**Government of Russian Federation**

**Federal State Autonomous Educational Institution of High Professional Education**

**«National Research University Higher School of Economics»**

Department of Psychology

**Syllabus for the course**

**« Introduction to Cognitive Science»**

37.04.01 «Cognitive sciences and technologies: from neuron to cognition», Master of Science

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# Scope of Use

The present program establishes minimum demands of students’ knowledge and skills, and determines content of the course.

The present syllabus is aimed at department teaching the course, their teaching assistants, and students of the Master of Science program 37.04.01 «Cognitive sciences and technologies: from neuron to cognition».

This syllabus meets the standards required by:

* Educational standards of National Research University Higher School of Economics;
* Educational program «Psychology» of Federal Master’s Degree Program 37.04.01, 2011;
* University curriculum of the Master’s program in psychology (37.04.01) for 2013.

# Learning Objectives

The main goal of this course is to introduce students into basic concepts of cognitive science, the basic methods of cognitive science and the main researches in the field of cognitive science.

# Learning outcomes

After completing the study of the discipline «Introduction to Cognitive Science» the student should:

* Know the subject and main concepts of cognitive science, its fields, connections with other disciplines, and how it bridges knowledge from multiple perspectives.
* Know basic contribution of disciplines such as philosophy, psychology, neuroscience and artificial intelligence to cognitive science.
* Know the basic methods and researches in the field of cognitive science
* Know the essence of the main methodological problems of cognitive science
* Be able to choose an adequate method of cognitive science, in accordance with the research task.
* Be able to critically and orally present on content from various approaches and interpret with respect to cognitive science.

After completing the study of the discipline « Introduction to Cognitive Science » the student should have the following competences:

| **Competence** | **Code** | **Code (UC)** | **Descriptors (indicators of achievement of the result)** | **Educative forms and methods aimed at generation and development of the competence** |
| --- | --- | --- | --- | --- |
| The ability to reflect developed methods of activity. | SC-1 | SC-М1 | The student is able to reflect developed methods of activity based on main concepts and approaches of cognitive science. | Lectures, group discussions |
| The ability to propose a model to invent and test methods and tools of professional activity. | SC-2 | SC-M2 | The student is able to propose a model to invent and test methods and tools of cognitive science. | Lectures, group discussions |
| The ability to independently become acquainted with new research methods, to change scientific profile of activity. | SC-3 | SC-M3 | The student is able to independently become acquainted with new methods of cognitive sciences. | Lectures, group discussions. |
| The ability to improve and develop intelligent and cultural level, to build track of professional development and career. | SC-4 | SC-M4 | The student is able to improve and develop intelligent and cultural level, to build track of professional development and career based on the theories of cognitive science. | Lectures, group discussions, tests |
| The ability to conduct professional (including research) activity in international environment. | SC-8 | SC-M8 | The student is able to conduct professional (including research) activity in international environment regarding main concepts of cognitive science. | Lectures, group discussions, tests, tests |
| The ability to communicate orally and in written form in English in the frame of professional and scientific intercourse. | PC-2 | IC-M2.1\_2.2\_2.4.1\_2.4.2. | The student is able to discuss problems of cognitive science both orally and in written form. | Lectures, group discussions, tests |
| The ability to use modern IT technologies for search and processing of information, work with professional databases and net communication. | PC-4 | IC-M4.1\_4.3\_4.4. | The student is able to use modern IT technologies for search and processing of information, work with professional databases and net communication to solve cognitive science problems. | Lectures, group discussions |
| The ability to describe problems and situations of professional activity in terms of humanitarian, economic and social sciences to solve problems which occur across sciences, in allied professional fields. | PC-5 | IC-M5.3\_5.4\_5.6\_2.4.1 | The student is able to describe problems and situations of professional activity in terms of cognitive science. | Lectures, group discussions |
| The ability to detect, transmit common goals in the professional and social activities. | PC-8 | SPC-M3 | The student is able to detect, transmit common goals in the cognitive science field. | Group discussions, tests |

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# Place of the discipline in the Master’s program structure

The course « Introduction to Cognitive Science » is core coursetaught in the first year of Master’s program «Cognitive sciences and technologies».

Knowledge and competence required to study the discipline:

* A good command of the English language
* A basic knowledge of psychology
* A basic knowledge of anatomy and physiology of central nervous system

Main competences developed after completing the study of this discipline can be used in studying of the following disciplines:

* Visual Perception and Attention
* Thinking and Emotional Modulation of Cognition
* Memory, Learning and Cognitive Development
* Theory and Methodology of Modern Psychology
* Neuroscience
* Cognitive Neuroscience and Neuroimaging Techniques

# Course Plan

| **№** | **Topic** | **Total hours** | **Contact hours** | | **Independent students’ work** |
| --- | --- | --- | --- | --- | --- |
| **Lectures** | **Seminars** |
|  | The basic concepts of cognitive science. | 16 | 2 | 2 | 12 |
|  | History of cognitive science. | 16 | 2 | 2 | 12 |
|  | Symbolic approach in cognitive science. | 14 | 2 | 2 | 10 |
|  | Modular approach in cognitive science. | 14 | 2 | 2 | 10 |
|  | Connectionism in cognitive science. | 14 | 2 | 2 | 10 |
|  | Interdisciplinary research methods in cognitive science: eye tracking. | 20 | 4 | 4 | 12 |
|  | Interdisciplinary research methods in cognitive science: brain imaging. | 24 | 6 | 6 | 12 |
|  | The problem of consciousness in cognitive science | 14 | 2 | 2 | 10 |
|  | The problem of the substrate of cognitive processes. | 14 | 2 | 2 | 10 |
|  | Interdisciplinary studies of perception and attention. | 24 | 6 | 6 | 12 |
|  | Interdisciplinary studies of learning and memory. | 20 | 4 | 4 | 12 |
|  | Interdisciplinary studies of thinking and speech. | 16 | 2 | 2 | 12 |
|  | Interdisciplinary studies of emotions and personality in cognitive science. | 16 | 2 | 2 | 12 |
|  | Artificial intelligence and robots. | 16 | 2 | 2 | 12 |
|  | Applied cognitive science. Ergonomics and usability. | 14 | 2 | 2 | 10 |
|  | Development and prospects of cognitive science. | 14 | 2 | 2 | 10 |
| **Total:** | | **266** | **44** | **44** | **178** |

# Grading system

The formula for the cumulative rate is as follows:

Оcum. = 0,4×Оactivity + 0,3×Оtest1 + 0,3×Otest2

The formula for the total rate is as follows:

Оtotal = 0,6×Оcum + 0,4×Оexam

The cumulative rate is not rounded! Only the total rate is rounded.

**Test1** is the multiple choice test with adaptive assessment on topics 6 and 7.

**Test2** is the multiple choice test with adaptive assessment on topics 10, 11 and 12.

**Table of Grade Accordance**

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

# Course Reading

**Topic 1. The basic concepts of cognitive science.**

1. Dahl, C. D., & Adachi, I. (2013). Conceptual metaphorical mapping in chimpanzees (Pan troglodytes). eLife, 2, e00932.
2. Dennett, D. (1994). Cognitive Science as Reverse Engineering: Several Meanings of 'Top-Down' and 'Bottom-Up'. Logic, Methodology and Philosophy of Science IX. Amsterdam, North-Holland, 1994, 679-689.
3. Lakoff G., Johnson, M. (1980). Conceptual Metaphors in Everyday Language. Journal of Philosophy, 77(8), 453-486.
4. Thagard, P. (2005). Being interdisciplinary: Trading zones in cognitive science. In S. J. Derry, C. D. Schunn & M. A. Gernsbacher (Eds.), Interdisciplinary collaboration: An emerging cognitive science, 317-339. Mahwah, NJ: Erlbaum
5. Thagard, P. (2009). Why cognitive science needs philosophy and vice versa. Topics in Cognitive Science, 1, 237-254.

**Topic 2. History of cognitive science.**

1. Chomsky, N. (1956). Three Models for the Description of Language. IRE Transactions on Information Theory, 2, 113–124
2. Miller, G. A. (2003). The cognitive revolution: a historical perspective. Trends in Cognitive Sciences, 7,141–144.
3. Miller, G. A. (1956). The magical number seven, plus or minus: two: Some limits on our capacity for processing information. Psychological Review, 63 (2), 81–97.
4. Newell, A., Shaw, J.C., & Simon, H.A. (1959). Report on a general problem-solving program. Proceedings of the International Conference on Information Processing, 256–264.

**Topic 3. Symbolic approach in cognitive science.**

1. Atkinson, R.C., & Shiffrin, R.M. (1968). Human memory: A proposed system and its control processes. In Spence, K.W.; Spence, J.T. The psychology of learning and motivation (Volume 2). New York: Academic Press, 89–195.
2. Newell, A., Shaw, J.C., & Simon, H.A. (1959). Report on a general problem-solving program. Proceedings of the International Conference on Information Processing, 256–264.

**Topic 4. Modular approach in cognitive science.**

1. Allport, D.A., Antonis, B., & Reynolds, P. (1972). On the division of attention: a disproof of the single channel hypothesis. Quarterly journal of experimental psychology, 24(2), 225-235.
2. Bates, E. (1994). Modularity, domain specificity and the development of language. Discussions in Neuroscience, 10(1/2), 136-149.
3. Chiao, J. Y., & Immordino-Yang, M. H. (2013). Modularity and the Cultural Mind: Contributions of Cultural Neuroscience to Cognitive Theory. Perspectives on Psychological Science : A Journal of the Association for Psychological Science, 8(1), 56–61.
4. Downing, P. E., Chan, A. W., Peelen, M. V., Dodds, C. M., & Kanwisher, N. (2006). Domain specificity in visual cortex. Cerebral Cortex, 16, 1453–1461
5. Prinz, J.J. (2006). Is the mind really modular? In R Stainton (ed) Contemporary Debates in Cognitive Science, Oxford, Blackwell, 22-26.

**Topic 5. Connectionism in cognitive science.**

1. Inceptionism: Going Deeper into Neural Networks // Google research blog. http://googleresearch.blogspot.ru/2015/06/inceptionism-going-deeper-into-neural.html
2. McClelland, J.L., & Rumelhart, D.E. (1981) An interactive activation model of context effects in letter perception: Part 1. An account of basic findings. Psychological Review, 88(5), 375-407.
3. McCulloch, W., & Pitts, W. (1943). A Logical Calculus of Ideas Immanent in Nervous Activity. Bulletin of Mathematical Biophysics ,5(4), 115–133.
4. Rosenblatt, F. (1958). The Perceptron: A Probabilistic Model For Information Storage And Organization In The Brain. Psychological Review, 65(6), 386–408.

**Topic 6. Interdisciplinary research methods in cognitive science: eye tracking.**

1. Ibbotson, M., & Krekelberg, B. (2011). Visual Perception and Saccadic Eye Movements. Current Opinion in Neurobiology, 21(4), 553–558.
2. Just, M.A. & Carpenter, P.A.(1976). Eye fixations and cognitive processes. Cognitive Psychology, 8(2), 441–480.
3. Knoblich G., Ohlsson S., & Raney G. (2001). An eye movement study of insight problem solving. Memory & Cognition,29(7), 1000–1009.
4. Martinez-Conde, S., Macknik, S.L., & Hubel, D.H. (2004). The role of fixational eye movements in visual perception. Nature Reviews Neuroscience, 5(3), 229-240.
5. Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. Psychological Bulletin, 124(3), 372–422.
6. Rayner, K. (2009). Eye movements and attention in reading, scene perception, and visual search. The Quarterly Journal of Experimental Psychology, 62(8),1457–1506
7. Rayner, K., Smith, T. J., Malcolm, G. L., & Henderson, J. M. (2009). Eye movements and visual encoding during scene perception. Psychological Science, 20(1), 6-10.
8. Schütz, A.C, Braun ,D.I, & Gegenfurtner, K.R. (2011). Eye movements and perception: a selective review. Journal of Vision, 11(5), 1-30.

**Topic 7. Interdisciplinary research methods in cognitive science: brain imaging.**

1. Amaro, E., & Barker, G.J. (2006). Study design in fMRI: Basic principles. Brain and cognition, 60( 3), 220-232.
2. Aronov, D., Andalman A.S, & Fee, M.S. (2008). A specialized forebrain circuit for vocal babbling in the juvenile songbird. Science, 320(5876), 630-634.
3. O'Craven, K., Downing, P., & Kanwisher, N. (2000). fMRI Evidence for Objects as the Units of Attentional Selection. Nature, 401, 584-587.
4. Owen, A.M., & Coleman, M.R. (2008). Functional neuroimaging of the vegetative state. Nature Review Neuroscience, 9(3), 235-243.
5. Robertson, E.M., Théoret, H., & Pascual-Leone, A. (2003). Studies in cognition: the problems solved and created by transcranial magnetic stimulation. Journal of Cognitive Neuroscience, 15(7), 948-960.
6. Tong, F., Nakayama, K., Vaughan, J. T., & Kanwisher, N. (1998). Binocular rivalry and visual awareness in human extrastriate cortex. Neuron, 21(4),753-759.
7. Walsh, V. & Cowey, A. (1998). Magnetic stimulation studies of visual cognition. Trends in Cognitive Sciences, 2(3), 103-110.
8. Wojciulik, E., & Kanwisher, N. (1999). The Generality of Parietal Involvement in Visual Attention. Neuron, 23(4), 747-764.

**Topic 8. The problem of consciousness in cognitive science.**

1. Chalmers, D. (1995). Facing up to the problem of consciousness. Journal of Consciousness Studies, 2(3), 200-219.
2. Cleeremans, A. (1997). Principles for Implicit Learning. In D. Berry (Ed.), How implicit is implicit learning? (pp. 196-234), Oxford: Oxford University Press
3. Posner, M. I., & Rothbart, M. K. (1998). Attention, self-regulation and consciousness. Philosophical Transactions of the Royal Society B: Biological Sciences, 353(1377), 1915-1927.
4. Schacter, D.L. (1987). Implicit memory: History and current status. Journal of Experimental Psychology: Learning, Memory, and Cognition,13(3), 501-518.
5. Seth, A.K., Baars, B.J., & Edelman, D.B. (2005). Criteria for consciousness in humans and other mammals. Consciousness and Cognition, 14(1), 119-139.

**Topic 9. The problem of the substrate of cognitive processes.**

1. Baars, B. J. (2002). The conscious access hypothesis: origins and recent evidence. Trends in Cognitive Science, 6(1), 47-52.
2. Jackson, F. (1982). Epiphenomenal Qualia. Philosophical Quarterly, 32(127), 127-136.
3. Kanwisher, N. (2001). Neural events and perceptual awareness. Cognition, 79(1-2), 89-113.
4. Libet, B. (1999). Do we have free will? Journal of Consciousness Studies, 6(8-9), 47-57.

**Topic 10. Interdisciplinary studies of perception and attention.**

1. Adamo, S.H., Cain, M.S., & Mitroff, S.R. (2013). Self-induced attentional blink: a cause of errors in multiple-target search. Psychological Science, 24(12), 2569-2574.
2. Duncan, J., & Humphreys, G. W. (1989). Visual search and stimulus similarity. Psychological Review, 96(3), 433-458.
3. Horowitz, T.S., & Wolfe, J.M. (1998). Visual search has no memory. Nature, 394(6693), 575-577.
4. Lavie, N. (1995). Perceptual load as a necessary condition for selective attention. The Journal of Experimental Psychology: Human Perception and Performance, 21(3), 451-468.
5. Raymond, J.E., Shapiro, K.L., & Arnell, K.M. (1992). Temporary suppression of visual processing in an RSVP task: an attentional blink? The Journal of Experimental Psychology: Human Perception and Performance, 18(3), 849-860.
6. Simons, D.J., & Chabris, C.F. (1999). Gorillas in our midst: sustained inattentional blindness for dynamic events. Perception, 28(9), 1059-1074.
7. Simons, D.J., & Levin, D.T. (1998). Failure to detect changes to people during a real-world interaction. Psychonomic Bulletin & Review, 5(4), 644-649.
8. Vecera, S.P., & Farah, M.J. (1994). Does visual attention select objects or locations? Journal of Experimental Psychology: General, 123(2), 146-160.
9. Wolfe J.M. (2001). Asymmetries in visual search: an introduction. Attention, Perception, & Psychophysics, 63(3), 381-389.

**Topic 11. Interdisciplinary studies of learning and memory.**

1. Baddeley, A. (2003). Working memory: looking back and looking forward. Nature Reviews Neuroscience, 4(10), 829-839.
2. Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? Progress in Brain Research, 169, 323-338.
3. Craik, F.I.M. & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11(6), 671-684.
4. Woodman, G.F., & Luck., S.J. (2004) Visual search is slowed when visuospatial working memory is occupied. Psychonomic Bulletin & Review, 11(2), 269-274.
5. Woodman, G. F., Vogel, E. K., & Luck, S. J. (2001). Visual search remains efficient when visual working memory is full. Psychological Science, 12(3), 219-224.

**Topic 12. Interdisciplinary studies of thinking and speech.**

1. Chein , J.M., Weisberg, R.W., Streeter, N.L., & Kwok, S. (2010). Working memory and insight in the nine-dot problem. Memory & Cognition, 38(7), 883-892.
2. Kershaw, T.C., & Ohlsson, S. (2001). Training for insight: The case of the nine-dot problem. In J.D. Moore & K. Stenning (Eds.), Proceedings of the Twenty-third Annual Conference of the Cognitive Science Society (pp. 489-493). Mahwah, NJ: Lawrence Erlbaum Associates.
3. Kershaw, T.C., Ohlsson, S., & Coyne, C. (2003). The fallacy of single-source explanations: The multiple difficulties of the nine-dot problem. In R. Alterman & D. Kirsh (Eds.), Proceedings of the Twenty-Fifth Annual Conference of the Cognitive Science Society (pp. 664-669). Cognitive Science Society.
4. Wegbreit, E., Suzuki, S., Grabowecky, M., Kounios, J., & Beeman, M. (2012). Visual Attention Modulates Insight Versus Analytic Solving of Verbal Problems. The Journal of Problem Solving, 4(2), 94–115.

**Topic 13. Interdisciplinary studies of emotions and personality in cognitive science.**

1. Funke, J., Wagener, D., and Spering, M. (2005). The role of emotions in complex problem-solving. Cognition and Emotion, 19(8), 1252-1261.
2. Lamy, D., Amunts, L, & Bar-Haim, Y. (2008). Emotional priming of pop-out in visual search. Emotion, 8(2), 151-161.
3. McHugo, M., Olatunji, B. O., & Zald, D. H. (2013). The emotional attentional blink: what we know so far. Frontiers in Human Neuroscience, 7, 151.

**Topic 14. Artificial intelligence and robots.**

1. Chaminade, T., Rosset, D., Da Fonseca, D., Nazarian, B., Lutcher, E., Cheng, G., & Deruelle, C. (2012). How do we think machines think? An fMRI study of alleged competition with an artificial intelligence. Frontiers in Human Neuroscience, 6, 103
2. Colby, M.K., Weber, S., & Hilf, F.D. (1971). Artificial paranoia. Artificial Intelligence, 2(1), 1-25.
3. Turing, A. M. (1950) Computing machinery and intelligence. Mind, 49, 433–460.
4. Wiese, E., Wykowska, A., Zwickel, J., & Müller, H. J. (2012). I See What You Mean: How Attentional Selection Is Shaped by Ascribing Intentions to Others. PLoS ONE, 7(9), e45391. doi:10.1371/journal.pone.0045391

**Topic 15. Applied cognitive science. Ergonomics and usability.**

1. Norman, D.A. (2002). The Design of Everyday Things. Basic Books, Inc. New York, NY, USA
2. Tomlin, C. (2010). 24 Usability Testing Tools. <http://www.usefulusability.com/24-usability-testing-tools/>

**Topic 16. Development and prospects of cognitive science.**

1. Gibson, J.J. (1979). The Ecological Approach to Visual Perception. Boston: Houghton Mifflin
2. Maguire, E.A., Gadian, D.G., Johnsrude, I.S., Good, C.D., Ashburner, J., Frackowiak, R.S. J., & Frith, C.D. (2000). Navigation-related structural change in the hippocampi of taxi drivers. Proceedings of the National Academy of Sciences of the United States of America, 97(8), 4398-4403.
3. McClure, S.M., Li, J., Tomlin, D., Cypert, K.S., Montague, L.M., & Montague, P.R. (2004). Neural correlates of behavioral preference for culturally familiar drinks. Neuron, 44 (2), 379-387.

# Educational Technology

The following educational technologies are used in the study process:

* Lectures involving continuous use of multimedia presentations, demonstrations and movies
* Self-study of required readings
* Discussion and analysis of topics in the group

# Equipment

The course requires a laptop, projector, and acoustic systems.