Programme of advanced academic doctoral training – academic year 2017 / 2018

Scientific research, communication and deontology

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Lectures delivered based on the materials of

Prof. Alexandru Nichici, Eng. PhD

Tenure professor of transversal disciplines in the programmes of advanced academic doctoral training from 2008/2009 to 2010/2011

Course outline

1. Science. Technology. Knowledge. Basics of scientific research. The scientific researcher.
2. Scientific research in engineering. Systemic approach.
3. Operational models in scientific research. Presentation of the research findings.
4. Communication through scientific papers.
5. Doctoral thesis. Deontology of scientific research and scientific communication.

Skills envisaged

1. Meeting necessary requirements for institutional integration in universities and research centres.
2. Assessment of the advantages/disadvantages of a scientific research method – identification of validation methods proper to a given topic.
3. Application of deontological rules related to scientific research and scientific communication, by means of a written text and oral discourse.
4. Application of argumentation rules in editing a scientific written text and a scientific oral discourse.
5. Application of deontological rules in research projects editing and implementation.
6. Selection of scientific papers publication options for the optimal exploitation of research findings. Development of communication relations within this context.
7. Elaboration of a doctoral thesis on grounds of specific standards.

Observing ethical values in the university

ETHICS- i) All moral conduct standards (broad meaning). Ii) Philosophical subject studying these standards.
DEONTOLOGY – All standards of conduct and ethical obligations of a certain profession (broad meaning). Branch of ethics studying the specific standards and obligations of a certain professional activity.
The main teaching and research objectives of UPT are grounded in the observation of ethical values, out of which arise the rules of conduct and the activity of the UPT community.

The spirit of the UPT ETHICAL AND DEONTOLOGICAL CODE
- Searching the truth through knowledge (based on rigour, integrity and equity).
- Liberty in teaching and research (nucleus of academic liberty) exercised and observed by each member of the UPT community, in relation to the academic community, society and the environment, both nationally and internationally.
- Respect of the university towards each community member, by maintaining a proper climate in order to accomplish their teaching and research objectives, irrespective of their status (teaching staff, students or other community members), by an equal treatment of all members.

Main Bibliography

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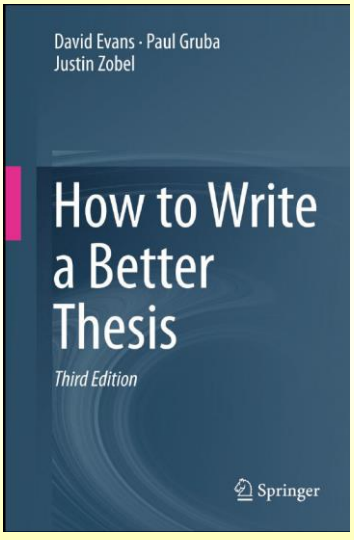
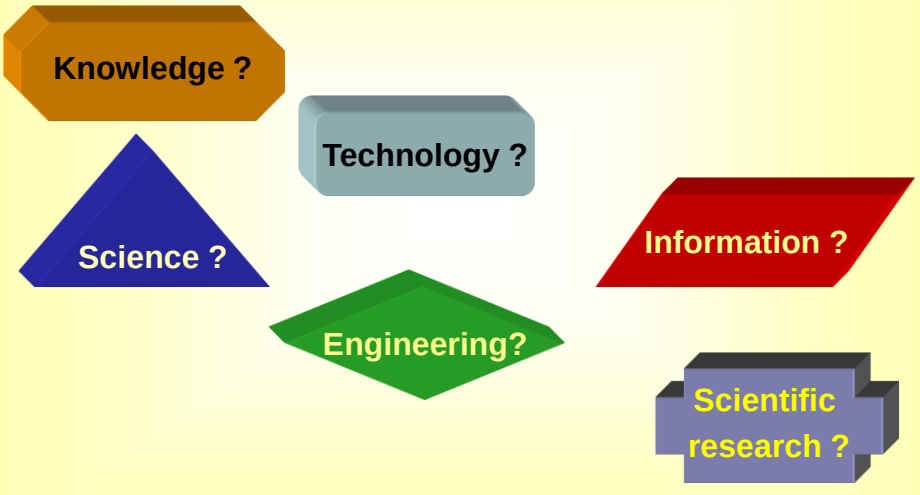


Lecture topics

1. Fundamental concepts
2. Scientific knowledge
3. Information
4. Scientific research

1. Fundamental concepts

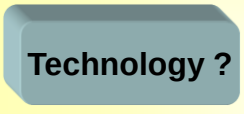


Knowledge (from the Latin ***connoscere***)

The action of knowing and its result. Constientious reflection of actual reality, irrespective of the knowledgeable individual. Familiarisation with someone or something, that might include information, facts, descriptions or skills acquired through expertise or education.

Science (from the Latin ***scientia*** , meaning *knowledge*):

Systematic human activity through which knowledge, under the form of explanations and predictions that can be verified, about nature, society and thinking (about the universe and about reality) is acquired and systematized.

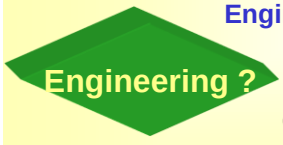


Technology (from the Greek: **technologia**, through the French**:** **technologie**)

1. Knowledge of relevant principles and **ability** of obtaining proper results;

2. Science of methods and means of material processing;

3. Totality of processes, methods, operations, etc. used to make a certain product.



Engineering: Engineer's profession

Engineer (from the Italian: **ingegnere**)

Expert with technical and theoretical education acquired in tertiary education, who performs a technical activity of design, research, management and driving of technological processes in a plant.

Information: Each new element, in relation to prior knowledge, contained within the significance of a symbol or group of symbols (written text, oral message, images, instructions for a device, etc.)

Scientific research (from the Latin: circitare - „to snoop around”**):** Original investigation in order to get new scientific or technical knowledge.

Knowledge

- **content:**
  - fundamental principles and values of organization, management and evolution of nature and human society;
  - models of physical reality, especially mathematical and IT models;
  - contextual data and information, and one’s own acquired experience, verified in practice and available at individual and institutional level
- **final objectives:**
  - to discover the essence of the physical and spiritual world;
  - to provide answers and solutions to people’s need to understand and interact efficiently and durably with the natural and social environment.

Engineering

- **A specific form of human activity,**

  multidisciplinary in nature, reasonable and rigorous,

  creative and innovative, with multiple economic, social and ecological implications.

- **Aim:** to design, create and make best use of final and effective science and technology integration systems and processes.

- **Main objectives:** to promote and implement optimal decisions in the design, creation and use of goods and services necessary to human society.

Science and technology – defining elements

Defining elements	**SCIENCE** **What? Why?**	**TECHNOLOGY** **What for? What with? How?**
Fundamental objectives	Acquisition of new information and knowledge concerning the interrelations within the natural environment and human society, and their causal interpretation	Creation of new information, knowledge and practical applications in relation to the artificial environment of human existence
Public image - static	A multitude of hypotheses and assertions related to the nature and evolution of the world we live in, supported by arguments and tested at a certain moment	A multitude of information, knowledge and actions applied to design, to make and to use different products under the form of goods and services
Public image - dynamic	A conservative knowledge process associated with the creation, validation and communication of hypotheses and assertions	A creative process of transforming natural resources into new artificial energy carriers, energy and information

Science and technology – defining elements

Defining elements	SCIENCE What ? Why ?	TECHNOLOGY What for ? What with ? How ?
Main Purpose	Answers to the existential questions of human beings, factually proved and generalized by credible patterns	Practical solutions to the existential problems of individuals and the society
Real Purpose	Deep and ample knowledge of the natural and social environment of human existence	Application of knowledge (science, engineering, management etc.) to solve certain practical problems
Scope	Wide, unlimited, global scope	Scope limited to the area of application

2. Scientific knowledge

- based on a scientific manner of thinking and action; (the most rigorous form of knowledge)
- acquired through scientific research programmes and activities;
- achieved through the identification, acquisition, interpretation and validation of relevant data, information and knowledge for a certain category of natural phenomena or for a specific object of study (integrated holistically, or on grounds of isomorphism identification).

3. Information

- raw information – a lot of numerical, alphabetical, alpha-numerical, symbolical and logical elements, representing related concepts, facts and data under encoded form;
- scientific information – relevant information, essential to a given context or environment, for example, a phenomenon, a process, a natural or artificial system;

Essential factors to classify an *information element* as scientific information, at a given moment :

(1) independent and rigorous testing

(2) peer review (= evaluation of scientific or professional papers by other persons working in the same field) and publication

(3) measurable, effective or potential error

(4) degree of acceptance within the scientific community

- technical information – operational information, necessary and sufficient for the systematic and repeated transformation of natural resources into artificial corporal and non-corporal products;

Technical information is associated to technical knowledge, being characterized by its own abstract concepts, theories and rules, as well as by its own structure and dynamics of change. Essentially, they all aim at applications to real situations.

Technical knowledge arises from, and is incorporated into human activity, as compared to scientific knowledge, which, for example, is an expression of the physical world and its phenomena.

4. Scientific research

- Scientific research – an activity / investigation process through which people acquire new **data, information and knowledge** about the world they live in and/or about themselves, systematized under the form of laws and principles. It requires social effort to widen an area of knowledge.

- A research is considered and accepted as "scientific activity" if and only if it is performed according to a **logical method**, grounded in scientific reasoning and action.

- **Research implies risks** (assumed loss): scientific, economic, technical, etc. risks. Through rational approaches, the challenges represented by risks may find proper answers.

A. Defining elements

Main objectives :

- **principled level**

- searching and investigating truth about the essence of human beings and of their environment;

- development of theories and models able to describe, accurately and without any doubt, the realities of human existence;

- **pragmatic level**

- creation of the theoretical and/or practical premises to solve the problems that condition the technical, economic, cultural and social progress of humankind in harmony with nature;

Scientific research

Main functions :

- **formative function**: developing certain systematic abilities and skills, specific to research; promoting teamwork and scientific reasoning and behaviour;
- **cognitive function**: critical assessment of the current state; deepening and increasing knowledge in specific fields of science and technology;
- **informative function**: fostering and maintenance of public opinion interest and, in particular, of the interest of individuals and institutions able and willing to finance future scientific research.

Scientific research

B. Logical stages of scientific research

No.	Stages	Remarks
1	**Observation and primary assessment**	Critical investigation to describe the structure, state and development trends of the researched phenomena, processes and/or systems
2	**Defining the problem**	Defined clearly, concisely and completely, the problem can be identified by asking questions such as : **What? Why? When? Where? How? How much?** Solving the problem may improve the situation
3	**Launching a hypothesis**	The hypothesis/ hypotheses refer(s) to rational, possible, probable and verifiable explanations of / solutions to the previously defined problem

No.	Stages	Remarks
4	**Performing an experiment**	An experiment is a real, controlled intervention in the evolution / functioning of the object of research; the experiment has as objectives the testing and validation of the assumed hypothesis/hypotheses
5	**Developing a theory**	A theory is a generalized synthesis of the hypothesis/hypotheses validated by the experiment; generally. The theory can also be described by mathematical structures (e.g. statistical models) or information ones (e.g. computer models)

C1. Scientific research procedure – Stages of a professional scientific research programme

- acquisition of data, information and knowledge relevant to the structure and function of the investigated system (T: function-functional-functionality)
- information identification of the object of research
- determination of problems restricting the achievement of objectives and/or performance improvement of the system under consideration (T: restriction-constraint)
- developing ideas and actions representing solutions to problems, and deciding upon the hypotheses conditioning and /or supporting them (T: generation-acquisition)

Scientific research

- multi-criteria evaluation of available options / solutions and making an optimal decision under given conditions (T: optimal-improvement);
- theoretical and/or empirical investigation of the state and development of the object of research, under circumstances that allow for testing and validation of the adopted solutions and hypotheses;
- evaluation of the findings, drawing conclusions and delimitation of the fields of validity and applicability;
- elaboration and presentation of the research report/synthesis, according to a scientific paper template.

(„T:" – terminology - discussion)

Scientific research

C2. Scientific research procedure
- Competencies and skills required to be a good researcher

- systemic thinking and behaviour (T: system – systemic-systematic);
- analytical and integration skills in defining and solving problems;
- linguistic, scientific and technical communication skills for a wide range of problems, partners and audiences;
- rapid and efficient availability and adaptability to change;
- multi - and inter- disciplinary approach of surrounding realities;

Scientific research : researcher

- critical spirit and creativity in any situation;
- integration into a team and adaptation to team work;
- interest and effort in life-long training;
- management competencies and skills in scientific research, industry, services, business and the civil society;
- deep understanding of the economic, social and ecological environment of contemporary society.

Scientific research

C3. Scientific research procedure – research project management

- adequate and realistic identification of the **resources** needed for the implementation of the scientific research programme: human resources, infrastructure, financial resources; (resource = reserve or source);
- proper time management for each stage in the scientific research programme and elaboration of the research schedule;
- assessment of research costs;
- identification of research funding sources;
- elaboration of the research project by adapting the programme of the professional research to the funder's requirements;

Scientific research

- the research project should include research, legal, finance and administrative staff;
- responsible conclusion of the funding agreement for the research project by understanding the rights, obligations and clauses therein;
- execution of the research project in accordance with the contract provisions, by observing the report schedule, the procurement policies, the legislation in effect;
- preparation of audits requested by the funder;
- making use of the project findings, according to the obligations specified in the funding agreement;

Scientific research

- closing the contract and clarifying the ownership of the research findings;
- archiving the project documents, so that further audits may be performed (every 3, 5 or 10 years).