SAKEN SEIFULLIN
UNIVERSITY

ХАЛЫҚАРАЛЫҚ УНИВЕРСИТЕТІ
МЕЖДУНАРОДНЫЙ УНИВЕРСИТЕТ
INTERNATIONAL UNIVERSITY

CONFIRMED
Deputy Chairman of the Board for Academic Affairs - Rector of Seifullin Kazakh Agricultural University
A. Abdyrov
28.10 20 21 y.

CONFIRMED
Chairman of the Board, Rector
JSC «International University of Information Technologies»
A.K. Khikmetov
26.01 20 21 y.

EDUCATIONAL PROGRAM

«6B06115 - Digital agricultural systems and complexes»

Code and classification of the field of education: 6B06 - Information and communication technologies

Code and classification of areas of study: 6B061 - Information and communication technology

Group of educational programs: 057 - Information technology

ISCED level: 6

NQF level: 6

ORC level: 6

Duration of study: 4 years

Credits: 240

Almaty, 2021

Authors' team:

1. JSC "International University of Information Technologies":

1.1 Uskenbayeva R.K., – Rector of JSC "MUIT"

1.2 Sharipov B.Zh. – Director of the "Center for Educational Innovation and SMART Learning"

1.3 Umarov T.F. – First Vice-Rector of JSC "MUIT"

1.4 Rysbayuly B. – Professor of the Department of "Mathematical and Computer Modeling"

1.5 Ydyris A.Zh. – Head of the Department of "Mathematical and Computer Modeling"

1.6 Ipalakova M.T.–head.Department of Computer Engineering and Information Security

1.7 Bakhtiyarova E.A. – Head of the Department "Radio Engineering, Electronics and Telecommunications"2.

2. NAO "Kazakh Agrotechnical Research University named after S.Seifullin":

2.1 Ismailova A.A. - PhD, Associate Professor of the Department of «Information systems» of S.Seifullin KATRU;

2.2 Shausenova A. G. – Candidate of technical sciences, head of the department "Information systems" of S. Seifullin KATRU;

2.3 Issakova G.O. - PhD, Senior Lecturer of the Department "Information Systems", S. Seifullin KATRU;

2.4 Likhachevsky D.V. – Candidate of technical sciences, Associate Professor, Dean of the Faculty of Computer Engineering of the Belarusian State University of Informatics and Radioelectronics, Belarus;

2.5 Tanykpaeva B. E. - Senior Lecturer of the Department "Information Systems", S. Seifullin KATRU;

2.6 Ispusinov A. M. - head of the consulting department – «Platonus» LLP.

2.7 Sagandykov S. K. – student of educational program 6B06101 – «Software Engineering».

The team of authors was approved by the order of the NCJSC «S. Seifullin Kazakh Agro Technical Research University», № 374-H of "18" November 2023y.

Educational program 6B06115 - «Digital agricultural systems and co mplexes» considered at the meeting of the Department "Information Systems" №7 of "09" March 2023 y.

Approved by the Faculty of the CSaPE Council protocol №10 of "16" March 2023y.

Passport of the educational program 6B06115 - «Digital agricultural systems and co mplexes» has been updated in the Unified platform of higher education from 25.08.2023 y.

CONTENTS

1 Description of the educational program

1.1 Purpose of education program

A specialist in the digitalization of agriculture using software language tools in solving production tasks and performing data analysis that identifies trends. And also this educational program will allow you to develop mobile applications for the needs of the agricultural sector.

A specialist in the digitalization of agriculture provides consulting services for consumers in the application of OT-infrastructure components in the agricultural sector of the economy, to modernize agricultural systems and complexes.

Training of highly motivated IT personnel with knowledge and skills in the field of creation and maintenance of information and control systems focused on application in digital agricultural systems and complexes for digitalization of agriculture The ultimate goal is to train a specialist in the field of digitalization of agriculture, to increase the efficiency of the industry and provide additional opportunities to consumers through the use of ICT technologies for processing, storing, exchanging and managing information.

The objectives of the educational program «Digital agricultural systems and complexes» are:

- Software development using modern information technologies for agricultural equipment and machinery designed for the production, processing and storage of livestock and crop products.
- Setup, control of work, use of modern equipment and software tools involved in the agricultural enterprise.
- Design of automatic and technological processes of production, processing and storage of crop and livestock products.
- Selection of modern solutions to increase the productivity of the enterprise, based on the specifics of its work and financial capabilities.
- Participation in the testing of software systems, automation tools, technological equipment, agricultural machinery.
- Calculation of the cost of project implementation, costs of operation and maintenance of equipment, material and labor resources, possible losses from defects and downtime.
- Formation of competencies in various fields of programming and modern applied mathematics and computer science.
- Obtaining skills of professional work in solving applied and analytical problems in the field of digitalization of agriculture with the use of modern tools and tools of information technology.
- Development of technological and infrastructural requirements for the management system of agricultural systems and complexes, processes and technologies.
- Learning to work in an English-speaking environment, adaptation to the international education system.

1.2 Learning outcomes

LO 1. To know about the principles and laws of the historical development of society, the historical periodization of the history of Kazakhstan, as well as to be competent in management, economics, law and environmental protection, in methods and methods of scientific research, socio-economic relations, to have entrepreneurship skills.

LO 2. Be able to work in any operating system and with databases; apply methods and means of information protection; work with spreadsheets, consolidate data, build diagrams.

LO 3. Create mathematical models using the methods of modern information technologies and apply mathematical models and methods of various processes, as well as competent in the operation of engineering systems.

LO 4. Describe the basic concepts of linear algebra and analytical geometry; the basic fundamental concepts of mathematical analysis; theory of limits; theory of continuous functions of one variable; differential calculus of functions of one real variable.

LO 5. Use programming language tools in solving agricultural problems and interpret the results of a comprehensive analysis of agricultural processes, identify trends, and make a forecast.

LO 6. Be able to find the necessary experimental and technological foundations on which the necessary properties of agricultural models can be recreated more efficiently and accurately.

LO 7. To argue the choice of basic standards, principles and design patterns, methods, tools and programming languages, as well as to perceive professional information in English for conducting and publishing scientific research.

LO 8. Develop and / or use software, hardware, information, mathematical, functional support of information systems, including algorithms and methods of information security, design database architectures, software.

LO 9. To carry out installation, configuration, testing, maintenance of system and application software of computer systems and networks, as well as the ability to apply machine learning and statistical modeling methods to select functions and classify the received data.

LO 10. Demonstrate knowledge in the field of physical training, know the current legislation in the field of anti-corruption, the basic laws and principles of philosophy, cultural studies and socio-political disciplines

LO 11. Be able to explain the principles of functioning of agricultural systems; use knowledge in the field of agriculture in professional activities.

LO 12. Be able to implement the necessary experimental and technological foundations to achieve higher profitability of the agro-industrial complex and animal husbandry.

LO 13. To develop design work in the agricultural sector with the use of IT technologies, design of engineering systems, mechanical and electrical equipment and means of mechanization using modern innovative developments in the field of energy conservation.

LO 14. Perform calculations of agricultural machinery designs, including using software products, as well as understand the processes of automation of processing, storage and transportation of agricultural products.

LO 15. Be able to apply the main legislative, regulatory, reference documents and bases of the state system of standardization and certification, metrology, as well as to make calculations, design of agricultural buildings and structures, farms and greenhouses, heat supply systems, ventilation, water supply, sewerage, organization of agricultural production.

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

Implementation of tasks within the framework of applied computer programs to optimize the placement of crops in zonal crop rotation systems; calculation of fertilizer doses; selection of high-yielding plant varieties; breeding of highly productive animal breeds, creation of biologically active feed additives, new medicines for animals, etc. The use of geoinformation technologies for land management and land management; maintaining the state land cadastre of the history of fields and the development of technological maps for the cultivation of agricultural crops.

But, the need for competent specialists in this field far exceeds the capabilities of universities to prepare these specialties.

At the same time, the qualification requirements imposed by employers in most cases are much more than the competencies that a student receives within the walls of a university.

These circumstances determine the relevance of the development and improvement of the educational program for training programmers of a wide profile at the bachelor's level.

«Digital agricultural systems and complexes» is the subject of professional activity of specialists in the development, maintenance of application software and management of ICT projects in agricultural sectors.

EP «Digital agricultural systems and complexes» in the direction 6B061 Information and communication technologies, is aimed at meeting the needs of the agricultural sector in qualified personnel in the field of information technology and computer technology, capable of solving complex engineering tasks.

The competitive advantages of the graduate of the EP «Digital agricultural systems and complexes» are:

Implementation of tasks within the framework of applied computer programs to optimize the placement of crops in zonal crop rotation systems; calculation of fertilizer doses; selection of high-yielding plant varieties; breeding of highly productive animal breeds, creation of biologically active feed additives, new medicines for animals, etc. The use of geoinformation technologies for land management and land management; maintaining the state land cadastre of the history of fields and the development of technological maps for the cultivation of agricultural crops.

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The competitive advantages of a graduate of the EP «Digital Agricultural Systems and Complexes» are:

– to argue for the choice of basic standards, principles and design patterns, methods and tools and programming languages;

– to show sociability, initiative and psychological readiness for work, including when working in a team and to make managerial and technical decisions;

– design and develop comprehensive software for the agricultural sector of the economy;

– knowledge of modern methods of automation of engineering and graphic works, basic techniques of work when using modern graphic programs;

– knowledge of the composition and completeness of design and technological documentation;

– knowledge of the rules for the design of technological processes for the production of blanks, route and operational maps;

– knowledge of the structure of algorithms for computer-aided design of technological processes;

– knowledge of information technologies for designing machines, assembly units and technological processes;

– knowledge of the basics of performing flat drawings and SD models of simple parts and assembly units in graphic packages;

– the ability to carry out the mathematical formulation of applied problems and implement it in the form of algorithms and programs in an algorithmic language, as well as the use of methods for solving them;

– knowledge of methods of mathematical modeling in the professional field, methods of decision-making;

– ability to work with professional databases and information resources for various purposes;

– to understand the trends and prospects for the development of digital technologies;

– understand the opportunities and risks of implementing digital technologies.

The proposed project of the educational program promotes the acquisition by students of a greater number of trending professional skills, thus, it allows them to provide employment and high wages.

Stakeholders are:

- companies providing agricultural consulting services;
- companies designing and selling agricultural machinery;
- companies developing software for modern technical devices;
- large agricultural complexes;
- farms, etc.

3 Competence model (portrait) of a graduate

3.1 Areas of professional activity

Areas of professional activity of graduates of the EP «Digital agricultural systems and complexes» in the direction 6B061 Information and communication technologies»:

- the sphere of agro–industrial and livestock complex (geo–positioning, precision farming, etc.);
- the sphere of material production ("smart farms"; "smart greenhouses"; raw materials management, storage and transportation of agricultural products; management agricultural transport);

– the sphere of data processing ("big data", graphical constructions, optimization calculations).

3.2 Types of professional activity

Types of professional activity of graduates of the EP «Digital agricultural systems and complexes» in the direction 6B061 Information and communication technologies:

- the market of agricultural consulting services providing intellectual services to agricultural enterprises;

– development, testing, maintenance of software for agricultural robots, equipment, sensors or agrobots;

– automation of a set of ecosystems of one natural and climatic zone, a single natural complex characterized by some basic type of vegetation or other feature of the landscape (biome);

- the use of new methods of managing the production process using GIS, GPS and a new generation of computers (precision farming).

– highly automated types of agro-industrial complex located in a specially designed high-rise building (vertical farm).

– research and experimental research activities in research institutions, design and scientific organizations of agricultural direction as a researcher, software developer;

– organizational and managerial activities in public administration bodies, in the service sector, administrative management, in business structures as the head of the project management department, an expert analyst, an engineer for automated management systems.

3.3 General education competencies

After successful completion of this program, the student will possess the following general education competencies:

1) assesses the surrounding reality on the basis of worldview positions formed by knowledge of the fundamentals of philosophy, which provide scientific understanding and study of the natural and social world by methods of scientific and philosophical cognition;

2) interprets the content and specific features of the mythological, religious and scientific worldview;

3) argues his own assessment of everything that is happening in the social and industrial spheres;

4) shows a civic position based on a deep understanding and scientific analysis of the main stages, patterns and peculiarities of the historical development of Kazakhstan;

5) uses methods and techniques of historical description to analyze the causes and consequences of events in the history of Kazakhstan;

6) assesses situations in various spheres of interpersonal, social and professional communication, taking into account basic knowledge of sociology, political science, cultural studies and psychology;

7) synthesizes knowledge of these sciences as a modern product of integrative processes;

8) uses scientific methods and techniques of research of a specific science, as well as the entire socio-political cluster;

9) develops his own moral and civic position, as well as independently comprehensively and critically analyze historical and modern sources, draw conclusions and argue them;

10) operates with social, business, cultural, legal and ethical norms of the Kazakh society;

11) demonstrates personal and professional competitiveness;

12) applies in practice knowledge in the field of social sciences and humanities;

13) selects methodology and analysis;

14) summarizes the results of the study;

15) synthesizes new knowledge and presents it in the form of humanitarian socially significant products;

16) enters into communication in oral and written forms in Kazakh, Russian and foreign languages to solve the problems of interpersonal, intercultural and

industrial (professional) communication;

17) carries out the use of language and speech means based on the system of grammatical knowledge; analyze information in accordance with the communication situation;

18) assesses the actions and actions of the communication participants.

19) uses various types of information and communication technologies in personal activities: Internet resources, cloud and mobile services for the search, storage, processing, protection and dissemination of information;

20) builds a personal educational trajectory throughout life for self-development and career growth, focus on a healthy lifestyle to ensure full-fledged social and professional activities through methods and means of physical culture;

21) have basic knowledge and communication skills in the areas related to the educational program "Digital agricultural systems and complexes" in Kazakh, Russian and English in practical and research activities;

22) applies the acquired knowledge for effective socialization and adaptation in changing socio-cultural conditions;

23) has the skills of quantitative and qualitative analysis of social phenomena, processes and problems.

3.4 Core competencies

After successful completion of this program, the student will have the following basic competencies:

1) have the skills to use algorithms and programs to calculate the parameters of technological processes;

2) know the main directions of ICT development, the basics of using information resources for searching and storing information, the architecture and components of computer systems, the main goals and objectives of information security, the use of search engines and electronic resources for professional purposes;

3) the ability to apply methods of solving differential and integral calculus of functions of several variables in applied problems, to be able to apply methods of solving differential equations in solving applied problems, to determine the optimal methods for solving practical problems;

4) know the methodological, regulatory and guidance materials related to the work performed, the main characteristics of natural and man-made environments;

5) be able to develop methodological, regulatory materials, technical documentation, as well as proposals and measures for the implementation of developed projects and programs;

6) have an idea of the Python high-level programming language for further work with data;

7) have an idea of scripting languages and methods of writing program codes for them;

8) have an understanding of trends in data mining technologies, standards and tools;

9) know the main problems that arise in data analysis and ways to solve them, types and methods of organizing data warehouses, classification of analytical systems.

10) learning skills necessary for independent continuation of further education in the field of study;

11) know the methods of scientific research and academic writing and apply them in the field under study, as well as possess modern technologies for information support of scientific research;

12) apply knowledge and understanding of facts, phenomena, theories and complex dependencies between them in the field under study;

13) understand the importance of the principles and culture of academic integrity.

3.5 Professional Competencies

After successful completion of this program, the student will possess the following professional competencies:

1) master high-level programming languages, database creation and support, data analysis. Have the skills to develop new algorithms to solve problems in data analysis.

2) the ability to develop and use graphical technical documentation;

3) understand the theoretical basis of electrical engineering, electronics and microprocessor technology;

4) the ability to organize agribusiness in the conditions of digitalization of the economy and conduct information and marketing business;

5) knowledge of the device and understanding of the principle of operation of modern agricultural machinery;

6) be competent in the knowledge of modern methods of construction and use of geoinformation systems;

7) possess knowledge in the field of design, modeling, construction and operation of unmanned aerial vehicles (UAVs) and autopilot;

8) the ability to use modern information processing technologies, to search, store, process and analyze information from various sources and databases;

9) be able to create and develop comprehensive software for digital agricultural systems and complexes;

10) the ability to use information technology and software modeling tools in agriculture;

11) the ability to use control systems, navigation and automatic regulation of technological parameters of processes in agriculture and service organization;

12) knowledge of the basic methods of organizing the protection of production personnel and the population from the possible consequences of accidents, catastrophes, natural disasters;

13) ability to process large amounts of information;

14) readiness to assess the level of security of digital systems of agriculture and animal husbandry, to organize the protection of information;

15) readiness to use technical means of automation and control systems, automation of technological processes and digitalization systems;

16) the ability to assess the current state of development of agricultural digitalization systems.

4 Base of professional internships

Educational practice, lasting 2 weeks, takes place on the basis of the Department of "Information Systems" of the Kazakh Agrotechnical University named after S.Seifullin in the first year.

Educational practice takes place on the basis of the chair «Information Systems» of the Kazakh Agricultural Research University named after S. Seifullin in the first year.

Work practice takes place on the bases of state or private organizations in IT department after the 2nd, 3rd courses and after the first term of the 4th course with the duration of 4-6 weeks.

Pre-diploma practice takes place at the Department of "Information Systems".

№	Name	Telephone	Email	Website
1)	Astana IT, Astana, 31/2 Saryarka Ave.	+7 775 188 8007	info@astana-it.kz	http://astana-it.kz
2)	IT Holding Samgau; Astana, 5B, Imanbayeva str.	+7 717228 1815 +7 777003 3311	Info@samgau.com	http://samgau.com
3)	Oyul Kazakhstan Association of IT-companies, Astana, 6/5 Kabanbay Batyr Ave.	+7 717292 5552		http://itk.kz
4)	JSC National Infocommunication Holding Zerde, Astana, 1 Almaty str.	+7 717257 0778		http://zerde.gov.kz
5)	TransTeleCom JSC,13 Abai Avenue, Astana	+7 717260 0029		http://ttc.kz
6)	Computer Academy "Shag", 23, AliyaMoldagulova str.	+7 717 231 3328 +7 717 291 1458	astana@itstep.org	http://astana.itstep.kz
7)	Net.com" LLP, Astana, 22 Kazhymukan Munaitpasova str.	+7 717 247 8177		http://netcom.kz
8)	Corporate Business Systems, Astana, 3, Kabanbaybatyr Ave.	+7 727 262 2218		http://cbs.kz
9)	InesSoft LLP, 8 MukhtarAuezov Street, Astana	+7 717 272 8510		http://inessoft.kz

10)	Expert-A Training Centre, Astana, 2/1 Bauyrzhan Momyshuly Ave.	+7 771 909 4456 +7 717 262 5266	info@expert-a.kz	http://expert-a.kz
11)	Somnium Astana LLP, 12/2 Kunayev str,	+7 7172 68-98-14;		
12)	AstanaInavation JSC			
13)	JSC Electronic Finance			

14)	National Information Technologies JSC Astana, 8 Orynbor Str., Astana	+7 7172 74-10-70;
		+7 7172 74-10-81;		

15)	Union of Farms of Kazakhstan Republican Association	87019996661;
		87172509928;
		Ibraev Serik
			ibrayev.sn@gmail.com	www.sfk.kz

16)	PLATONUS LLP	87055166919;
		87172472525;
		Айдар Манас
			ISPUSINOV@PLATONUS.KZ	PLATONUS.KZ

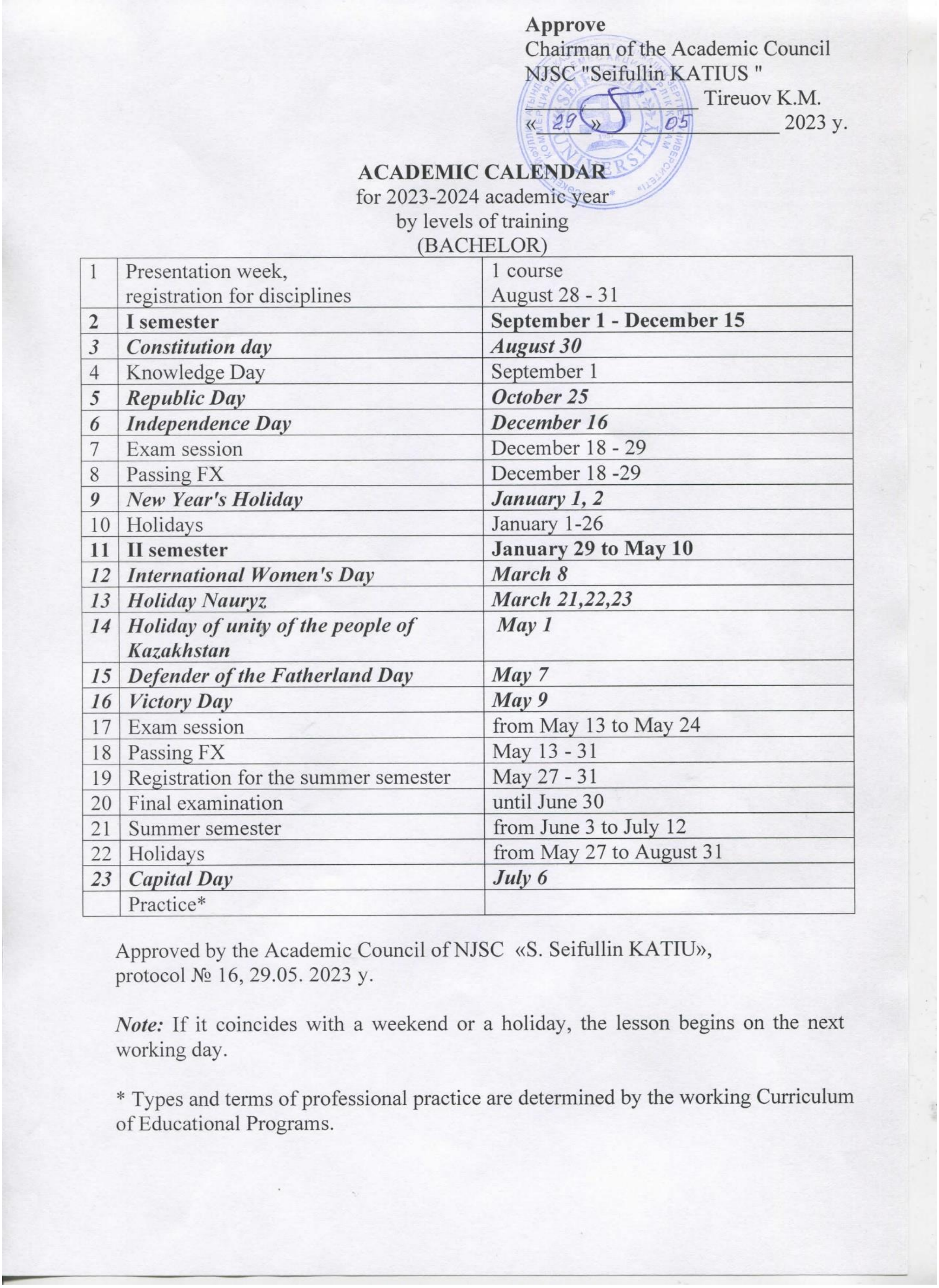
17)	GlobalServicesInternational, MukhitovAzat	87077555273;	maz@gse.kz	
18)	TerraPoint LLP	87015333406;	Aida_mullasheva@mail.ru	Муллашева Аида финансовый директор
19)	AVR Group KZ LLP, Astana, Kuishi Dina Street 14	87085446945	augmented.vr@gmail.com	www.avr-group.net
20)	Expert agricultural company, Astana, 38/4 Zheltoksan str.	+7 (7172) 571592		18493-kz.all.biz
21)	Technosila LLP-Kazakhstan, Astana, Republic Ave., 62	+7 (7172) 323594		20088.kz.all.biz

5 Structure of the undergraduate education program

№	Name of cycles and disciplines	Total workload	
		in academic hours	in academic credits
1	2	3	4
1	General Education Disciplines (GER) cycle	1680	56
1)	Mandatory component	1530	51
	History of Kazakhstan	150	5
	Philosophy	150	5
	Foreign language	300	10
	Kazakh (Russian) language	300	10
	Information and communication technology	150	5
	Socio-political knowledge module (sociology, political science, cultural studies, psychology)	240	8
	Physical education	240	8
2)	A university component and/or an optional component	150	5
2	Cycle of core and core disciplines (DB, PD)	At least 5280	At least 176
1)	A university component and/or an optional component		
2)	Professional practice		
3	Additional training (VET)		
1)	Optional component		
4	Final certification	At least 240	At least 8
	Total	At least 7200	At least 240

Appendix 1

Academic calendar



Approve
Chairman of the Academic Council
NJSC "Seifullin KATIUS "
_____________ Tireuov K.M.
« 29 » 05 _____________ 2023 y.

ACADEMIC CALENDAR
for 2023-2024 academic year
by levels of training
(BACHELOR)

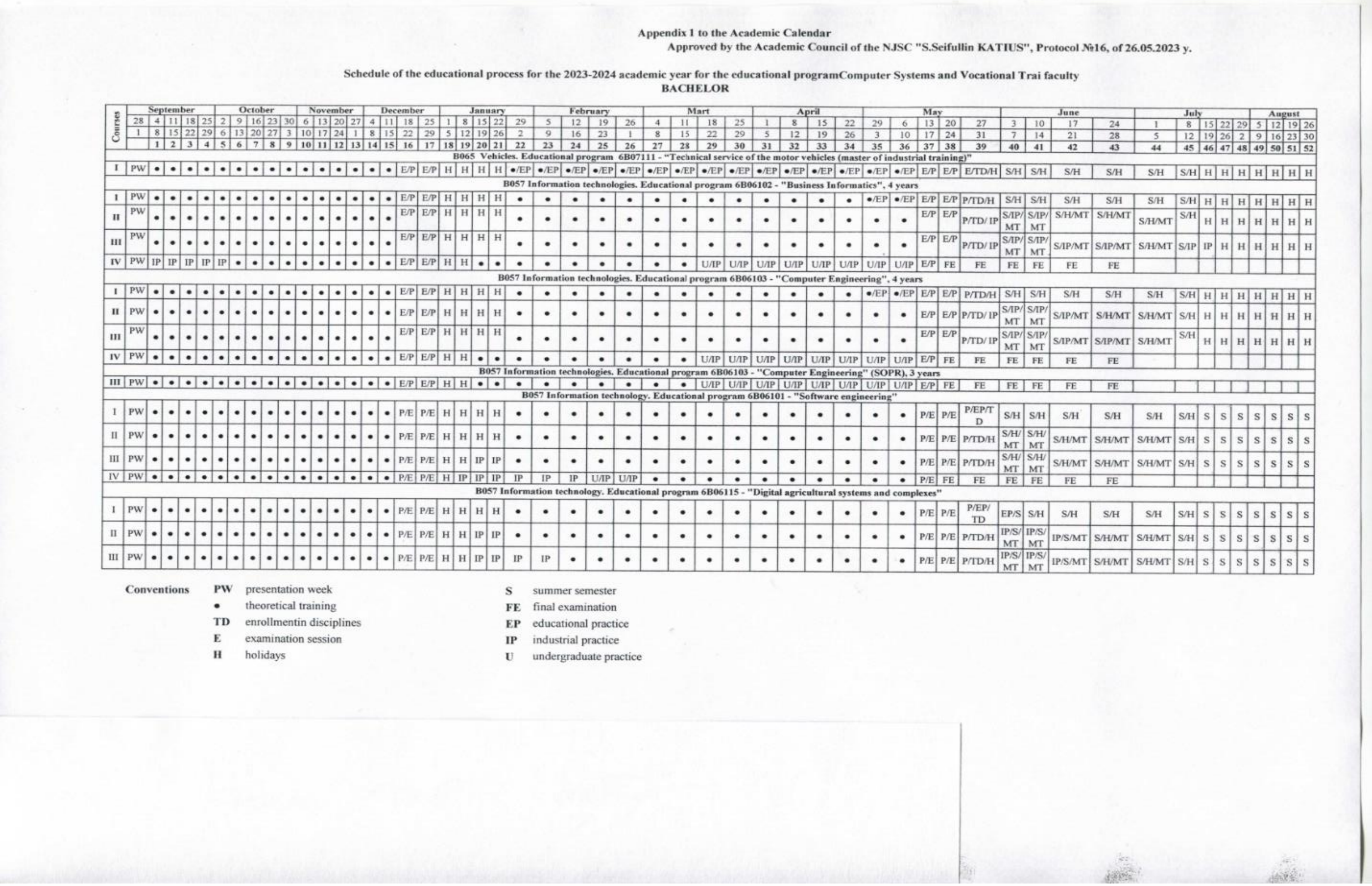
1	Presentation week, registration for disciplines	1 course August 28 - 31
2	**I semester**	**September 1 - December 15**
3	***Constitution day***	***August 30***
4	Knowledge Day	September 1
5	***Republic Day***	***October 25***
6	***Independence Day***	***December 16***
7	Exam session	December 18 - 29
8	Passing FX	December 18 -29
9	***New Year's Holiday***	***January 1, 2***
10	Holidays	January 1-26
11	**II semester**	**January 29 to May 10**
12	***International Women's Day***	***March 8***
13	***Holiday Nauryz***	***March 21,22,23***
14	***Holiday of unity of the people of Kazakhstan***	***May 1***
15	***Defender of the Fatherland Day***	***May 7***
16	***Victory Day***	***May 9***
17	Exam session	from May 13 to May 24
18	Passing FX	May 13 - 31
19	Registration for the summer semester	May 27 - 31
20	Final examination	until June 30
21	Summer semester	from June 3 to July 12
22	Holidays	from May 27 to August 31
23	***Capital Day***	***July 6***
	Practice*	

Approved by the Academic Council of NJSC «S. Seifullin KATIU»,
protocol № 16, 29.05. 2023 y.

Note: If it coincides with a weekend or a holiday, the lesson begins on the next working day.

* Types and terms of professional practice are determined by the working Curriculum of Educational Programs.

Appendix to the Academic Calendar



Appendix 1 to the Academic Calendar

Approved by the Academic Council of the NJSC "S.Seifullin KATIUS", Protocol №16, of 26.05.2023 y.

Schedule of the educational process for the 2023-2024 academic year for the educational programComputer Systems and Vocational Trai faculty

BACHELOR

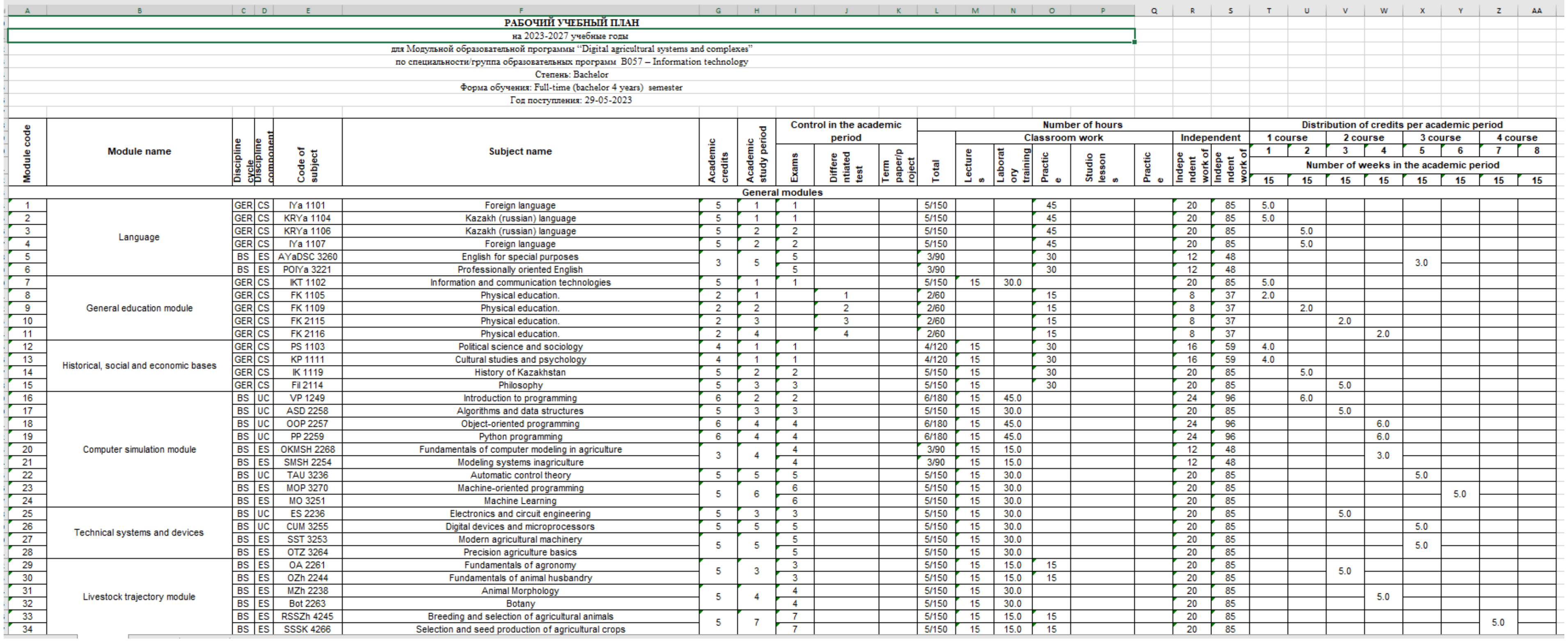
Courses	September					October					November				December				January					February				Mart				April				May					June				July					August			
	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26
	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	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	30
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	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
B065 Vehicles. Educational program 6B07111 - “Technical service of the motor vehicles (master of industrial training)”																																																					
I	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	•/EP	E/P	E/P	E/TD/H	S/H	S/H	S/H	S/H	S/H	S/H	H	H	H	H	H	H	H
B057 Information technologies. Educational program 6B06102 - "Business Informatics", 4 years																																																					
I	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•/EP	•/EP	E/P	E/P	P/TD/H	S/H	S/H	S/H	S/H	S/H	S/H	H	H	H	H	H	H	H
II	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	P/TD/ IP	S/IP/ MT	S/IP/ MT	S/H/MT	S/H/MT	S/H/MT	S/H	H	H	H	H	H	H	H
III	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	P/TD/ IP	S/IP/ MT	S/IP/ MT	S/IP/MT	S/IP/MT	S/H/MT	S/IP	IP	H	H	H	H	H	H
IV	PW	IP	IP	IP	IP	IP	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	•	•	•	•	•	•	•	•	•	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	E/P	FE	FE	FE	FE	FE	FE									
B057 Information technologies. Educational program 6B06103 - "Computer Engineering", 4 years																																																					
I	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•/EP	•/EP	E/P	E/P	P/TD/H	S/H	S/H	S/H	S/H	S/H	S/H	H	H	H	H	H	H	H
II	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	P/TD/ IP	S/IP/ MT	S/IP/ MT	S/IP/MT	S/H/MT	S/H/MT	S/H	H	H	H	H	H	H	H
III	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	P/TD/ IP	S/IP/ MT	S/IP/ MT	S/IP/MT	S/IP/MT	S/H/MT	S/H	H	H	H	H	H	H	H
IV	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	•	•	•	•	•	•	•	•	•	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	E/P	FE	FE	FE	FE	FE	FE									
B057 Information technologies. Educational program 6B06103 - "Computer Engineering" (SOPR), 3 years																																																					
III	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	E/P	E/P	H	H	•	•	•	•	•	•	•	•	•	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	U/IP	E/P	FE	FE	FE	FE	FE	FE									
B057 Information technology. Educational program 6B06101 - "Software engineering"																																																					
I	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	P/EP/TD	S/H	S/H	S/H	S/H	S/H	S/H	S	S	S	S	S	S	S
II	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	P/TD/H	S/H/ MT	S/H/ MT	S/H/MT	S/H/MT	S/H/MT	S/H	S	S	S	S	S	S	S
III	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	H	IP	IP	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	P/TD/H	S/H/ MT	S/H/ MT	S/H/MT	S/H/MT	S/H/MT	S/H	S	S	S	S	S	S	S
IV	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	IP	IP	IP	IP	IP	IP	U/IP	U/IP	•	•	•	•	•	•	•	•	•	•	P/E	FE	FE	FE	FE	FE	FE									
B057 Information technology. Educational program 6B06115 - "Digital agricultural systems and complexes"																																																					
I	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	H	H	H	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	P/EP/ TD	EP/S	S/H	S/H	S/H	S/H	S/H	S	S	S	S	S	S	S
II	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	H	IP	IP	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	P/TD/H	IP/S/ MT	IP/S/ MT	IP/S/MT	S/H/MT	S/H/MT	S/H	S	S	S	S	S	S	S
III	PW	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	H	H	IP	IP	IP	IP	•	•	•	•	•	•	•	•	•	•	•	•	•	P/E	P/E	P/TD/H	IP/S/ MT	IP/S/ MT	IP/S/MT	S/H/MT	S/H/MT	S/H	S	S	S	S	S	S	S

Conventions

PW	presentation week
•	theoretical training
TD	enrollmentin disciplines
E	examination session
H	holidays
S	summer semester
FE	final examination
EP	educational practice
IP	industrial practice
U	undergraduate practice

Appendix 2

Working curriculum



РАБОЧИЙ УЧЕБНЫЙ ПЛАН
на 2023-2027 учебные годы
для Модульной образовательной программы "Digital agricultural systems and complexes"
по специальности/группа образовательных программ B057 – Information technology
Степень: Bachelor
Форма обучения: Full-time (bachelor 4 years) semester
Год поступления: 29-05-2023

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
Module code	Module name	Discipline cycle	Discipline component	Code of subject	Subject name	Academic credits	Academic study period	Control in the academic period			Number of hours								Distribution of credits per academic period							
											Total	Classroom work					Independent		1 course		2 course		3 course		4 course	
								Exams	Differentiated test	Term paper/project		Lectures	Laboratory training	Practice	Studio lessons	Practice	Independent work of	Independent work of	1	2	3	4	5	6	7	8
																			Number of weeks in the academic period							
																			15	15	15	15	15	15	15	15
General modules																										
1	Language	GER	CS	IYa 1101	Foreign language	5	1	1			5/150			45			20	85	5.0							
2		GER	CS	KRYa 1104	Kazakh (russian) language	5	1	1			5/150			45			20	85	5.0							
3		GER	CS	KRYa 1106	Kazakh (russian) language	5	2	2			5/150			45			20	85		5.0						
4		GER	CS	IYa 1107	Foreign language	5	2	2			5/150			45			20	85		5.0						
5		BS	ES	AYaDSC 3260	English for special purposes	3	5	5			3/90			30			12	48					3.0			
6		BS	ES	POIYa 3221	Professionally oriented English			5			3/90			30			12	48								
7	General education module	GER	CS	IKT 1102	Information and communication technologies	5	1	1			5/150	15	30.0				20	85	5.0							
8		GER	CS	FK 1105	Physical education.	2	1		1		2/60			15			8	37	2.0							
9		GER	CS	FK 1109	Physical education.	2	2		2		2/60			15			8	37		2.0						
10		GER	CS	FK 2115	Physical education.	2	3		3		2/60			15			8	37			2.0					
11		GER	CS	FK 2116	Physical education.	2	4		4		2/60			15			8	37				2.0				
12	Historical, social and economic bases	GER	CS	PS 1103	Political science and sociology	4	1	1			4/120	15		30			16	59	4.0							
13		GER	CS	KP 1111	Cultural studies and psychology	4	1	1			4/120	15		30			16	59	4.0							
14		GER	CS	IK 1119	History of Kazakhstan	5	2	2			5/150	15		30			20	85		5.0						
15		GER	CS	Fil 2114	Philosophy	5	3	3			5/150	15		30			20	85			5.0					
16	Computer simulation module	BS	UC	VP 1249	Introduction to programming	6	2	2			6/180	15	45.0				24	96		6.0						
17		BS	UC	ASD 2258	Algorithms and data structures	5	3	3			5/150	15	30.0				20	85			5.0					
18		BS	UC	OOP 2257	Object-oriented programming	6	4	4			6/180	15	45.0				24	96				6.0				
19		BS	UC	PP 2259	Python programming	6	4	4			6/180	15	45.0				24	96				6.0				
20		BS	ES	OKMSH 2268	Fundamentals of computer modeling in agriculture	3	4	4			3/90	15	15.0				12	48				3.0				
21		BS	ES	SMSH 2254	Modeling systems inagriculture			4			3/90	15	15.0				12	48								
22		BS	UC	TAU 3236	Automatic control theory	5	5	5			5/150	15	30.0				20	85					5.0			
23		BS	ES	MOP 3270	Machine-oriented programming	5	6	6			5/150	15	30.0				20	85						5.0		
24		BS	ES	MO 3251	Machine Learning			6			5/150	15	30.0				20	85								
25	Technical systems and devices	BS	UC	ES 2236	Electronics and circuit engineering	5	3	3			5/150	15	30.0				20	85			5.0					
26		BS	UC	CUM 3255	Digital devices and microprocessors	5	5	5			5/150	15	30.0				20	85					5.0			
27		BS	ES	SST 3253	Modern agricultural machinery	5	5	5			5/150	15	30.0				20	85					5.0			
28		BS	ES	OTZ 3264	Precision agriculture basics			5			5/150	15	30.0				20	85								
29	Livestock trajectory module	BS	ES	OA 2261	Fundamentals of agronomy	5	3	3			5/150	15	15.0	15			20	85			5.0					
30		BS	ES	OZh 2244	Fundamentals of animal husbandry			3			5/150	15	15.0	15			20	85								
31		BS	ES	MZh 2238	Animal Morphology	5	4	4			5/150	15	30.0				20	85				5.0				
32		BS	ES	Bot 2263	Botany			4			5/150	15	30.0				20	85								
33		BS	ES	RSSZh 4245	Breeding and selection of agricultural animals	5	7	7			5/150	15	15.0	15			20	85							5.0	
34		BS	ES	SSSK 4266	Selection and seed production of agricultural crops			7			5/150	15	15.0	15			20	85								

Annex 2 (continued)

35	Physical and mathematical	BS	UC	AG 1234	Algebra and geometry	5	1	1			5/150	15		30			20	85	5.0							
36		BS	UC	MA 1235	Mathematical analysis	5	2	2			5/150	15		30			20	85		5.0						
37		BS	UC	Fiz 2248	Physics	4	3	3			4/120	15	30.0				16	59			4.0					
38		BS	UC	TVMS 2246	Probability Theory and Mathematical Statistics	4	3	3			4/120	15		30			16	59			4.0					
39		BS	UC	DMML 2247	Discrete Mathematics and Mathematical Logic	4	4	4			4/120	15		30			16	59				4.0				
40	Algorithmization and programming module	**BS**	**UC**	**UP 1233**	**Educational practice**	**2**	**2**				**2/60**					60				2.0						
41	Module of trajectory of animal husbandry	BS	ES	FZh 3265	Animal Physiology	5	5	5			5/150	15	30.0				20	85					5.0			
42		BS	ES	FR 3266	Plants physiology			5			5/150	15	30.0				20	85								
43		AS	ES	SUBD 3325	Database management systems	4	6	6			4/120	15	30.0				16	59						4.0		
44		AS	ES	TBD 3317	Database theory			6			4/120	15	30.0				16	59								
45		AS	ES	ATPRZ 4326	Automation of technological processes in crop production agriculture	5	7	7			5/150	15	30.0				20	85							5.0	
46		AS	ES	ATPZh 4306	Automation of technological processes in animal husbandry			7			5/150	15	30.0				20	85								
47		AS	ES	APZhP 4307	Automation of traceability of livestock products	4	8	8			4/120	15	30.0				16	59								4.0
48		AS	ES		Automation of traceability of crop production			8			4/120	15	30.0				16	59								
49		AS	ES	TPPZh 4319	Production technology of animal husbandry products	5	8	8			5/150	15	30.0				20	85								5.0
50		AS	ES	TPPR 4323	Production technology of plant growing products			8			5/150	15	30.0				20	85								
51	Professional practices	**AS**	**CS**	**PP 2314**	**Internship**	**4**	**4**				**4/120**					120						4.0				
52		**AS**	**CS**	**PP 3314**	**Internship**	**4**	**6**				**4/120**					120								4.0		
53		**AS**	**CS**	**PP 4314**	**Pre diploma practice**	**9**	**8**				**9/270**					270										9.0
54	Technical systems and devices	AS	ES	GTA 3320	Geoinformation technologies in agriculture	3	5	5			3/90	15		15			12	48					3.0			
55		AS	ES	BAADSST [illegible]	Unmanned vehicles and autopilots			5			3/90	15		15			12	48								
56		AS	ES	ILSPZh 3324	Intelligent logistics systems of livestock enterprises	5	6	6			5/150	15	30.0				20	85						5.0		
57		AS	ES	ILSA 3302	Logistics in the agro-industrial complex			6			5/150	15	30.0				20	85								
58		AS	ES	ISUA 3309	Intelligent logistics systems in the agro-industrial complex	4	6	6			4/120	15	30.0				16	59						4.0		
59		AS	ES	CAS 3318	Digitalization of agricultural services			6			4/120	15	30.0				16	59								
60		AS	UC	VSIVA 4303	Embedded systems and the Internet of Things in the agro-industrial complex	5	7	7			5/150	15	30.0				20	85							5.0	
61		AS	ES	OMR 4308	Fundamentals of mechanotronics and robotics	4	8	8			4/120	15	30.0				16	59								4.0
62		AS	ES	TEC 4322	Theory of electric chains			8			4/120	15	30.0				16	59								
Additional modules beyond qualification																										
Modules of choice																										
Scientifically research																										
63		GER	ES	OEP 3120	Basics of economics and law	5	6	6			5/150	15		30			20	85						5.0		
64		GER	ES	MNI 3121	Methodology of academic research						5/150	15		30			20	85								
65		GER	ES	Pre 3122	Entrepreneurship						5/150	15		30			20	85								
66		GER	ES	OAK 3123	Basics of anti-corruption culture						5/150	15		30			20	85								
67		GER	ES	EOBZh 3124	Ecology and life safety fundamentals						5/150	15		30			20	85								
68		BS	ES	AS 3269	Network administration	4	5	5			4/120	15	30.0				16	59					4.0			
69		BS	ES	AOS 3274	Administration of cloud systems						4/120	15	30.0				16	59								
70		BS	ES	ITZh 4271	Innovative technologies in livestock	5	7	7			5/150	15	30.0				20	85							5.0	
71		BS	ES	ITR 4267	Information technology in crop production						5/150	15	30.0				20	85								
72		BS	ES	SSMPKRZ 4272	Metrology, standardization and quality assurance in crop production and agriculture	5	7	7			5/150	15		30			20	85							5.0	
73		BS	ES	SSMPKZh 4273	Metrology, standardization and quality assurance in animal husbandry						5/150	15		30			20	85								
74		AS	ES	ITSSH 3321	Information technology inagriculture	3	6	6			3/90	15	15.0				12	48						3.0		
75		AS	ES	CTSH 3321	Digital technologies in agriculture						3/90	15	15.0				12	48								
76		AS	ES	PRIP 4327	Design and development of Internet applications	5	7	7			5/150	15	30.0				20	85							5.0	
77		AS	ES	WT 4328	Web technologies						5/150	15	30.0				20	85								
Weekly average workload at hours																			60	60	60	60	60	60	60	44

Annex 3: Matrix for the attainability of the learning outcomes of an educational program through the disciplines.

№	Name of discipline	Short description of discipline	Number of loans of credits	Formative learning outcomes														
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11	LO 12	LO 13	LO 14	LO 15
	General Education Cycle Higher Education Component/Optional Component																	
1.	Methodology of academic research	The study of various techniques and methods of scientific research: analysis, synthesis and design in General. Determination of the purpose, objectives and factors affecting the design. Ability to apply research results in design. Work with sources. Analysis of analogues. Preparation of the concept.	5							+								
2.	Basics of anti-corruption culture	The course forms a system of knowledge on combating corruption, and the development on this basis of a civil position in relation to this phenomenon. As a result of mastering the discipline, students will be able to: navigate the legislation; analyze and apply legal acts in specific situations, follow moral	5										+					
3.	Entrepreneurship	The discipline is focused on the formation of students' comprehensive understand-ing of entrepreneurship and the possibilities of organizing entrepreneurial activity. The content of the discipline characterizes the essence of entrepreneurial activity, its types and functions, subjects of entrepreneurial activity and the business environ-ment, and also reflects the features of the mechanism for creating your own busi-ness, business planning, financial and personnel support, characterizes the types of entrepreneurial risks and ways to prevent and minimize them.	5	+														
4.	Ecology and life safety fundamentals	The course forms practical skills in identifying dangerous and harmless natural conditions, in preventing the causes and conditions for the occurrence of dangerous situations, in protecting the population and the production facility from the possible consequences of dangerous situations. Features of labor protection for women and youth, supervision and control.	5	+														
5.	Basics of economics and law	The discipline promotes knowledge of the subject of economic theory and methods of research, the basis of public production and forms of public economy, the mechanism of functioning of the market system, production, costs and income of the firm, national economy. Demonstrate knowledge and skills in the financial and monetary credit system in the national economy and economic security. To master the basics of the theory of the state and law, the basics of constitutional,	5	+														

		administrative, civil, labor, family, criminal law.																
	Cycle of core disciplines Higher education component																	
6.	Automatic control theory	Automatic control theory is a highly developed scientific discipline based on deep philosophical concepts and rigorous mathematical methods. With the development of production and the complication of objects in technology, new management problems arise. Methods of parametric and structural optimization, stochastic and adaptive control, state space, filtering, estimation, and identification are widely used in the research and design of control systems.	5			+				+								
7.	Algebra and geometry	"The purpose of the course is to familiarize students with the basic methods of linear algebra and their applications to problems of analytical geometry. In the center of the presentation is the theory of linear systems of arbitrary form. The classification of finite-dimensional operators over various fields is performed. From a single point of view, based on the apparatus of matrix theory, the problems of classification of curves and surfaces of the second order are considered. The main facts related to the theory of polynomials are presented."	5				+				+							
8.	Algorithms and data structures	The concept of the algorithm, algorithms' structure: linear, branched, cyclic. Introduction to algorithms. Sorting, Shell algorithm, search algorithms, recursive algorithm. Formal languages and grammars, automaton Turing machines. Data structure: array, sets, records, stack, linked list, tree, graph, hash table, file. The compression algorithm is the Huffman algorithm, the Euclidean algorithm.	5									+						
9.	Introduction to programming	The course is designed for studying of algorithms and program development to solve different problems. For this purpose, program structure, principles of construction of algorithms and programs, methods of solving, algorithmization, programming, debugging and implementation of programs, using the language C++ are considered	6					+		+								
10.	Discrete Mathematics and Mathematical Logic	The study of discrete objects, the solution of combinatorial problems, the study of types of mappings and binary relations, the reduction of propositional algebra formulas to normal forms, the application of logic algebra to the theory of switching circuits. The capabilities for analysis and synthesis, and mathematical maturity are developing.	4			+	+											
11.	Mathematical analysis	The aim of the course is to introduce students to the important branches of calculus and its applications in IT. During the educational process, students	5				+											

		should learn and be able to apply mathematical methods and tools to solve various applied problems. Moreover, they study fundamental methods of studying infinitesimal variables by means of analysis, which is based on the theory of differential and integral calculations.																
12.	Object-oriented programming	This course will provide the skills to develop console or windows applications using Java programming language using object-oriented programming concepts. Topics of the course include the OOP paradigm, Java programming, file processing, exceptions, structures, collections, object-oriented programming concepts.	6							+								
13.	Digital devices and microprocessors	The course covers the key principles of digital electronics, features of digital signals, ways of organizing the interaction of elements, nodes and devices of digital systems. Basic information about binary logic, digital signals, codes, synchronization, and symbols on diagrams is provided. The principles of construction and application of operational and permanent storage devices are described. The basics of programming of microprocessor systems are considered.	5													+		
14.	Physics	The discipline studies the basic physical phenomena, fundamental laws and concepts, as well as methods of physical research. Considers techniques and methods for solving typical problems from various fields of physics, introduces modern scientific equipment, forms the skills of conducting an experiment, the ability to highlight specific physical content in applied problems of a future specialty	4									+				+		
15.	Probability Theory and Mathematical Statistics	The course focuses on the probability and statistics of any events, as well as on the relationship between mathematics and programming through an interdisciplinary training program that deepens the mathematical understanding of probability and develops the skills of logical and algorithmic thinking.	4			+	+											
16.	Electronics and circuit engineering	Structure and principle of operation of semiconductor devices. Varieties and structure of power sources. Parametric and compensatory voltage stabilizers. Dependent and autonomous voltage inverters. Optoelectronic devices. Circuitry of amplifying devices. Feedbacks of amplifiers. Purpose of feedbacks and ways of their organization.	5													+		
17.	Python programming	Students will learn how to edit and manage the Python source code. Dictionaries. Iteration and recursion. Indexed loops. Conditional loops. Introduction to sorting. Sorting algorithms: sorting by selection, sorting by insertion, bubble sort. Complexity	6					+		+								

		of algorithms. Search and sort. Efficient sorting methods: binary or dichotomous research, fusion sort, quick sort																
	Cycle of basic disciplines/ Elective Component																	
18.	Fundamentals of agronomy	Formation of knowledge of agricultural crops, conditions and technologies of their cultivation. Types, varieties and varieties of cultivated plants, the peculiarities of growing individual crops taking into account their biological characteristics. The main cultivated plants, their origin, the possibilities of economic use of cultivated plants, the main techniques and methods of crop production.	5											+	+			
19.	English for special purposes	The discipline is aimed at studying general scientific terminology and terminology for the language of the corresponding specialty in English, forms skills in four types of communicative activity: reading with a full understanding of authentic texts in the specialty, the ability to write an essay on a specialty problem, the ability to listen to authentic messages containing professional information, the ability to discuss specialty issues	3							+								
20.	Fundamentals of computer modeling in agriculture	The discipline is the basic training of students in the theory of mathematical and computer modeling and computer-aided design of systems. Conducting interactive lectures, practical classes and/or active laboratory work using computer presentations. Using a computer testing form/ticket to check students" independent work.	3	3				+										
21.	Modeling systems inagriculture	Basic concepts of the theory of systems modeling. Mathematical methods of modeling information processes and systems. Network models. Queuing systems. Petri nets. Generalized A-circuit models. Conceptual, algorithmic, static models, modeling of processes in agriculture, to carry out simulation modeling when using agricultural machinery or the operation of an electrical network, to conduct a simulation experiment on a computer	3					+										
22.	Selection and seed production of agricultural crops	The course studies the concept of a variety, the source material and methods of its creation, the types of plant breeding, the use of biotechnology in breeding, the methods of selection and evaluation of breeding material, the organization of the selection process, the state variety testing and regionalization of varieties and hybrids, seed production processes, the organization of seed production of individual crops in modern conditions, varietal and seed control in seed cultivation of field crops, varietal change and varietal renewal.	5												+			
23.	Breeding and selection of agricultural animals	The discipline studies the basic laws of inheritance signs and principles of heredity in the individual development of	5					+							+			

		agricultural animals, exterior, interior and constitution of agricultural animals; comprise the selection and assortment, genetic parameters of selection, the doctrine of the breed; students master methods of breeding animals; analyzes selection and breeding work in animal husbandry.																
24.	Botany	The discipline studies the anatomical, morphological structure of plants, the structure and functions of the vegetative and generative organs of plants, their significance and the diversity of species common in the experimental sites of the region under study;the main characteristics of plants of various systematic groups.Knowledge of the characteristics of these objects is an important foundation for a deeper consolidation of the studied course.	5						+					+				
25.	Administration of cloud systems	Basic concepts, logical and physical principles of building computer and telecommunications networks; principles of interaction of computers and network equipment at the hardware and software level; basic knowledge of network technologies that are used at the beginning of work as a network specialist; principles of functioning of computer networks, principles of interaction of network elements, methods of calculation and network construction.	4									+						
26.	Precision agriculture basics	The studying of technological processes of precision farming, the study of the latest laboratory equipment and GPS systems that ensure the implementation of precision farming technologies. The use of parallel and automatic driving systems and the formation of practical skills in working with GIS technologies. Formation of student's system of professional knowledge, skills and abilities on the methods and ways of organizing and reliable operation of complex technical systems for the production of crop products using precision farming technologies.	5													+		
27.	Animal Morphology	Discipline studies the anatomical structure of the organism of farm animals and its organs, features of the body structure of various types of farm animals, basics of cell structural organization, body tissues of farm animals, students master the basics of cytology, general and private embryology and histology, the nervous system, the circulatory system and lymph formation, the immune system, respiration, digestion, lactation, metabolism, energy, reproduction process.	5						+									
28.	Animal Physiology	The discipline forms theoretical knowledge the structural and functional organization of	5						+									

		animals, homeostasis, principles of nervous and humoral regulation of functions, physiology of the central nervous system, cardiovascular, digestive and respiratory systems. It studies the physiological processes occurring in the body of animals, the role and physiology of the endocrine glands, the biological significance of energy and metabolic processes, the processes of excretion of vital products of the body.																
29.	Network administration	The study of the discipline involves the formation of knowledge and practical skills in the use of modern technologies for the construction and administration of a local network at the enterprise level. It allows you to get acquainted with the basic data transmission protocols in modern networks, to master modern tools used for local network administration. It helps to master modern software tools that are used in network administration.	4									+						
30.	Professionally oriented English	To form the professional foreign language speech of future specialists to increase the level of professional competence, proficiency in a professional foreign language for the implementation of written and oral information exchange, further development of speech activity (reading, writing, listening and speaking - monologue and dialogic speech). Rules of speech behavior in accordance with situations of professional communication, depending on the style and nature of communication in the social, household and academic spheres.	3							+								
31.	Modern agricultural machinery	The main directions of development of mechanization of agricultural production. Advanced models of foreign agricultural machinery. The study of the designs of the main mechanisms and equipment of agricultural machinery and the latest equipment and GPS systems that ensure the performance of agricultural work using precision farming technologies.	5											+		+		
32.	Fundamentals of animal husbandry	Formation of knowledge of the biological features of the main species and breeds of animals bred in farms of different regions of the country. Reproduction of the herd and directed rearing of young animals. Feeding, keeping, breeding of farm animals and poultry. Technologies of the production of livestock products.	5												+			
33.	Innovative technologies in livestock	The discipline considers innovative technologies of keeping and feeding animals. Innovative technologies to produce of animal meat, such as beef, lamb, horse meat, poultry and rabbit meat. Innovative technologies to produce of animal	5												+		+	+

		milk in various branches like cattle breeding, horse breeding, camel breeding, sheep breeding and goat breeding. Innovative technologies to produce of eggs from different kind of poultry. Innovative technologies to produce of bee products.																
34.	Metrology, standardization and quality assurance in animal husbandry	Get basic information about standardization, certification and technical metrological measurements, equipment for determining the quality of products in the agro-industrial complex. Interchangeability and standardization of equipment and parts, technical measurements of parts, quality of manufacture, modern agricultural equipment used to assess the quality of livestock products.	5											+			+	+
35.	Machine-oriented programming	The main types of registers, the rationale for using the operational and system registers of the microprocessor; the scope of the system command application of microprocessors; system functions and their parameters; flows and processes that are recorded in instances; error handling mechanisms. Conducting interactive lectures, practical classes and/or active laboratory work using computer presentations.	5			+						+						
36.	Machine Learning	The course introduces students to the theoretical foundations and algorithms of machine learning, their possible practical implementations and application in solving real problems. Within this course, students should get an idea of the problems solved with the help of the considered theory, and the principles of construction of some basic classifiers	5			+						+						
37.	Metrology, standardization and quality assurance in crop production and agriculture	Legislative and regulatory frameworks used by the state system of standardization and certification and metrology in crop production, the use of normative and technical documents of the standardization and certification system, metrology of the CIS countries to overcome technical barriers preventing entry into the world market. Methodology for determining quality indicators in accordance with standards and confirmation in accordance with the Law on Technical regulation	5														+	+
38.	Information technology in crop production	The discipline is aimed at studying the theoretical and practical knowledge of students about modern geographical information systems, remote sensing of the earth, information systems of control, accounting and monitoring in relation to agricultural technology; mastering methods of differentiated application of fertilizers and plant protection products, creating a database for the production of crop products, studying statistical and applied programs in crop production.	5												+		+	+

39.	Plants physiology	Physiology of plant cells. The main parts and properties of the cell. Water regime of plants. Mineral nutrition of plants. Plant respiration. Photosynthesis. Transformation and transport of organic substances in plants. Growth and development of plants. Integration of physiological processes in the plant. Plant protection and resistance mechanisms.	5						+									
	Profile disciplines/ University component																	
40.	Embedded systems and the Internet of Things in the agro-industrial complex	Embedded systems and IoT. Embedded system: a computer hardware system with embedded software: surveillance systems, robots, CNC machines, programmable logic controllers, industrial automation and control systems. IoT and digitalization (automation) in agriculture — the creation of complex highly automated production and logistics chains: wholesale and retail trading companies, logistics, agricultural producers and their suppliers.	5					+										
	Profile disciplines/ Elective Component																	
41.	Digitalization of agricultural services	To master the modern principles of technical service in the system of the agro-industrial complex Summary: Means of digitalization of the agro-technical service, as well as the system of technical service (TO). The content of digitalization and technology of maintenance of tractors and machines. Types and frequency of maintenance.	4					+										
42.	Geoinformation technologies in agriculture	Data sources are direct measurements in the fields with subsequent interpolation and processing of images from aircraft and space satellites. GIS can solve the problems of accounting for farmland, determining the value of land, monitoring the activities of agricultural enterprises, determining damage and compensation payments in emergency situations, GIS analytical tools solve the problems of increasing the sustainability of agricultural production and reducing its cost.	3						+						+			
43.	Intelligent logistics systems in the agro-industrial complex	Intelligent control systems. Automation of production is the highest stage of mechanization, computerization of production is the highest stage of its automation, intellectualization of production is the highest stage of computerization. The course includes consideration of intelligent control systems for agricultural machinery, robotic field management systems, intelligent control systems for dairy farms, pig farms and poultry farms, etc. Robots for animal care are considered	5						+									
44.	Logistics in the agro-industrial	The use of methods, technologies and artificial intelligence systems	4					+	+						+			

	complex	in the field of logistics in the agro-industrial complex and supply chain management, ideas about modern concepts and knowledge management systems of the organization. work with intelligent systems in the management of logistics processes. Introduces methods and technologies of knowledge representation and formalization, principles of knowledge management in agricultural organizations, technologies of intelligent search and linguistic data analysis.																
45.	Digital technologies in agriculture	The discipline examines various aspects of the digital transformation of the agricultural sector and is aimed at training students who are able to effectively apply digital technologies in this area, formulate digitalization tasks, evaluate the results of their implementation and implementation	3			+										+		+
46.	Information technology in agriculture	The basic concepts of the theory of systems modeling are given. Mathematical methods of modeling information processes and systems. Network models. Queuing systems. Petri nets. Generalized A-circuit models. Conceptual, algorithmic, static models. Modeling of processes in agriculture, the formation of skills, skills to carry out simulation modeling of a separate operation when using agricultural machinery, the operation of an electrical network, to conduct a simulation experiment on a computer.	3			+										+		+
47.	Database theory	The concept of a database system, relational databases (tabular models). Transition from data abstraction to transaction management with additional materials to improve query performance. Current trends in the design of database systems, which also determine the latest developments in the broader history of data storage technologies.	4		+													
48.	Design and development of Internet applications	Internet technologies. Classification and types of web applications. Web application development tools: HTML5, CSS3; JavaScript and jQuery libraries; basic tools of the Web Matrix development environment. Client-server interaction. Development of client-server applications. Web design.	5							+	+							
49.	Intelligent logistics systems of livestock enterprises	Formation of knowledge and skills of using methods, technologies and artificial intelligence systems in the field of logistics in enterprises and supply chain management, as well as ideas about modern concepts and management systems of the organization. The discipline is focused on obtaining knowledge and practical skills of working with intelligent systems	5												+			

		in the management of logistics processes																
50.	Automation of traceability of livestock products	Owns the principles of automation of agricultural production in animal husbandry. Summary: Automation of technologies for processing, storage and transportation of livestock products. Automation of feed production and animal husbandry. Automation of power supply and water supply	4												+			
51.	Production technology of animal husbandry products	Course studies the modern methods of breeding agricultural animals; economic prerequisites of organization and production of livestock products in farms, peasant farms, joint-stock farms of the Republic of Kazakhstan, the CIS countries and other foreign countries; applies the production technologies of livestock products.	5											+				+
52.	Automation of technological processes in animal husbandry	The main feature of the development of automation in animal husbandry is the inextricable connection of technology with biological objects, variable parameters (in time) – animals and birds. The connection of technology and biological objects as a human-machine system, which is caused by: Complexity and diversity of production processes, a variety of technological processes and equipment. Poultry and livestock industries are also characterized by all groups of automation objects.	5														+	+
53.	Database management systems	Learn the basics of databases and database management systems. Know the principles of the relational data model, the basics of working with database management systems, relational algebra and relational calculus. Be able to create databases, administer DBMS, archive data, perform SQL queries, data sampling, search. Have database design and development skills	4		+													
54.	Fundamentals of mechanotronics and robotics	Fundamentals of the design and use of software tools, programming of robotic devices. Mastering knowledge of the theoretical and practical foundations of the design of robotic devices; mastering knowledge about the purpose and capabilities of software for controlling robotic devices; forming skills of working with software and using software tools to solve problems of automation of control of robotic devices.	4			+						+						
55.	Unmanned vehicles and autopilots	The course introduces the principles of construction and operation of modern unmanned aerial vehicles. Gives concepts about aerodynamics, the main design features of UAV models. the course discusses the features of the use of UAVs in the study of the soil cover of pastures. Attention is also paid to unmanned tractors and other mechanisms. Parallel driving. The	4												+			

		issues of the use of UAVs and autopilots in precision animal husbandry are considered.																
56.	Production technology of plant growing products	Theoretical foundations of crop production. Ways to increase the production of field crops. Factors determining the growth, development of plants, yield and quality of the crop. Programming of harvests of field crops. Theoretical foundations of component compatibility in mixed and joint crops. Models of energy-saving technologies for the production of biologically pure agricultural products. Methods of energy assessment of technological techniques. Fundamentals of soil conservation crop production.	5											+				+
57.	Automation of traceability of crop production	The study of the discipline is aimed at mastering the principles of automation of agricultural production. Automation of processing, storage and transportation of agricultural products, phytosanitary safety, the ability to control and monitor processes at all stages of processing and transportation of products. Automation of post-harvest processing and storage modes.	4														+	
58.	Automation of processes in crop production technological agriculture	The discipline is aimed at mastering the principles of automation of calculations of technological maps and production plans of agricultural production. The study of methods of composing technological mapping of agricultural crops of various crops, the preparation of production plans with the calculation of the required volumes of work, a large number of agricultural machinery and working equipment, stocks of fuel and electric energy, as well as the financing of wages	5														+	+
59.	Theory of electric chains	The course has been designed to introduce fundamental principles of circuit theory commonly used in engineering research and science applications. Techniques and principles of electrical circuit analysis including basic concepts such as voltage, current, resistance, impedance, Ohm's and Kirchoff's law; basic electric circuit analysis techniques, resistive circuits, 1st order and 2nd order circuits; circuits with DC and AC sources.	4			+						+						
60.	Web technologies	Classification and types of web applications. Web application development tools: HTML, HTML5, CSS3. Client-server interaction. Technologies for developing client-server applications. Installed a website. JavaScript and jQuery libraries. Platform Node.js . Vue frameworks.js , Angular 2 and React 15. CMS systems. A programming interface for accessing and managing the DOM API supported by the web page.	5							+								