COURSE/MODULE DESCRIPTION (SYLLABUS)

1.	Course: **Molecular Neurobiology of Learning and Memory**
2.	Language of instruction: **English**
3.	Faculty: **Faculty of Biotechnology**
4.	Course/module code: **29-BT-S1-E3-EngN**
5.	Course/module type (*mandatory* or *elective*): **elective**
6.	Programme: **Bsc Biotechnology**
7.	Study cycle **1st**
8.	Year: **2nd**
9.	Semester *(autumn* or *spring):* **autumn**
10.	Form of tuition and number of hours: Lecture: **15 h**
11.	Coordinator(s): **Jerzy Mozrzymas, Prof.**
12.	Initial requirements (*knowledge, skills, social competences*): **Basic knowledge of cell biology, human physiology and experimental techniques based on the phenomenon of fluorescence.**
13.	Objectives: **To gain current knowledge about the cytoarchitecture of neural networks, in particular neurophysiology of excitatory and inhibitory synapses. Understanding the mechanisms of brain rhythms along with their role in cognitive processes. Acquiring current knowledge about various molecular mechanisms of synapse plasticity and the function of this plasticity in learning and memory. To gain knowledge of the latest experimental techniques by which the molecular mechanisms of learning and memory are studied at the level of individual synapses and entire neuronal circuits.**

14.	Content: • **The cytoarchitecture of synapses and neural networks in the neocortex and the hippocampus: the role of excitatory and inhibitory synapses; logical functions of the neuron and local neural networks; brain rhythms – mechanisms, cognitive functions.** • **Interdisciplinary studies on the structure-function relationship of synaptic receptors: synapse ultrastructure; function of ionotropic postsynaptic receptors; patch clamp technique; study of the structure-function relationship of a selected receptor using electrophysiological techniques and molecular modeling.** • **Neuroplasticity in learning and memory: types of neuroplasticity; synaptic Hebbian plasticity; homeostatic plasticity and its role in brain development (critical period); plasticity of excitability; long-term synaptic plasticity (LTP); role of synaptic plasticity in learning (engram, consolidation, reconsolidation).** • **Review of selected experimental techniques used in the study of molecular mechanisms of learning and memory: electrophysiological techniques; CLARITY; behavioral methods of memory testing in laboratory animals; in vivo brain imaging using two-photon microscopy.** • **Memory trace (the engram): examples of neuronal activity and synaptic plasticity markers: c-fos, CaMKII, MMP-9; optogenetics; coding of artificial memory traces in live animals.**	
15.	Learning outcomes: Student: • **has in-depth knowledge in the field of: biochemistry, molecular biology, neurophysiology, neuroscience and biomedicine;** • **has knowledge about currently broadly studied fields in the neuroscience;** • **is fluent in the usage of scientific literature in the field of neuroscience; knowledge of English terminology in the field of neuroscience;** • **adequately prioritize in order to carry out specific research projects;** • **understands the need for a systematic review of professional literature in order to broaden and deepen his or her knowledge**.	Outcome symbols: K_W03, K_W05 K_U02, K_K03, K_K05
16.	Recommended literature: • **Mark Bear, Barry Connors, Michael Paradiso "Neuroscience: Exploring the Brain, 4th Edition"; Lippincott Williams and Wilkins.** • **Actual scientific literature in case of new discoveries that have not been covered by the textbook.**	

<table>
<tr><td>17.</td><td colspan="2">Methods of verification of the assumed learning outcomes:
written test (1h)</td></tr>
<tr><td>18.</td><td colspan="2">Conditions of earning credits:
Positive outcome of the final test (more than 50% of good answers); one-choice questions.</td></tr>
<tr><td rowspan="5">19.</td><td colspan="2">Student’s workload:</td></tr>
<tr><td>Activity</td><td>Number of hours for the activity</td></tr>
<tr><td>Hours of instruction (as stipulated in study programme) :
• lecture: 15 h</td><td>15 h</td></tr>
<tr><td>Student’s own work:
• preparations before lectures,
• reading of relevant literature,
• preparations before final exam.</td><td>15 h</td></tr>
<tr><td>Total number of hours:</td><td>30 h</td></tr>
<tr><td></td><td>Number of ECTS:</td><td>2 ECTS</td></tr>
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