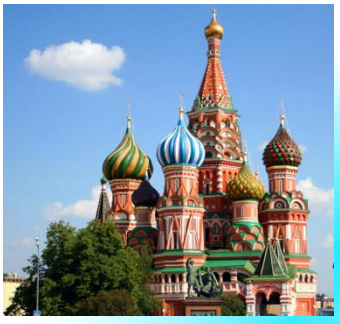
Summer School at Gubkin University of Oil and Gas in Moscow



Be ready for one of the most exiciting experiences in your life, Summer School at one of the best Russian Universities – Gubkin University of Oil and Gas!

Duration: *1.08.2018 – 11.08.2018*

- Philosophy and Methodology of Science for Energy Research (6 credits)

Conditions:

- No fee courses
- Accommodation: in Gubkin campus
  single room 2000 rub/day
  room for 2 persons 1000 Rub/day
  (own bathroom and shared kitchen)
- Students should pay for tickets
- We will help with invitations for visa
- Students should have Swedish/European citizenship (in this case visa could be received in Stockholm)

Reasons for KTH students to take part:

- ✓ compressed education:
- ✓ another pedagogical and methodological approaches in education
- ✓ friendly environment for international students
- ✓ chance to study in amazing city – Moscow!

Don't miss your chance to study in Moscow!

We could take 15 KTH Master students only.

Selection criteria: total grades for the autumn semester 2018.

Deadline for application: 1st of March 2018.

How to apply: send a message with you name and the total grade for the autumn semester 2018 to

vladimir.kutcherov@energy.kth.se

Philosophy and Methodology of Science for Energy Research
(6 hp)

Disposition:

- Lectures 34 h
- Seminars 12 h
- Project course work 2h
- Written examination 2 h
- Literature study (40h), preparation for seminars (24h), project development (8h), paper writing (36h)

Purpose of the course

The course provides an introduction to the theory and methodology of science for energy research and is intended for masters students or beginning PhD students. One aim is to supply the basic concepts needed for placing the techniques and knowledge acquired in the student's other courses in the wider context of the natural sciences. Another aim is to provide the basic intellectual tools that allow for a reasoned and critical assessment of results and methods from the wide variety of disciplines that the student is likely to encounter during his or her continued career in research and/or in professional life, especially for energy researchers.

Learning outcomes

After completed course, the student will be able to

- account for and apply fundamental concepts from the theory and methodology of science on problem areas within the theory and methodology of science, especially for energy research,
- account for fundamental theories concerning the epistemological and explanatory status of science,
- identify and critically discuss, both orally and in writing, fundamental theoretical and methodological issues in the technical, natural and social sciences important for energy issues,
- identify and critically discuss, both orally and in writing, specific methodological problems in a study, the design of an experiment, the use of a particular method of measurement, or the use of a particular model,
- analyze the relationship between the basic results of a study and the conclusions that legitimately can be drawn on the basis of the results,
- identify and critically discuss fundamental theoretical and methodological problems within the student's area of research,
- identify and critically discuss specific theoretical and methodological problems within the student's own research,
- identify and critically discuss specific theoretical and methodological problems within others' research,
- plan and critically estimate research work, PhD thesis, paper and conference presentation,
- write scientific paper on the own research area,
- be ready to estimate quality of the peer paper.

Course main content

Preliminary work. Literature study

In two weeks before the start of the course students will receive literature and questions to work on.

Block 1: Scientific methodology and framework for energy research

The main purpose of the first block is to provide basic concepts of science and knowledge for energy researcher. During discussion and group work students will try to formulate main properties of science and will try to differ energy research from other fields. Main steps of knowledge making will be discussed. Also students will distinguish practical and theoretical knowledge and how they are used in science, get acquainted with the classical definition of knowledge. Science will be discussed also from the social point of view: subjectivity, inter-subjectivity and objectivity. Norms and values in science. Contested concepts. Three problems with the classical definition of knowledge. The Gettier problem. Relativism. Degrees of knowledge. Science as a *social* enterprise.

Block 2: Designing and implementing energy research

The main purpose of the second block is penetrating through the main aspects of energy research, especially working on hypothesis. How to make a good hypothesis? What makes good hypothesis good? Is it possible to make non-scientific hypothesis? During the work on the block main aspects of logical process of hypothesis making will be discussed: inference: deductive, plausible, inductive.

The main instrument of energy research: Inductivism. The principle of induction. Critique of inductivism. Discovery versus justification. Karl Popper. Hypotheses. The Hypothetico-Deductive Method of hypothesis testing. The asymmetry of falsification and verification. Auxiliary hypotheses. Hidden premises in hypothesis testing.

How to check the hypothesis and make a conclusions after. In this part several aspects will be discussed: Quine/Duhem-thesis. Ad hoc-hypotheses. Causal relations. Empiricism. Two problems with causality: Hume. *Covariance* between variables. Causal relations among variables. Spurious relations. Statistical methods for detecting *spurious* relations. Statistical hypothesis testing. Error of type I and II. Mass correlation.

Block 3: Tools and methods in energy research

What challenges are standing in front of energy researcher? What can influence the results and their interpretation? Theory dependence of observations. Observer influence. Observer expectations. The measurement process in energy research. One cannot eliminate all the mistakes, but what can be done is to estimate their values. Reliability and validity. Systematic and random errors. Calibration of measurement equipment. Measures and scales in energy research. Temperature, Joules and Kelvin. Operationalizing a concept. Measurement scales. Meaningful transformations/meaningful operations.

How to find the law of nature? What differs it from a pure description? Natural laws, general claims and fundamental laws. Is there any necessity in laws of nature? Necessitarianism: Laws

are *necessary*. The First Law of Thermodynamic. The regularity theory: laws as *axioms*. The problem of a Free will.

What does it mean to explain something? The Deductive-Nomological model for explanations. The Inductive-Statistical model for explanations. The Statistical-Relevance model for explanations. The Pragmatic model for explanations. Discussion of explanation examples in energy research,

Kinds of observations. Controlled observation. Manipulation. Connection between experimentation and causality. Five components in constructing of an experiment. Planning the experiment. Constucting the experimental setup. Realization. Constancy and controlled variation.

Block 4: When trying to solve energetic issues

Making a breakthrough in energy research. How to make a discovery? Phenomenological approach for energy related discoveries. Algorithm of solving previously unsolved problem from psychological point of view. Separation. Effects of the observer's expectations. Serendipity. Sub-ideal experiments.

How not to lose what you had found? Documenting of the experimental data. Blinding. Repeatability of the experiments.
Where to dig? How to find a field where humanity is ready to make a breakthrough?
Naive inductivism. Empiricism versus rationalism. The rise and fall of logical positivism. Observation sentences, theoretical entities. Reductionism: can all sciences be reduced to physcis?
Karl Popper: falsificationism, crucial experiments.
Kuhn: The structure of scientific revolutions. Normal science. Paradigms. Paradigm shifts and incommensurality.
Lakatos: Research programmes. Social constructivism: the Edinborough school.

Block 5: Research interpretation, evaluation and impact

How to make your subjective knowledge intersubjective? Presentation of the results. Buiding a model that fits your discovery. Systematization of models. Idealisation. Models in science. Process models. The different stages of model-building. Model selection. Incorporating scientific knowledge. Model fitting. Model validation. Data-mining.
Reputation is very important in the scientific field. Good reputation will bring you new friends, PostDocs and collaborators, but misconduct may ruin everything. Scientific honesty and scientific misconduct. Publication ethics. Research on animals and humans. Ethical codes.
From the idea to PhD defence procedure. Publishing, conferences. Fundrising.

Block 6. Writing a scientific article.

Structure of scientific publication. IMRaD, its history. Head, authors, affiliations, abstract. Introduction part, results, discussion, conclusions. Acknowledgements. What and in what part should be written. Do and do not in scientific paper. References and their different styles. Endnote, Mendeley, Word reference package. Ethical cases in publishing paper. Who should be the first author. Differences between Ph.D. thesis, conference thesis, paper and a review. Peer-review system and submission process.

Seminar 1. (Given after block 1 lecture material).
Students now grasped the main ideas about science and knowledge. To start with main logical constructions one should practice making a definition.

Definition clinic. One of the main concept in science is definition. It helps us to speak with each other on one language, especially when dealing with the highly abstract terms. But if one doesn't pay attention to definitions, he may come to wrong conlusions. Mistakes of formulations and definitions. Ambiguity. Construction of definition. Lexical ambiguity. Syntactic ambiguity. Vagueness. Circularity. During the seminar after discussion of main mistakes during formulation of definitions, students will have to provide their own definition on the given notion. This will be done in the form of group work.

(Previously seminar work was graded also as pass or fail as in this document).

Seminar 2. (Given after block 2 lecture material).
Students now should understand the main ideas about making a hypothesis. Now it is time to discuss the example of the real research where hypothesis was formulated and the outcomes of this approach.
Text seminar: Experiment and observation. History of science today provides us huge number of the experiments and their description, where we may see the long road from the initial hypothesis to sometimes revolutionary outcomes. The purpose of this seminar is to examine and discuss the use of experiments in energy science. For the seminar to be successful it is important that all participants are prepared and willing to take part in the discussion.
Before the seminar students will receive a task to read the certain text and answer the questions. Answer will be discussed on the seminar.

Seminar 3. (Given after block 3 lecture material).
To understand reliability and validity, measurement scales and procedures and how they are used to explain things one should experience reading of the real scientific text where these topics are discussed.

Scientific writing. Science has rather severe publication form. To read and to write in scientific way one should have an experience, group discussion of pluses and minuses of the certain energy science related text will be a good step forward. Before the seminar students will receive a task to read the certain text and answer the questions. Answer will be discussed on the seminar.

Seminar 4. (Given after block 4 lecture material).

To make a serious impact to energy technology research one should deal with the topics, objects, methods or ideas not accepted everywhere (otherwise it will be done before). That means student have to have the ability to distinguish scientific texts|methods|tools with non-scientific.

Scrutinizing scientific text. Today we face a lot of materials that formally may attributed as scientific. What differs scientific text from non-scientific? Analysis of the text. Understanding at practice what makes science the science. Before the seminar students will receive a task to read the certain text and answer the questions. Answer will be discussed on the seminar.

Seminar 5. (Given after block 6 lecture material).

Analysys of the scientific paper. Searching for good and bad moments in the paper. In the boots of referee. criteria to accept and reject a paper.

Seminar 6. Presentation Analysis of students papers and results of "peer-review" process made by schoolmates. Discussion of the problems student faced during writing the article.

As a result of this part of the course student must submit and article to certain journal.

Pass or fail. Criteria of the mark is based on the fulfillment of the journal obligation for the article ready for submission process.

Project work. Comparison of the alternative theories (E.g. classic medicine and homoeopathy) 15 minutes (presentation, or using desk - to formulate or underline major points)

1. Present the problem (e.g. How to fix a human to a normal (fully functional from other people point of view) and safe (for him and other people) condition,
2. Show the major fundamental idea of both theories as correct and precise as possible. (Ask question, what this theory ain't going to answer, that means where the theory stops)
3. Present basic principles of both theories (number of claims that are not in the main idea body but are essential for the theory, e.g. Do not harm,)
4. Present the main definitions in the theories frameworks (e.g. what is illness, what is health, what is treatment)
5. Some major features that differ this field of problem (e.g. medicine deals the most complex object that we know - our body, number of influencing factors and their effect are enormous etc).
6. How the alternative theories are trying to answer on the main question? And discuss what theory is better and why.

Written examination.
The purpose of written examination is to check students understanding of the main course concepts related to energy research. Examination will be given in written form of 20 test question and 5 open answer questions based on the materials of lectures, seminars and course literature.

Requirements for final grade (pass or fail)

- Active participation in seminars

(To get Pass for the seminar: hometask for the seminar must be submitted before start of the seminar in written form. All the questions necessary to be answered in written form must be answered correctly)

Previously the grading was also P\F for seminars (One passed seminar gave you 10 points. 4 seminars – 40 semester points totally)

- Passed written exam

  (To get Pass for the Examination – 14 (from 20) multiple choice question answers must be correct, 3 (from 5) answers for open question must be correct

Previously the grading system was like this: each multiple choice question gave 3 points, each open question – 8 points. Students who made >85 received A, >71 B, >55 C, <55 F for the exam. For total mark exam gave 40%. So if one received 85 points, he has got A for the exam and 0.85*40=34 points for the semester.

- Passed project work

  (To get Pass for the Project original presentation must be made. Analysis according to the task list must be completed.)

Previously the grading system for the project was like this: 20 points could be gained totally.

5 points – quality of presentation (slides, structure, using of figures, appropriate use of colours, quantity of text on the screen, clarity)

5 points - quality of speech (English language level, clarity, emotional impact, scientific vocabulary, scientific modesty)

10 points – quality of description of the problems and the analysis of the topic (clarity, integrity, depth of the understanding, honesty, scientific approach)

FINAL GRADING FOR THE COURSE

As a whole student may receive 100 points: 30 for seminars, 15 for the project, 15 for the scientific paper, 40 for the exam.

Students who made >85 received A, >71 B, >55 C, <55 F for the course. C-mark and higher gives full number of credits.

Literature

1. Chalmers, A. F. *What Is the Thing Called Science?* 3rd ed. Indianapolis/Cambridge: Hackett Publishing Company, 1999.
2. Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. "On Being a Scientist." 27. Washington D.C.: National Academy of Sciences, 1995.
3. Day, Robert A. *How to Write & Publish a Scientific Paper*. 5th ed.: Oryx Press, 1995.
4. Hansson, Sven Ove. *The Art of Doing Science*. Stockholm: Department of Philosophy and the History of Technology, KTH, 2007.

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Supplementary information

Language of instruction: English