Study programme : BSc in Biology

Degree level: Bachelor degree

Course title: Techniques of Molecular Biology

Professor: dr Andjelka Ćelić

Elective course: required

Number of ECTS: 5

Prerequisites:

Course objective:
Offer students a theoretical and practical introduction to methods used to study nucleic acids (DNA, RNA) and proteins as informational and operating molecules in living systems, whose processes depend on their structure, function and interactions.

Course outcome:
Following successful completion of preliminary and final exams, students will have obtained knowledge and experience in basic molecular biology techniques that they will be able to apply to their future research in a wide range of biological laboratories.

Course content:
Theoretical part
Model organisms (1) used to study biological phenomena in molecular biology (bacteria, yeasts, nematodes, plants, mammals); working with cell cultures. **Molecular cloning (2,3,4):** isolation, purification, quantification, identification of DNA and RNA; Formation and analysis of cDNA and genomic libraries; Enzymatic manipulation of DNA and RNA; PCR amplification of genes and DNA sequences; Plasmids and vectors; Mutagenesis; Transformation and transfection - introduction of foreign DNA into bacteria, yeast and mammalian cells; DNA sequencing. **DNA expression (5):** Northern & Southern blot, RT-PCR, RNAi, shRNA, microarrays. **Targeted genome editing (6)**: ZFN, TALEN and CRISPR/Cas9. **Recombinant expression of proteins (7,8,9):** Homologous and heterologous expression; Isolation (protein chromatography), detection (SDS-PAGE) and identification (Western blotting, limited proteolysis, sequencing, mass spectroscopy), protein analysis (fluorescent spectroscopy, CD, SAXS, NMR, X-ray analysis). **Genetic engineering (10):** cloning of plants and animals, genetically modified organisms, therapeutic cloning, ethical dilemmas. **Protein-protein interactions (11):** (Y2H, TAP-Tag / MS, Co-IP, FRET, BRET, ITC, SPR); **Protein-DNA interactions (12):** EMSA and ChIP. **Immunological methods in molecular biology (13):** karyotype analysis, immunohistochemistry, FISH. **Protocols in epigenetics (14):** analysis of DNA methylation, analysis of epigenetic markers. **Genetic manipulation of animals (15):** knock-in, knock-out, knock-down mice. The use of bioinformatics in molecular biology will be addressed.

Practical part
Practical classes will be organized in the form of experimental laboratory exercises and demonstrations consistent with the course program. Exercises represent a series of experiments during which students will master the basics of molecular cloning: from obtaining an initial DNA library through duplication of the desired gene or DNA fragment, enzymatic manipulation, as well as vector and insert preparation, ligation, bacterial transformation, cloning, validation, plasmid DNA purification, and preparation for DNA sequencing.

Reading List:

1. Sambrook, J., Fritsch, E.F., and Maniatis, T. (2001). Molecular cloning: a laboratory manual, Vol 1, 2, 3, 2nd edition (Cold Spring Harbor Laboratory Press).
2. T. A. Brown, Gene Cloning and DNA Analysis: An Introduction, 7th ed. Wiley-Blackwell (2016)
3. C. Howe, Gene Cloning and Manipulation, 2nd ed. Cambridge University Press (2007)

Total hours:				
Lectures: 2	Practicals:	Other:2	Student research work:	

Methods of instruction:
lectures, laboratory exercises, term papers and consultations

Assessment (maximum number of points 100)

Requirements	points	Final exam	points
Active participation in lectures		Written exam	30
Active participation in practicals		Oral exam	20
Laboratory reports	10		
Essay	10		
Preliminary exams	2x15		
Remark:			