MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SUMY NATIONAL AGRICULTURAL UNIVERSITY

DEPARTMENT OF BREEDING AND SELECTION OF ANIMALS AND AQUATIC BIO-RESOURCES

APPROVED

Head of Department
breeding and selection of animals
and aquatic bioresources
" 26 " 05 2020 y.
L. M. Khmelnychyi

SYLLABUS

Realization the genetic potential of farm animals

Specialty: 204 "Livestock production and processing technologies of animal products"

Educational program: 204 "Livestock production and processing technologies of animal products"

Degree: Ph.D.

Faculty: Biology and Technology

2020 – 2021 academic year

Syllabus on the **Realization the genetic potential of farm animals** for postgraduate students of specialty 204 **livestock production and processing technologies of animal products"**

Developers: Head of department of breeding and selection of animals and aquatic bioresources, Doctor of Agricultural Sciences,

Professor _____ **L. M. Khmelnychyi**

Syllabus approved at the meeting of the Department of breeding and selection of animals and aquatic biological resources:

protocol from "26" 05 2020 year № 13

Head of department _____ **L. M. Khmelnychyi**

Approved:

Guarantor of educational program _____ (L. M. Khmelnychyi)

Head of postgraduate and doctoral studies _____ (Лукянова І. В.)

1. Description of the syllabus

<table>
<tr><td rowspan="2">Name of indicators</td><td rowspan="2">Field of knowledge, direction of training, educational degree</td><td>Characteristic of the syllabus</td></tr>
<tr><td>full-time education</td></tr>
<tr><td>Quantity of credits – 5,0</td><td>Field of knowledge:
20 – agricultural sciences and food</td><td>Selective</td></tr>
<tr><td>Modules – 2</td><td rowspan="4">Specialty:
204 – livestock production and processing technologies of animal products”</td><td>Year of preparation:</td></tr>
<tr><td>Content modules: 3</td><td>2020-2021</td></tr>
<tr><td rowspan="3">Individual research task:</td><td rowspan="2">Course</td></tr>
<tr><td rowspan="15">Educational degree: Ph.D.</td></tr>
<tr><td>2</td></tr>
<tr><td rowspan="2">Total number of hours: 150</td><td>Semester</td></tr>
<tr><td>4 (s)</td></tr>
<tr><td rowspan="13">Weekly hours for full-time study:
classroom – 5
independent work of the student – 10</td><td>Lectures</td></tr>
<tr><td>20 hours</td></tr>
<tr><td>Practical</td></tr>
<tr><td>30 hours</td></tr>
<tr><td>Laboratory</td></tr>
<tr><td>-</td></tr>
<tr><td>Independent work</td></tr>
<tr><td>75 hours</td></tr>
<tr><td>Individual tasks:
25 hours</td></tr>
<tr><td>Type of control:</td></tr>
<tr><td>exam</td></tr>
</table>

Note.The ratio of the hours number of classroom lessons to independent and individual work is: 33,3/66,7

2. The purpose and objectives of syllabus

Purpose: formation of postgraduate students' theoretical knowledge and practical skills in breeding animals in the direction of maximizing their genetic potential through the use of modern methods and developments in genetics and breeding, the ability to use population-genetic parameters will reliably assess the genotype and phenotype of farm animals. Intensive use of the best genotypes, application of modern achievements of genetics, biotechnology and methods of cultivation, their skillful application in practice will allow to improve effectively existing and created breeds and types of farm animals.

Tasks: to master the modern theory of large-scale selection and to determine the degree of influence of genotypic and paratypic factors on the implementation of economically useful traits of animals in specific conditions of modern livestock production.

As a result of studying the syllabus postgraduate student must:

know the role of selection in the creation and improvement of farm animals, basic methods of selection research, modern methodological and organizational directions of the selection process, the relationship of selection with other sciences, the impact of genetic and population parameters on the effectiveness of selection process to improve breeds and individual herds; traits, forms and methods of selection, degree of heritability of selection quantitative traits, methods of genotype assessment; modern methods of assessing the genotype of animals by phenotype and genotype, the use of biotechnological methods in animal breeding at the present stage and in the future, methodological foundations of animal breeding, theoretical foundations of large-scale selection.

be able to calculate and reasonably use population-genetic parameters in determining the breeding situation in the herd and breed, using existing methods to objectively and reliably assess the genotype of the animal, to master modern methods of assessing cows on the exterior, to intensify selection to use advances in biotechnology; in modern conditions of using the principles of large-scale selection to be able to use breeding methods in the process of improving existing breeds and types of farm animals.

3. Program of the syllabus

Is being tested. Considered at a meeting of the department.
Protocol № 19, from "26" 05 2020 y.

Module 1
Theoretical and genetic aspects of farm animal selection

Content module 1. General theory and genetic bases of animal selection

Topic 1. Scientific and methodological bases of animal selection in the direction of realization of genetic potential. Development of animal husbandry and problems of improvement of breeding qualities of animals. Definitions and basic concepts of selection as a science. Subject, methods and tasks of selection of farm animals. Connection of selection with other disciplines. Monitoring of the gene pool of dairy cattle breeding of Ukraine and methods of acceleration of breed formation in it. Components of the selection process of Ukraine. Basic principles of the theoretical concept of breed formation. The main trends of selection and genetic research.

Topic 2. Genetic basis of selection of farm animals. Population genetics of farm animals. Parameters of population genetics. Frequency of traits occurrence, Hardy-Weinberg's law. Variability and its forms. Mathematical parameters of variability. Genetics of quantitative traits. The relative efficiency of selection depending on the number of traits. Genetic assessment of animal breeding value.

Content module 2. Molecular-genetic and population bases of increasing the production of animal productivity

Topic 3. The use of molecular genetics in animal husbandry. Modern molecular genetic approaches to increase the efficiency of selection process in animal husbandry in Ukraine. Selection by genotype. Selection using genetic markers. Advances in reproductive technologies. Artificial insemination. Multiple ovulation and embryo transplantation. Economic assessment of genetic improvement. The use of immunogenetic markers in animal breeding. Testing of cattle for genes of quantitative traits. Determination of genetic abnormalities in farm animals. Use of cytogenetic analysis to assess breeding animals. Areas of application of ISSR-markers. ISSR-typing in beekeeping.

Topic 4. Leading parameters of population genetics and their importance in improving the efficiency of animal breeding. Patterns of inheritance of quantitative traits. Definition and significance in animal breeding of heredity, repeatability and combined variability. Application of genetic parameters in selection work. Types of variability and factors that cause it. Genetic and environmental variance.

Content module 3. Means of providing genetic improvement of animals in the conditions of large-scale selection

Topic 5. The effectiveness of selection. Evaluation of animals by genotype. Selection differential, method of determination and its properties. Methods of evaluation of animals by genotype. Assessment by origin (by pedigree). Assessment of own productivity (phenotype). Evaluation by lateral relatives - sibs and semi-sibs. Assessment of offspring quality (genotype). Cytogenetics in the selection of farm animals. Changes in the state of populations under the influence of monofactorial genetic defects. Chromosome mapping. Numerical, chromosomal and structural disorders of the karyotype of animals. Distribution of chromosomal abnormalities and prospects for population development. Genetic load of populations. Testing of individual animals for recessive genes. Problems of genetic control of diseases in animals.

Topic 6. Factors of change in the genetic structure of animal populations. Theoretical foundations of large-scale selection in animal husbandry. Breeding traits of animal selection. Basic forms and methods of selection. Tasks and basic principles of large-scale selection. Factors influencing the efficiency of large-scale selection. Large-scale selection of dairy cattle. Large-scale selection in pig breeding. Principles of large-scale selection in poultry farming. The use of scientific and technical achievements in the selection of farm animals.

Module 2
Problematic issues of selection and biotechnology of reproduction of different species of farm animals

Content module 4. Selection of dairy and dairy-meat cattle depending on the influence of genotypic and paratypic factors

Topic 7. Selection of dairy and dairy-meat cattle in the direction of increasing the genetic potential of productivity. Biological and genetic features of dairy animals. The main selection traits of dairy cattle and methods of their estimation. Organization of selection of breeding animals of different categories. Selection in dairy farming. Methods of breeding dairy cattle. Features of selection work in herds of different categories. Modern selection criteria of cattle for dairy and meat productivity . Tasks and features of selection of dairy and dairy-meat cattle

Topic 8. Influence on the development of selection traits and record productivity of dairy cows of genotypic and paratypic factors. The state of productive and technological traits of cows depending on the breed. Influence of linear affiliation on the manifestation of productive indicators of cows. Influence of conditional blood of improving breed on development of selection signs. Population-genetic parameters of influence on the condition of economically useful cows. Manifestation of inbred depression and heterosis on the grounds of productivity. Hypotheses of the theory of heterosis. The dominant gene hypothesis proposed by Davenport and Bruce. The hypothesis of supremacy, set out in the works of E. East, G. Shell and H. Hayes. The hypothesis of genetic balance, developed by I. Lerner.

Biological and physiological features of highly productive cows. Feeding cows - the main paratypic factor of productivity. Productivity of cows depending on a

physiological condition. Technological features of cows and their productivity. Interaction "genotype - environment". Comparative characteristics of the gene pool of breeds.

Topic 9. Selection of pigs. Biological features of pigs as an object of selection. Directions and goals of selection in pig breeding. Signs of pig breeding. Population-genetic parameters of selection traits. Evaluation of breeding qualities of pigs. Selection in pig breeding. Methods of breeding pigs. Large-scale selection in pig breeding. Organization and evolution of the breeding sector in pig and poultry farming. Modern selection criteria for pigs and poultry. Stages of pig breeding. Genetic potential. Multiphase feeding. Advantages when using an additional phase. Types of fattening pigs. Bacon fattening. Fattening to fatty conditions. Implementation of pigs. The main method of genetic improvement: the BLUP index. Modern methods of increasing genetic potential. Marker selection. Molecular improvement. "Bet" on the parent index. Why "powerless" selection? Herd reproduction and pig herd structure. Preparation of sows for farrowing and its implementation.

Topic 10. Poultry breeding. **Poultry products.** Biological features of poultry as objects of selection. Directions of selection in poultry farming. Population-genetic parameters of poultry breeding traits. Relationship between breeding traits. Genotypic and phenotypic correlations. Features of selection in poultry farming. Breeding methods. Types of crossing. Large-scale selection in poultry farming. Poultry meat and egg productivity.

4. Structure of the syllabus

Names of content modules and topics	Total	including				
		l	lab	pr	ind	i.w.
1	2	3	4	5	6	7
Module 1. Theoretical and genetic aspects of farm animal selection						
Content module 1. General theory and genetic bases of animal selection						
Topic 1. Scientific and methodological bases of animal selection in the direction of realization of genetic potential	**12**	**2**		**3**		**7**
Topic 2. Genetic bases of selection of farm animals	**13**	**2**		**3**		**8**
Together with a content module 1	**25**	**4**		**6**		**15**
Content module 2. Molecular-genetic and population bases of increasing the productivity of animal productivity						
Topic 3. Use of molecular genetics in animal husbandry. Modern molecular genetic approaches to increase the efficiency of the selection process in animal husbandry in Ukraine	**12**	**2**		**3**		**7**
Topic 4. Leading parameters of population genetics and their importance in improving the efficiency of animal breeding	**13**	**2**		**3**		**8**
Together with a content module 2	**25**	**4**		**6**		**15**
Content module *3. Means of providing genetic improvement of animals in the conditions of large-scale selection*						
Topic 5. Selection efficiency. Evaluation of animals by genotype	**13**	**2**		**3**		**8**
Topic 6. Factors of change in the genetic structure of animal populations. Theoretical foundations of large-scale selection in animal husbandry	**12**	**2**		**3**		**7**
Together with a content module 3	**25**	**4**		**6**		**15**
Module 2 Problematic issues of selection and biotechnology of reproduction different species of farm animals						
Content module 4. Selection of dairy and dairy-meat cattle depending on the influence of genotypic and paratypic factors						
Topic 7. Selection of dairy and dairy-meat cattle in the direction of increasing the genetic potential of productivity	**12**	**2**		**3**		**7**
Topic 8. Influence on the development of selection traits and record productivity of dairy	**12**	**2**		**3**		**7**

cows of genotypic and paratypic factors.						
Topic 9. Selection of pigs	**13**	**2**		**3**		**8**
Topic 10. Poultry breeding. Poultry products	**13**	**2**		**3**		**8**
Together with a content module 4	**50**	**8**		**12**	**25**	**30**
Total hours	**150**	**20**		**30**	**25**	**75**

5. Topics and plan of lectures

№	Topic title and list of questions	Total hours
1	**Topic: Scientific and methodological foundations of animal breeding in the direction of genetic potential realization** 1. Development of animal husbandry and problems of improvement of breeding qualities of animals. 2. Definition and basic concepts of selection as a science. 3. Subject, methods and tasks of selection of farm animals. 4. Connection of selection with other disciplines.	2
2	**Topic: Genetic basis of farm animals selection** 1. Population genetics. 2. Parameters of population genetics. 3. Frequency of occurrence of a sign, Hardy-Weinberg's law. 4. Variability and its forms. 5. Mathematical parameters of variability.	2
3	**Topic: The use of molecular genetics in animal husbandry. Modern molecular genetic approaches to increase the efficiency of selection process in animal husbandry of Ukraine** 1. Selection by genotype. 2. Selection using genetic markers. 3. Advances in reproductive technologies. 4. Artificial insemination. 5. Multiple ovulation and embryo transplantation. 6. Economic evaluation of genetic improvement	2
4	**Topic: Leading parameters of population genetics and their importance in improving the efficiency of animal breeding** 1. Patterns of inheritance of quantitative traits. 2. Definition and significance in animal breeding of heredity, repeatability and combined variability.	2
5	**Topic: Efficiency of selection. Evaluation of animals by genotype** 1. Selection differential, method of determination and its properties. 2. Methods of evaluation of animals by genotype. 3. Assessment by origin (by pedigree). 4 Evaluation of own productivity (phenotype). 5. Evaluation by lateral relatives – sibs and semi-sibs. 6. Assessment of the quality of offspring (genotype).	2
6	**Topic: Factors of change in the genetic structure of animal**	2

	populations. Theoretical foundations of large-scale selection in animal husbandry 1. Breeding traits of animal selection. 2. Basic forms and methods of selection. 3. Tasks and basic principles of large-scale selection. 4. Factors influencing the efficiency of large-scale selection.	
7	**Topic: Selection of dairy and dairy-meat cattle in the direction of increasing the genetic potential of productivity** 1. Biological and genetic features of dairy animals. 2. The main selection traits of dairy cattle and methods of their estimation. 3. Organization of selection of breeding animals of different categories. 4. Selection in dairy farming. 5. Methods of breeding dairy cattle. 6. Features of selection work in herds of different categories.	2
8	**Topic: Influence on the development of selection traits and record productivity of dairy cows of genotypic and paratypic factors.** 1. The state of productive and technological traits of cows depending on the breed. 2. The influence of linear affiliation on the manifestation of productive indicators of cows. 3. Influence of conditional blood of improving breed on development of selection traits. 4. Population-genetic parameters of influence on the condition of economically useful cows. 5. Biological and physiological features of highly productive cows. 6. Influence of feeding, physiological condition and technological traits of cows and their productivity	2
9	**Topic: Selection of pigs** 1. Biological features of pigs as an object of selection. 2. Directions and goals of selection in pig breeding. Signs of pig breeding. 3. Population-genetic parameters of selection traits. 4. Evaluation of breeding qualities of pigs. Selection in pig breeding. 5. Methods of breeding pigs.	2
10	**Topic: Poultry breeding**. 1. Biological features of poultry as objects of selection. 2. Directions of selection in poultry farming. 3. Population-genetic parameters of breeding traits of poultry. 4. The relationship between breeding traits. 5. Genotypic and phenotypic correlations.	2
Total hours		**20**

6. Topics of laboratory classes

№	Topic title and list of questions	Total hours
1	**Topic: Using the Hardy-Weinberg formula to establish the genetic balance of the population on qualitative traits** 1. Population characteristics. 2. Determination of gene distribution in populations. Hardy-Weinberg's law. 3. An example of a typical task.	2
2	**Topic: Mathematical basis for estimating variability. Determination of average values of quantitative economically useful traits** 1. Biometrics (biological, variational statistics). 2. Methods for determining averages. 3. Calculation of the arithmetic mean for a small sample. 4. Calculation of the arithmetic mean for a large sample aggregate. 5. Determining the degrees of variability of the trait using the limit.	2
3	**Topic: Parameters of variability of selection traits** 1. Dispersion. 2. The standard deviation. 3. Calculation of the standard deviation for a small sample. 4. Calculation of standard deviation for a large sample.	2
4	**Topic: Relative indicator of variability of quantitative economically useful traits and their normal distribution** 1. Coefficient of variability, or variation. 2. Normal type of traits distribution.	2
5	**Topic: Representativeness and errors of indicators of sample sets of selection traits. Estimation of reliability of statistical values** 1. Representativeness of indicators of sample sets breeding traits. 2. Errors biometric indicators. 3. Estimation of reliability of statistical values. 4. Determining the reliability of the difference between the arithmetic means of two samples. 5. An example of a typical task.	2
6	**Topic**: **Relative variability of selection quantitative traits** 1. Relative variability and its significance in selection farm animals. 2. Calculation of the correlation coefficient for small samples. 3. An example of a typical task.	2
7	**Topic: Correlation analysis in the study of a large sample. Regression coefficient** 1. Calculation of the correlation coefficient for a large sample. 2. An example of a typical task. 3. Study the relationship between traits using a factor rectilinear regression.	2

	4. An example of a typical task.	
8	**Topic: Analysis of variance. Determining the strength of the influence of individual factors on the variability of quantitative traits** 1. Significance and use of analysis of variance in animal breeding. 2. Statistical complexes. 3. Basic terms and values used in analysis of variance. 4. An example of a typical task.	2
9	**Topic: Genetic and mathematical analysis of inheritance and patterns of variability of quantitative traits in animal populations. Heritability** 1. Theoretical substantiation of genetic-mathematical analysis to determine the heritability and recurrence of quantitative traits; 2. Features of the coefficient of heredity and methods of its determination; 3. Selection effect.	2
10	**Topic: Recurrence of selection traits** 1. The role of recurrence in assessing the breeding value of animals. 2. Method for determining the recurrence rate.	2
11	**Topic: Methods for assessing the exterior of cattle in ontogenesis** 1. The importance of exterior evaluation in farm animal breeding. 2. Measurement by instrumental method and determination of body structure indices of animals.	2
12	**Topic: Methods for assessing the morphological and functional properties of the udder of dairy cows** 1. Estimation of the udder in an instrumental way. 2. Visual assessment of the udder. 3. Functional properties of the udder.	2
13	**Topic: Estimation of cows by exterior type using modern method of linear classification** 1. Methods of linear classification of dairy cows. 2. Exterior profile graphing algorithm. 3. Target parameters of exterior traits of first-born cows in the system of unified method of linear classification of dairy cattle.	2
14	**Topic: Methods for determining the degree of phenotypic consolidation of breeding groups of animals** 1. Theoretical substantiation of estimation of selection groups of animals on the level of phenotypic consolidation of quantitative traits. 2. Method for determining the degree of phenotypic consolidation by selected traits of animals. 3. An example of a typical task.	2
15	**Topic: Basic principles of formation the leading selection group of cows** Get acquainted with method of creating cows of the leading selection	2

	group within the breed, selection of repair bulls and their assessment by phenotype and genotype.	
Total		**30**

7. Individual work

№	Topic title and list of questions	Total hours
1	**Topic: Scientific and methodological bases of animal selection in the direction of realization of genetic potential** 1. Monitoring of the gene pool of dairy cattle breeding of Ukraine and methods of acceleration of breed formation in in. 2. Components of the selection process in Ukraine. 3. Basic principles of the theoretical concept of breed formation. 4. The main trends of selection and genetic research.	7
2	**Topic: Genetic bases of selection of farm animals** 1. Genetics of quantitative traits. 2. The relative efficiency of selection depending on the number of traits. 3. Genetic assessment of animal breeding value	7
3	**Topic: Use of molecular genetics in animal husbandry. Modern molecular genetic approaches to increase the efficiency of the selection process in animal husbandry in Ukraine** 1. The use of immunogenetic markers in animal breeding. 2. Testing of cattle for genes of quantitative traits. 3. Determination of genetic abnormalities in farm animals. 4. Use of cytogenetic analysis to assess breeding animals. 5. Areas of application of ISSR-markers. 6. ISSR-typing in beekeeping.	7
4	**Topic: Leading parameters of population genetics and importance in improving the efficiency of animal breeding** 1. Application of genetic parameters in selection work. 2. Types of variability and factors that cause it.	7
5	**Topic: Selection efficiency. Evaluation of animals by genotype** 1. Cytogenetics in the selection of farm animals 2. Changes in the state of populations under the influence of monofactorial genetic defects. 3. Chromosome mapping. 4. Numerical, chromosomal and structural disorders of the karyotype of animals. 5. Distribution of chromosomal abnormalities and prospects for population development. 6. Genetic load of populations. 7. Testing of individual animals for recessive genes. 8. Problems of genetic control of diseases in animals.	7
6	**Topic: Factors changing the genetic structure of animal populations. Theoretical foundations of large-scale selection in animal husbandry**	8

	1. Factors influencing the efficiency of large-scale selection. 2. Large-scale selection of dairy cattle. 3. Large-scale selection in pig breeding. 4. Principles of large-scale selection in poultry farming. 5. The use of scientific and technical achievements in the selection of farm animals.	
7	**Topic: Selection of dairy and dairy-meat cattle in the direction of increasing the genetic potential of productivity** 1. Modern selection criteria for dairy and meat cattle productivity. 2, Tasks and features of selection of dairy and dairy-meat cattle	8
8	**Topic: Influence on the development of selection traits and record productivity of dairy cows of genotypic and paratypic factors.** 1. Manifestation of inbred depression and heterosis on the grounds of productivity 2. Hypotheses of the theory of heterosis. 3. Interaction "genotype - environment". 4. Comparative characteristics of the gene pool of breeds.	8
9	**Topic: Selection of pigs** 1. Large-scale selection in pig breeding. 2. Organization and evolution of the breeding sector in pig breeding. 3. Stages of pig breeding. Genetic potential. 4. Multiphase feeding, types of fattening pigs 5. The main method of genetic improvement: BLUP index. 6. Modern methods of increasing genetic potential. Marker selection.	8
10	**Topic: Poultry breeding.** 1. Features of selection in poultry. 2. Breeding methods. Types of crossing. 3. Large-scale selection in poultry farming. 4. Meat and egg productivity. 5. Modern selection criteria for poultry	8
Total		**75**

Individual tasks

№	Topic title and list of questions	
1	Using the database of own research to determine the population-genetic parameters of traits that characterize the reproductive qualities of sows	
2	To determine the influence of genotypic and paratypic factors on the growth and development of young pigs by the method of multifactor analysis	
3	Using our own database of breeding information to assess breeding groups of cattle by leading population and genetic parameters	

4	To determine the realization of the genetic potential of a selection group of animals	
5	Calculate the population-genetic parameters of the leading traits of dogs of the breed	
Total		**25**

8. Teaching methods

1. Methods of teaching by source of knowledge:

1.1. ***Verbal:*** story, explanation, conversation (heuristic and reproductive), lecture.

1.2. ***Visual***: demonstration, illustration, observation.

1.3. ***Practical:*** laboratory method, practical work, production and practical methods.

2. Teaching methods by the nature of the logic of cognition.

Analytical.

2.2. Methods of synthesis.

2.3. Inductive method.

2.4. Deductive method.

2.5. Translational method.

3. Teaching methods by the nature and level of independent mental activity of graduate students.

3.1. ***Problem*** (problem-information)

Partial search (heuristic).

3.3. Research.

3.4. Reproductive.

3.5. Explanatory and demonstrative.

4. Active teaching methods – use of technical means of training, classes, use of problem situations, excursions, classes on production, group researches, self-assessment of knowledge, simulation methods of training (built on imitation of future professional activity), use of educational and control tests, use of reference notes of lectures)

5. Interactive technologies – the use of multimedia technologies, interactive whiteboards and spreadsheets, case-study (method of analysis of specific situations), dialogue learning.

9. Control methods

1. Rating control according to the 100-point scale of ECTS assessment

2. Carrying out intermediate control during the semester (intermediate certification).

3. Polycriteria assessment of the current work of graduate students:

- the level of knowledge demonstrated in the laboratory;
- activity during the discussion of issues raised in class;
- results of performance and protection of laboratory works;
- express control during classroom classes;
- independent study of the topic as a whole or individual issues;
- performance of analytical and calculation tasks;
- writing essays;

- written assignments during tests;
- production situations.

4. Direct consideration in the final assessment of the graduate student's performance of a certain individual task:
- Scientific research work;
- educational and research work;
- educational and practical research with presentation of results, etc.

10. Distribution of credit points received by graduate students

Current testing and independent work							For modules and IWS	Exam	Total
Module 1 (40 points)				Module 2 (30 points)		IWS			
CM 1	CM 2	CM 3	CM 4	CM 5	CM 6				
T 1-2	T 3-4	T 5-6	T 7-9	T 10-15	T 16-18	15	70 (**55+15)**	30	100
9	9	9	9	9	10				

11. Full-time postgraduate score scale forms of education: national and ECTS

Total of points for all types of educational activities	Score ECTS	Score on a national scale	
		for exam course project (work), practice	for test
90 – 100	**A**	excellent	credited
82-89	**B**	good	
75-81	**C**		
69-74	**D**	satisfactorily	
60-68	**E**		
35-59	**FX**	unsatisfactory with the possibility of reassembly	unsatisfactory with the possibility of reassembly
1-34	**F**	unsatisfactory with mandatory re-study of the discipline	unsatisfactory with mandatory re-study of the discipline

12. Recommended literature

Basic

1. Melnyk, Yu. F., Kovalenko, V. P., Uhnivenko, A. M., Naidenko, K. A., Pelykh, V. H., [et.al.]. 2008. Selection of farm animals. In: Yu. F., Melnyk, V. P., Kovalenko and Uhnivenko, A. M., ed. Selektsiia silskohospodarskykh tvaryn, K.: «Intas».

2. Khmelnychyi, L. M. and Suprun, I. O., 2011. Osnovy henetyky ta selektsii silskohospodarskykh tvaryn [Fundamentals of genetics and selection of farm animals]. Navchalnyi posibnyk, *K.: Ahrarna osvita.*

3. Khmelnychyi, L. M., Suprun I. O. and Salohub, A. M., 2011. Osnovy henetyky tvaryn z biometriieiu. Navchalnyi posibnyk [Fundamentals of animal genetics with biometrics]. Navchalnyi posibnyk, *Sumy: Vydavnytstvo: PP Vinnychenko, M. D., FOP Domenko, V. V.*

4. Basovskyi, M. Z., Burkat, V. P., Vinnychuk, D. T. [et.al.]. 2001. Breeding of farm animals. In: Basovskyi, M. Z., ed. Rozvedennia silskohospodarskykh tvaryn, Bila Tserkva.

5. Zubets, M. V., Burkat, V. P., Melnyk, Yu. F., [et.al.]. 2007. Genetics, selection and biotechnology in animal husbandry. In: M. V., Zubets, and V. P., Burkat, ed. Henetyka, selektsyia i byotekhnolohyia v skotovodstve. Kyiv. BMT.

6. Pidpala, T. V., 2005. [Selection of farm animals]. *Selektsiia silskohospodarskykh tvaryn.* Mykolaiv.

Additional

1. Melnyk, Yu. F., Mykytiuk, D. M., Pyshcholka, V. A., [et.al.]. 2016. Selection program of the Ukrainian Black-and-White dairy breed of cattle for 2016-2021. In: V. P., Burkat and M. Ia., Yefimenko, ed. [Prohrama selektsii ukrainskoi chorno-riaboi molochnoi porody velykoi rohatoi khudoby na 2016-2021 roky]. Kyiv.

2. Hladiy, M.V. and Polupan, Yu. P., 2018. In: Hladiy, M. V., Bashchenko, M. I., Polupan, Yu. P., [et. al]. ed. [Breeding, genetic and biotechnological methods to improve and preserve the gene pool breeds of farm animals (Monograph)]. Selektsiyni, henetychni ta biotekhnolohichni metody udoskonalennya i zberezhennya henofondu porid sil's'kohospodars'kykh tvaryn (Monohrafiya). IRHT im. M. V.Zubtsia NAAN. Poltava, TOV «Firma «Tekhservis»

3. Sigurdsson A. and Jonmundsson J.V. 2011. Genetic Potential of Icelandic Dairy Cattle. Icelandic Agricultural Sciences 24(2011):55-64.

4. Rauw W. M. and Gomez-Raya L. Genotype by environment interaction and breeding for robustness in livestock. REVIEW ARTICLE. Front. Genet., 20 October 2015 | https://doi.org/10.3389/fgene.2015.00310

5. Appleby, M. C., and Fuentesfina, D. 2015. “The future of livestock: feeding the world sustainably and humanely,” in Food Security and Food Safety for the Twenty-first Century: Proceedings of the APSAFE2013, ed. S. Hongladarom (Singapore: Springer), 99–102. doi: 10.1007/978-981-287-417-7_8

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