STATE-OF-THE-ART EQUIPMENT AND METHODS FOR STUDYING BIOLOGICAL SYSTEMS

Basic Information

This is a course, which contributes to MSc award in Biology

Course period	From October 1st till February 1st, 1 semester (16 weeks)
Study credits	3 ECTS credits
Duration	108 hours
Language of instruction	English
Academic requirements	– BSc degree in Biology, Chemistry, Physics or Environmental Sciences or equivalent (transcript of records), – Good command of English (certificate or other official document)

Course Description

The course "State-of-the-Art equipment and methods for studying biological systems" is a compulsory course. It is designed to develop practical skills of work in a modern laboratory, after completion of the course students will get acquainted with the methods of processing and analysis of research results.

Special Features of the Course

The course is especially designed for those who wish to master the modern methods of laboratory work with biological systems, and bioluminescent proteins in particular. A series of practical studies within the course include: the basic methods of recombinant proteins cloning, expression and purification, and analyzing the obtained protein samples (purity, concentration, spectral properties, etc.). The phenomenon of nonradiative resonant energy transfer (FRET) is also dicussed within the course.

Course Aims

The course is aimed to provide students with knowledge and skills of contemporary methodology and techniques used in modern molecular biology and biophysics labs.

Course Objectives

The course has been designed to:

- provide students with skills of cloning, expression and isolation of the target protein from the biomass of producer cells;
- give students the basic knowledge of purification technique and obtaining enriched fractions of protein samples using various types of chromatographic methods;
- provide students with knowledge and skills of analytical methods of modern biotechnology (gel electrophoresis, spectrophotometry);
- teach the participants of the course spectroscopic methods;
- develop time management skills, planning, conducting and analyzing the results of an experiment.

Learning Outcomes of the Course

After completing the course students should be able to:

- to develop a concept of research project within the framework of the designated problem, formulate the goal, objectives, relevance, significance (scientific, practical, methodological and other depending on the type of project), expected results and possible areas of their application; to manage a scientific project at all stages of its life cycle;
- to organize and manage the work of a research team, develop the strategy to achieve the aim of the project;
- to demonstrate knowledge and skills of state-of-the art experimental methods in molecular biology and biophysics.

Course (module) Structure

Learning Activities	Hours
Lectures	-
Practice sessions / Seminars,	36
Self-study Assignments	72
Final Exam (including preparation)	-
Total study hours	**108**

Course Outline

Week	Practical work / Assignments	Hours
1	• Briefing «Protein cloning and expression» • Practical work «Isolation of the clitin apoprotein from the biomass of bacterial producing cells (*E. coli*, strain BL21-Gold)»	6
2	• Briefing «Protein purification techniques» • Practical work «Purification of apoclitin by ion exchange chromatography under denaturing conditions»	

		6
3	• Briefing «Gel electrophoresis» • Practical work «Analysis of the obtained protein preparations by gel electrophoresis according to the Laemmli method»	6
4	• Briefing «Protein spectroscopy» • Practical work «Methods for determining protein concentration»	6
5	• Briefing «Green Fluorescent Protein» • Practical work «Energy transfer effect in the clitin - cgreGFP system (spectroscopy)»	6
6	• Briefing «Förster resonanse energy transfer» • Practical work «Förster radius and efficiency of energy transfer from bioluminescent donor to fluorescent acceptor (FRET)»	6

Assessment

The overall course percentage grade will consist of the combined grades of 6 modules assignments (100%):

- reports on 6 lab works (each 16,6%, 100% total).

The overall course percentage grade will be converted into a letter grade as follows:

A = 91-100%
B = 81-90%
C = 71-80%
D = 61-70%
E = less than 61%.

Attendance Policy

Since almost every class contains practical work in laboratory, attendance of all of them is obligatory. Missing one or more of laboratory work classes will result in “No final grade”.

Web page of the course

The webpage of the course «State-of-the-Art Equipment and Methods for Studying Biological Systems» is available through E-learning SibFU web site: www.e.sfu-kras.ru. You

must be logged in to access this course. Course Guide and all accompanying materials are also available at the course web-page.

Core reading

Selected chapters of the books:

- Lee J. Bioluminescence, the Nature of the Light. – 2016.
- Shimomura O. Bioluminescence: Chemical Principles and Methods, Revised Edition. – 2012.
- Haddock S. H. D. Bioluminescence in the sea. / S. H. D. Haddock, M. A. Moline, J.F. Case. // Annu. Rev. Mar. Sci. 2010. 2, PP. 443-493.
- Lakowicz J. R. Energy Transfer. In Principles of Fluorescence Spectroscopy. 3rd edition. 2006. Springer. ISBN: 978-0-387-46312-4
- Nelson D. L. and Cox M. M. Lehninger Principles of Biochemistry. 5th edition.

Facilities, Equipment and Software

The program is designed with emphasis on practical skills development. The classes are held in the modern and well-equipped SibFU Laboratory of Bioluminescent Biotechnologies. This laboratory was established through the collaboration of the world's strongest team of scientists engaged in fundamental research of light emission by living organisms, i. e. bioluminescence, and the Nobel Laureate Professor Osamu Shimomura.