



Subject card

Subject name and code	Methodology of scientific research, PG_00039711						
Field of study	Materials Engineering, Materials Engineering, Materials Engineering						
Date of commencement of studies	February 2022	Academic year of realisation of subject			2022/2023		
Education level	second-cycle studies	Subject group			Obligatory subject group in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			1.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Solid State Physics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Jarosław Rybicki				
	Teachers		prof. dr hab. inż. Jarosław Rybicki				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	E-learning hours included: 0.0						
	Metodologia pracy naukowej_22/23 - Moodle ID: 26521 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26521						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	15		2.0		8.0	25
Subject objectives	The course aims at presentation of modern methods of thinking applied in science and technology						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K7_W05		A student knows contemporary methods of reasoning in science and technology		[SW1] Assessment of factual knowledge		
	K7_K01		Typical and most frequent methodological errors are discussed		[SK4] Assessment of communication skills, including language correctness		
	K7_U01		A student is able to perform a correct deductive and reductive reasoning		[SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p>1. INTRODUCTION. Ontological, psychological, semiotic, theory-cognitive terminology. Formal logic. Philosophy of logic. Methodology vs. science. Science vs. logic.</p> <p>2. PHENOMENOLOGICAL METHOD. Objectivity of phenomenologists. Return to "issue in itself", intuitive cognition.</p> <p>3. SEMIOTIC METHODS. Sign and its three dimensions. Formalism. Essence of formalism - calculation. Application of calculation to non-mathematical subjects. Validation of formalism. Eidetic and operational sense. Models. Artificial language. Syntactic rules of sense. Construction of language. Atomic and molecular expressions. Notion of syntactic category. Functors and arguments. Examples of syntactic nonsense. Semantic functions and levels. Two semantic functions of sign. Designation and significance. Semantic levels. Language and meta-language. Semantic meaning and verifiability. Rule of verifiability. Verification levels: technical possibility, physical possibility, logical possibility, transempirical possibility. Principle of intersubjectivity. Verifiability of general clauses.</p> <p>4. AXIOMATIC METHOD. Structure of indirect cognition. Law and rule. Two basic forms of inference: deduction and reduction. Reliable and unreliable rules of inference. Concept of axiomatic system. Structure of axiomatic clause system. Requirements for axiomatic system. Constitutional system. Progressive and regressive deduction. Mathematical logic. Methodological significance. Implication and derivability. Definition and creation of concepts. Basic types of definition. Real and nominal definitions. Syntactic and semantic definitions. Analytical and synthetic definitions. Types of syntactic definitions: clear definitions, contextual definitions, recursive definitions, definitions by axiomatic system. Semantic deictic definitions. Real definitions. Application of axiomatic method. Axiomatization of logic of Hilbert-Ackermann clauses.</p> <p>5. REDUCTION METHODS. Historical introductory remarks. Concept and division of reduction. Concept of verification and explanation. Regressive reduction. Reduction sciences. Structure of natural sciences. Observation clauses. Progress in natural sciences. Verification of hypotheses. Experience and thinking. Types of explanatory sentences. Causal explanation and teleological explanation. Co-occurrence laws and functional laws. Deterministic laws and statistical laws. Authentic and non-authentic induction. Division of induction. Primary and secondary induction. Qualitative and quantitative induction. Deterministic and statistical induction. Enumerative and eliminatory induction. Postulates of determinism, closed system, relationship between laws, simplicity.</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	written test	51.0%	100.0%
Recommended reading	Basic literature	J. M. Bocheński, Współczesne metody myślenia, wydawnictwo "W drodze", Poznań (1992)	
	Supplementary literature	K. Popper, Logika odkrycia naukowego, PWN (1983) M. Grzegorzczak, Logika matematyczna, PWN (1979)	
	eResources addresses		

Example issues/
example questions/
tasks being completed

Complete the following sentences:

1. The sign for an objective concept is defined by the word....., and the sign for an objective sentence - by the word
2. The word "methodology" originates from the Greek words, and the "word," and it literally means the same as ".....".
3. The relations between words as signs are called..... relations, and the relations between their meanings are called..... relations.
4. A sign has an when we know its semantic counterpart. A sign has an sense only if we know how to use it.
5. Meaningful expressions of a language can be divided into two classes: and (complex) expressions.
6. The term describes the class of expressions of a language in which any expression can be replaced with any other expression of this class as part of a meaningful statement while the statement will not lose its
7. "Denoting" corresponds to (*extensio*) of an objective concept, and corresponds to its content (*intensio*).
8. Objects denoted by a name are called its The designate of a sentence is its
9. The essential idea of the semantic degrees theory is that the language relating to should be distinguished from the language relating to: the latter relative to the former is called its
10. The procedure that allows us to determine whether a sentence is true or false is called The sentence is verifiable, if it can be..... or.....
11. The operation in which are clearly formulated in order to justify a conclusion is called "proof".
12. All the processes of proving can be divided into two great classes, namely and..... Induction is a variation of
13. *Modus ponendo ponens* (Latin: *the way that affirms by affirming*) – **sentential calculus** tautology which says that if we recognize the truth of, then we also have to recognize the truth of its successor.
14. Two types of deductive inference should be distinguished: and deduction.
15. In the classic mathematical logic two concepts of consequence are distinguished: and.....
16. The definition describes what a thing is, while and the nominal definition does not refer to things but to
17. Nominal definitions can be either..... or.....
18. It is possible to distinguish four different types of syntactic definitions:, , and definitions.

19. Falsification is logically , and is never final because inference from the predecessor about the successor is not reliable.

20. Sentences which describe occurrence of phenomena are called

21. sentences are called "hypotheses" until they are verified.

After verification, they become

22. A hypothesis becomes a only when (1) it has been confirmed by verification in many cases; (2) it not been in any case.

23. Explanatory sentences are divided into:

(a) explanation and teleological explanation

(b) co-occurrence laws and functional laws

(c) deterministic laws and laws.

24. Cause means:

(1) a condition which

(2) temporarily precedes what is triggered causally or is at least concurrent with it

(3) is in certain relations with it.

25. Authentic inductions can be classified according to the type of explanatory sentences into and and and inductions.

Work placement

Not applicable