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**Federal State Autonomous Educational Institution of Higher Education
Peoples' Friendship University of Russia named after Patrice Lumumba
RUDN University**

Agrarian and Technological Institute

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

MATHEMATICAL MODELING AND DESIGN

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

1. COURSE GOAL(s)

The discipline "Mathematical Modeling and Design" is part of the Master's program "Integrated Plant Protection" under the field of study 35.04.04 "Agronomy" and is studied in the 3rd semester of the 2nd year. The discipline is delivered by the Agrobiotechnology Department.

The discipline consists of 4 sections and 9 topics and is aimed at studying methods of information processing for human analysis to perform management tasks related to production activities in the field of agriculture.

The purpose of mastering the discipline is: formation of basic ideas about obtaining and processing information for human analysis and making decisions based on it to perform management tasks related to production activities in the field of agriculture.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Mathematical Modeling and Design" is aimed at developing the following competencies (parts of competencies) in students:

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

Competence code	Competence descriptor	Competence formation indicators (within this course)
GC-7	Able to search for necessary sources of information and data, perceive, analyze, memorize and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the received information to solve problems, evaluate information, its reliability, build logical conclusions based on incoming information and data	GC-7.1 Evaluates information, its reliability, builds logical conclusions based on incoming information and data;
GPC-1	Able to solve problems of development of the field of professional activity and/or organization based on the analysis of scientific and production achievements	GPC-1.1 Demonstrates knowledge of the main methods of analysis of scientific and production achievements in agronomy;
GPC-4	Able to conduct scientific research, analyze results and prepare reporting documents	GPC-4.1 Analyzes methods and ways of solving research problems;
PC-3	Able to organize, conduct and analyze the results of experiments (field trials)	PC-3.1 Masters modern methods of processing research results using methods of mathematical statistics;

Competence code	Competence descriptor	Competence formation indicators (within this course)
PC-4	Able to create models of crop cultivation technologies, plant protection systems, and varieties	PC-4.1 Applies modern methods of mathematical statistics for building models of various crop cultivation technologies, plant protection systems, varieties;
PC-5	Able to prepare scientific and technical reports, reviews and scientific publications based on the results of conducted research	PC-5.2 Uses methods of mathematical statistics when processing data and preparing a report;

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Mathematical Modeling and Design" belongs to the mandatory part of Block 1 "Disciplines (modules)" of the higher education program.

Within the framework of the higher education program, students also master other disciplines and/or practices that contribute to achieving the planned learning outcomes of the discipline "Mathematical Modeling and Design".

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*
GC-7	Able to search for necessary sources of information and data, perceive, analyze, memorize and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the received information to solve problems, evaluate information, its reliability, build logical conclusions based on incoming information and data	Scientific and Research Practice; Scientific research work; Information Technology; Information Databases;	Scientific research work;
GPC-1	Able to solve problems of development of the field of professional activity and/or organization based on the analysis of scientific and production	Scientific and Research Practice; Scientific research work; Biological Method of Plant Protection; Instrumental methods of research; Bacterial Diseases;	Biotechnology in Plant Protection; Plant Quarantine; Plant immunity; Scientific research work;

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
	achievements	Information Technology;	
GPC-4	Able to conduct scientific research, analyze results and prepare reporting documents	Scientific research work; Scientific and Research Practice; Instrumental methods of research; Bacterial Diseases; Biological Method of Plant Protection;	Plant Quarantine; Biotechnology in Plant Protection; Plant immunity; Scientific research work; Undergraduate practice/Pre-diploma practice;
PC-3	Able to organize, conduct and analyze the results of experiments (field trials)	Scientific research work; Scientific and Research Practice; Biological Method of Plant Protection;	Scientific research work;
PC-4	Able to create models of crop cultivation technologies, plant protection systems, and varieties	Scientific and Research Practice; Biological Method of Plant Protection; Plant Protection in Organic Farming**; Pest Risk Analysis**; Forecast of Development of Agricultural Pests and Diseases**; Nematodes**; Weed biology and management**; Bacterial Diseases;	Plant immunity;
PC-5	Able to prepare scientific and technical reports, reviews and scientific publications based on the results of conducted research	Molecular Methods of Diagnostics**; History and methodology of scientific Agronomy; Fundamentals of Scientific Communication**; Manuscript Design**; Scientific research work; Scientific and Research Practice;	Scientific research work; Undergraduate practice/Pre-diploma practice;

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

** – Elective disciplines/practices

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total labor intensity of the discipline "Mathematical Modeling and Design" is 4 credit units.

*Table 4.1. Types of academic activities during the periods of higher education programme mastering (full-time training)**

Type of academic activities	Total academic hours	Semesters/training modules
		3

Type of academic activities	Total academic hours	Semesters/training modules
		3
<i>Contact academic hours</i>	34	34
including:		
Lectures (LC)	0	0
Lab work (LW)	0	0
Seminars (workshops/tutorials) (S)	34	34
<i>Self-studies</i>	82	82
<i>Evaluation and assessment (exam/passing/failing grade)</i>	28	28
Course workload	academic hours	144
	credits	4

* To be filled in regarding the higher education programme correspondence training mode.

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1: Methodological and theoretical foundations of modeling and design	Topic 1.1. The concept of models and modeling. The importance of modeling in scientific research on agronomy.	LC, S
	Topic 1.2. Properties of the model. Principles of modeling.	LC, S
Module 2: Storage structures and access methods	Topic 2.1. Data processing systems (SOD).	LC, S
	Topic 2.2. Data structures for FSO and access methods.	LC, S
Module 3: Modeling of highly productive agricultural systems	Topic 3.1. Modeling in crop breeding. The requirement for the grade model. Modeling in crop yield planning.	LC, S
	Topic 3.2. Models of fertilizer and plant protection systems, soil treatment. The use of modeling in the practice of regulating the weed component of agrophytocenoses.	LC, S
	Topic 3.3. The main technological blocks for controlling the production process of plants.	LC, S
Module 4: Databases	Topic 4.1. Basic concepts of databases. Database properties. Requirements for the organization of the database.	LC, S
	Topic 4.2. Levels of data representation. The life cycle of the database. The database design process.	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	A lecture hall for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	Computer classes; Multimedia board, projector, 16 workstations
Seminar	A classroom for conducting seminars, group and individual consultations, current and mid-term assessment; equipped with a set of specialized furniture and technical means for multimedia presentations.	Computer classes; Multimedia board, projector, 16 workstations
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. *Mathematical Modeling with Differential Equations in Physics, Chemistry, Biology, and Economics*. DOI: 10.3390/books978-3-0365-4626-1. ISBN: 9783036546254, 9783036546261. Publisher: MDPI – Multidisciplinary Digital Publishing Institute. Publisher website: www.mdpi.com/books. Publication date and place: Basel, 2022. Classification: Research & information: general; Mathematics & science. Pages: 150.
2. Malygin, A.A. *Mathematical modeling of economic processes in agriculture: an educational and methodological guide* / A.A. Malygin. — Ivanovo: Verkhnevolzhsky State Agrarian University, 2022. — 95 p. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/263741>

Additional readings:

1. *Engineering and technological solutions to the problems of agro-industrial complex and society development. Proceedings of the LVIII International scientific and practical conference of students, postgraduates and young scientists "Strategic resources of the Tyumen agroindustrial complex: people, science, technology": conference proceedings*. — Tyumen: State Agrarian University of the Northern Urals, 2024. — 1457 p. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/441635>
2. *Mathematical modeling in the classification of soil systems: a textbook / compiled by E.G. Pivovarova; edited by G.G. Morkovkin*. — Barnaul: AGAU Publ., 2020. — 71 p. — Text: electronic // Lan: electronic library system. — URL: <https://e.lanbook.com/book/197217>

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/>
- EL "Znanium": <https://znanium.ru/>

2. Databases and search engines:

- Sage: <https://journals.sagepub.com/>
- Springer Nature Link: <https://link.springer.com/>
- Wiley Journal Database: <https://onlinelibrary.wiley.com/>
- Scientometric database Lens.org: <https://www.lens.org>

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

- Lecture course on the discipline "Mathematical Modeling and Design".

* 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:

Professor of the Agrobiotechnology Department

Zargar M.

position, department

name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Director of the Agrobiotechnology Department

Pakina E. N.

name of department

name and surname

**HEAD
OF HIGHER EDUCATION PROGRAMME:**

Director of the Agrobiotechnology Department

Pakina E. N.

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