(SYLABUS)

Name of the department / clinic providing the course:

Department of Molecular Neurochemistry

Course title: Biotechnologia

Course profile: practical

Specialty: Medical Biotechnology

Level of course unit: 2nd grade

Course unit title: Pracownia Practice rotation – Advanced Research Techniques in Neuroscience

Course unit code:

Type of course unit: optional

Course aims:

The aim of the course is to familiarize students with state-of-the art laboratory techniques used in neuroscience research through practical training sessions. During the course, student is expected to gain a sufficient level of research experience to use advanced laboratory equipment, independently plan the experiments and be able to analyze various type of neuroscience data.

Form of study: Stacjonarne

Year of study: 2

Types of educational activities and number of hours allocated: laboratory

Laboratory 160 h, Self-learning 140 h

Number of ECTS credits allocated and their structure according to students' from of learning: 10

Names of course unit's faculty: dr hab. n. med. Tomasz Boczek, prof. uczelni

Prerequisites:
Before taking the exam, you must have passed:

Learning activities and teaching methods: individual work or work in a small group (max. 2 students), problem-solving research tasks, problem-based discussion, demonstrations.

Course unit content:
1. Preparation of embryonic hippocampal neurons for in vivo culturing. Methods for separation of neurons from glial cells. Techniques for long-term culturing of primary neurons and primary astrocytes. Checking the culture purity with neuronal/glial markers.
2. Visualization of neuronal morphology: cell body stains, fiber stains, Golgi stain, intracellular and juxtacellular labeling with fluorescent dyes and quantum dots.
3. Visualizing nervous system function with static markers of activity: Assaying neuronal activity and cellular function in fixed neurons. Techniques for neuronal fixation, permeabilization and antigen-specific labelling.
4.Preparation of plasmid constructs for cellular imaging. Checking plasmid integrity.
5. Visualizing neural activity: Imaging calcium transients and imaging synaptic transmission with unimolecular fluorescent protein-based sensors.
6.Time-lapse imaging with reporter genes.
7. Live-cell imaging of neuronal signaling pathways using FRET sensors: sensor design and basic characteristic, ratiometric and intensiometric sensors, sensor dynamic range, real-time high-resolution FRET imaging techniques, data acquisition and analysis. Using FRET-based perfusion chamber screening for assessment of drug efficiency.
8. Neuronal gene delivery strategies: calcium phosphate transfection and lipid-mediated transfection. Assessment of delivery efficiency. Optimization techniques.
9. Adenoviral system for efficient gene delivery to primary neurons: the overview of adenoviral plasmids, strategies for efficient cloning of gene of interest into adenoviral backbone using the complementary overhangs, the use of fluorescent reporters, preparation of clones, colony screening, adenovirus propagation and titration.
10. Transduction of primary neurons with adenovirus or adeno-associated virus serotype 2. Evaluation of transduction efficiency and potential toxicity of a transgene.
11. Evaluating neuronal survival and outgrowth using fluorescent-based assays. Scholl analysis. Analysis of neuronal spines and mushrooms morphology.

Course objectives:

Knowledge:

BM1_PO_W04 - student understands the functioning of the human body in physiological and pathological conditions

BM1_PO_W05- student knows biological and biochemical processes, as well as the genetic and environmental conditions influencing the modification of the pathways at the molecular level

BM1_PO_W10 - student knows the basic viral vector systems commonly used in molecular biology and biotechnology

BM1_PO_W12- student has knowledge of the molecular biology methods and technologies used to analyze, design and modify genetic material

BM1_PO_W14- student knows research techniques used in biological sciences and basic medical sciences

BM1_PO_W16- student knows the rules of work in biological laboratories, the applicable health and safety regulations, and is able to determine the risks and how to prevent them

Skills:

BM1_PO_U01- student plans and performs research tasks using analytical methods, computer simulations, and basic industrial techniques

BM1_PO_U02 - student can formulate and solve research problems, including unusual conditions of biological, chemical, or technological processes

BM1_PO_U03- student can choose the right sources of information and make a critical analysis of them

BM1_PO_U04- student can apply the right methods and choose the right tools to complete the planned task

BM1_PO_U08 - student can interact with people forming a team to solve research problems in the field of biological sciences and basic medical and pharmaceutical sciences

BM1_PO_U010 - student can develop the scientific theory, prepare the documentation of his/her own results or a selected scientific problem in Polish and English

Attitudes and transferrable (generic) competencies:

BM1_PO_K01 - student speaks English at the B2 + level in the field of biomedical sciences, especially
medicine, biology and biotechnology, clinical research, and drug production

BM1_PO_K02 - student can determine the utility of the results of the study in the field of biological science, basic medical and pharmaceutical sciences, biotechnology, and bioinformatics

BM1_PO_K03 - student can communicate with specialists in the field of biological sciences and basic medical and pharmaceutical sciences, biotechnology, and bioinformatics using specialized terminology

BM1_PO_K05 - student fulfills obligations towards society and acts for the public interest in a further scientific or professional career

BM1_PO_K06 - student can evaluate of his/her knowledge and knows when to ask other scientists to solve a research problem

Required and recommended learning resources (readings):

Required: David Levithan, Guide to Research Techniques in Neuroscience, Elsevier Science Publishing Co Inc, ISBN: 9780128186466, 2022 r.

Assessment methods and criteria:
Attendance to all laboratories is mandatory.
Student is allowed to have one unjustified absence during the course. In case of justified absence, student can get a credit during the next class. In case of more than one absence, student is obliged to justify the absence by the end of the course. Only medical justification or a letter from the Dean's office will be accepted.

Additional information:

Statement and signature of the course leader:
I hereby state that the content of the curriculum included in the syllabus below is the result of my individual work completed as part of work contract/cooperation resulting from a civil law contract, and that author rights to this title are not the property of a third party.