MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
Federal state autonomous educational institution
of higher education
«Far Eastern Federal University»
(FEFU)

SCHOOL OF BIOMEDICINE

«AGREED»
Head of education program
«General medicine»
_____ Khotimchenko Yu.S._____
(signature) (Full name)
«09» of July 2019

«APPROVED»
Director of the Department of Clinical Medicine
_____ Geltser B.I._____
(signature) (Full name)
«09» of July 2019

WORKING PROGRAM OF ACADEMIC DISCIPLINE (WPAD)
«Medical Biotechnology»
Educational program
Specialty 31.05.01 «General medicine»
Form of study: full time

year 3 semester 6
lectures 18 hours
practical classes 36 hours
laboratory works not provided
total amount of in-classroom work 54 hours
independent self-work 54 hours
including exam preparation 36 hours
control works ()
credit not provided
exam 6 semester

The working program is drawn up in accordance with the requirements of the Federal state educational standard of higher education (level of training), approved by the order of the Ministry of education and science of the Russian Federation from 09.02.2016 № 95.

The working program of the discipline was discussed at the meeting of the Department of fundamental and clinical medicine. Protocol No. 8, 09 of July 2019

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ABSTRACT

The discipline " Medical Biotechnology"is designed for students enrolled in the educational program 31.05.01"General Medicine".

Discipline is implemented in the 3 course, 6th semester, is a variable discipline for choice.

In the development of the working program of the discipline used the Federal state educational standard of higher education in the specialty 31.05.01 " General Medicine " (level of training specialty).

The total complexity of the development of the discipline is 3 credits, 108 hours. The curriculum includes 18 hours of lectures, practical classes (36 hours), and independent work of the student (18 hours).

The course program is based on the basic knowledge gained by students:

GPC-1- the willingness to solve common tasks of professional activity with the use of information and bibliographic resources , biomedical terminology , information and communication technologies , taking into account the main requirements for information security

GPC 7- the readiness to use basic physical and chemical, mathematical and other natural science concepts and methods in solving professional problems

The purpose of the discipline " Medical Biotechnology" is to teach students the basic methods of working with genetic engineering structures and the formation of a comprehensive understanding of the use of molecular biology methods in biomedical research.

Tasks:

* To study the theoretical basis of molecular biology and genetic engineering methods
* Become familiar with PCR and molecular cloning techniques
* Get acquainted with the methods of nucleotide sequence analysis
* To study basic methods of work with human cancer cell cultures
* To study the theoretical basis of the action of anticancer drugs

As a result of studying this discipline, the following professional competencies (elements of competencies) are formed in students.

Form of final knowledge control: pass-fail exam

Competence code and formulation	**Stages of competence formation**	
the willingness to solve common tasks of professional activity with the use of information and bibliographic	Knows	– place and role of molecular modeling in medicine; – main concepts, definitions, methods and approaches used in molecular genetic studies

resources , biomedical terminology , information and communication technologies , taking into account the main requirements for information security (GPC – 1)		in medicine; – use of molecular genetic technologies in pharmacology and clinical medicine; – biomedical problems solved by approaches of molecular genetic modeling
	Is able to	– formulate problems of molecular genetic studies in medicine
	Possesses	– the main principles of molecular genetic research organizing in medicine

the readiness to use medical devices, provided by medical assistance procedures (GPC -11)	Knows	– methods, technologies and products of molecular genetic studies in medicine
	Is able to	– use knowledge of methods, technologies and products of molecular genetic studies in medicine for the patient treatment of
	Possesses	– skills and planning the introduction of new products and molecular genetic studies in medicine for patients treatment

the willingness to participate in implementation of new methods and techniques aimed at protection of public health. (PC – 22)	Knows	– place and role of molecular modeling in medicine; – main concepts, definitions, methods and approaches used in molecular genetic studies in medicine; – use of molecular genetic technologies in pharmacology and clinical medicine; – biomedical problems solved by approaches of molecular genetic modeling
	Is able to	– formulate problems of molecular genetic studies in medicine
	Possesses	– the main principles of molecular genetic research organizing in medicine

For the formation of the above competencies in the discipline "Medical Biotechnology" the following methods of active / interactive learning are used:

Lectures:

1. Lecture-visualization
2. Lecture-conversation

Workshops:

1. Seminar dispute
2. Workshop
3. Expanded conversation
4. Laboratory work

I. STRUCTURE AND CONTENT OF THEORETICAL PART OF THE COURSE

Section I. Principles of molecular cloning. Polymerase chain reaction

Topic 1. Organization of the genome. Central dogma of molecular biology

The central dogma of molecular biology. The concept of the gene. The structure of the genomes of prokaryotes and eukaryotes. The operon structure of prokaryotic genes and the discontinuous structure of eukaryotic genes. Messenger RNA. The concept of cistron. Gene expression. The concept of amplification in living organisms.

Topic 2. Polymerase chain reaction

DNA replication in prokaryotes and eukaryotes. Amplicon. Primers and DNA polymerase. Taq polymerase and its recombinant forms. The mechanism of PCR. Types of PCR.

Topic 3. Methods for determination of DNA sequences

The primary structure of biopolymers. Electrophoresis of nucleic acids. Fluorescently labeled dideoxynucleotide triphosphates. Sanger sequencing.

Topic 4. Transcription and reverse transcription. PCR with reverse transcription

Transcriptional mechanisms in prokaryotes and eukaryotes. Reverse transcription mechanisms in viruses. The use of qualitative and quantitative reverse transcription PCR in molecular biotechnology.

Topic 5. Translation. Cell-free translation systems

Translaton mechanisms in eukaryotic and prokaryotic cells. Cell-free translation systems and their use in molecular biotechnology.

Section II. Principles of molecular design and cloning using microorganisms and vector systems

Topic 1. Model biological systems and objects of molecular biotechnology

The concept of a model object. Model system. Viruses: Tobacco Mosaic Virus, Bacteriophage T4, Lambda Phage. Eubacteria: Escherichia coli, Bacillus subtili, Mycoplasma genitalium. Fungi: Saccharomyces cerevisiae, Schizosaccharomyces pombe. Plants: Arabidopsis thaliana. Mammalian cell cultures.

Topic 2. Recombinant DNA technology

The concept of recombination. Recombinant DNA. Restriction endonucleases. Restriction sites. Sticky and blunt ends. Restriction analysis of DNA molecules.

Topic 3. Preparation of DNA fragments for cloning

The concept of vector. Promoters. Polylinker

Topic 4. Types of cloning vectors

Single- and multicopy replication origins. Types of promoters. Expression inductors. Insulators.

Topic 5. Selective markers

The concept of selection. Selective markers. Classification of selective markers. Antibiotics and selective media. White and blue selection.

Topic 6. Cloning in E. coli

Competent cells. Transformation. Heat shock and electroporation. Seeding on a nutrient medium. Selection and analysis of transformed clones by PCR and restriction.

Topic 7. Cloning in yeast systems

Vectors for cloning in yeast. Yeast growth media. Specificity of selection and growth of yeast culture. Transformation of yeast cells.

Section III. The creation and use of genetic constructs for transgenesis in mammalian cells. Transgenic animals. Prospects for gene therapy

Topic 1. Transition from transgenic microorganisms to eukaryotic systems

Why can't we use microorganisms for expression of full-size eukaryotic genes . Protein folding. Post-translational modifications of proteins. Homologous recombination. The line of chicken B-lymphocytes DT40 and its advantages. Applications of the CRISPR-Cas9 technology.

Topic 2. Artificial chromosomes

The concept of artificial chromosomes. Artificial chromosomes as vectors. BAC, YAC, MAC, PAC, HAC.

Topic 3. Artificial human chromosomes (HAC)

Organization of artificial human chromosomes. HAC differences from other artificial chromosomes. LoxP-Cre recombination. HPRT-mediated selection.

Topic 4. Prospects for usage of artificial human chromosomes in gene therapy

Expression of full-length genes in human artificial chromosomes. Gene delivery to human cells. Elimination of an artificial chromosome. Tet-R repressor for expression control . The use of insulators to stabilize the expression.

Theme 5. Transgenic mammals: mice, pigs and cattle

Transgenic animals. Chromosome adjustment. Selection of animals. Technologies for creating transgenic mammals. Using retroviral vectors to create transgenic animals. DNA microinjection method.

Topic 6. Technologies based on stem cell modification

Pluripotent embryonic stem cells. Production and selection of transgenes. Microinjection into mammalian blastocyst. Crossing of transgenes. Obtaining lines of transgenic animals.

Topic 7. Cloning of organisms using the nuclear transfer method

Using the mammary epithelium as a source of genetic material for cloning. Growing epithelia of the mammary glands in culture. Induction of the G0 phase. Removal of the nucleus from the egg. The merging of the donor nucleus and the recipient egg. Implantation into the body of a surrogate mother.

Section IV. Development and creation of genetic constructions for biopharmaceutical purposes. Industrial production of drugs and bioactive substances.

Topic 1. Recombinant microorganisms used for protein synthesis

Expression strains of E. coli. Expression vectors. Expression inductors, IPTG. Reverse transcription. DNA cloning.

Topic 2. Production of human proteins in microbiological systems using cloned DNA

Interferon production system. Obtaining of human hormones using genetic engineering methods. Antibody production in E. coli. Insulin production methods.

Topic 3. Production of antibiotics, vitamins and other biologically active substances in living systems. Modern strains of microorganisms used to obtain biologically active substances. Methods for their cultivation, methods for isolation and purification of active biomolecules.

Topic 4. Production of monoclonal antibodies. Classical hybridoma technology. Modern approaches to the creation of monoclonal antibodies. Humanized antibodies. Antibody use in medicine and biotechnology

Topic 5. Bioreactors and methods of fermentation

Industrial production of proteins for pharmaceutical use. Organization of biotechnological production using recombinant microorganisms. The use of fermenters for the industrial production of antibiotics, vitamins and other drugs

Topic 6. Modern approaches to the search, creation and introduction of new drugs

Stages of drug development: target identification, screening of “hits”, optimization of “hits”, preclinical and clinical trials. Examples of successful introduction of new drugs for targeted cancer therapy.

Section V. Analysis of genetically determined pathologies, monogenic and multifactorial diseases

Topic 1. Basic principles of genetic analysis

Single nucleotide substitutions (Single Nucleotide Polymorphisms, SNP). Mutations: deletions, insertions, transversions, transitions. Application of sequencing methods for mutagenesis studies. Clustal DNA sequence comparison. Database of single nucleotide substitutions.

Topic 2. PCR in the diagnosis of genetically determined pathologies

Selection of primers for diagnostic PCR. Touchdown PCR, English Long-range PCR, real-time PCR. The method of quantitative PCR and its application in the diagnosis. Fluorescent tags for genotyping using PCR.

Topic 3 Using DNA hybridization methods in diagnostics

DNA hybridization. DNA hybridization probes. Analysis of satellite DNA sequences.

Section VI. From genetic analysis to genomic medicine: technologies of genome-wide screening of associations with pathology

Topic 1. Application of NGS methods for biomedical research

Basic principles of genome sequencing. Emulsion PCR. Creating of libraries. Full-genome sequencing methods for the identification of multifactor diseases. Transcriptome sequencing. Annotation of sequences in databases. Full Genome Screening for Pathology Associations.

Topic 2. Methods and resources of bioinformatics

Bioinformatics: the origin, goals, objectives, methods. Databases: classification, basics of structures. Databases of protein sequences. Database of nucleic acid sequences. Databanks of metabolic pathways. Databases containing the results of global expression analysis experiments. The main bibliographic databases. NCBI, ENTREZ and BLAST - assignment, tools, tasks. Alignment of two sequences, dot matrixes.

Topic 3. Using nucleotide sequence databases for medical research

Acquaintance with NCBI databases. The concept of formats: FASTA and GenBank. Alignment of nucleotide sequences. Databases of SNPs associated with pathologies.

PRACTICAL PART OF THE COURSE.

Lesson 1. Organization and principles of work in molecular-biological laboratories for biomedical research

Lesson plan:

1. Laboratory glassware and principles of working with it.
2. Equipment
3. Autoclaving. Dry heat cabinet. Washing of lab glass. Disposable and reusable plastic.
4. Practical skills of working with analytical, mechanical and electronic scales.

Lesson 2. Preparation of solutions for the isolation and analysis of nucleic acids

Lesson plan:

1. Methods of expressing the concentration of solutions.
2. Methods for preparing solutions of a given concentration (according to the density of the solution).
3. Potentiometry. Structure and function of potentiometer and pH meter. Structure and function of the glass and combined electrodes.
4. Potentiometric titration. Buffer solutions, buffer capacity.

Lesson 3. Principles of manipulation with biomaterial, isolation and analysis of nucleic acids

Lesson plan:

1. Principles of manipulation with tissue or cell samples and laboratory animals.
2. Rules of work in the molecular biological laboratory.
3. Room classification according to the degree of purity.
4. Laminar flow.
5. Work with cell cultures. Work with laboratory animals.

Lesson 4. Workshop on the topic "Organization and principles of work in molecular-biological laboratories for biomaterial manipulation, isolation and analysis of nucleic acids"

Workshop issues:

1. Principles of manipulation of tissue and cell samples and laboratory animals
2. Classification of rooms according to the degree of purity.
3. Laboratory glassware and principles of working with it

4. Methods of preparing solutions of a given concentration (according to the density of the solution).

5. Ways of expressing the concentration of solutions

Lesson 5. Methods of DNA and RNA isolation from various sources

Lesson plan:

1. Homogenization of tissues. Liquid methods.
2. Solid state methods. Chaotropic agents.
3. Phenol-chloroform extraction. Separation of samples into phases.
4. Precipitation of nucleic acids using isopropyl and ethyl alcohol.
5. Co-precipitators: linear polyacrylamide, glycogen, sodium acetate.

Lesson 6. Nucleic acid gel electrophoresis

Lesson plan:

• Theory of separation of molecules in an electric field.

• Agarose and polyacrylamide gels.

• Electrophoresis buffers. Loading buffers Molecular weight markers. Nucleic acid staining for their visualization, ethidium bromide and SYBR Green.

• Analysis of the results of electrophoresis of RNA and DNA. Determining the quality of nucleic acid purification by electrophoresis.

Lesson 7. Nucleic acid spectrophotometry

Lesson plan:

1. Optical density of DNA and RNA solutions.
2. The Bouguer – Lambert – Beer Law. Calculation of the concentration of nucleic acid concentration.
3. Structure and function of spectrophotometer, photocolorimeter and spectrometer.

Lesson 8. DNA isolation from tissue samples

Lesson plan:

1. Methods of DNA extraction from various sources.
2. Phenol-chloroform extraction.
3. Isolation of chromosomal DNA by the method of Sambrook and Russell, 2001

Lesson 9. Analysis of the quality of the isolated DNA in agarose gel and using spectrophotometry

Lesson plan:

1. The theoretical basis of the analysis of the quality of the purified DNA in agarose gel
2. The dependence of the efficiency of the separation of DNA fragments from the percentage of agarose in the gel
3. DNA staining in agarose gels.
4. Buffers for loading samples into the gel
5. Types of Electrophoresis Buffers
6. Analysis of the quality of isolated DNA using spectrophotometry
7. The Bouguer – Lambert – Beer Law
8. Optical density

Lesson 10. Workshop on the topic "Working with nucleic acids"

Questions to the workshop:

1. Methods for isolating of nucleic acids
2. Phenol-chloroform extraction
3. Analysis of the quality of nucleic acids using gel electrophoresis
4. Spectrophotometry of nucleic acids
5. The Bouguer – Lambert – Beer Law. Calculation of concentration of nucleic acid.

Lesson 11. Design of gene-specific primers

Lesson plan:

1. Definition of primer
2. Calculation of the annealing temperature of the primer
3. Testing of primers *in silico*

Lesson 12. PCR amplification

Lesson plan:

1. Theory of polymerase chain reaction
2. Selection of PCR conditions
3. Types of PCR machines
4. Electrophoresis of PCR products in agarose gel
5. Analysis of PCR results

Lesson 13. Isolation of a fragment from an agarose gel

Lesson plan:

1. Kits for DNA extraction from agarose or polyacrylamide gel
2. Features of electrophoresis in the preparation of samples for separation from the gel
3. Classic methods of DNA extraction from agarose gel

Lesson 14. DNA sequencing

Lesson plan:

1. Theory of Sanger sequencing
2. Use of labeled nucleotide terminators
3. Sample preparation for sequencing
4. Reaction with Big Dye (Big Dye Reaction)
5. Cleaning PCR Products with the Big Dye XTerminator Purification Kit
6. Analysis of the results of the sequencing reaction

Lesson 15. Analysis of nucleotide sequences using the Vector NTI software package and NCBI databases

Lesson plan:

1. Work with files in Geen Bank and FASTA format
2. Vector NTI Software Features
3. Comparison of the obtained sequences with databases
4. Search for polymorphisms in sequences of interest

Lesson 16. Workshop on the topic "Work with nucleic acids"

Questions to the workshop:

1. Theory of polymerase chain reaction
2. Design of primers
3. DNA electrophoresis and separation from the gel
4. Sanger sequencing
5. Search for polymorphisms in sequenced sequences
6. Work with files in Geen Bank and FASTA format

Lesson 17. Working with mammalian cell cultures

Lesson plan:

1. Methods of cultivation of cells and tissues.

2. Primary and secondary cultures, stable cell lines.

3. Basic nutrient media and the first cell lines of humans and mammals, HeLa cells.

4. Serum and serum-free cultivation, serum quality, endotoxin testing, growth factors.

5. Principles of equipment and equipment for cell culture rooms, boxes, germicidal lamps, HEPA filtration, laminar cabinets (benches), laminar cabinets classes, burners, high quality water treatment plants, dry heat sterilization cabinets, autoclaves, cell incubators, inverted microscopes .

Lesson 18. Molecular cloning and recombinant DNA

Lesson plan:

1. Recombinant DNA.
2. Restriction endonucleases.
3. Restriction sites. Blunt and sticky ends.
4. Mapping of the DNA molecule.
5. Preparation of DNA fragments for cloning
6. Competent cells. Transformation.
7. Features of heat shock and electroporation

Lesson 19. Transfection of mammalian cells

Lesson plan:

1. The concept of transfection.
2. Types of transfection reagents
3. The use of liposomes and electroporation
4. Recombination and viral transfection systems

Lesson 20. Selection in cell culture and selection of transformed clones

Lesson plan:

1. Selective markers of mammalian cells.
2. Composition of selection media
3. Rules of cultivation and the calculation of the concentration of antibiotics
4. Selection of clones by morphological criteria
5. Identification of transformed clones by PCR

6. The selection of GFP - positive clones

Lesson 21. Flow cytofluorimetry

Lesson plan:

1. Basic concepts, device and principle of operation of flow cytometer
2. Applying the method of flow cytometry for the analysis of cell populations
3. Preparation of cell suspensions for flow cytofluorometry
4. Work on the flow cytometer BD ACCURI: instrument calibration, data collection and primary analysis.
5. Detailed analysis of the data obtained using the WinMDI 2.9 software: the construction of one- and two-parameter histograms, the differentiation of single cells and cell aggregates, the creation of regions, gating, statistical data processing.
6. Interpretation of the results: analysis of the distribution of cells by size-morphological parameters (based on analysis of the parameters of light scattering) and on the phases of the cell cycle (based on the analysis of fluorescence of propidium iodide).

Lesson 22. Workshop on the topic "Working with Mammalian Cell Cultures"

Questions to the workshop:

1. Methods of transfection
2. Selective markers of mammalian cells and selective media
3. Recombination and viral transfection systems
4. Methods of culturing of cells and tissues.
5. Rules of cultivation and the calculation of the concentration of antibiotics
6. Cell culture rooms, hoods and dquipment.
7. Basic concepts, device and principle of operation of flow cytometer

Lesson 23. Hybridom technology

1. Immunization of an animal by an antigen.
2. Isolation of a subpopulation of B-lymphocytes, respectively reacting with antibody for each component of the complex antigen.
3. Isolation of B-lymphocytes responsible for the production of the protectively active part of the antigen, their suspension with plasmacytoma cells of BALB/c myeloma mice in the presence of polyethylene glycol (PEG), production and selection of hybridomas.
4. Testing hybridomas for the ability to produce specific antibodies and for production activity.

5. Clonal selection. Hybrid cells are transferred to a nutrient medium, where they proliferate and form a clone of progeny cells of a single hybridoma.
6. Cloned hybridomas are checked for the ability to synthesize antibodies and for productivity. Selected hybridomas are stored at minus 70 ºC.

Lesson 24. Biotechnological production of antibiotics

1. Seeding of cells
2. Transfer of cells into the inoculator
3. Transfer of cells into the fermenter, control of optimal conditions for the production of antibiotics.
4. The accumulation of the desired substance at the stage of trophophase.
5. Induction of secondary metabolism genes
6. Isolation and purification of the antibiotic.

Session 25. Seminar on the development and introduction of new drugs

Educational situational role-playing game. Students are divided into subgroups, during the seminar each subgroup chooses a real existing disease and thinks through all the stages of the development and implementation of an innovative targeted drug against it; each stage is discussed in the course of group discussions between the teacher and students.

III. SCHOLASTIC-METHODICAL PROVISIONING FOR THE STUDENTS' INDIVIDUAL WORK

Scholastic-methodical provisioning for the students' individual work in the discipline «Molecular Genetic Technology in Medicine» is presented in Supplement 1 and includes:

- schedule for performing individual work in the discipline, including the approximate time to allocate on each task;
- description of the tasks for individual work of students and methodical recommendations for their completion;
- requirements for submission and registration of results of individual work.

IV. CONTROL FOR ATTAINING THE COURSE GOAL

№	Controled sections/topics of the discipline	Codes and stages of forming the competences		Means for evaluation	
				Current control	Half-way attestation
1	**MODULE I.** Biomolecular modeling and simulation **MODULE II**. Protein structure modeling	GPC-7 - readiness to use main physicochemical, mathematical and other natural science concepts and methods for solving professional problems	Knows	OS-1 Interview	Questions offset 1 semester -1-10
			Is able to	WW1 Test	WW1 Test
			Possesses	OS-3 Report	OS-2 Colloquium
2	**MODULE III**. 3D-structure of biomolecule complexes and its use in biotechnology and molecular pharmacology	PC-2 - ability to conduct preventive medical examinations, clinical examinations and clinical supervision;	Knows	OS-1 Interview	Questions offset 1 semester -11-36
			Is able to	WW1 Test	WW1 Test
			Possesses	OS-3 Report	OS-2 Colloquium
3	**MODULE I**. Biomolecular modeling and	PC-21 - ability to participate in research	Knows	OS-1 Interview	Questions offset 1 semester -1-36

	simulation **MODULE II.** Protein structure modeling **MODULE III**. 3D-structure of biomolecule complexes and its use in biotechnology and molecular pharmacology		Is able to	WW1 Test	WW1 Test
			Possesses	OS-3 Report	OS-2 Colloquium
4	**MODULE I**. Biomolecular modeling and simulation **MODULE II.** Protein structure modeling **MODULE III**. 3D-structure of biomolecule complexes and its use in biotechnology and molecular pharmacology	PC-22 - willingness to participate in new methods and techniques implementation aimed at protecting citizens health.	Knows	OS-1 Interview	Questions offset 1 semester -15-30
			Is able to	WW1 Test	WW1 Test
			Possesses	OS-3 Report	OS-2 Colloquium

Control and methodological materials, as well as criteria and indicators necessary for the assessment of knowledge and skills and characterizing the stages of the competencies formation are presented in Supplement 1

Main literature
(electronic and print)

1. National Center for Biotechnology Information / Springer, Berlin, Heidelberg https://link.springer.com/referenceworkentry/10.1007/978-3-662-48986-4_301184
2. Advances in Biochemical Engineering/Biotechnology / Springer, Eangland https://link.springer.com/bookseries/10
3. Biotechnology of Extremophiles / Springer International Publishing Switzerland 2016 https://link.springer.com/book/10.1007/978-3-319-13521-2#editorsandaffiliations

Online resources and information

1. Informational project "MolBiol" on classical and molecular biology: http://www.molbiol.ru/
2. Bioinformatics portal, programming and data analysis: http://www.bioinformatics.ru/
3. Website of the European Bioinformatics Institute (EMBL-EBI): http://www.ebi.ac.uk/
4. BLAST: Website of computer programs used to search for protein or nucleic acid homologues: http://blast.ncbi.nlm.nih.gov/Blast.cgi
5. GenBank: Database of annotated nucleotide sequences of DNA and RNA: http://www.ncbi.nlm.nih.gov/genbank/
6. UniProt: Annotated protein amino acid sequence database: http://www.uniprot.org/
7. PDB: A database of spatial structures of proteins and nucleic acids: http://www.rcsb.org/pdb/home/home.do
8. SCOPUS: Bibliographic and abstract database of scientific articles: http://www.scopus.com/
9. Web of Science: a search platform that combines abstract databases of publications in scientific journals and patents: https://apps.webofknowledge.com/
10. PubMed: Abstract database of medical and biological publications of the National Center for Biotechnology Information USA (NCBI): http://www.ncbi.nlm.nih.gov/pubmed

The list of resources information and telecommunications network "Internet"

1. A tool to test primers in silico http://insilico.ehu.es/PCR/Amplify.php
2. Database for searching for single nucleotide substitutions http://compbio.cs.queensu.ca/F-SNP/
4. A tool to translate DNA sequence into reverse complementary
5. http://arep.med.harvard.edu/labgc/adnan/projects/Utilities/revcomp.html form
6. 4. http://rosalind.info/problems/locations/ resource for self-study of Rosalind bioinformatics.
7. 5. http://www.ncbi.nlm.nih.gov/ site of the National Center for Biotechnological Information NCBI, Genebank database.
8. 6. http://blast.ncbi.nlm.nih.gov/Blast.cgi BLAST: Basic Local Alignment Search Tool, an online program for aligning biological macromolecular sequences
9. 7. http://www.mendeley.com/ Mendeley: Free reference manager and PDF organizer; library program.
10. 8. http://www.ebi.ac.uk website of the European Institute of Bioinformatics
11. 9. http://www.scopus.com - bibliographic database and Scopus citation index
11. http://thomsonreuters.com/thomson-reuters-web-of-science/ bibliographic database and citation index Web of Sicence
12. http://www.molbiol.ru - Russian-language informational site and forum on molecular biology

V. List of information technologies and software

The location of the computer equipment on which the software is installed, the number of jobs	**List of software**
The computer class of the School of biomedical AUD. M723, 15 jobs	Microsoft Office Professional Plus 2013 is an office Suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.).); 16.04 7 Zip - free file archiver with a high compression ratio data; Adobe Acrobat XI Pro-software package for creating and viewing electronic publications in PDF format; AutoCAD Electrical 2015-three-dimensional computer-aided design and drawing system; ESET Endpoint Security 5-comprehensive protection of workstations based on Windows OS. Virtualization support +

	new technologies; WinDjView 2.0.2 - program for recognition and viewing of files with the same format DJV and DjVu; SolidWorks 2016-CAD software for automation of industrial enterprise at the stages of design and technological preparation of production Compass - 3D LT V12-three-dimensional modeling system Notepad++ 6.68-text editor

VI. METHODOLOGICAL RECOMMENDATIONS ON THE COMPLETING THE DISCIPLINE

The main source of information and the knowledge-forming component of the discipline "Molecular Genetic Technology in Medicine" is a series of lectures.

Students guidelines:

1. Students must attend all the lectures and note-taking the material presented.
2. The assimilation and consolidation of lecture materials should be carried out in first days after listening to a lecture.
3. First, it is necessary to study the lecture notes, diagrams and figures. If necessary, read to the recommended literature.
4. In conclusion, try to answer the questions of the lecture plan.
5. In case of missing a lecture, study the material on the lecture topic using the recommended literature. This significantly increases self-preparation time.
6. It is necessary to return to the lecture materials again: while preparing for the final lesson; in preparation for the final control (it is necessary to pay attention to the control questions).

Work with educational and scientific literature is the main form of self-preparation work and it is mandatory to pass the oral and test examinations. It includes the development of lecture material, study of recommended sources and literature on the theme of lectures.

The lecture Analytical essay should contain a record of the main questions of the lecture offered by the teacher (when they are shown), the main sources and literature on the topics and conclusions for each question.

An Analytical essay should be made in a separate notebook. It should be neat, readable, and not contain unrelated information or pictures. The Analytical essays of the scientific literature for self-preparation should also be carried out carefully, contain answers to each question posed in the topic, have a link to the source of information, name and year of publication. A synopsis can be a reference (contain only the main key positions), but at the same time allowing to give a complete answer to the question, it can be detailed. The volume of the Analytical essay is determined by the student.

While working with educational and scientific literature, a student may:

- make notes in the course of reading in the form of a simple or detailed plan (create a list of the main issues discussed in the source);
- to make these (quoting the most important places of the article or monograph, a short summary of the main ideas of the author);
- prepare annotations (a brief summary of the main issues of the work);
- create notes (detailed theses that).

Having chosen the necessary source, one should find the section of interest on the table of contents or the alphabetical index, as well as the section of the lecture notes or textbook of the same name. In case of any difficulties in understanding the educational material, refer to other sources where the presentation may be more accessible.

It should be noted, that working with literature is not only useful as a means of a deeper study of any discipline but also an integral part of the future graduate's professional activity.

One of the forms for self-preparing work with scientific literature is the performance of creative tasks - writing popular science articles, described in detail in Supplement 1.

CLASSROOM, EQUIPMENT AND MATERIAL REQUIREMENTS FOR THE DISCIPLINE

Lectures and practical classes revered an audience (computer class) with a blackboard and multimedia equipment (personal computer or laptop, a projector with a screen or monitor).

Practical lessons required to have an audience (computer class) with personal computers for each student.

Medical biotechnology	Multimedia audience: Monoblock Lenovo C360G-i34164G500UDK; projection Screen Projecta Elpro Electrol, 300x173 cm; Multimedia projector, Mitsubishi FD630U, 4000 ANSI Lumen 1920 x 1080; Flush interface with automatic retracting cables TLS TAM 201 Stan; Avervision CP355AF; lavalier Microphone system UHF band Sennheiser EW 122 G3 composed of a wireless microphone and receiver; Codec of videoconferencing LifeSizeExpress 220 - Codeconly - Non-AES; Network camera Multipix MP-HD718; Two LCD panel, 47", Full HD, LG M4716CCBA; Subsystem of audiocommentary and sound reinforcement; centralized uninterrupted power supply	690922, Primorsky Krai, Vladivostok, island Russian, the Saperny Peninsula, the village of ayaks, 10, RM. M 421
	Laboratory of biomedical cell technologies Device for polymerase chain reaction with the detection of amplification products in" real time " CFX96 Touch Real Time System Camera for electrophoresis Mini-Sub Cell GT System (BioRad 1704467) Camera for vertical electrophoresis Mini-PROTEAN Tetra	690922, Primorsky Krai, Vladivostok, island Russian, the Saperny Peninsula, the village of ayaks, 10, RM. M820, M823, M826

	Cell, BioRad 1658003 Chamber for vertical electrophoresis PROTEAN II xi Cell (BioRad 1651803) System for fixing and processing of electrophoretic gels Gel Fix System Hydrogen index (pH) meter of solutions complete with electrode and calibration system PB-11-P11 A thermostatic shaker ES-20/60 Laboratory centrifuge MiniSpin Autoclavable single-channel HTL dispenser of variable volume 100-1000 µl Discovery Comfort (4046) Autoclavable single-channel HTL dispenser of variable volume 20-200 µl Discovery Comfort (4045) Autoclavable dispenser of odnokon. variable volume 2-20 µl Discovery Comfort (4043) Autoclavable dispenser of odnokon. variable volume 10-100 µl Discovery Comfort (4044) Biacore X100 automated system for the analysis of intermolecular interactions with a set of additional parts and software System for continuous monitoring of living cells in culture, cell-IQ MLF image formation and analysis, Chip Technologies, Czech Republic Personal CO2 incubator - with Galaxy cell monitoring and vitality enhancement system (CO48R-230-1200) Cabinet laminar flow of the 2nd class of biological protection, the size of the working surface 150 cm SafeFAST Elite215S Bactericidal UV air recirculator, UVR-M Magnetic stirrer, MSH-300i Miniracer-shaker MR-1 Thermoshaker tablet, PST-60 HL - 4 System for obtaining ultra-pure water Simplicity (SIMSV00EU) Laboratory centrifuge for sample preparation by centrifugation 5804r Refrigerator low-temperature Forma 902 Automatic single-channel variable volume dispenser 0.2-2 µl, Discovery Comfort series (DV2) Automatic vertical autoclave MLS-3020 U Analytical scale-series Adventurer Pro AV213 Scales precision Pioneer series (PA413 Dispenser, electric, serological pipettes Swiftpet PRO Distiller GFL-2008 Water bath-thermostat with mixing WB-4MS, Dry air thermostat MIR-262 Medical om-1 suction device Scales precision Pioneer series (PA413	

THE MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
Federal State autonomous education institution of higher education
«Far Eastern Federal University»
(FEFU)

SCHOOL OF BIOMEDICINE

FUND ASSESSMENT TOOLS

TRAINING COMPLEX OF DISCIPLINE

Medical biotechnology

Educational program
Preparation for 31.05.01. General Medicine
Form of training full-time

Vladivostok
2017

FEA Passport

Completed in accordance with the Regulations on the Funds of Evaluation Assets of Educational Programs of Higher Education - Bachelor's Programs, Specialties, FEFU Magistrates, approved by order of the Rector No. 12-13-850 of 12.05.2015.

Competence code and formulation	**Stages of competence formation**	
GPC-7 - readiness to use main physicochemical, mathematical and other natural science concepts and methods for solving professional problems;	Knows	– place and role of molecular modeling in medicine; – main concepts, definitions, methods and approaches used in molecular genetic studies in medicine; – use of molecular genetic technologies in pharmacology and clinical medicine; – biomedical problems solved by approaches of molecular genetic modeling
	Is able to	– formulate problems of molecular genetic studies in medicine
	Possesses	– the main principles of molecular genetic research organizing in medicine
PC-2 - ability to conduct preventive medical examinations, clinical examinations and clinical supervision;	Knows	– the main principles of medical examinations in order to conduct genetic research
	Is able to	– organize medical examinations in order to conduct genetic research
	Possesses	– the main skills of medical examinations in order to conduct genetic research
PC-21 - ability to participate in research;	Knows	– techniques for molecular genetic studies in medicine
	Is able to	– how to plan molecular genetic studies in medicine;
	Possesses	– skills to plann molecular genetic studies in medicine;
PC-22 - willingness to participate in new methods and techniques implementation aimed at protecting citizens health.	Knows	– methods, technologies and products of molecular genetic studies in medicine
	Is able to	– use knowledge of methods, technologies and products of molecular genetic studies in medicine for the patient treatment
	Possesses	– skills and planning the introduction of new products and molecular genetic studies in medicine for patients treatment

Guidelines that determine the results of the discipline evaluation procedures development

Current certification of students on the subject «Molecular Genetic Technology in Medicine» is conducted in accordance with the local regulations of the Far Eastern Federal University and is mandatory.

Current certification in the discipline «Molecular Genetic Technology in Medicine» is held in the form of control measures (test papers, tests) on the evaluation of actual student learning outcomes, and by a master teacher.

Examination means of checking the ability to apply this knowledge to solve problems of a certain type on the problems of the course. Complete control tasks in the discipline mainly includes tasks designed to test the knowledge of molecular biology.

Test is a system of standardized tasks to automate the procedure of measuring the level of knowledge and skills of the student. in the discipline Foundation test items include various kinds of tests, such as the establishment of compliance, true / false, the query selects an answer.

The objects of evaluation are:

- Subject matter (the activity in the classroom, the timeliness of the implementation of different types of jobs, the attendance of all classes in the discipline attested);
- The degree of assimilation of theoretical knowledge;
- The level of mastery of practical skills and abilities for all types of academic work;
- The results of independent work.

The interim certification of students on the subject «Molecular Genetic Technology in Medicine» is conducted in accordance with the local regulations of the Far Eastern Federal University and is mandatory.

On the subject «Molecular Genetic Technology in Medicine» is provided offset in the 6 semesters. Test carried out in writing.

Topics of essays and presentations

1. Obtaining monoclonal antibodies
2. Preparation of recombinant vaccines
3. Biotechnological production of antibiotics
4. Molecular cloning
5. Plant Genetic Engineering
6. Application of homologous recombination in biotechnology
7. Protein Engineering in vivo

8. Transgenic animals
9. Fruit fly Drosophila melanogaster, as a model system
10. The bacterium Escherichia coli, as a model system
11. Saccharomyces cerevisae yeast, as a model system
12. Nematode Caenorhabditis elegans, as a model system
13. Fish Danio rerio, as a model system
14. Mouse Mus musculus and rat Rattus norvegicus, as a model system
15. Animal viruses as biotechnology tools.
16. Nucleic Acid Sequencing Methods
17. Ribozymes and RNA aptamers and their application in biotechnology
18. The use of antibodies in biotechnology
19. Plasmids of bacteria and their use as vectors
20. Methods of sterilization of laboratory glassware and devices
21. Methods for the production of recombinant proteins
22. Mammalian cell cultures
23. E. coli strains used in biotechnological projects.
24. Features of the expression of recombinant proteins in eukaryotic cells
25. Yeast expression vectors
26. Types of promoters in expression vectors
27. Directed mutagenesis and genetic engineering of proteins
28. Phage display
29. Ribosome display
30. Preparation of recombinant proteins using eukaryotic systems

Evaluation Criteria

The stated understanding of the abstract as a holistic copyright text defines the criteria for its evaluation: the novelty of the text; the validity of the choice of source; the degree of disclosure of the essence of the issue; compliance with the requirements for registration.

The novelty of the text: a) the relevance of the research topic; b) novelty and independence in the formulation of the problem, the formulation of a new aspect of the well-known problem in the establishment of new connections (interdisciplinary, intra-subject, integration); c) the ability to work with research, critical literature, systematize and structure the material; d) the appearance of the author's position, independence of assessments and judgments; d) stylistic unity of the text, the unity of genre features.

The degree of disclosure of the essence of the question: a) the plan compliance with the topic of the abstract; b) compliance with the content of the topic and plan of the abstract; c) completeness and depth of knowledge on the topic; d) the validity of the methods and methods of work with the material; e) the ability to generalize, draw conclusions, compare different points of view on one issue (problem).

The validity of the choice of sources: a) evaluation of the used literature: whether the most famous works on the topic of research are involved (including recent journal publications, recent statistics, summaries, references, etc.).

Compliance with the requirements for registration: a) how correct the references to the used literature, references are; b) assessment of literacy and presentation culture (including spelling, punctuation, stylistic culture), knowledge of terminology; c) compliance with the requirements for the volume of the abstract.

The reviewer should clearly state the remark and questions, preferably with references to the work (possible on specific pages of the work), to research and evidence that the author did not take into account.

The reviewer can also indicate: whether the resident has addressed the topic earlier (essays, written works, creative works, olympiad works, etc.) and whether there are any preliminary results; how the graduate conducted the work (plan, intermediate stages, consultation, revision and processing of written or lack of a clear plan, rejection of the recommendations of the head).

The student submits an essay for review no later than a week before the defense. The reviewer is the supervisor. Experience shows that it is advisable to acquaint the ordinator with the review a few days before the defense. Opponents are appointed by the teacher from among the residents. For an oral presentation, an intern will need 10–20 minutes (approximately as long as he answers with tickets for the exam).

Grade 5 is set if all the requirements for writing and defending an essay are fulfilled: the problem is indicated and its relevance is justified, a brief analysis of various points of view on the problem under consideration is made and one's own position is logically presented, conclusions are formulated, the topic is fully disclosed, the volume is met, the external requirements are met design, given the correct answers to additional questions.

Grade 4 - the basic requirements for the abstract and its protection are met, but there are shortcomings. In particular, there are inaccuracies in the presentation of the material; there is no logical sequence in the judgments; not sustained volume of the abstract; there are omissions in the design; Additional questions for the protection given incomplete answers.

Grade 3 - there are significant deviations from the requirements for referencing. In particular: the topic is covered only partially; factual errors in the content of the abstract or when answering additional questions; during the protection there is no output.

Grade 2 - the topic of the essay is not disclosed, there is a significant misunderstanding of the problems