., Spargo J., and Penn C.J. Soil Fertility and Plant Nutrition. In: Neal Van Alfen, editor-in-chief. Encyclopedia of Agriculture and Food Systems, Vol. 5, San Diego: Elsevier; 2014. pp. 166-184.file:///C:/Users/franp/Downloads/EncyAgfoodsystemsprintedchapter.pdf. 4 Jones, C., and K. Olson-Rutz. Plant Nutrition and Soil Fertility. Nutrient Management Module No. 2. Bulletin 4449-2, Montana State University Extension. Accessed October 31, 2018 at http://landresources.montana.edu/nm/documents/NM2.pdf. 5 Varinderpal-Singh, R. Kaur, Bijay-Singh, B S Brar, and A. Kaur. 2016. Precision nutrient management: A review. Indian Journal of Fertilizers 12(11):1-15https://www.researchgate.net/publication
8. Content of the discipline. Theory of plant nutrition, mechanisms and methods of plant nutrition regulation. Soil properties in connection with plant nutrition and the use of fertilizers. Agrochemical characteristics of the soils of the Republic of Kazakhstan. The concept of fertilizers, application features. Physico-chemical properties of fertilizers, their interaction with the soil. The utilization rate of nutrients from the soil and from fertilizers. Determination of fertilizer standards. Agrochemical examination of soils. Compilation and registration of electronic agrochemical cartograms. The use of the results of agrochemical analysis of soils for calculating fertilizer rates and mapping prescriptions in technologies of differentiated fertilization.	

1. Basic information about the discipline:	
Name of the discipline	**Optimization of mineral nutrition of agricultural crops**
2. Number of credits	5
3. Prerequisites:	Biology, biochemistry, agriculture, crop production, agrochemistry, scientific bases of plant nutrition and application of fertilizers
4. Post-requirements:	Digital technologies in crop production, GIS and remote sensing technologies in agriculture, farming systems and crop production
5. Competencies:	**A.** Demonstrate a systematic understanding of the theoretical foundations of plant nutrition, their requirements for environmental factors; features of the behavior and transformation of fertilizers in the soil; the nature of the interaction of factors determining the productivity of crops. **B**. Plan, develop, implement and adjust scientifically sound methods of managing soil processes, resources, rational and effective methods of using fertilizers to increase soil fertility and increasing the productivity of crops. **C.** Contribute to the expansion of knowledge on plant nutrition and soil fertility improvement. **D.** Critically analyze, evaluate and synthesize new and complex ideas in the development of a scientifically sound system for the use of fertilizers, drawing up technological projects for obtaining a given productivity of agricultural crops and reproduction of soil fertility of various agrocenoses.

	E. Communicate their knowledge and achievements about techniques and methods purposeful management of soil fertility, ensuring the optimization of nutrition and the realization of potential productivity.
6. Author of the course	Doctor of Agricultural Sciences, Professor, Academician of the Higher School of Economics Chernenok V.G.
7. Basic literature	1. V.G. Mineev. Agrochemistry. MSU, 2004., 2017 2. B.A. Yagodin. Agrochemistry. M. Kolos, 2003. 3. A.P. Shcherbakov Soil fertility, circulation and balance of nutrients. M.: Kolos, 1983. - 189 p. 4. T.M. Kulakovskaya. Optimization of the agrochemical system of soil nutrition.-M.:Agropromizdat. 5. V.G. Chernenok. Nitrogen regime of soils of Northern Kazakhstan and the use of nitrogen fertilizers. Akmola, 1997. 6. V.G. Chernenok. Features of the phosphorus regime of the soils of Northern Kazakhstan. Akmola. Bulletin of AAU Science. № 9, 1997. 7. V.G. Chernenok. Theoretical foundations for optimizing the conditions of phosphorus nutrition of grain crops. Astana. Bulletin of Science of AAU. Vol. 2. No. 2, 1998. 8. Scientific foundations and practical methods of soil fertility management and crop productivity in Northern Kazakhstan. Astana, 2009. 9. V.G. Ecological problems of agrochemistry.-M.: Publishing House of Moscow State University, 1988 V.G. Mineev. Chemicalization of agriculture and the natural environment.-M. A. Agropromizdat. is 1990
8. The content of the discipline. The role of fertilizers in the management of soil fertility, productivity and quality of agricultural crops. Foreign experience in optimizing nutrition. The state of chemicalization in the Republic of Kazakhstan. Nutrition as one of the most important factors of plant life and nutrition management techniques. The main types and forms of fertilizers, their influence on the physico-chemical properties of the soil and plant nutrition. Methods for determining the need of crops for fertilizers and their assessment. Diagnostic indicators of soil availability of batteries. Optimization of nitrogen nutrition conditions. Optimization of phosphorus nutrition conditions. Optimization of potash nutrition conditions. Methods of purposeful management of soil fertility and crop productivity. Methods of purposeful management of soil fertility and crop productivity. Methodology for constructing an optimized fertilizer system. Economic and ecological justification of methods for optimizing mineral nutrition of crops that ensure the realization of their potential and the formation of the maximum possible yield in the current conditions of cultivation (moistening).	

1. Basic information about the discipline:	
Name of the discipline	**Phytosanitary technologies of cultivation of agricultural crops**
2. Number of credits	5
3. Prerequisites:	Integrated plant protection systems against harmful organisms.
4. Post-requirements:	Master's thesis
5. Competencies:	**A.** Knowledge of modern phytosanitary technologies of crop cultivation; general principles of systemic optimization of the phytosanitary state of agroecosystems; methods of phytosanitary monitoring; environmental groupings of harmful organisms. **B.** Knowledge of modern methods of phytosanitary monitoring and

	phytosanitary diagnostics of agroecosystems according to the periods of formation of elements of the crop structure; principles of complementarity in the development of phytosanitary systems and technologies; skills in using the acquired knowledge to organize plant protection from harmful organisms. **C.** Ability to compare, formulate conclusions, build their own arguments, express their position on the main issues of crop cultivation technologies. **D.** The ability to carry out phytosanitary diagnostics on their own competently; to assess the phytosanitary condition of soil, crops, perennial plantings and crop products; to plan protective measures and independently solve plant protection problems; to competently build a system of protection of major crops.
6. Author of the course	Turganbayev T.A., Sadykov B.S.
7. Basic literature	1. Sadykov B.S. Phytosanitary technologies of cultivation of agricultural crops / B.S. Sadykov, T.A. Turganbayev. – Astana, KATU named after S. Seifullin, 2015. – 260 p. 2. V.A. Chulkina, E.Yu. Toropova, G.Ya. Stetsov. Integrated plant protection: phytosanitary systems and technologies. Moscow: Kolos, 2009. – 670 p. 3. EBS "Znanium": Bazdyrev G.I. Integrated protection of plants from harmful organisms: Textbook / G.I.Bazdyrev, N.N. Tretyakov et al. - M.: SIC INFRA-M, 2014 - 302s.
8. The content of the discipline. General principles of system optimization of phytosanitary condition of agroecosystems. Modern trends in the formation of phytosanitary. Systems and technologies for optimizing the phytosanitary condition of agroecosystems. Phytosanitary condition of agricultural land. Assessment of the state of agroecosystems and development of techniques and methods for their sustainable development. Phytosanitary technologies of cultivation of the main agricultural crops. Environmentally safe crop protection systems for farming conditions. Phytosanitary diagnostics of agroecosystems. Determination of phytosanitary problems of agroecosystems.. Methods for determining the phytosanitary condition of soils. Methods of phytoexpertiza of seeds. Methods of phytosanitary monitoring and phytosanitary diagnostics of agroecosystems by periods of formation of elements of the crop structure.	

1. Basic information about the discipline:	
Name of the discipline	**Fundamentals of scientific research and experimental planning**
2. Number of credits	5
3. Prerequisites:	History and philosophy of science
4. Post-requirements:	Technical support of technological processes in the precision farming system, Master's thesis
5. Competencies:	**A.** Knowledge and understanding of the main provisions of creative thinking; scientific tasks; creative work on the search, analysis, development and introduction into production of significant developments; goals, objectives and stages of research, experimental methods. **B.** Possession of practical skills in conducting scientific research; methods of substantiation of the main design and technological parameters of the work of working bodies, machines, aggregates; methods of conducting experimental studies and processing

	experimental data. **C.** The ability to compare, formulate conclusions, build their own argumentation, express their position on the main issues of scientific research and experimental planning. **D.** The ability to compare, formulate conclusions, build their own argumentation, express their position on the main issues of scientific research; evaluate theoretical and experimental research. **E.** The ability to analyze the state of scientific research; questions of planning experiments to substantiate the main parameters and modes of operation of working bodies, mechanisms of agrotechnological machines.
6. Author of the course	Kostyuchenkov N.V., Zaichko G.A., Iskakov R.M.
7. Basic literature	1. Kovrikov I.T. Fundamentals of scientific research and UNIRS. Textbook./ I.T. Kovrikov. – Orenburg: LLC "Agency "Press", 2011. – 212 p. 2 Leonov A.N., Dechko M.M., Lovkis V.B. Fundamentals of scientific research and modeling: UMK. – Minsk: BGATU, - 2010. - 276 p. 3 Fundamentals of scientific research in examples and tasks: an educational and methodical manual / A.N. Leonov, M.M. Dechko, V.B. Lovkis. – Minsk: BGATU, – 2013. - 136 p. 4 Rykov V.V., Itkin V.Yu. "Mathematical statistics and experiment planning", 2008. 5 Grishentsev A.Yu. "Theory and practice of technical and technological experiment", 2010.
8. The content of the discipline. The concept of creative thinking. Scientific research works. Formulation of scientific tasks, implementation of research results in production or educational process. Own argumentation expressing its position on the main issues of scientific research. Patenting, modeling of technological processes and creation of new efficient machines for agriculture. Modern methods of planning experiments of technological processes of agrotechnological machines. Key issues of planning experiments to substantiate the main parameters and modes of operation of working bodies, mechanisms of agrotechnological machines. Tasks, organization and stages of experimental research. Setting tasks. Planning an experiment to obtain a mathematical model of the process. Plans of the first order. Second-order plans. Optimization of research objects. Methodological support of the experiment.	

1. Basic information about the discipline:	
Name of the discipline	**The methodology of the experimental case**
2. Number of credits	5
3. Prerequisites:	Bachelor's degree course fundamentals of scientific research
4. Post-requirements:	Theoretical foundations of modern seed science and crop seed production, Agrobiological foundations of field crop cultivation technologies, Farming systems and crop production. Biometrics.
5. Competencies:	*have an idea:* - about modern methods of scientific agronomy. *To know:* - the main elements of the methodology of field experience, the basic principles of data processing of field experience, on the impact of the methodology of field experience on its error. *be able to:* - plan, lay and conduct single-factor and multifactorial experiments; maintain documentation and reporting on field experience; conduct phenological and other related observations of the growth and

	development of agricultural crops during their growing season. *have skills:* -the technique of laying field experience, the methodology of experiment planning; methods of crop accounting and methods of preliminary processing of experimental data; principles of processing long-term data of field experiments. *be competent:* - to the practical use of in-depth knowledge in the field of scientific agronomy.
6. Author of the course	Amralin Askar Uralovich
7. Basic literature	1 Mozhaev N. I., Serikpaev N. A., Stibayev G. zh.the basics of scientific research in agronomy. Astana, 2010. 2 armor B. A. method of field experience. Moscow, Agropromizdat Publ., 1985. 3 methods of experience in senokos and pastries. M., VNII kormov, 1971 4 Ivannikov A.V. biometrics (statistical processing of quantitative indicators). "I'm sorry," she said. - Astana: izd-Vo Kazgatu, 2005. 5 Ivannikov A.V. biometrics workshop. Training manual.- Astana: Kazatu publishing house, 2006.
8. The content of the discipline. The methodology of experimental work as a subject. The significance of the experiment for solving practical problems. Requirements for the researcher. Research methods used in scientific agronomy. Observation, experiment. Characteristics of research methods. Statistical method. Requirements for field experience. Natural and agrotechnical typicality. The main elements of the methodology of field experience. Methods of placing variants in experiments (statistical, randomized, Latin square method, standard). The influence of the elements of the methodology on the accuracy of field experience (number of variants, shape and area of the plot. The number of repetitions, the equalization of the fertility of the experimental plot, the methods of placing options, the orientation of plots in relation to the relief, roads, forest belts. Planning of field experience. Schematic plan. The work plan of the experience. Methods of accounting for yield in field experiments. Production experience. Primary processing of crop data. Basic methods of static processing of experimental data. Analysis of variance, correlation, regression. Straight-line correlation. Dot graph. Regression analysis. Preparation of a scientific report on the results of field experience. Agrotechnical and economic evaluation of the results. Promotion and implementation of the results of field experience.	