Course Title (in English)  Topics in Neurobiology
Course Title (in Russian) Семинар по нейробиологии
Lead Instructor(s) Artamonov, Dmitry

Status of this Syllabus The syllabus is a work in progress (draft)
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Contact Person’s E-mail d.artamonov@skoltech.ru

1. Annotation

Course Description A research paper-based course. Overview of current research relating to various ‘hot topics’ in neurobiology and discussion of current research articles on the subject. Analysis of experiments and research described in scientific papers are presented by students and critically discussed by the class led by the instructor. Novel methods in neurobiology - optogenetics, molecular magneto technique, FLARE, transparent tissues imaging will be discussed in depth. Topics include mapping of the brain and behavior, optogenetic manipulation of memory engrams, mouse models of Alzheimer disease, synaptic plasticity, dendritic spines morphology, pathology and neurodegenerative diseases.

Course Prerequisites Optional course. Course requires basic knowledge of molecular and cellular biology. Prior attendance of a Neuroscience course is highly desirable.

2. Structure and Content

Course Academic Level Master-level
Number of ECTS credits 3
<table>
<thead>
<tr>
<th>Topic</th>
<th>Summary of Topic</th>
<th>Lectures (# of hours)</th>
<th>Seminars (# of hours)</th>
<th>Labs (# of hours)</th>
</tr>
</thead>
</table>
| Synaptic transmission. Plasticity. | 1. Synapses and synaptic transmission Synthesis and release of neurotransmitters and the biochemistry of synaptic responses. The experimental approaches used to examine these processes. The physiology of fast synaptic communication. Dysfunction and various diseases.  
2. Synaptic plasticity Signaling pathways in synaptic plasticity. Long-term synaptic plasticity and the consolidation of memory  
4. Memory and memory engrams | 0 | 13 | 0 |
| Neurodegenerative diseases | 1. Neurodegenerative diseases.  
2. Alzheimer’s disease (AD). Overview of neuropathological changes in AD Tauopathy, neuropathology, genetics – PSEN1 and PSEN2. Calcium signaling in AD affected neurons.  
3. Criteria of mouse models of neurodegeneration replication of clinical phenotype, age-progressing phenotype, control for the effect of genetic mutation, validation of a model.  
5. Methods, experimental design and readouts  
6. Testing drugs (e.g. memantine and BACE inhibitors) in mouse models of AD.  
7. FDA approved medication for AD and the story of drugs that failed (e.g. Dimebon)  
8. Mouse models of inherited neurodegenerative diseases.  
9. Huntington’s disease and Spinocerebellar Ataxias. | 1 | 12 | 0 |
| Novel Methods in Neurobiology | 1. Imaging of transparent tissues  
2. Iterative expansion microscopy  
5. Application of these methods for functional analyses of neuronal circuits. | 2 | 13 | 0 |

3. Assignments
### Assignment Type

<table>
<thead>
<tr>
<th>Assignment Type</th>
<th>Assignment Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>As homework, research papers are given for careful studying during the week before the seminar. Students prepare a Powerpoint presentation and present it in front of the class.</td>
</tr>
</tbody>
</table>

### 4. Grading

**Type of Assessment**

<table>
<thead>
<tr>
<th></th>
<th>Pass/Fail</th>
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</thead>
</table>

#### Grade Structure

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Activity weight, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects</td>
<td>50</td>
</tr>
<tr>
<td>Class Participation</td>
<td>20</td>
</tr>
<tr>
<td>Attendance</td>
<td>20</td>
</tr>
<tr>
<td>Final Project</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Grading Scale

**5. Basic Information**

**Attendance Requirements**

Optional with Exceptions

**Maximum Number of Students**

<table>
<thead>
<tr>
<th></th>
<th>Maximum Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall:</td>
<td>10</td>
</tr>
<tr>
<td>Per Group (for seminars and labs):</td>
<td></td>
</tr>
</tbody>
</table>

**Course Stream**

Science, Technology and Engineering (STE)

**Course Term (in context of Academic Year)**

Term 1

**Students of Which Programs do You Recommend to Consider this Course as an Elective?**

<table>
<thead>
<tr>
<th>Masters Programs</th>
<th>PhD Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biotechnology</td>
<td></td>
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</tbody>
</table>

**Course Tags**

Biotechnology

**6. Textbooks and Internet Resources**

**Required Textbooks**

|--------------------|

**Web-resources**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
</table>

**7. Facilities**

**8. Learning Outcomes**
<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Skill</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern techniques and methods in neurobiology</td>
<td>Ability to present and discuss experimental data</td>
<td>Presentation in English</td>
</tr>
<tr>
<td></td>
<td>Ability to read scientific literature in broad area of neurobiology</td>
<td>Design of experimental research in the neurobiology field</td>
</tr>
</tbody>
</table>

Do you want to specify outcomes in another framework?

Knowledge-Skill-Experience is good enough

9. Assessment Criteria

Select Assignment 1 Type | Project

Input Example(s) of Assignment 1 (preferable)
Novel and Emerging Methods


Optogenetics


Imaging of transparent tissues


PolyQ neurodegenerative diseases


Alzheimer’s Disease


11. Pre-plaque conformational changes in Alzheimer’s disease-linked Ab and APP, O.Klementieva, Nat. Communications, 2017,

Memory Engrams


The quality of this short talk, analysis of research presented and critical discussion by students are evaluated. Students should be able to understand in details all the methods applied in the article they are presenting during a seminar. The following listed below are evaluated -

1. The ability to present and discuss experimental data.
2. The ability to critically assess data presented in the literature.
3. The ability to make a high-quality presentation in English.
4. Knowledge of modern techniques and methods in neurobiology described in the article.

If all 4 criteria are satisfied student gets 2 points, if any 2 criteria are satisfied – 1 point, if the student satisfies only 1 criterion or violates all 4 criteria his presentation is evaluated at 0 points.

In addition, active participation in the seminar is evaluated for the rest of the class. If the student answers at least 2 question from the instructor or the student making the presentation or if the student asks at least 2 correct questions he gets 1 point, if not – 0 (zero) points.

10. Additional Notes