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
«30» 05 2019 y.

EDUCATIONAL PROGRAM
«Agroengineering»

Code and classification of the field of education:
08 – «Agriculture and bioresources»
Code and classification of training areas:
8D085 – «Land management»
Code in the International Standard Classification of Education:
8D08

Qualification: Doctor of Philosophy PhD/according to the educational program «Agroengineering»
Duration of training: 3 years (scientific and pedagogical direction)

Nur-Sultan, 2019

The author's team:

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The team of authors was approved by the order of JSC «KATU named after S.Seifullin» № 932-N dated 12.12.2018; № 962-N dated 12.12.2018 and № 964-N dated 12.12.2018.

Educational program «Agroengineering»
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.

Dean of the Faculty S.O. Nukeshev

Head of the Department «Agricultural Machinery and Technology» Kaspakov E.Zh

Content

1 Passport of the educational program

1.1 Purpose of the educational program:

The purpose of the educational program (EP) «Agroengineering» is to train PhD doctors with relevant professional skills and competencies that contribute to solving theoretical and practical aspects of the impact of agroengineering systems (innovative and digital technology, technologies of the agro-industrial complex) to obtain potential agricultural productivity, and systemic problems facing agriculture.

To achieve the above goal , the tasks are formulated:

1.To develop independent thinking, the ability to think scientifically and conduct scientific research in the field of agroengineering to study the behavior of growth, plant development and agroinformatics using innovative methods;

2. Association of the competent scientific and pedagogical staff of KATU, participants of agriculture for the preparation of PhD doctors, taking into account the needs of the labor market and the practice orientation of graduates;

3. Providing students with flexible educational trajectories with the formation of students' motivation for self-realization, taking into account the practice-oriented research activities;

4. Formation of scientific and professional skills and competencies among doctoral students that contribute to solving the most promising trends in agriculture and related sectors: mechanization, automation of agriculture, for solving engineering problems in agroengineering systems by using appropriate methods of analysis, synthesis and engineering design;

5. Formation of the readiness of doctors in the profile for the organization and conduct of practice-oriented innovation and research activities.

2 General characteristics of the educational program (relevance, features, competitive advantages, uniqueness, stakeholders, etc.)

The relevance of the educational program «Agroengineering» is due to the increasing demand in the labor market today for specialists, professionals in the field of modern methods of design, engineering design, planning experiments, scientific research focused on finding solutions to many of the most important global problems of our time, agroengineering, mechanization of technological processes in the precision farming system, which is in in world practice, it is very necessary for the introduction of innovations and digitalization of agriculture.

The educational program was developed jointly with professors of the University of California at Davis (USA), leading specialists and successful managers of farms, and also coordinated with the Dublin descriptors and the European Qualifications Framework on the basis of the State Mandatory Standard of Higher Education approved by the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 (№ 604) and the standard curriculum of the specialty in the field of training 8D085 – «Land management».

The total number of credits for this educational program is 180 credits, of which: the total number of credits for theoretical training is 53 credits (including all types of practices – 25 credits), the doctoral student's research work, including internship and dissertation completion – 115 credits, final certification – 12 credits.

A feature of the educational program is the consolidation of theoretical knowledge, while a high-quality professional infrastructure (educational resources) has been created on the basis of KATU, which is necessary for the implementation of OP:

-Scientific and experimental campus of the University (with an area of 12,000 hectares)

- Kazakh-Belarusian Personnel Training and Retraining Center;
- Kazakh-Chinese Agricultural Mechanization Center;
- Kazakh-German Precision Farming Center «Glass»;
- Kazakh-American Precision Farming Center «John Deer»;
- Laboratory of 3-D visualization and modeling;
- Pavilions of agricultural machinery;
- animal husbandry mechanization laboratories;
- laboratories for testing internal combustion engines and fuel injection pumps;
- laboratories of service maintenance of transport equipment;
- GIS Technology Center;
- Design Bureau;
- workshop with metal cutting and welding equipment;
- robotics laboratory;
- laboratory of fuel and lubricants;
- reading and computer rooms.

In addition, the faculty, together with doctoral students, takes an active part in the implementation of the National Program for the Digitalization of the country's agro-industrial complex. At the moment, the industries in agro-energy, agro- and bio-processing, agrotechnology, food industry, aquaculture, agriculture, crop production, animal husbandry and timber processing need specialists with good training and digital literacy.

The uniqueness of the EP lies in the absence of such programs in Kazakh universities that combine all theoretical and practical aspects of managing agroengineering systems with the most promising trends in the agro-industrial complex and related sectors - mechanization, agricultural automation, digital technologies, including blockchain technologies, KPI technologies, etc.

Within the framework of this educational program, doctoral students have the opportunity to travel to leading universities in Europe, the USA, China and the EAEU, to study and undergo scientific internships at leading universities in the world, such as the University of Angers (Université d'Angers, France), the University of California at Davis (UC Davis, USA), Xinjiang Agricultural University and the North-Western University of Agriculture and Forestry (China), Weienstephan-Triesdorf University of Applied Sciences (Germany), Belarusian

State Agrarian Technical University (Belarus), etc, Graduates of the specialty study in the master's and doctoral programs of the People's Republic of China and the USA.

The advantage of the educational program is that it is optimized on the basis of many years of practice, taking into account the solution of all accumulated problems, and is maximally adapted to the world modern realities of the development of agroengineering systems. Competent and professional teaching staff, scientific consultants of dissertations have a high citation index, as well as a huge body of knowledge, confirmed by the implementation of the results in production.

The competitive advantages of this educational program are the following:

- highly qualified and relatively young teaching staff (about 70% settled down);
- high material and technical equipment of the educational program (there are 3 operating centers at the department);
- training is conducted in three languages (state, Russian and English);
- distance learning has been introduced with the use of Internet technologies for continuous training of specialists from production;
- dual training technology has been introduced (some classes are held at production and research institutes);
- Programs have been widely implemented: international credit mobility, external and internal mobility of the Ministry of Education and Science of the Republic of Kazakhstan.
- close communication with employers and graduates of the educational program has been established;
- 100% provision of a hostel for living during training.

The main stakeholders of the EP are:

1. Teaching staff, doctoral students, undergraduates, parents, persons equated to them and relatives of doctoral students;
2. Ministry of Agriculture of the Republic of Kazakhstan – State Inspection Committee in the agro-industrial complex;
3. Management of organic products and technical regulation;
4. Research institutes and research and production centers;
5. Consulting companies for education and training;
6. Agro-industrial complex, farms and peasant farms;
7. Plants, factories and plants;
8. Patent, design bureau.

3 Competence model (portrait) graduate

3.1 Areas of professional activity

A PhD is a degree that implies some contribution to science. It is research that can become an important link in solving modern issues of science, technology and economics, which cannot but motivate. In addition, this program will allow you to continue your scientific career.

The scope of professional activity of the PhD doctor in the direction of «Agroengineering» includes:

- the study of wildlife and its patterns, the use of agroengineering systems for economic purposes;
- scientific research, scientific production, design organizations, nature protection bodies, practical enterprises and design organizations and machine testing stations;
- management activities in agricultural organizations of various forms of ownership, local and republican governing bodies of education, agriculture.

3.2 Types of professional activity

A graduate of the educational program «Agroengineering» in the field of training 8D085 – «Land management» can hold the positions of engineers, mechanics, managers, designers, leading specialists:

- in higher educational institutions, research institutes;
- in various types of agricultural formations (firms, enterprises, farms and peasant farms);
- in machine technology stations (MTS);
- in social and entrepreneurial complexes (SEC);
- at processing and energy supply enterprises, plants, factories, plants;
- in design and engineering organizations;
- in local and republican agricultural management bodies.

3.3 General education competencies

The graduate of the educational program «Agroengineering» has the following general educational competencies:

- knowledge and understanding in the field of mathematics, natural sciences and in the broad context of bioengineering;
- demonstration of developing knowledge and orientation in the field of study, based on advanced knowledge of this field, in the development and (or) application of ideas in the context of research.
- professional application of their knowledge, understanding and ability to solve problems in a new environment, in a broader interdisciplinary context.
- the ability to use the basics of natural science knowledge and methodology to identify production problems and solve professional tasks;
- confident use of modern information technologies for work, leisure and communication;
- knowledge of the traditions and culture of the peoples of Kazakhstan; awareness of the attitude of tolerant behavior of the individual and prevention of domestic racism, xenophobia, extremism; possession of high spiritual qualities;
- ability to apply modern experimental methods of working with biological objects in field and laboratory conditions, skills of working with modern equipment.

3.4 Basic competencies

Agroengineering basically considers not just science, but the practical application of scientific knowledge to solve urgent problems with the effective use of costs. The graduate of the educational program «Agroengineering» must possess the following basic competencies:

- possess basic knowledge in the field of bioengineering science, have the ability to engage in self-study, be able to effectively manage time and information, strive for professional and personal growth;
- have deep theoretical knowledge and practical experience, basic engineering knowledge in the field of development of agroengineering systems, mechanization of agricultural production;
- have scientific ideas about agroengineering, deep theoretical knowledge and practical experience, the ability to apply modern ideas about the basics of agrotechnological production, genetic engineering, nanobiotechnology and molecular modeling;
- to know and understand the goals and objectives of production, technological, organizational and managerial activities in the field of development of agroengineering systems in the agricultural direction.

3.5 Professional competencies

The professionalism of the PhD doctor is considered today as a condition for achieving effective and modern software and solving scientific and production tasks. Modernization of production forms new models of problem solving in order to qualitatively increase their level of scientific self-knowledge. Therefore, a graduate of this educational program will be able to set goals and achieve them, plan their work, be able to develop a strategy for solving a problem and aim at its implementation, constantly improve their professional level and monitor the achievements of science and technology in their field.

The doctoral student of the educational program «Agroengineering» must possess the following key competencies:

- to consider rationalization proposals for improving the technologies of storage and processing of agricultural products and to give conclusions on the expediency of their use.
- have deep theoretical knowledge and practical experience,

basic engineering knowledge in the field of development of agroengineering systems and mechanization of agricultural production, have scientific ideas about agroengineering;

- to know and understand the goals and objectives of production, technological, organizational and managerial activities in the field of development of agroengineering systems in the agricultural direction.

4 Base of professional practices (all types of practices)

The educational program of the scientific and pedagogical doctoral program includes 2 types of practices - pedagogical, research:

Pedagogical practice is organized in order to develop the skills of doctoral students to develop a training course, independently conduct all types of training sessions, as well as gain experience in organizational and educational work. Pedagogical practice of doctoral students is a mandatory part of the educational program of higher professional education and is conducted in accordance with the approved working curriculum and schedule of the educational process.

Research practice is a form of professional training of doctoral students for scientific, pedagogical and scientific activities, which is a type of practical activity of doctoral students related to conducting scientific research within the chosen topic of research work. The objects of the doctoral student's research practice are various organizations of the industrial, research sphere, divisions of enterprises, farms and peasant farms, joint-stock companies and private firms, as well as higher educational institutions. It also applies to scientific and production associations, scientific, design and design organizations, public administration bodies and social infrastructure of the national economy. The University has concluded contracts with enterprises for the passage of doctoral students.

The largest employers for conducting research practices are: scientific and production center of grain farming named after A.I. Barayev; LLP "North Kazakhstan Agricultural Experimental Station"; JSC Atameken-Agro; LLP "Agrocenter Astana"; LLP Agrofirma "Rodina"; LLP "Eurasia Group"; Akkol branch of LLP "KazNIIMESH"; Akmola Phoenix LLP; Izhevsk PC; TNK LLP; Shakhterskoye LLP; STAGRO LLP; Agricultural Engineering Design Bureau; S.Seifullin Kazakh Agrotechnical University, etc.

5 Structure of the educational program of doctoral studies 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.	Educational component	660	23
1.1	Cycle of basic disciplines (BD)	330	11
1)	University component — Complex analysis	120	4
2)	Elective component — Pedagogical activity of a higher school teacher	90	3
	Component of choice — Forecasting of technological progress and justification of the machine system in crop production	120	4
3)	Pedagogical practice	300	30
1.2	Cycle of profile disciplines (PD)	330	12
1)	University component - Scientific foundations of precision agriculture	120	4
	University component - Modern equipment and means of mechanization of production processes in crop production	120	4
	Component of choice — Methodology of scientific research and experimental data processing	90	3
3)	Research practice	300	10
2	Research work	300	10
1)	Research work of a doctoral student, including internship and doctoral dissertation	3390	113
3	Additional types of training		
4	Final certification	360	12
1)	Writing and defending a doctoral dissertation	360	12
	Total	5400	180

Appendix 1. Academic Calendar***

Академический календарь на 2019-2022 гг.
для образовательной программы "Агроинженерия"
Код и классификация направлений подготовки 8D085-Землеустройство
Степень: доктор PhD (научно-педагогическое)

Срок обучения: 3 года
Форма обучения: очная

КУРСЫ		Сентябрь					Октябрь					Ноябрь				Декабрь				Январь				
I	2019	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
	2020	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31
№ недели		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
I		П	.	.	.	.	./РК	.	.	./Н	./Н	./РК	С	С	ЗД	Зд/Зс	К	К	К	.	.	./РК	.	./РК
II	2020		31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25
	2021		4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29
№ недели		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
II			Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	ОН	К	К	Н	Н	Н	Н	Н	Н	Н	Н	Н
III	2021		30	6	13	20	27	4	10	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24
	2022		3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28
№ недели		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
III			Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	ОН	К	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н

КУРСЫ		Февраль				Март				Апрель				Май				Июнь				Июль				Август			
I	2019	3	10	17	24	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24
	2020	7	14	21	28	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28
№ недели		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
I		Пп	Пп/Н	Пп/Н	Пп/Н	Пп/Н	Пп/Н	С	Ип/Ия	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	Ип	К	К	К	К
II	2020	1	8	15	22	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23
	2021	5	12	19	26	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
№ недели		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
II		Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	ОН	К	К	К	К	К	К	К	К	К	К	К	К	К	К	К
III	2021	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	
	2022	4	11	18	25	4	11	19	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26
№ недели		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
III		ОН	Н	Н	Н	Н	Н	Н	Н	Н	Ия	Ия	Ия	Ия	Ия	Ия	Ия	Ия	Ия	Ия	Ия	Ия									

1 кредит НИРД в период теоретического обучения

Обозначения

Презентация	Теор. обучение	Экзамен сессия	Рубеж контроль	Каникулы	НИРД	Отчет НИРД	Итоговая аттестация	Исследовательская практика	Запись на дисципли	Педагогическая практика	Сдача FX	Летний семестр
П	•	С	Р	К	Н	ОН	ИА	Ип	ЗД	Пп	Зд/Зс	Л

Праздничные дни

День знаний	1 сентября	Международный женский день	8 марта
День Первого президента	1 декабря	Праздник "Наурыз"	21-23 марта
День независимости РК	16 - 17 декабря	День единства народов Казахстана	1 мая
Новый год	1-2 января	День защитника отечества	7 мая
День Конституции РК	30 августа	День Победы	9 мая
		День столицы	6

Appendix 2. Working Curriculum

Шифр модуля	Наименование модуля	Цикл дисциплины	Компонент дисциплины	Код дисциплины	Наименование дисциплины	Кредиты РК	Кредиты ECTS	Контроль по семестрам			Объем в часах							Распределение объема учебных часов по семестрам/триместрам/ кварталам								
								Экзамены	Дифференцированный зачет (практика)	Дифференцированный зачет (курсовая)	Всего	Аудиторные	в т.ч.			СРДП	СРД	1	2	3	4	5	6	7	8	9
													Лекции	Практические	РК1,РК2, Экз			Количество недель в семестре/триместре/квартале								
Модули специальности																										
1		ПД		ПИ	Исследовательская практика	20	80		3		600									20						
2		ПД	ВК	NOTZ 7301	Научные основы точного земледелия	5	7,5	2			150	50	30	20			100		5							
3	Механический	ПД	ВК	SolSMPPvR 7302	Современное оборудование и средства механизации процессов производства в растениеводстве	6	9	1			180	60	30	30			120	6								
4		БД	ВК	КА 7303	Комплексный анализ	6	9	1			150	50	30	20			100	6								
5		БД	КВ	PDPVSH 7202	Педагогическая деятельность преподавателя высшей школы	5	7,5	2			180	60	30	30			120		5							
				PTPIOSMvR 7202	Прогнозирование технического прогресса и обоснование системы машин в растениеводстве																					
6	Инженерно-математический	БД	ВК	ПП	Педагогическая практика	5	20		2		150	50	30	20			100		5							
8	Методологический	ПД	КВ	MNE 7201	Методология научного эксперимента	6	9	1			180	60	30	30/.			120	6								
				MMB 7304	Методика научных исследований и обработки опытных данных																					
Итого теоретического обучения						53	142	5	2	0	1590	330	180	150			660									
НИРД	Научно-исследовательская работа докторанта, включая прохождение стажировки и выполнение докторской диссертации					115	460		1,2,3,4,5,6,7,8,9		3450							2	4	1	20	20	20	20	20	8
ИА	Итоговая аттестация					12	48		6		360															12
	Оформление и защита докторской диссертации					12	48		6		360															
	Итого					180					5400	330	180	150			660	20	19	21	20	20	20	20	20	20

Appendix 3. Description of the disciplines of the university component

1. Basic information about the discipline:	
Name of the discipline	**Comprehensive analysis**
2. Number of credits	5
3. Prerequisites:	Mathematics (calculus, vector analysis, linear algebra, differential equations), physics
4. Post-requirements:	Doctoral dissertation
5. Competencies:	**A.** To use the concepts and methods of mathematics in the practice of scientific research, the study of general and particular methods of mathematical description of natural phenomena; **B.** Acquisition of practical skills in applying the basics of mathematical apparatus to solve theoretical and applied problems, the ability to translate the solution of practical problems into the language of logic. **C.** The ability to compare, formulate a statement of problems, build their own method of solution, prove and substantiate the correctness of your reasoning; **D.** In the field of communication – the formation of personality, the development of intelligence and abilities for logical and algorithmic thinking; **E.** In the field of education – the ability to apply mathematical methods in various branches of natural science and technology, obtaining systematic fundamental education.
6. Author of the course	Department of Mathematics
7. Basic literature	1. Elias Stein and Remi Shakarachi. Complex Analysis, Princeton Lectures in Analysis. 2003. UK: Princeton University Press. (from the UC Davis website) 2. Rick Miranda, Algebraic Curves and Riemann Surfaces (AND, Graduate Studies in Mathematics, Vol 5), ISBN10:0821802682. (from the UC Davis website) 3. T. Gamelin. Complex Analysis, Springer Verlag, 2001, 478 pages, ISBN 0387950699. (from the UC Davis website) 4. Eberhard Freitag, Rolf Busam, Complex Analysis, Springer Verlag, 2005, 547 pages. ISBN 3540257241. (from the UC Davis website) 5. Jerrold E. Marsden, Michael J. Hoffman, Basic Complex Analysis, 1998. ISBN-10: 071672877X. (from the UC Davis website) 6. Sveshnikov A.G. Tikhonov A.N., Theory of functions of a complex variable. Moscow: MSU, 2004. 7. Shabunin M.I. Theory of functions of a complex variable. M.: BINOM, 2002, 248 p. 8. Privalov I.I. Introduction to the theory of functions of a complex variable. Saint Petersburg: Lan, 2009. 432 p.
8. The content of the discipline. Analytic continuation, Riemann surfaces, conformal mapping, Riemann's theorem, integer functions, special functions, elliptic functions. Cauchy's theorem, Cauchy integral formula, meromorphic functions, complex logarithm, integer functions, Weierstrass formula, gamma and zeta functions, prime number theorem. Conformal mapping, Schwartz's lemma, analytic automorphisms, Riemann's theorem, elliptic functions, Eisenstein series, Jacobi theta functions, asymptotics, Bessel functions, Airy function, Riemann surfaces.	

1. Basic information about the discipline:	
Name of the discipline	**Scientific foundations of precision agriculture**
2. Number of credits	5
3. Prerequisites:	Technical support of technological processes in the precision farming system, advanced biometeorology
4. Post-requirements:	PhD thesis
5. Competencies:	**A.** Knowledge and understanding of modern systems of precise technologies of cultivation of agricultural crops; knowledge of the general principles of systems, technical means of monitoring the condition of fields; knowledge of the economic and environmental effects of the use of precise technologies. **B**. Knowledge of modern monitoring methods and means of information support for modern agriculture; procedures for obtaining and interpreting remote sensing of the Earth; skills in using mechanisms for improving and developing the information technology base of precision agriculture for the production of crop products. **C.** Ability to compare, formulate conclusions, build their own arguments, express their position on the main issues of crop cultivation technologies monitoring. **D.** The ability to use the methodology of modern modeling methods to solve precision farming problems; organization of precision experiments in soil and climatic conditions of a particular farm; assess the condition of the soil, crops; plan activities and independently solve precision farming problems.
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	**Modern equipment and means of mechanization of production processes in crop production**
2. Number of credits	6
3. Prerequisites:	Theoretical foundations of agricultural production mechanization (Master's degree course)
4. Post-requirements:	PhD thesis
5. Competencies:	**A**. Knowledge and understanding of the main tasks of mechanization of crop production. **B.** Knowledge of methods of solving problems in the field of improving the designs of mechanization tools, finding methods to improve their performance. **C**. Ability to compare, formulate conclusions, build their own arguments, express their position on the main issues of the development of new technical means and modes of agricultural technological processes. **D.** The ability to present basic technical, scientific and theoretical knowledge and skills of their application to solve theoretical and practical tasks in the field of high–performance use of agricultural machinery in the production of crop production. **E.** The ability to identify priorities for solving problems taking into account various aspects of activity.
6. Author of the course	Aduov M.A.
7. Basic literature	1 Khalansky V.M., Gorbachev I.V. Agricultural machines - M.: KolosS, 2004. — 624 p. 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., Karpov S.N., Nukusheva S.A. Seeders with combined coulters for direct sowing of grain crops. Monograph, KATU named after S. Seifullin, - Astana: 2017. - 142 p.
8. The content of the discipline. Modern machines and tools for tillage. Technological bases of mechanical tillage. Tillage machines and tools for tillage. Traction resistance and balance of the arable unit. Interaction of working bodies of machines with agricultural crops. Machines for applying organic and mineral fertilizers. Technological process of machines and calculation of basic parameters. 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. Forage harvesting machines. Harvesting machines. Grain cleaning and sorting machines. Reclamation machines.	

Appendix 4. Description of elective component disciplines

1. Basic information about the discipline:	
Name of the discipline	**Pedagogical activity of a high school teacher**
2. Number of credits	5
3. Prerequisites:	Higher School Pedagogy (Master's degree course)
4. Post-requirements:	PhD thesis
5. Competencies:	**A.** Knowledge and understanding about the basics of the theory of education, upbringing and development, the general and professional pedagogical culture of the teacher, about pedagogical values in the structure of professional pedagogical culture, about the technology of pedagogical activity, about the theory and practice of pedagogical management, about the norms of professional and pedagogical ethics, about the essence and means of advanced training of specialists, scientific schools **B**.Knowledge of methods of solving problems in the conditions of globalization and internationalization; methodology of scientific cognition. **C.** The ability to organize, plan and implement the process of scientific research; analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions; analyze and process information from various sources; embody professional and personal-creative potential for the implementation of state policy and strategy in the field of education, solving problems and tasks of improving and developing methodological, theoretical, methodological and other bases and means of training competitive and mobile specialists. **D.** The ability to present the skills of pedagogical and personal interaction and communication with the subjects of the educational process, in the context of jointly achieving the goals and solving the tasks of teaching and training specialists, using the appropriate languages of communication, education and upbringing, as well as modern rules, methods and means of communication. **E.** The ability to promote the development of a knowledge-based society.
6. Author of the course	Sagalieva Zh.K.
7. Basic literature	1. Ibraeva K.J. «Pedagogy of higher school», 2012. 2. Fundamentals of pedagogical activity [Electronic resource], 2008. Karaganda: KarSU Publishing House http://www.rmeb.kz/default.asp?sign=1&dbid=RMEB 3. Vakhterov V.P. Subject method of teaching, 2014. http://e.lanbook.com/books/element.php?pl1_id=46362
8. The content of the discipline. Fundamentals of the theory of teaching, upbringing and development, general and professional pedagogical culture of the teacher, pedagogical values in the structure of professional pedagogical culture, technology of pedagogical activity, theory and practice of pedagogical management, norms of professional and pedagogical ethics, the essence and means of advanced training of specialists. The application of acquired knowledge and skills, developed abilities in pedagogical, scientific, social and other activities that serve to ensure the required quality and effectiveness of training, the upbringing of a harmoniously and	

comprehensively developed personality of the student, the realization of the idea of advanced vocational education. The ability to really embody professional and personal-creative potential: for the implementation of the state's policy and strategy in the field of education, solving problems and tasks of improving and developing methodological, theoretical, methodological and other foundations and means of training competitive and mobile specialists; for the formation of fundamental and systemic knowledge, as well as relevant skills, competencies and methods students' thinking, for the development of innovative pedagogical systems, methods, methods and technologies of teaching. The skills of pedagogical and personal interaction and communication with the subjects of the educational process, in the context of joint achievement of goals and solving the tasks of teaching and training specialists, using the appropriate languages of communication, education and upbringing, as well as modern rules, methods and means of communication. Possession of didactic knowledge and skills, modern teaching methods and technologies, the art of managing the educational process for the effective achievement of learning goals and results.

1. Basic information about the discipline:	
Name of the discipline	**Forecasting of technological progress and justification of the machine system in crop production**
2. Number of credits	5
3. Prerequisites:	Fundamentals of Scientific Research (Master's degree course)
4. Post-requirements:	PhD thesis
5. Competencies:	**A.** Have an idea of the main characteristics of machines, trends in the improvement of technical means, technology of agricultural work and the justification of the system of machines for agricultural production. **B.** Know practical skills in determining quality indicators, cleaning, drying and active ventilation of agricultural raw materials. **C.** Be able to implement the process of scientific research; analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions; analyze and process information from various sources; conduct independent scientific research characterized by academic integrity, based on modern theories and methods of analysis. **D.** Have skills in the field of critical analysis, evaluation and comparison of various scientific theories and ideas; analytical and experimental scientific activities; scientific writing and scientific communication; planning, coordination and implementation of research processes; participation in scientific events, fundamental scientific domestic and international projects; formation of a sense of tolerance, respect and compliance with legislation. **E**. Be competent in the field of scientific and pedagogical activity in conditions of rapid renewal and growth of information flows; in conducting theoretical and experimental scientific research; in the field of designing and creating new types of mechanized technologies and means of mechanization of agriculture.
6. Author of the course	Iskakov R.M.
7. Basic literature	1. Iskakov R.M. Engineering design. Astana, 2016. – 124 p. 2. Small Russian Encyclopedia of Prognostics, ed. Bestuzheva-Lada I.V., M., Institute of Economic Strategies, 2007. 3. Business planning: Textbook for universities/ Edited by V.M. Popov, S.I. Lyapunov, S.G. Mlodika. – M.: Finance and Statistics, 2012. – 816 p. 4. Collection of business plans with comments and recommendations / Edited by V.M. Popov. — M.: Finance and Statistics, 2012. — 488 p. 5. Babich, T.N. Forecasting and planning in market conditions: Textbook / T.N. Babich, I.A. Kozyeva, Yu.V. Vertakova, E.N. Kuzbozhev. - M.: SIC INFRA-M, 2013. - 336 p. 6. Babkov, V.Yu. Mobile communication networks. Frequency-territorial planning: Textbook / V.Yu. Babkov. - M.: GLT, 2013. - 222 p. 7. Bochkarev, A.A. Planning and modeling of the supply chain / A.A. Bochkarev. - M.: Alfa-Press, 2008. - 192 p.
8. The content of the discipline. Methods of forecasting and planning. Budget planning. Cost management. Methods of forecasting scientific and technological progress. Principles and main stages of forecasting. Planning as a science and type of activity. Fundamentals of forecasting methodology. Feasibility study. Business plans. Comparison of costs, investments and payback.	

1. Basic information about the discipline:	
Name of the discipline	**Methodology of scientific experiment**
2. Number of credits	6
3. Prerequisites:	Mathematics, physics, theoretical mechanics, circuit theory, MTP operation, mathematical modeling of technological processes of agricultural machinery, history and philosophy of science, fundamentals of scientific research, Master's thesis.
4. Post-requirements:	Technical support of technological processes in the precision farming system, PhD thesis
5. Competencies:	**A.** Have an idea about the use of scientific research, scientific information in practice; setting scientific tasks; independent, creative work on the search, analysis, development in the production of scientific and technical developments. **B.** Know practical skills in conducting scientific research, methods of conducting experimental research and processing experimental data. **C.** Be able to compare, formulate conclusions, build arguments, express their position on the main issues of scientific research; evaluate theoretical and experimental research. **D.** Have skills in the field of tolerance, respect and compliance with legislation in the field of scientific research, the use of planning experiments of technological processes. **E.** Be competent in conducting scientific research to substantiate the parameters and modes of working bodies of agricultural machines.
6. Author of the course	Kostyuchenkov N.V.
7. Basic literature	1. Fundamentals of scientific research: Textbook / B.C. Kravchenko, E.I. Trubilin, B.C. Kurasov, V.V. Kutseev, E.V. Truflyak. KubGAU. - Krasnodar, 2005. 136 p. 2. Fundamentals of scientific research: Methodological guidelines. Collection of tasks / B.C. Kravchenko, E.I. Trubilin, B.C. Kurasov, V.V. Kutseev, E.V. Truflyak. KubGAU. - Krasnodar, 2005. 105 p. 3. Vedenyapin G.V. General methodology of experimental research and processing of experimental data. – M.: Kolos, 1973. 4. Zavalishin F.S., Matsiev M.G. Methods of research on the mechanization of agricultural production. – M.: Kolos, 1982.5. Melnikov S.V., Aleshkin V.R., Roshchin P.M. Experiment planning in research of agricultural processes. – L.: Kolos, 1980. 6. Kovrikov I.T. Fundamentals of scientific research and UNIRS. Textbook./ I.T. Kovrikov.-Orenburg: LLC "Agency "Press", 2011.212 p. 7. Fundamentals of scientific research and modeling: educational and methodological complex /A.N. Leonov, M.M. Dechko, V.B. Lovkis. -Minsk : BGATU, 2010. - 276 p. 8. Fundamentals of scientific research in examples and tasks: an educational and methodological manual/A.N. Leonov, M.M. Dechko, V.B. Lovkis; edited by A.N. Leonov – Minsk: BGATU, 2013. 136 p.
8. The content of the discipline. Basic concepts and definitions. Research methodology. Methodology of scientific experiment. Establishing the degree of mutual connection between phenomena. Processing and analysis of research results. Analysis of variance. Planning an experiment while searching for optimal conditions. Correlation and regression analysis. Approximation of experimental data by the least squares method. Modern programs and technical means of visual observation of ongoing processes on the PC display. Fundamentals of identification of technological systems of agro-industrial complex, Simulation of technological processes on a PC.	

1. Basic information about the discipline:	
Name of the discipline	**Methodology of scientific research and experimental data processing**
2. Number of credits	6
3. Prerequisites:	philosophy of science, fundamentals of scientific research, master's thesis.
4. Post-requirements:	Technical support of technological processes in the precision farming system, PhD thesis
5. Competencies:	**A**. Have an idea about the use of scientific research, scientific information in practice; setting scientific tasks; independent, creative work on the search, analysis, development in the production of scientific and technical developments. **B**. Know practical skills in conducting scientific research, methods of conducting experimental research and processing experimental data; **C**. Be able to compare, formulate conclusions, build arguments, express their position on the main issues of scientific research; evaluate theoretical and experimental research. **D.** Have skills in the field of tolerance, respect and compliance with legislation in the field of scientific research, the use of planning experiments of technological processes; **E.** Be competent in conducting scientific research to substantiate the parameters and modes of working bodies of agricultural machines.
6. Author of the course	Kostyuchenkov N.V.
7. Basic literature	1. Fundamentals of scientific research: Textbook / B.C. Kravchenko, E.I. Trubilin, B.C. Kurasov, V.V. Kutseev, E.V. Truflyak. KubGAU. - Krasnodar, 2005. 136 p. 2. Fundamentals of scientific research: Methodological guidelines. Collection of tasks / B.C. Kravchenko, E.I. Trubilin, B.C. Kurasov, V.V. Kutseev, E.V. Truflyak. KubGAU. - Krasnodar, 2005. 105 p. 3. Vedenyapin G.V. General methodology of experimental research and processing of experimental data. – M.: Kolos, 1973. 4. Zavalishin F.S., Matsiev M.G. Methods of research on the mechanization of agricultural production. – M.: Kolos, 1982.5. Melnikov S.V., Aleshkin V.R., Roshchin P.M. Experiment planning in research of agricultural processes. – L.: Kolos, 1980. 6. Kovrikov I.T. Fundamentals of scientific research and UNIRS. Textbook./ I.T. Kovrikov.-Orenburg: LLC "Agency "Press", 2011.212 p. 8. Fundamentals of scientific research in examples and tasks: an educational and methodical manual/A.N. Leonov, M.M. Dechko, V.B. Lovkis; edited by A.N. Leonov – Minsk: BGATU, 2013. 136 p.

8. The content of the discipline. BASIC CONCEPTS AND DEFINITIONS. Classification of studies. Stages and sequence of research work. The concept of observation and measurement. Observation errors. Planning and organization of the experiment. RESEARCH METHODOLOGY. The concept of research methodology. Errors of measuring instruments. Determination of the time spent on research. PROCESSING AND ANALYSIS OF RESEARCH RESULTS. Basic concepts of mathematical statistics. Problems of mathematical statistics in the processing of experimental data. ANALYSIS OF VARIANCE. PLANNING AN EXPERIMENT WHILE SEARCHING FOR OPTIMAL CONDITIONS. Basic concepts and definitions. Setting up and conducting an experiment. Processing of the obtained results and construction of a mathematical model. CORRELATION AND REGRESSION ANALYSIS. APPROXIMATION OF EXPERIMENTAL DATA BY THE LEAST SQUARES METHOD. Linear function. Quadratic function. Hyperbolic function. Exponential function.