Syllabus for the course «Cognitive Neuroscience»

(4 ECTS)

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1. **Course Description**
   a. «Cognitive Neuroscience»
   b. **Pre-requisites**

      The course is based on the knowledge in biology, physiology, anatomy and psychology. The following knowledge and competence are required to study the discipline:

      - A good command of English language.
      - Basic knowledge of brain anatomy.

   c. **elective**
   d. **Abstract**

      This course aims to introduce the students to neural processes that support high order functions. This course aims to introduce and discuss a number of commonly used methods and tools of cognitive neuroscience. We will explore the neural principles governing various aspects of behavior, vision, sensory-motor control, learning, and memory. Specific topics that will be covered include perception, attention, cognition, language and mirror neurons mechanism. The course is primarily aimed at masters graduate students interested in learning the neural basis of human cognition.

2. **Learning Objectives**

   Learning objectives of the course "Cognitive Neuroscience" are to introduce students to the neurobiological basis of cognition, its foundation and connections to other branches of knowledge:

   - Fundamental theory about neural processes that underlay high order cognitive functions;
   - Recent progress in the field;
   - Research Methods in neuroscience applicable to the fields.

3. **Learning Outcomes**

After completing the study of the course "Cognitive Neuroscience" the student should:

- Know basis of neural processes that support high order functions;
- Know methods used to study the neuronal basis of cognition;
- Be able to distinguish the capacities and restrictions applied by brain structure and functioning to psychological processes;
- Possess skills for choosing appropriate neuroscience methods for psychological research;
- Possess skills to come up with own research proposals;
- Possess skills to understand and present scientific articles

4. Course Plan

№	Topic
1.	Perception
2.	Attention
3.	Memory
4.	Language
5.	Emotions
6.	Motor Control
7.	Neuroscience of music

5. Reading List

a. Required

1. The Oxford Handbook of Cognitive Neuroscience, Volume 1: Core Topics. Edited by Kevin N. Ochsner and Stephen Kosslyn. Oxford University Press, 2013. Режим доступа: http://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199988693.001.0001/oxfordhb-9780199988693
2. The Brain : An Introduction to Functional Neuroanatomy. Charles Watson, Matthew Kirkcaldie, and George Paxinos. Elsevier Science & Technology, 2010. Режим доступа: https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=629994&query=Brain+functional++Neuroanatomy
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10. Innocenti I, Giovannelli F, Cincotta M, Feurra M, Polizzotto NR, Bianco G, Cappa SF, Rossi S. Event-related rTMS at encoding affects differently deep and shallow memory traces. Neuroimage. 2010 Oct 15;53(1):325-30. doi: 10.1016/j.neuroimage.2010.06.011. Epub 2010 Jun 16. PMID: 2060100 https://www.sciencedirect.com/science/article/pii/S1053811910008554

11. Pulvermüller, F. Brain mechanisms linking language and action. 2005. Nature Reviews Neuroscience 6, 576-582 . Doi:10.1038/nrn1706 https://www.nature.com/articles/nrn1706
12. David Poeppel. Genetics and language: a neurobiological perspective on the missing link (-ing hypotheses) J Neurodev Disord. 2011 Dec; 3(4): 381–387. doi: 10.1007/s11689-011-9097-0 https://jneurodevdisorders.biomedcentral.com/articles/10.1007/s11689-011-9097-0
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b. Optional

None

6. Grading System

The current grade (Gtest) is given by the teacher as grade for control tests (5 questions for each topic). The class grade (Gclass) is given by the teacher for attendance and activity during class hours. The self-research grade (GResearch) is given by the teacher for the results of scientific research. The cumulative grade (Gcumulative) for the student's achievements during the course is calculated by the end of the course on the basis of the current grade, the class grade, and the self research grade:

Gcumulative = 0.3 *Gtest + 0.3 * Gclass + 0.4 * Gresearch.

The examination grade (Gexam) is given by the teacher during the final examination. The final grade (Gfinal) is calculated on the basis of the cumulative grade and the examination grade:

Gfinal = 0.6 * Gcumulative (1 to 10) + 0.4 * Gexam (1 to 10)

The grades are rounded up arithmetically.

If the cumulative grade of a student equals 8, 9 or 10, the student can opt that the final grade be given equal to the cumulative grade:

Gfinal = Gcumulative

If the student is eligible for this option, he/she has to inform the teacher about his/her decision concerning the final grade before the examination.

Table of Grade Correspondence

Ten-point Grading	Scale Five-point Grading Scale	
1 - very bad 2 – bad 3 – no pass	Unsatisfactory – 2	FAIL
4 – pass 5 – highly pass	Satisfactory – 3	PASS
6 – good 7 – very good	Good – 4	
8 – almost excellent 9 – excellent 10 – perfect	Excellent – 5	

The final grade, which is the resultant grade for the course, goes to the certificate of Master's degree.

7. Guidelines for Knowledge Assessment

Type of grading	**Type of work**	**Characteristics**
Continuous	Paper presentation	Talk on the seminar on the topic related to the lectures, 60 minutes each.
Continuous	Research Proposal	Choice of tasks that will help students to develop their own research ideas. Finally should be presented to the class.
Continuous	Attendance	Evaluation of attendance lectures and seminars
Final	Exam	Exam will include multiple choice questions, short answers questions and one essay

		question.

Continuous assessment:

1) **Paper presentation.** Students have to present one paper or to make a short literature review on the subject that is relevant to the course topics. Presentations can be made by groups of student but not more than 3 people in each group. Presentation should last 45 minutes and then 15 minutes discussions take place. Main criteria for evaluation are relevance of the topic, understanding of the material and presentation skills.

   or

   Research. As a homework students should choose one of the tasks described below:

   - Media Critique. Students will find a news article of 500 words or more that reports on a neuroscientific finding relevant for course topic. Based on the news article (published since 1995) and the original journal article on which it is based, students are to prepare a 2-4 page (double-spaced) critique of the news article's claims and assess the degree to which it correctly represents the research finding and whether it might mislead the public's understanding of neuroscience and behavior.
   - Research ideas. Students will write down a research proposal based their ideas related on the main sections of the course (Perception, Attention, Memory, Language, Emotion, Plasticity, Mirror System).They will introduce their hypothesis, methods, collecting data and expected results. Moreover if they will test their paradigm on a sample of subjects, they may get extra score.
   - Commentary. Students will write down a Commentary paper on a recent original research published in the Cognitive Neuroscience field. Commentary is a critical paper that aims to highlight positive and negative aspect of the published research.

Work should be done in three parts:

1) Abstract;

2) Report in a written form;

3) Presentation of the work on the seminar. 15 minutes to present and 10 minutes for discussion.

2) Attendance. Attendance will be evaluated as a percentage of seminars and lectures that a student was present on.

3) Weekly tests. Each week students will perform a short test on the covered topic.

Final assessment is the final exam. This exam will cover all topics that have been discussed during lectures and seminars. It will consist of multiple-choice, short answer questions and one essay question with opportunity to choose between topics. The main source to prepare the exam is slides from the lectures.

Sample of final exam questions

Decide whether the statement is true or false:

1. Short-term memory is a sub-component of long term memory
2. Broca area is involved in comprehension processes
3. Action observation activate mirror neurons of the primary motor cortex
4. The role of BDNF in memory performance
5. Neglect is an attentional deficit
6. Prosopagnosia is a memory deficit

Final exam questions:

1. Anatomy of the visual system: Retina and Chiasm
2. Visual cortex: Dorsal and Ventral stream
3. Bottom up processing of object recognition
4. Top-down processing of object recognition
5. Visual perception deficits: Visual Agnosia and prosopagnosia
6. Object recognition and context valence
7. Face recognition
8. Selective attention: Dichotic listening, Stroop test, Visual Search
9. Divided attention
10. Sustained attention
11. Neural correlates of attention: Orienting attention network, Executive attention network, Frontal eye Field, Pulvinar Nucleus, Superior Colliculus

12 Attention impairments in every day life: inattentional blindness

13. Attention impairments in patients: blindsight and neglect
14. The Atkinson & Shiffrin's model
15. The Alan Baddeley Model
16. Working Memory: Encoding, Short-term memory, Rehearsal
17. Long Term Memory: Explicit and Implicit Memory (Declarative and Procedural memory), episodic memory, semantic memory, Skill Learning, Priming, Conditioning.

18. Deep and shallow episodic encoding
19. Neural Correlates of memory
20. Classical memory processes effects (primacy and recency effect)
21 Long-term potentiation and long-term depression at a gross level and at a cellular level
22. Patient HM and his memory disorder.
23. Interfering transiently with brain function (TMS and rTMS)
24. The Baddeley “episodic buffer” model
25. The H.E.R.A. model
26. Anterograde and Retrograde Amnesia
27. Language Comprehension
28. Language Production
29. Timing of linguistic brain processes
30. Different types of Aphasia
31. Non-verbal communication: Embodied Cognition
32. Neuroanatomy of Broca aphasia
33. TMS studies of action verbs
34. Differences for bilingual people
35. The mirror-neuron system in monkey
36. The mirror-neuron system in humans: anatomy
37. Mirror System and Autism
38. Cortico-cortical connectivity of motor imagery and action observation
39. Mirror therapy(MT) in neurorehabilitation
40. Clinical use of MT
41. Physiological mechanisms of MT
42. Music production
43. Timing in music

8. Methods of Instruction

The following educational technologies are used in the study process:

- Lectures involving continuous use of multimedia presentations,
- Seminars involving team oral discussions and paper presentations,
- Homework assignments,
- Self-study of recommended literature

9. Special Equipment and Software Support (if required)

The course requires a computer or laptop, projector, and acoustic systems for multimedia presentations and video.