History and Philosophy of Science

Course Guide

Siberian Federal University
History and Philosophy of Science

Course Guide

This course contributes to the requirements for the Degree of Candidate of Science in Computer Science.

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1. Course Description

This course contributes to the requirements for the Degree of Candidate of Science in Computer Science

| Course period     | 2 semesters  
|                  | First semester: from October, the 1st to February, the 1st (18 weeks)  
|                  | Second semester: from February, the 1st to June, the 1st (18 weeks)  
| Study credits    | 3 ECTS credits  
| Duration         | 108 hours  
| Language of instruction | English  
| Academic requirements | – MSc degree in Computer Science or equivalent (transcript of records),  
|                  | – good command of English (certificate or other official document)  

1.1 Course overview

The subject of philosophy of science is the analysis of theoretical, cognitive and methodological grounds of modern scientific knowledge.

Currently scientific knowledge is analyzed in its logical, epistemological and socio-cultural aspects.

1.2 Special features

The course presents philosophical understanding of science as a system of knowledge, human activity and a social institution. The course covers general tendencies of science history, methodology of scientific cognition, the role of science in society and a number of related issues. A special part of the course is devoted to basic philosophical dispositions influencing how the modern science image is shaped in the mind of the public. The course is aimed at demonstrating the state of modern science in its inextricable link with its history.

1.3 Course aims and objectives

Course Aims

The aim of the course is to provide the general background of history and philosophy of science and to prepare students for their postgraduate exams as well as to give knowledge adequate to the current state of development of this scientific discipline and to help shape students into competent researchers and educators in the field of philosophy of science.

Course Objectives

The objective of the course is to gain knowledge of general problems of history and philosophy of science as well as philosophical problems of students' field of postgraduate study. The course presents philosophical understanding of science as a system of knowledge, human activity and a social institution. The course covers general tendencies of science history, methodology of scientific cognition, the role of science in society and a number of related issues.
A special part of the course is devoted to basic philosophical dispositions influencing how the modern science image is shaped in the mind of the public. The course is aimed at demonstrating the state of modern science in its inextricable link with its history.

1.4 Learning outcomes

After completing the course students should be able to use the philosophical study methods applied to science, to do scientific research according to all principles of scientific ethic and personal responsibility for the aims, means and results of scientific work.

2. Course Lecturer, Contact Information

Viacheslav Kudashov,
Professor, Doctor in Philosophy Sciences
Humanitarian University
Siberian Federal University
e-mail: vkudashov@mail.ru
Google Scholar page:
https://scholar.google.com/citations?user=_fhGzYAAAAJ&hl=en
Additional information is available at:
https://structure.sfu-kras.ru/node/1269

3. Prerequisites

A background in courses of history and philosophy will help in faster and better understanding of every topic. Nevertheless, each part of the course includes a short introduction of methods that are required for its study. Therefore, a student without the denoted experience must be encouraged to make some additional efforts in education.
4. Course Outline

<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures/Seminars/ Assignments</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Semester 1</strong></td>
<td></td>
</tr>
<tr>
<td>1-9</td>
<td>Module 1. General problems of the philosophy of science</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td><strong>Semester 2</strong></td>
<td></td>
</tr>
<tr>
<td>10-24</td>
<td>Module 2. Modern philosophical problems of the branches of scientific knowledge</td>
<td>72</td>
</tr>
<tr>
<td>36</td>
<td>Final Exam</td>
<td>36</td>
</tr>
</tbody>
</table>

4.1 Course requirements

4.1.1 Web-page of the course

Course materials and required reading materials are available on the course webpage “History and Philosophy of Science”. The webpage is available through the SibFU E-learning portal www.e.sfu-kras.ru. You must be logged in to access this course https://e.sfu-kras.ru/enrol/index.php?id=1502.

4.1.2 Required reading

Core Reading


**Additional Reading**


2.3. Babich B.E. Against postmodernism and the "new" philosophy of science:


4.1.3 Course materials

The main book that will guide a student through the course is *data History and Philosophy of Science: A guide for graduate students and applicants* book. It contains all of topics of this course according to the schedule. It will provide you with useful links at the end of each chapter that will help students to improve their understanding of the topics.

4.1.4 Required feedbacks

Students are free to contact the lecturer by email. The name of department and a number of a group should be written in the subject or in the beginning of the letter for convenience. More information on how to contact the lecturer can be found in «Lecturer information» section of this Guide.

4.2 Course Structure

<table>
<thead>
<tr>
<th>Learning Activities</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>Lectures</td>
<td>30</td>
</tr>
<tr>
<td>Practice sessions / Seminars,</td>
<td>16</td>
</tr>
<tr>
<td>Self-study Assignments</td>
<td>26</td>
</tr>
<tr>
<td>Final Exam (including preparation)</td>
<td>36</td>
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<tr>
<td>Total study hours</td>
<td>108</td>
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### 4.3 Time schedule of the course and course outline

<table>
<thead>
<tr>
<th>№</th>
<th>Theme</th>
<th>Week</th>
<th>Learning Activities</th>
<th>Hours</th>
<th>Home Assignment and Reading</th>
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<tbody>
<tr>
<td>1</td>
<td>Module 1. General problems of the philosophy of science</td>
<td>1-18</td>
<td>Topic 1 &quot;The Subject of History and Philosophy of Science&quot;.</td>
<td>4</td>
<td>1.1, 2.1, 2.5, 22.26, 2.7, 2.9, 2.11, 2.21, 2.23, 2.25, 2.26, 2.28, 2.29, 2.30, 2.32, 2.33, 2.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Topic 2</strong> &quot;Science as a System of Knowledge, Practice and a Social Institution. Role of Science in Development of Culture and Civilization”</td>
<td>4</td>
<td>1.1, 2.5, 2.12, 2.18, 2.35, 2.36, 2.38</td>
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<tr>
<td></td>
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<td></td>
<td><strong>Topic 3</strong> &quot;Origination of Science the Main Stages of Its Historical Evolution&quot;</td>
<td>2</td>
<td>1.1, 2.24, 2.12, 2.13, 2.27, 2.33</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Topic 4</strong> &quot;Main Concepts of Modern Philosophy of Science&quot;</td>
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<td>1.1, 2.2, 2.3, 2.7, 2.10, 2.19, 2.20, 2.21, 2.26, 2.33</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Topic 5</strong> &quot;Main Concepts of Modern Philosophy of Science&quot;</td>
<td>4</td>
<td>1.1, 2.7, 2.12, 2.21, 2.25, 2.30, 2.36</td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
<td>Total Assignment</td>
<td>Section Numbers</td>
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<tr>
<td><strong>Topic 6</strong></td>
<td>&quot;Structure of scientific knowledge&quot;</td>
<td>4</td>
<td>1.1, 2.7, 2.12, 2.25, 2.26, 2.36, 2.39</td>
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<tr>
<td><strong>Topic 7</strong></td>
<td>&quot;Science dynamics as a process of creating new knowledge. Communication in science&quot;</td>
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<td>1.1, 2.5, 2.33, 2.40</td>
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<tr>
<td><strong>Topic 8</strong></td>
<td>&quot;Traditions and innovations in the development of science. Scientific revolutions. Types of scientific rationality&quot;</td>
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<td>1.1, 2.9, 2.12, 2.25, 2.33, 2.38</td>
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<tr>
<td><strong>Topic 9</strong></td>
<td>&quot;Distinctive Features of Modern Science&quot;</td>
<td>4</td>
<td>1.1, 2.8, 2.9, 2.26, 2.33</td>
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<tr>
<td><strong>Home assignment 1</strong></td>
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<td>6</td>
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<tr>
<td>2</td>
<td>Module 2. Modern philosophical problems of the branches of scientific knowledge</td>
<td>1-18</td>
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<td></td>
</tr>
<tr>
<td><strong>Topic 1</strong></td>
<td>&quot;Philosophical Problems of Informatics&quot;</td>
<td>16</td>
<td>1.1, 2.15, 2.41</td>
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<td></td>
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<tr>
<td><strong>Home assignment 2</strong></td>
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<td>20</td>
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4.4 Module I. General Problems of Philosophy of Science

**Topic 1. The Subject of History and Philosophy of Science**

A philosophical study of science, its aims and goals. The problem of subject demarcation of philosophy of science, methodology of science, logic of science and science studies. Philosophy of science in the system of scientific knowledge.


**Topic 2. Science as a System of Knowledge, Practice and a Social Institution. Role of Science in Development of Culture and Civilization**

Knowledge as a product of scientific work. Different approaches to understanding of scientific knowledge. Theoretical form as a specific type of scientific knowledge representation in culture. Validity of scientific knowledge and


**Topic 3. Origination of Science the Main Stages of Its Historical Evolution.**

Problem of science origin as a problem of understanding of its essential features as well as of its genesis conditions and history periodization. Theories of science origin.
Protoscience and science. Two strategies of generating knowledge: generalization of practical experience and construction of theoretical models allowing to go beyond existing forms of production and common experience. Culture of antique city-states and origination of the first forms of theoretical science. Antique logic and mathematics. Development of logical norms of scientific thinking and science organization in medieval universities. Role of Christian theology in changing the contemplative stance of scientists: a person is a creator (from the small letter); manipulating natural objects – alchemy, astrology, magic. Western and eastern medieval science.


**Topic 4. Main Concepts of Modern Philosophy of Science**
Positivism as the first explicit conception of philosophy of science. Positivism genesis as a change in perception of the object of cognition, criteria of scientific knowledge, role and mechanisms of science development.


The Second Positivism (empirical criticism) and the study of the mechanisms of cognition. E. Mach, R. Avenarius on “gnosiological roots of metaphysics”. Avoiding “jumps” and “gaps” in scientific cognition as the main goal of empirical criticism. Ontology of empirical criticism: objective reality as a system of “perceptive complexes”.

analysis in analytical philosophy tradition as analysis of ordinary language meaning (G. Ryle, J. Wisdom, J. Austin, P. Strawson).

Postpositivism (T. Kuhn, I. Lakatos, P. Feyerabend) and critical rationalism (K. Popper) on mechanisms of scientific knowledge formation. Structural units of science: theory (K.Popper), paradigm (T.Kuhn), scientific research program (I. Lakatos). Popper’s conception of three worlds: world of physical phenomena, world of psychological states, world of objective content of consciousness. Falsification (empirical possibility to prove a theory wrong) as demarcation criteria for scientific knowledge demarcation. Science dynamics: “normal science” periods and “scientific revolutions” (T.Kuhn), positive and negative heuristics in development of scientific research programs (I. Lakatos). Feyerabends methodological anarchism as a critique of cumulative model of science development. Methodological principle of proliferation of scientific theories as a basis of theoretical pluralism in science. “Anything goes” as the only universal methodological principle of scientific knowledge.

Objective and methodological dichotomy of scientific cognition: hermeneutics and neo-Kantianism (Baden school), reviewing the problem of social sciences and the humanities specific nature. Natural sciences and cultural sciences, human sciences (W. Dilthey, W. Windelband, H. Rickert): the nature of the object, the nature of determinism. The relation between the general and the particular: the humanities - individualizing (idiographic), natural - summarizing, generalizing (nomothetic). The principle of values reference as the basis of the methodology of social cognition. "Freedom from esteemation" as a methodological principle of interpretive sociology of Max Weber.

Schutz's phenomenological sociology of science. Everyday experience as a source of scientific notions and forms of logical thinking.


**Topic 5. Grounds of Science. Social and Cultural Factors Determining Them**

Interaction of science with non-scientific types of knowledge. Knowledge and faith as fundamental types of human experience. Styles of thinking and transdisciplinary links in development of science.


Scientific picture of the world as one of the most important conceptual grounds of scientific cognition. Main elements of the scientific picture of the world: time and space conditions and fundamental laws of nature. Ideals, principles and norms of a scientific research: 1) conclusiveness, explanation and proof of scientific knowledge; 2) knowledge description and structuring.

Logical and methodological grounds of scientific knowledge. Three methodological levels in scientific work: philosophical, uniform for all sciences and specific for one particular science. Methods and theoretical problems. Disciplinary matrices of particular sciences (symbolic generalizations, values and particular problem example-solutions).

Role of methodological reflection and methodological synthesis in scientific cognition.

**Topic 6. Structure of scientific knowledge.**
The subject and the notion of scientific knowledge. Scientific knowledge organization forms: idea, problem, hypothesis, theory. Scientific knowledge as a dynamic cognitive system.

Relative nature of empirical and theoretical levels of scientific cognition. The role of theoretical notions. The idea of theoretical terms and counterarguments to it. The thesis of fundamental impossibility of reduction of theoretical terms to empirical ones.

Forms of scientific knowledge development: fact, problem, hypothesis, theory, scientific research program. Special features of a scientific fact. Requirements to an adequately formulated scientific problem. Hypothesis types. Logical and methodological requirements to a scientific hypothesis.

Scientific theory functions. Classification of scientific theories. Structure of a scientific theory. Formation and development of a scientific theory. Theoretical scheme as a coherent system of abstract objects of a given theory.

Scientific research program as a sequence of changing theories. Integrating model of scientific theories development. Stages of scientific systems testing: metatheoretical, intertheoretical, philosophical and empirical.

**Topic 7.** Science dynamics as a process of creating new knowledge. Communication in science.

The problem of new knowledge in science. Historical variability of social and cultural conditions and internal scientific mechanism of knowledge generation. Proving unity and necessity of knowledge: insufficiency of inductive or hypothetic and deductive methods.

Role and place of the grounds of science and its structural components in generating new knowledge. Double-oriented character of science grounds and its empirical data interaction. Primary theoretical models and laws formation. Role of analogy in theoretical search. Grounding and explaining procedures of theoretical knowledge, unacceptability of ungrounded claims. Interrelation between the logic.
of discovery and the logic of grounding. Difference in science grounding between philosophy and natural sciences.


Elements of communicative process in science. Types and forms of communication in science. Ambivalent nature of interaction among scientists. Problems of modern scientific communication. Communicative ability of science: cognitive and sociological, informational, hermeneutical and semantical approaches. Scientific communication as information; translation; dialogue and interaction.

Communication functions in science. Communication as a condition of creating and translation knowledge; a condition of mutual understanding and connection; an indicator of a scientific research line development; a means of
scientist’s socialisation. The link between the communicativeness of cognitive activity and knowledge verity.

**Topic 8.** Traditions and innovations in the development of science. Scientific revolutions. Types of scientific rationality.

The development of science as a system of synchronic (cooperation, competition) and diachronic (translation) processes of interaction. Scientific tradition as translation of scientific theories, methods, symbolic generalizations, science language and values. Structural units of a scientific tradition: paradigm (T.Kuhn), scientific research program core (I.Lakatos). Normal science as a traditional stage of scientific development within one paradigm.

M. Polanyi’s implicit knowledge conception: tradition as translation of values, unspoken pre-conditions of scientific knowledge, models of problem setting and problem solving, scientific ethos. Scientific tradition as a means of making scientific activity stereotyped (P. Feyerabend).


Scientific revolutions as radical changes of scientific knowledge grounds and a scientific picture of the world. Positive and negative heuristics in scientific research program development (I.Lakatos), a scientific program “degeneration symptom” and its replacement by a new one. P. Feyerabend’s epistemological anarchism as a proclamation of pluralism of scientific knowledge. The notion of proliferation as multiplication of mutually contradictive theories and hypotheses.
Scientific revolutions as an indicator of scientific rationality types genesis (classical, non-classical, post-non-classical). Main characteristics of a classical type of scientific rationality. The first scientific revolution of the XVII century: classical natural sciences and a mechanistic picture of the world. The second scientific revolution: disciplinary-organized science. Post-non-classical rationality: non-linear determinism, intersubjective nature of scientific cognition, social and cultural influence on science. The third scientific revolution – the late XIX – the first half of XX centuries: quantum-relativistic tendencies in natural sciences. The fourth scientific revolution – the second half of XX – the early XXI centuries: IT, systemic nature of scientific research.

**Topic 9.** Distinctive Features of Modern Science.

Science turning into an immediate productive force. Industrialization and intensification of scientific researches: big scientific centers, mathematization of knowledge, mathematic modeling and computer experiment. Industrially organized science and a scientist's self-fulfillment in a modern world.

New sciences origination: new research objects discovery; natural sciences, humanities and social studies integration; meta-scientific areas of research and theories. Object, method and ideals of modern science. Role of non-linear dynamics and synergetics in modern understanding of historically developing systems. Global evolutionism and the modern scientific picture of the world.

Convergence of natural sciences and humanitarian and social studies ideals. Comprehension of social and inner scientific values as a necessary condition of modern science development. Including social values in the process of scientific research strategy choice.

New ethical problems of science in the end of the XX century. The problem of humanitarian control in science and high technologies. Ecological, social and humanitarian expertise in scientific and technical projects.

Post-non-classical science and a shift in world outlook of the technogenic civilization. Scientism and anti-scientism. A search for a new way of civilization
development, new functions of science in culture. Role of science in solving global problems.

4. 5 Module 2. Philosophical Problems of Particular Sciences

Topic 1 Philosophical Problems of Informatics


Informational society and the problem of informational reality. The Internet as a semiotic system. The Internet as a special “virtual reality”. Philosophical understanding of “virtual reality”. The role of Internet and informational technologies in forming the modern society. Cyberspace notion.

5. Assessment

The first module (36 hours) ends with a test based on the results of testing. The second module (72 hours) ends with the preparation of an essay and passing the exam. The final exam is an oral exam.

Based on an independent study of historical and scientific material, a graduate student must submit an essay on the history of the relevant branch of science in agreement with the supervisor of the dissertation and the instructor of
the philosophy department. If there is a positive assessment, the graduate student is allowed to take an exam in the history and philosophy of science.

6. Attendance Policy

Students are expected to attend classes regularly. In case of missing an in-lab activity a student should perform additional work submitted to the instructor within a week after a class was missed.

Every topic involves an assignment. A written report on the assignment should be submitted within two weeks from the moment students received a list of problems. The final mark will rely on the same grading policy as for the final exam.

7. Required Course Participation

There are no special requirements for the course participation. The preferred type of report submission is the electronic one. Students can use the web-version of the course (link) for a better progress. All problems for solution could be found there together with text from the course book.

8. Facilities, Equipment and Software

There is no special equipment that is required for the course
Annex 1 Final Oral Exam Questions


1. Place and role of science in culture development.
2. Science and other types of cultural and cognitive activity (muth, art, religion, common mind cognition).
3. Philosophy and science. Role of philosophical ideas and principles in grounding scientific cognition.
6. Formation and main stages of historical development of science.
7. Origination and development of ideals of mathematized and experimental scientific knowledge (G. Galilei, F. Bacon, R. Descartes).
13. Scientific picture of the world, its historical forms and functions in the systemic organization of cognition and scientific world outlook.
15. Styles of thinking, interdisciplinary bonds and interactions in science.
17. Empirical and theoretical levels of scientific cognition.
18. Fact, notion and regularity in a scientific study.
20. General scientific methods and methods of particular sciences in scientific cognition.

21. The role of general scientific methods in solving theoretical problems.

22. Mathematization and modeling in a theoretical study.

23. A scientific theory as the most complete form of scientific cognition. Ways of a scientific theory formation.


25. Social and cultural pre-conditions of scientific revolutions. Change in meaning of cultural world outlook grounds. Change in the grounds of science.

26. Historical change of scientific rationality types: classical, non-classical and post-non-classical science.

27. Main characteristics of modern post-non-classical science. Differentiation and integration processes in science.

28. Science dynamics as a process of generating new knowledge. Procedures of theoretical knowledge grounding.


30. Synergetic approach in system analyses of science development.


32. Link between social and intrinsic scientific values as a condition of timely development of science.

33. Scientism and anti-scientism. Post-non-classical science and values of technogenic civilization.


35. Social values and the process of research strategy choice.

36. Science as a social institution. Sociological and cultural approaches to studying its functions.

37. Scientific communities and their historical types. Scientific schools and scientist training.
38. The problem of communication in science. Developing ways of scientific knowledge translation.
39. Internet, computerization and scientific knowledge development processes.
40. Interaction of science with non-scientific types of knowledge. Knowledge and faith.

Part 2. Modern Philosophical Problems of Particular Sciences (according to the post-graduate student’s field of scientific study).

Philosophical Problems of Informatics:
1. Evolution of the subject of informatics understanding in the second half of the 20th century.
2. The object and the subject of modern informatics.
4. The meaning of social information in its semantic, syntactic and pragmatic characteristics unity.
5. Attributive and functional-cybernetic conceptions of information.
7. Informational society and the problem of informational reality.
8. The Internet as a semiotic system. The Internet as a special “virtual” reality. Philosophical understanding of “virtual reality”
9. The role of the Internet and informational technologies in the development of modern society.
10. The notion of “cyberspace”.
11. The problem of personality in informational society.
15. Informatics and negenthropy.
Annex 2 Example of Final Oral Exam Questions

1. Place and role of science in culture development.

2. The Internet as a semiotic system. The Internet as a special “virtual” reality. Philosophical understanding of “virtual reality

3. The essay on the history of the relevant branch of science.