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Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University

Agrarian -Technological Institute
educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Instrumental methods of research
course title

Recommended by the Didactic Council for the Education Field of:

35.04.04 Agronomy
field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

Integrated Plant Protection
higher education programme profile/specialisation title

2025

1. COURSE GOAL(s)

The purpose of mastering the discipline "Instrumental methods of research" is the formation of a highly qualified specialist with theoretical knowledge and practical skills on modern innovative technologies in agricultural production.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Instrumental methods of research" is aimed at the formation of the following competencies (part of the competencies) among students:

Table 2.1. List of competences that students acquire through the course study

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GK-1	Able to carry out search, critical analysis of problem situations on the basis of a systematic approach, to develop an action strategy	GK-1.2 Uses a systematic approach to solve the tasks
OPK-1	Able to solve the tasks of developing the field of professional activity and (or) organization based on the analysis of scientific and industrial achievements;	OPK-1.1 Demonstrates knowledge of the main methods of analyzing the achievements of science and production in agronomy
OPK-3	Able to use modern methods of problem solving in the development of new technologies in professional activities	OPK-3.1. Analyzes methods and methods of solving problems for the development of new technologies in agronomy
OPK-4	Able to conduct research, analyse results and prepare reporting documents	OPK-4.1. Analyzes methods and methods of solving research problems
OPK-7	Able to own the tools for working with large arrays of structured and unstructured information, use modern digital methods of processing, analysis, interpretation and visualization of data in order to solve the tasks of professional and research activities in the field of agronomy	OPK-7.2. Uses modern digital methods of data processing, analysis, interpretation and visualization in order to solve the tasks
PK-2	Able to develop experimental techniques and master new research methods.	PK-2.2 Applies modern types and methods of conducting observations and accounting in field experiments;

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

Mastering the discipline "Instrumental methods of research" is aimed at forming the following competencies (part of the competencies) among students:

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
GK-1	Able to carry out search, critical analysis of problem situations on the basis of a systematic approach, to develop an action strategy	Scientific research work / Научно-исследовательская работа; Manuscript Design; Information Technology; Pest Risk Analysis; Forecast of Development of Agricultural Pests and Diseases; History and methodology of scientific Agronomy;	Undergraduate practice / Преддипломная практика; Scientific research work / Научно-исследовательская работа; Plant immunity; Biotechnology in Plant Protection;
OPK-1	Able to solve the tasks of developing the field of professional activity and (or) organization based on the analysis of scientific and industrial achievements;	Bacterial Diseases; Information Technology; Scientific research work / Научно-исследовательская работа;	Biotechnology in Plant Protection; Plant Immunity; Plant Quarantine; Scientific research work / Научно-исследовательская работа;
OPK-3	Able to use modern methods of problem solving in the development of new technologies in professional activities	Scientific research work / Научно-исследовательская работа;	Scientific research work / Научно-исследовательская работа;
OPK-4	Able to conduct research, analyse results and prepare reporting documents	Scientific research work / Научно-исследовательская работа; Bacterial Diseases;	Biotechnology in Plant Protection; Plant Immunity; Plant Quarantine; Scientific research work / Научно-исследовательская работа; Undergraduate practice / Преддипломная практика;
OPK-7	Able to own the tools for working with large arrays of structured and unstructured information, use modern digital methods of processing, analysis, interpretation and	Information Technology; Scientific research work / Научно-исследовательская работа;	Scientific research work / Научно-исследовательская работа;

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
	visualization of data in order to solve the tasks of professional and research activities in the field of agronomy		
PK-2	Able to develop experimental techniques and master new research methods.	Scientific research work / Научно-исследовательская работа; Molecular Methods of Diagnostics;	Biotechnology in Plant Protection; Plant Immunity; Plant Quarantine; Scientific research work / Научно-исследовательская работа;

* To be filled in according to the competence matrix of the higher education programme.

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

Possible wording

The total labor intensity of the discipline "Instrumental methods of research" is 5 credits for full-time education.

Table 4.1 – Types of educational work by periods of mastering the OP HE for full-time education

Type of academic activities		Total academic hours	Semesters/training modules			
			1	2	3	4
Contact academic hours		*87*		*36*	*51*	
including:						
Lectures (LC)		29		12	17	
Lab work (LW)						
Seminars (workshops/tutorials) (S)		*58*		24	34	
Self-studies		*58*		*28*	*30*	
Evaluation and assessment (exam/passing/failing grade)		*35*		*8*	*27*	
Course workload	academic hours_	**180**		**72**	**108**	
	credits	**5**		**2**	**3**	

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1: General provisions	Topic 1.1. Classification of instrumental methods for the study of environmental objects, sampling, sample preparation, separation and concentration, measurement (definition), data processing, conclusions and report, presentation of chemometrics	LC; S

Course module title	Course module contents (topics)	Academic activities types
Module 2: Atomic absorption spectrometry	Topic 2.1. Theoretical foundations of the atomic emission spectrometry method, radiation sources used in atomic emission spectrometry, spectrometers for atomic emission spectrometry, possibilities of the atomic emission spectrometry method for the analysis of environmental objects	LC; S
	Topic 2.2. Theoretical foundations of the atomic absorption spectrometry method, the device of atomic absorption spectrometers, the possibilities of the atomic absorption spectrometry method, water analysis by atomic absorption spectrometry, air analysis by atomic absorption spectrometry, atomic absorption method for determining lead in air in accordance with the international standard ISO 9855, determination of heavy metals in soil in accordance with with the international standard ISO 11047, food analysis, analysis of biological samples	LC; S
Module 3: Spectral analysis methods	Topic 3.1. Infrared spectroscopy, ultraviolet spectroscopy, nuclear magnetic resonance spectroscopy, gas-liquid chromatography, high-performance liquid chromatography, mass spectrometry, chromato-mass spectrometry	LC; S
Module 4: Electrochemical methods of analysis	Topic 4.1. Theoretical foundations of electrochemical analysis methods, potentiometry, voltammetry, possibilities of electrochemical methods for the analysis of environmental objects, determination of the mass fraction of nitrate ions in plant products, fruit and vegetable processing products, feed, compound feeds and feed raw materials by potentiometric method, determination of the mass concentration of vitamin C in fruits and berries by voltammetric method, determination of iodine in food products and food raw materials by the voltammetric method	LC; S
Module 5: Chromatography	Topic 5.1. Theoretical foundations of chromatography as a method of separation and determination of chemicals, gas-liquid chromatography, high-performance liquid chromatography, ion chromatography, mass spectrometry, chromato-mass spectrometry, determination of essential oils, determination of anions.	LC; S

* - to be filled in only for **full** -time training: *LC - lectures; LW - lab work; S - seminars.*

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	**Classroom equipment**	**Specialised educational / laboratory equipment, software, and materials for course study** (if necessary)
Lecture hall	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a blackboard (screen) and multimedia presentation equipment.	
Seminary	An auditorium for seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification, equipped with a set of specialized furniture and multimedia presentation equipment.	
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment.	

* The premises for students' self-studies are subject to **MANDATORY** mention

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

1. Instrumental methods of analysis in agricultural research Инструментальные методы исследования в агрономии : education and Methodical Complex / В.Д. Нагорный. - Книга на английском языке; электронные текстовые данные. - M. : PFUR, 2013. - 171 c.

2. Instrumental research methods : a textbook / S. A. Korostylev, E. A. Ustimenko, E. V. Golosnoy [et al.]. Stavropol : SSAU, 2021. 108 p. ISBN 978-5-9596-1805-6. — Text : electronic // Lan : electronic library system. — URL: https://e.lanbook.com/book/245774

Additional readings:

1. Instrumental research methods in agrochemistry : a textbook / S. A. Korostylev, E. A. Ustimenko, N. V. Gromova [et al.]. Stavropol : SSAU, 2024. 109 p. — Text : electronic // Lan : electronic library system. — URL: https://e.lanbook.com/book/400229

2. Subbotina, M. G. Instrumental methods for assessing the quality of agricultural products: laboratory practice : a textbook / M. G. Subbotina. Perm : PGATU, 2024. 44 p. ISBN 978-5-94279-627-3. — Text : electronic // Lan : electronic library system. — URL: https://e.lanbook.com/book/420671

Internet sources

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System (RUDN ELS) http://lib.rudn.ru/MegaPro/Web
- EL "University Library Online" http://www.biblioclub.ru
- EL "Yurayt" http://www.biblio-online.ru
- EL "Student Consultant" www.studentlibrary.ru
- EL "Lan" http://e.lanbook.com/

2.Databases and search engines:

- electronic foundation of legal and normative-technical documentation http://docs.cntd.ru/
- Yandex search engine https:// www .yandex.ru/
- Google search engine https://www.google.ru/
- Scopus abstract database http://www.elsevierscience.ru/products/scopus/

*Training toolkit for self- studies to master the course *:*

The set of lectures on the course «Instrumental methods of research»

* The training toolkit for self- studies to master the course is placed on the course page in the university telecommunication training and information system under the set procedure.

DEVELOPERS:

position, department	name and surname
position, department	name and surname
position, department	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

name of department	name and surname

HEAD
OF HIGHER EDUCATION PROGRAMME:

position, department	name and surname