SYLLABUS

REGARDING THE QUALIFICATION CYCLE FROM 2021TO 2022

1. BASIC COURSE/MODULE INFORMATION

Course/Module title	*Molecular biology*
Course/Module code *	
Faculty (name of the unit offering the field of study)	*College of natural Sciences, Institute of Biology and Biotechnology*
Name of the unit running the course	*Institute of Biology and Biotechnology*
Field of study	Biology
Qualification level	II grade
Profile	*general academic strand*
Study mode	*stationary*
Year and semester of studies	*I year, I semester*
Course type	*specialized*
Language of instruction	English
Coordinator	Justyna Ruchala, PhD
Course instructor	*Justyna Ruchala, PhD*

* - as agreed at the faculty

1.1.Learning format – number of hours and ECTS credits

Semester (no.)	Lectures	Classes	Colloquia	Lab classes	Seminars	Practical classes	Internships	others	**ECTS credits**
I	28			44					4

1.2. Course delivery methods

☒ conducted in a traditional way

- involving distance education methods and techniques

1.3. Course/Module assessment (exam, pass with a grade, pass without a grade)

CREDIT WITH GRADE, EXAM

2. PREREQUISITES

Knowledge in the fields of biochemistry, molecular biology, and cell biology.

3. OBJECTIVES, LEARNING OUTCOMES, COURSE CONTENT, AND INSTRUCTIONAL METHODS

3.1. Course/Module objectives

O1	*Expanding theoretical knowledge in the field of structure and functions of biological macromolecules and macromolecular complexes of DNA, RNA and proteins.*
O2	*To acquaint students with the molecular basis of the main cellular processes.*
O3	*Preparing students to use selected experimental techniques used in molecular biology.*

3.2. COURSE/MODULE LEARNING OUTCOMES (TO BE COMPLETED BY THE COORDINATOR)

Learning Outcome	The description of the learning outcome defined for the course/module	Relation to the degree programme outcomes
LO_01	The student understands and describes the main elements of the structure of nucleic acids and proteins, characterizing their biological functions.	O_K_04
LO_02	The student understands the course of key processes related to the metabolism of nucleic acids and proteins and the expression of genetic information.	O_K_01
LO_03	The student knows the application of molecular biology in industry and medicine.	O_K_01
LO_04	The student knows the use of advanced techniques and research tools, including bioinformatics used in molecular biology for the modification and analysis of genomes	O_K_05
LO_05	The student is able to identify recombinants obtained in the course of exercises, and also propose methods of their analysis	O_S_05, O_S_06
LO_06	The student is able to handle specialized equipment with the principles of occupational health and safety and good laboratory practice, the scope to perform independent research tasks	O_S_02
LO_07	The student is able to use publicly available databases of sequences and structures of biological macromolecules and uses a professional language in the field of	O_S_11
LO_08	Student is able to perform tasks while working in a team performing the tasks provided for in the program of practical classes.	O_S_02

3.3. Course content (to be completed by the coordinator)

A. Lectures

Content outline
Structure, properties and functions of nucleic acids.
Structure and functions of proteins. Influence of protein structure on its biological function.
Protein evolution. Evolution of the RNA world. The formation of the first cells. The role of mutations in evolution.
Central dogma of molecular biology - the flow of genetic information.
Structure of chromosomes and structure of genomes: prokaryotic and eukaryotic.
DNA replication in Prokaryotes and Eukaryotes. DNA metabolism in the cell cycle.
Mutagenesis. Repair processes. Mechanisms of recombination. Transpositions.
RNA metabolism: the process and regulation of transcription. RNA maturation, RNA dependent synthesis of DNA and RNA.
Genetic code - characteristics and properties. Deviations from the universality of the genetic code. Unusual amino acids in the protein structure: selenocysteine and pyrolysine.
Protein biosynthesis and it's control.
Post-translational events.
Genome sequencing, main methods, genome editing. Application of molecular biology in various branches of industry and medicine - molecular diagnostics and gene therapy (therapeutic and lethal genes).

B. Classes, tutorials/seminars, colloquia, laboratories, practical classes

Content outline
Getting to know the health and safety regulations, laboratory equipment and good laboratory practice.
Introduction to DNA cloning. Features of cloning vectors and expression vectors. Types of vectors used for cloning in prokaryotic and eukaryotic organisms.
Structure of a plasmid vector. The most common methods of DNA isolation. Mini prep isolation of DNA by the alkaline lysis method.
Application of restriction endonuclease in DNA analysis. Restriction hydrolysis of recombinant plasmid DNA.
DNA electrophoresis in agarose gel - theoretical introduction. Analysis of the recombinant restriction map in order to determine the expected size of the restriction hydrolysis products - the principle of assessing the size of the obtained DNA fragments (comparison with a size marker; rules for determining the calibration curve and its application to determine the length of linear DNA fragments).

Preparation of agarose gel, electrophoresis of plasmid DNA fragments, detection of DNA in UV light, analysis of results (comparison of plasmid migration with the image of its digestion products; evaluation of the size of the obtained DNA fragments).
Ligation of DNA fragments: principles of experiment planning, the use of T_4 ligase, alkaline phosphatase and Klenow fragment in the preparation of recombinant DNA.
Transformation of cells with foreign DNA: - discussion of classical methods of bacterial transformation - transformation of a laboratory strain of Escherichia coli with a recombinant plasmid obtained previously by ligation (electrotransformation).
Polymerase chain reaction (PCR): - process of the reaction - matrix preparation - designing starters - thermostable polymerases - principles of planning the experiment and optimization of the process of the reaction. Discussion of the possibilities of using PCR in various types of experiments
Selection of recombinants after transformation: - antibiotic resistance test - β-galactosidase induction and selection by colony color, lacZ operon action Transcription and expression vectors: characteristics, application. Overview of the basic methods of clone analysis: restriction mapping, partial restriction digest, nucleic acid labeling. Nucleic acid sequencing.
RNA isolation, evaluation of the quality and concentration of nucleic acids after isolation, reverse transcription and obtaining cDNA as a template for qPCR reactions.
Real-time PCR reaction, the principle of the reaction, analysis of the obtained results.
To acquaint students with the functioning and capabilities of selected databases and programs for the analysis of the structure and functions of biological macromolecules - planning the insertion of an insert into a plasmid in silico.

3.4. Methods of Instruction

e.g.

Lecture: a problem-solving lecture/a lecture supported by a multimedia presentation/ distance learning
Classes: text analysis and discussion/project work (research project, implementation project, practical project)/ group work (problem solving, case study, discussion)/didactic games/ distance learning
Laboratory classes: designing and conducting experiments

Lecture - lecture with multimedia presentation
Laboratory exercises - work in the laboratory, work in groups, processing the results, performing experiments

4. Assessment techniques and criteria

4.1 Methods of evaluating learning outcomes

Learning outcome	Methods of assessment of learning outcomes (e.g. test, oral exam, written exam, project, report, observation during classes)	Learning format (lectures, classes,...)
LO-01 – LO-03	*PRESENCE IN LECTURES, ACTIVITY, EXAM*	L
LO-04 – LO-08	TEST, ACTIVITY, OBSERVATION DURING CLASSES	LE

4.2 Course assessment criteria

Assessment methods:

A: Questions to remember;

B: Message to understand questions;

C: Solving a typical written task;

D: Solving a non-standard written task;

Assessment criteria:

- for insufficient solution of tasks only in area A and B = grade 2.0

- for solving tasks only in area A and B, the possibility of obtaining max. ratings 3.0

- for solving A + B + C tasks, the possibility of obtaining max. ratings 4.0

- for solving tasks in the area of A + B + C + D, the possibility of obtaining a score of 5.0
Completion of the laboratories is based on the positive grades obtained in the tests, final tests, and the performance of experiments during classes.

5. Total student workload needed to achieve the intended learning outcomes – number of hours and ECTS credits

Activity	Number of hours
Scheduled course contact hours	72
Other contact hours involving the teacher (consultation hours, examinations)	20
Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.)	38

Total number of hours	130
Total number of ECTS credits	4

* One ECTS point corresponds to 25-30 hours of total student workload

6. Internships related to the course/module

Number of hours	
Internship regulations and procedures	

7. Instructional materials

Compulsory literature: "Molecular biology", B.R. Glick, American Society of Microbiology, 2017.
Complementary literature: „Lehninger Principles of Biochemistry", D. L. Nelson, M. M. Cox; W. H. Freeman – 5. edycja, 2008. „Genomes 2nd edition" T. A. Brown, Garland Science, 2002. http://ncbi.nlm.nih.gov./books/bv.fcgi?rid=genomes

Approved by the Head of the Department or an authorised person