Federal State Autonomous Educational Institution of Higher Education "Peoples' Friendship University of Russia"

Agrarian Technological Institute

PROGRAM
STATE FINAL EXAMINATION

Direction of training

06.06.01- Biological Sciences

Focus of the program (profile, specialization)

03.02.07 - Genetics

Graduate qualifications (degree)

Researcher. Research Teacher

2021.

1. General Provisions

1.1. The program of final tests (certification, exam) for graduate students in the direction 06.06.01 "Biological Sciences" is designed to prepare for passing exams in special disciplines, taking into account the profile of preparation: 03.02.07 "Genetics".

The program contains a description of the main topics of the discipline sections, a list of literature necessary to prepare for the exam; an indicative list of questions to prepare for the exam. Examinations are conducted in oral and written forms.

As part of the exam, graduate students must show good knowledge in the field of genetics: principles and methods of genetic analysis, patterns of inheritance of traits during intraspecific hybridization in the absence and presence of linkage, interaction of non-allelic genes, chromosomal theory, molecular structure of a gene and the mechanism of its expression, fundamentals of genetic engineering, molecular genetic methods in genetics, breeding, seed and plant growing, non chromosomal heredity, variability, polyploidy, distant hybridization, incompatibility, inbreeding and heterosis, genetics of individual development, genetics of sex, population genetics, basics of plant genomics.

During the exam, graduate students must show competence in the field of classical, molecular genetics, plant genetics, farm animals and humans, cytogenetics, immune-genetics, biometrics, population genetics, genetic engineering.

1.2. State final certification in the direction 06.06.01- Biological Sciences (Plant Genetics Program) includes an interdisciplinary state examination and defense of the final qualification work in the form of a scientific qualification work (NKR)

1.3. The results of any of the types of attestation tests included in the state final attestation are determined by the marks "excellent", "good", "satisfactory", "unsatisfactory".

2. Goals and objectives of the state final certification

2.1. The purpose state final certification - an assessment of the theoretical knowledge of graduates, as well as their skills in solving pedagogical, scientific, scientific and practical (research) and other professional tasks of a theoretical and applied nature within the direction, taking into account the profile of training.

2.2. Tasksrstate final certification are:

- checking the quality of teaching the basic natural science laws and phenomena necessary in professional activity;
- determination of the level of theoretical and practical readiness of a graduate to perform professional tasks in accordance with the qualifications received;
- establishing the degree of the individual's aspiration for self-development, improving their qualifications and skills;
- checking the ability to find organizational and managerial solutions in non-standard situations and the willingness to bear responsibility for them;
- verification of proficiency in theoretical and experimental research methods in the field of agriculture;
- checking the readiness to conduct teaching activities in educational programs of higher education;
- increasing the efficiency of the use of scientific and technological achievements, reforming the scientific sphere and stimulating innovation.

3. State examination program.

3.1. The state exam is conducted in oral and written forms. the exam ticket contains 4 questions, 2 hours are given for preparation.

3.2. As part of the state exam, the degree of development of graduates of the following competencies is checked:

• UC-1 with the ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary areas

• UC-2 with the ability to design and carry out complex research, including interdisciplinary, based on a holistic systemic scientific worldview using knowledge in the field of history and philosophy of science

• UC-3 willingness to participate in the work of Russian and international research teams to solve scientific and scientific and educational problems

• UC-4 readiness to use modern methods and technologies of scientific communication in the state and foreign languages, including the readiness to communicate in oral and written forms in Russian and foreign languages to solve the problems of professional activity, possession of foreign language communicative competence in official business, educational professional, scientific, sociocultural, everyday spheres of foreign language communication

• UC-5 Ability to plan and solve problems of one's own professional and personal development

• GPC-1: possession of the methodology of theoretical and experimental research in the field of agriculture, agronomy, plant protection, selection and genetics of agricultural crops, soil science, agrochemistry, landscape development of territories, technologies for the production of agricultural products

- GPC-2: readiness for teaching in the basic educational programs of higher education.
- PC-1: the ability to understand modern problems of biology and use fundamental biological concepts in the field of professional activity to formulate and solve new problems;
- PC-2: the ability to use basic theories, concepts and principles in the chosen field of activity, the ability to think systemically;
- PC-3: readiness to independently analyze the available information, set the goal and objectives of the study and propose methods for their solution;
- PC-4: knowledge of the history and methodology of plant genetics, expanding general professional, fundamental training;
- PC-6: the ability to professionally draw up, present and report the results of research work in accordance with the approved forms;
- PC-7 the ability to apply the methodological foundations of design and carry out laboratory research using modern equipment;
- PC-8: the use of knowledge of regulatory documents governing the organization and methods of conducting research work, the ability to ensure industrial safety measures;
- PC-9. the presence of skills in the formation of educational material, lecturing, readiness for teaching in higher education and the management of research work (R&D) of students, the ability to present educational material in oral, written and graphic form for various contingents of students.

3.3. The scope of the state examination:

The exam consists of 4 questions. The examination board assesses each exam question separately, on a 100-point (100 percent) scale. The final mark for the exam is determined based on the sum of the points scored by the graduate student for each of the four questions, and dividing them by 4.

3.4. Content of the state exam:

1. The history of the development of genetics. Charles Darwin and the pangenesis hypothesis. The main provisions substantiating this hypothesis. The theory of evolution by J.B. Lamarck.
2. The main provisions of the De Vries mutation theory. Spontaneous mutations. Forward and backward mutations. Genomic mutations.
3. The concept of populations. Determination of gene frequencies and genotype ratios in populations. Establishing the proportion of heterozygotes. Calculation of gene frequencies based on the Hardy-Weinberger formula.
4. Inheritance of traits in monohybrid crosses. Dominance. Recessiveness. Codominance. Uniformity of the first hybrid generation. Splitting second generation hybrids
5. The value of G. Mendel's work in the formation of genetics as a science. Methods of genetics: hybridological, cytological, physicochemical, ontogenetic, mathematical, etc.
6. Cell division. Mitosis. The biological significance of mitosis. Meiosis. Pathology of mitosis and meiosis. Genetic control of meiosis. The genetic significance of meiosis.
7. Chromosomal sex determination. Sex chromosomes. Sex ratio in nature. The influence of factors of the internal and external environment on the development of gender characteristics.
8. The concept of heterosis. Genetic hypotheses of heterosis (hypothesis of dominance, hypothesis of overdominance, hypothesis of genetic balance, hypothesis of a compensatory gene complex) Hypothesis of dominance and its genetic justification. Use of the phenomena of inbreeding and heterosis in agricultural practice
9. Cellular structure of organisms. Cell structure. Cell division. Mitosis. The biological significance of mitosis. Meiosis. Pathology of mitosis and meiosis.
10. The interaction of genes that do not interfere with the manifestation of each other. Differences between the interaction of dominant and recessive genes. Complementary Gene Interaction. Suppression. Dominant epistasis. Cryptomeria (recessive epistasis). Polymerism.
11. Mitochondrial inheritance. Respiratory failure studies in yeast. Genetic maps of organelles.
12. The concept of distant hybridization. Types of hybrids obtained by distant hybridization of plants and animals. Non-breeding barriers to distant hybridization. Methods for overcoming non-breeding during distant hybridization.
13. Regulation of gene expression at the transcriptional level. Changes in transcription in ontogenesis. Differential transcription mechanisms. Control of gene expression at the level of RNA processing, translation.
14. Population ratios for sex-linked genes. Elementary processes of evolution. Change in the genetic structure of a population as a result of selection.

15. Molecular labeling. Polymerase chain reaction. Creation of molecular markers. Genomic libraries.
16. Cytoplasmic male sterility in plants. The influence of nuclear genes on the manifestation of CMS. The use of CMS to obtain hybrid seeds.
17. The law of homologous series in the hereditary variability of N.I. Vavilov. Induced mutations. Physical mutagenic factors. Radiation and absorption doses. Lethal and sublethal doses of mutagens. Chemical mutagens. Biological mutagens.
18. Haploidy. Morphological features and identification of haploid plants. Methods for the experimental production of haploids. The use of haploidy in genetics and breeding.
19. Evidence for a genetic role for nucleic acids. DNA transforming factor of pneumococcus. Nucleic acids are the hereditary material of viruses. The phenomenon of bacterial transduction. The structure of nucleic acids. Chemical composition and specificity of DNA.
20. RNA as genetic material and its replication. RNA types in polypeptide synthesis. Matrix RNA. Ribosomal RNA. Transport RNA. DNA transcription on an RNA template (reverse transcription).
21. Molecular basis of cytoplasmic heredity. Features of reproduction of organelles in the cell. The importance of nonchromosomal inheritance in understanding the problems of the evolution of eUCaryotic cells, the origin of cell organelles - plastids and mitochondria.
22. The concept of heterosis. Genetic hypotheses of heterosis (hypothesis of dominance, hypothesis of overdominance, hypothesis of genetic balance, hypothesis of a compensatory gene complex) Hypothesis of dominance and its genetic justification. Patterns of manifestation of heterosis in the second hybrid generation.
23. Polymerism. Features of the inheritance of quantitative traits. Transgression. Pleiotropy. Genes modifiers. Penetrance and expressiveness of genes. The influence of external conditions on the manifestation of gene action. The rate of reaction of the genotype.
24. Inheritance of sex-linked traits. Inheritance of sex-linked traits in humans. Nondisjunction of X chromosomes. Balance theory of sex determination. Non-divergence of chromosomes in humans.
25. Genetic code and its properties. Proofs of the tripletness of the code. Works by Nirenberg, Ochoa and others on decoding codons. Code degeneracy. Versatility of the code.
26. IV Michurin's works on overcoming non-breeding in fruit crops (the mediator's method, pollination with a mixture of pollen, the method of preliminary vegetative convergence). Features of distant hybrids in the first and subsequent hybrid generations. Overcoming the infertility of distant hybrids.

27. General splitting formulas for independent inheritance. Cleavage control. The statistical nature of the splitting. Comparison of the theoretically expected and actually observed splitting. Estimation of the resulting deviations using the $\chi 2$ method (chi-square).
28. Protein biosynthesis. Regulation of protein synthesis. Scheme of genetic control of enzyme synthesis in bacteria. Regulator gene, operon, structural genes. The central theory of the gene.
29. Nonchromosomal heredity of the genetic material of the cell according to the Jinks scheme. Features of cytoplasmic inheritance, differences from nuclear. Research methods: reciprocal, backcrossing, biochemical methods.
30. Inbreeding in cross-pollinated crops. Inbred minimum. Intucht - plant lines. Inbreeding in humans and animals.
31. Crossing over. Crossover mechanism. The size of the cross and the linear arrangement of genes in the chromosome. Single and multiple cross. Interference. Coincidence coefficient.
32. Features of the organization of the promoter region of eUCaryotes. Genetic engineering problems. Methods for the isolation and synthesis of genes. Characterization of restriction enzymes. The concept of gene vectors (plasmids, viruses).
33. Changes in the structure of chromosomes under the influence of mutagens. Changing the position and order of genes on chromosomes. Change in the structure of the gene. Point mutations. Transitions and transversions. Reading frame shift. Damaged DNA repair. Antimutagens.
34. Aneuploidy. Types of aneuploids. The mechanism of occurrence of aneuploids. Features of meiosis and gamete formation in aneuploids, their viability. Experimental production of aneuploid plants. Significance of aneuploids for genetic research.
35. Allopolyploidy. Types of allopolyploids. The works of GD Karpechenko to create Raphanobrassica. The role of amphiploidy in restoring the fertility of distant hybrids. Obtaining and using wheat-rye Triticale hybrids. Synthesis and resynthesis of species. The role of allopolyploidy in plant evolution and breeding.
36. Ontogenesis is a hereditarily determined program for the development of an individual. Genome stability and differential gene activity in the process of individual development. The effects of gene expression at the stage of embryogenesis.
37. Change in gene frequencies with complete dominance. Change in gene frequencies in the absence of dominance. Change in gene frequencies during overdominance. Genetic-automatic processes in the population (random gene drift).
38. Chargaff's rule. Watson-Crick DNA structure model. General features of DNA replication. DNA synthesis in eUCaryotes.

39. Overdominance hypothesis and its genetic basis. Examples of monogenic heterosis: additional action of alleles, alternative synthesis routes, synthesis of the optimal amount of a certain substance. The use of the phenomena of inbreeding and heterosis in practice.
40. Alternative splicing routes. Translational regulation mechanisms. Post-translational activation and inactivation of proteins.
41. Migrations and their impact on population structure. Population isolation factors. The concept of genetic load.
42. Direct gene transfer methods (microinjection, electroporation, bioballistics, liposomes, etc.). Use of Ti-plasmids from A. tumephaciens, viruses and viroids as vectors in genetic engineering of plants. Evidence for the integration of foreign genes. Advances in plant transgenesis. Mobile genetic elements.
43. Inheritance of sex-limited and gender-dependent traits. Practical use of sex-linked traits (silkworm, hops, etc.).
44. Crossing over. Crossover mechanism. The size of the cross and the linear arrangement of genes in the chromosome. Single and multiple cross.
45. Regularities of the inheritance of traits during dihybrid crossing. Regularities of the inheritance of traits in trihybrid crossing. General splitting formulas for independent inheritance. Cleavage control.
46. EUCaryotic gene structure: exons, introns. Post-transcriptional transformations of mRNA in eUCaryotes (processing, splicing).
47. Conditions for the implementation of Mendelian laws. Genetic symbolism. Recording of crosses and their results. Multiple allelism.
48. Experimental production of aneuploid plants. Significance of aneuploids for genetic research. Obtaining augmented and replaced lines and their practical use.
49. Genetic-automatic processes in the population (random gene drift). Migrations and their impact on population structure. Population isolation factors. The concept of genetic load. Genetic homeostasis of populations.
50. Gene amplification. Tissue-specific activity of genes. Pleiotropic action of genes in ontogenesis. The interaction of genes that determines the formation of traits in ontogeny. The relationship of cells in morphogenesis.
51. Elementary processes of evolution. Change in the genetic structure of a population as a result of selection. Change in gene frequencies with complete dominance. Change in gene frequencies in the absence of dominance. Change in gene frequencies during overdominance.
52. Methods of genetics: hybridological, cytological, physicochemical, ontogenetic, mathematical, etc. The subject of genetics and its place in the system of biological sciences.

The importance of genetics for solving problems of breeding, medicine, biotechnology and ecology.

53. The law of "gamete purity". Regularities of the inheritance of traits during dihybrid crossing. Regularities of the inheritance of traits in trihybrid crossing. General splitting formulas for independent inheritance. Cleavage control.
54. Genetic maps of chromosomes. Cytological evidence of crossing over. Factors Affecting Chromosome Crossing. Types of meiotic recombination: equal and unequal crossing over. Molecular bases of crossing over.
55. Interference. Coincidence coefficient. Localization of genes. Linked gene inheritance and crossing over. The linear arrangement of genes in the chromosome. Genetic maps of chromosomes.
56. Complementary Gene Interaction. Suppression. Dominant epistasis. Cryptomeria (recessive epistasis). Polymerism. Features of the inheritance of quantitative traits. Transgression. Pleiotropy.
57. The concept of populations. Determination of gene frequencies and genotype ratios in populations. Establishing the proportion of heterozygotes. Calculation of gene frequencies based on the Hardy-Weinberger formula.
58. Modification variability. Hereditary variability. Combinative variability. Mutational variability. The main provisions of the De Vries mutation theory. Spontaneous mutations. Forward and backward mutations. Genomic mutations.
59. Evidence for a genetic role for nucleic acids. DNA transforming factor of pneumococcus. Nucleic acids are the hereditary material of viruses. The phenomenon of bacterial transduction. The structure of nucleic acids. Chemical composition and specificity of DNA. Chargaff's rule. Watson-Crick DNA structure model.
60. Cellular structure of organisms. Cell structure. Chromosomes, their types and structure. Cell division. Mitosis. The biological significance of mitosis. Meiosis. Pathology of mitosis and meiosis. Genetic control of meiosis. The genetic significance of meiosis. Micro- and macrosporogenesis.
61. Features of the organization of the promoter region of eUCaryotes. Genetic engineering problems. Methods for the isolation and synthesis of genes. Characterization of restriction enzymes. The concept of gene vectors (plasmids, viruses). Methods for producing recombinant DNA, methods for cloning genes.
62. The law of homologous series in the hereditary variability of N.I. Vavilov. Induced mutations. Physical mutagenic factors. Radiation and absorption doses. Lethal and sublethal doses of mutagens. Chemical mutagens. Biological mutagens. Classification of mutations.

63. The concept of heredity and variability. The history of the development of genetics. Charles Darwin and the pangenesis hypothesis. The main provisions substantiating this hypothesis. The theory of evolution by J.B. Lamarck. The value of G. Mendel's work in the formation of genetics as a science.
64. General splitting formulas for independent inheritance. Cleavage control. The statistical nature of the splitting. Comparison of the theoretically expected and actually observed splitting. Estimation of the resulting deviations using the $\chi 2$ method (chi-square).
65. Non-divergence of chromosomes in humans. Inheritance of sex-limited and gender-dependent traits. Types of sex determination.
66. RNA as genetic material and its replication. RNA types in polypeptide synthesis. Matrix RNA. Ribosomal RNA. Transport RNA. DNA transcription on an RNA template (reverse transcription).
67. Molecular basis of cytoplasmic heredity. Features of reproduction of organelles in the cell. The importance of nonchromosomal inheritance in understanding the problems of the evolution of eUCaryotic cells, the origin of cell organelles - plastids and mitochondria.
68. Classification of mutations. Changes in the structure of chromosomes under the influence of mutagens. Changing the position and order of genes on chromosomes. Change in the structure of the gene. Point mutations. Transitions and transversions. Reading frame shift. Damaged DNA repair. Antimutagens.
69. Monosomal analysis method. Haploidy. Morphological features and identification of haploid plants. Methods for the experimental production of haploids. The use of haploidy in genetics and breeding.
70. Features of distant hybrids in the first and subsequent hybrid generations. Overcoming the infertility of distant hybrids. Features of formative processes in distant hybrids. Introgression of genes during distant hybridization. Genomic analysis. Protoplast culture.
71. Inbreeding coefficient as a measure of the degree of inbreeding. An increase in the coefficient of inbreeding in a number of generations with different types of related crosses. Inbreeding in cross-pollinated crops. Inbred minimum. Intucht line of plants.
72. Elementary processes of evolution. Change in the genetic structure of a population as a result of selection. Change in gene frequencies with complete dominance. Change in gene frequencies in the absence of dominance. Change in gene frequencies during overdominance.
73. Plant genomics.

74. **Methodical recommendations for the preparation and passing of the final state exam**

4.1. Recommended reading

1. Genetics. Textbook. for universities. / ed. A.A. Zhuchenko, Academician of the Russian Academy of Agricultural Sciences, Moscow: KolosS, 2005.
2. Zhimulev I.F. General and molecular genetics. - Novosibirsk NSU, 2004.
3. Inge-Vechtomov G.S. Genetics with the basics of selection. - SPb.: N-L, 2010.
4. PUChalskiy V.A. Introduction to genetics. - M .: KolosS, 2007.
5. William S. Clag, Michael R. Cummings. Fundamentals of Genetics. –M .: Technosphere, 2009.
6. Romanova EV, P. Kezimana. General Genetics: study guide, English. lang. -M: RUDN, 2018.
7. Torres Miño CJ, Romanova EV Problemas de Genética (Spanish): study guide. -M: RUDN, 2015.

4.2. Additional recommendations

1. Ayala F., Keiger J. Modern genetics. T. 1-3. Moscow: Mir, 1988.
2. Bakai A.V., Kochish I.I., Skripnichenko G.G. Genetics. –M .: KolosS, 2006.
3. Glazer V.M., Kim A.I., Orlova N.N. and other Tasks in modern genetics. Textbook / ed. M.M. Aslanyan. - M.: KDU, 2005.
4. Dolgodvorova L.V., Ivanova S.V. and others. Problem book on genetics. - M .: Moscow Agricultural Academy, 1996.
5. Durnev A.D., Seredenin S.B. Mutagens. - M .: Medicine, 1998.
6. Ivanova S.V. and other Tasks in genetics. - M .: MSKhA, 1998.
7. A.S. Konichev, G.A. Sevastyanova Molecular biology. - M .: Academy, 2003.
8. Lutova L.A., Ezhova T.A. , Dodueva I.E .. Osipova M.A. Plant development genetics. - SPb. : Publishing house of NL, 2010.
9. Maksimov G.V. and others. A short dictionary of genetic terms. - M .: University book, 2001.

5. Evaluation tools, designed to establish, in the course of attestation tests, the level of training of graduates who have completed the development of EP VO in the direction of training / specialty, the requirements of the corresponding OS of VO RUDN...

A maximum of 100 points can be received for the correct completion of all written assignments. The results of the test part of the exam are taken into account in favor of the graduate student in case of disagreement between the members of the examination committee.

The final grade for each part is set based on the number of points scored by the applicant (Table 1).

Table 1.

Exam grading table

Number of points	Final grade
<50	Unsatisfactory
56 - 68	Satisfactorily
69 - 85	Good
86 - 100	Excellent

The mark "5" (excellent) is given if:

- the content of the examination card material is fully disclosed;
- the material is presented correctly, in a certain logical sequence;
- demonstrated systematic and deep knowledge of program material;
- the terminology is precisely used;
- the ability to illustrate theoretical positions with specific examples is shown, to apply them in a new situation;
- the assimilation of previously studied related issues, the formation and stability of competencies, abilities and skills was demonstrated;
- the answer sounded independently, without leading questions;
- demonstrated the ability to creatively apply knowledge of theory to solving professional problems;
- demonstrated knowledge of modern educational and scientific literature;
- One or two inaccuracies were allowed in the coverage of secondary issues, which are corrected according to the remark.

A score of "4" (good) is given if:

- the questions of the examination material are presented in a systematic and consistent manner;
- demonstrated the ability to analyze the material, but not all conclusions are reasoned and evidentiary;
- the assimilation of basic literature is demonstrated.
- the answer basically satisfies the requirements for the mark "5", but at the same time has one of the disadvantages:
- there are small gaps in the statement that did not distort the content of the answer;
- one or two flaws were made when covering the main content of the answer, corrected according to the comment of the examiner;
- a mistake or more than two shortcomings were made in the coverage of secondary questions, which are easily corrected at the comment of the examiner.

The grade "3" (satisfactory) is given if:

- the content of the material is incompletely or inconsistently disclosed, but a general understanding of the issue is shown and skills are demonstrated that are sufficient for further
- assimilation of the material;
- mastered the main categories on the considered and additional issues;
- there were difficulties or mistakes in the definition of concepts, the use of terminology, corrected after several leading questions;
- with incomplete knowledge of the theoretical material, insufficient formation of competencies, abilities and skills was revealed, the student cannot apply the theory in a new situation;
- the assimilation of basic literature is demonstrated.

6. Requirements for the final qualifying work

6.1. A student who has passed the state exam is allowed to defend the NKR. The defense of the NKR is held at an open meeting of the State Examination Commission (SEC).

State final attestation is carried out in the form of an oral presentation of the NKR, followed by oral answers to the questions of the SEC members in accordance with the University Regulations on the NKR. The report and / or answers to questions from the SEC members may be in a foreign language.

6.2. As part of the defense of the NKRthe degree of development of graduates of the following competencies is checked:

- UC-1 with the ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary areas
- UC-2 with the ability to design and carry out complex research, including interdisciplinary, based on a holistic systemic scientific worldview using knowledge in the field of history and philosophy of science
- UC-3 willingness to participate in the work of Russian and international research teams to solve scientific and scientific and educational problems
- UC-4 readiness to use modern methods and technologies of scientific communication in the state and foreign languages, including the readiness to communicate in oral and written forms in Russian and foreign languages to solve the problems of professional activity, possession of foreign language communicative competence in official business, educational professional, scientific,

sociocultural, everyday spheres of foreign language communication

- UC-5 Ability to plan and solve problems of one's own professional and personal development
- GPC-1: knowledge of the methodology of theoretical and experimental research in the field of agriculture, agronomy, plant protection, selection and genetics of agricultural crops, soil science, agrochemistry, landscape development of territories, technologies for the production of agricultural products
- GPC-2: readiness for teaching in the basic educational programs of higher education.
- PC-1: the ability to understand modern problems of biology and use fundamental biological concepts in the field of professional activity to formulate and solve new problems;
- PC-2: the ability to use basic theories, concepts and principles in the chosen field of activity, the ability to think systemically;
- PC-3: readiness to independently analyze the available information, set the goal and objectives of the study and propose methods for their solution;
- PC-4: knowledge of the history and methodology of plant genetics, expanding general professional, fundamental training;
- PC-6: the ability to professionally draw up, present and report the results of research work in accordance with the approved forms;
- PC-7 the ability to apply the methodological foundations of design and carry out laboratory research using modern equipment;
- PC-8: the use of knowledge of regulatory documents governing the organization and methods of conducting research work, the ability to ensure industrial safety measures;

PC-9. the presence of skills in the formation of educational material, lecturing, readiness to teach in higher education and the leadership of research work

6.3. List of graduation thesis' topics:

An approximate list of graduation thesis' topics is annually developed in the department and approved by the Scientific Council of the Institute. The student has the right to propose his own graduation thesis' topic with the necessary justification for the feasibility of its development.

6.4. Tasks that the student must solve in the process of performing the graduation thesis

The student's work during the academic year consists of the following stages:
reading literature, conducting research, writing a draft version of the work, writing a white paper version of the work.
The student in a timely manner together with the scientific advisor formulates (clarifies) the topic and objectives of the research. During the graduation course, he periodically presents to the supervisor the intermediate results of the work. The student takes into account the wishes and comments of the supervisor, correcting the text. Correction of the topic is agreed with the supervisor. The final version of the work is provided to the supervisor in such terms that the remaining time is enough to make adjustments in accordance with the supervisor's comments.

6.5. The stages of the final qualification work , the conditions for admitting a student to the defense procedure, requirements for the structure, volume, content and design, as well as the list of mandatory and recommended documents submitted for defense are indicated in the methodological instructions approved in the prescribed manner:

The structural elements of the graduation thesis are:

- title page;
- content;
- introduction;
- the main part, consisting of chapters, which are divided into paragraphs, or from sections without further division into parts;
- conclusion;
- list of sources used;
- applications (if necessary).

The volume of the graduation thesis is at least 50 typewritten pages (excluding attachments). The proportion of parts of the work must be balanced in terms of volume. The scope of applications is not limited. Format: A4 page; margins no more than: 3 cm on the left, 2 cm above and below, 1.5 cm on the right; Times New Roman font; font size no more than 14; no more than one and a half interval. The volume of work is not artificially inflated (too large margins, font and spacing, each paragraph from a new page with a large number of paragraphs).

6.6 Evaluation tools.
Defense of a scientific and qualifying work includes a student's presentation, and also answers to questions from the reviewer and members of the examination committee. The student is given 10-15 minutes to perform. After the speech, the student answers the questions of the commission. Further, the written reviews of the head and the reviewer are announced, after which the author of the work answers the questions and comments in the reviews.
A scientific report based on the results of the graduation thesis (dissertation) is evaluated in accordance with the criteria established for dissertations for the degree of candidate:
- relevance;
- the depth and thoroughness of the disclosure of the topic, the content of the work, the quality of the analysis scientific sources and practical experience;
- personal participation of the applicant for a scientific degree in obtaining the results set out in the dissertation, the degree of reliability of the results of the research conducted by the applicant for a scientific degree, their novelty, and practical significance.

The results of the presentation of a scientific report on the performed graduation thesis are determined by estimates:
- "excellent" (graduation thesis fully complies with the qualification requirements and is recommended for protection);
- "good" (graduation thesis is recommended for defense, taking into account the comments made without repeated
scientific report);
- "satisfactory" (graduation thesis is recommended for substantial revision and re-submission of the scientific report);
- “unsatisfactory” (graduation thesis does not meet the qualification requirements).
The decision of the state examination commission is made at a closed meeting. If the opinions of the commission members differ, the assessment is determined by voting by a simple majority of votes, with an equal number of votes, the vote of the chairman of the commission (in his absence, the deputy chairman) is decisive. The grade is announced after the defense and is put in the minutes of the meeting of the state examination commission and in the student's record book.

Developers:

Associate Professor of the Agrobiotechnology Department Romanova E.V.

Program Manager:
Associate Professor of the Agrobiotechnology Department Romanova E.V.

Director of the Agrobiotechnology Department Pakina E.N.