MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL AVIATION UNIVERSITY

Faculty of Linguistics and Social Communications

Department of Philosophy

METHOD GUIDE TO PRACTICAL CLASSES

on

«Philosophical Problems of Scientific Cognition»

for Educational and Professional programs of Second (Master) Level of Higher Education of all Specialties

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INTRODUCTION

The subject «Philosophical Problems of Scientific Cognition» is the theoretical and practical basis of a set of knowledge and skills that contribute to the formation of the scientific and worldview foundations of a master's degree student, enriching him with the methodological culture necessary for effective spiritual and practical activity, the ability to conduct scientific research work following the modern science requirements.

Main target to study the subject is to form systemic ideas about science as a system of knowledge, a field of activity, and a social institution, the formation of methodological consciousness, the assimilation of the mechanisms of innovative solutions in modern science, as well as the production of practical skills for applying scientific knowledge in research activities provided by each educational and professional program.

The tasks of the discipline study are:

– mastering the basic provisions of the discipline;

– development of methodological culture;

– development of skills and abilities to analyze scientific texts;

– development of skills and abilities to discuss current scientific problems, to distinguish the subject, object, methods and techniques of scientific research;

– development of skills and abilities to apply philosophical methodology to research;

– development of skills and abilities to highlight the stages of scientific research and determine the innovative component of its results.

Course Training Program is approved by the guarantors of educational and professional programs of second (Master) level of higher education, in particular, regarding the place, objectives, tasks, and content of the academic discipline «Philosophical Problems of Scientific Cognition» to achieve the objectives and program learning outcomes, as well as obtaining the competencies provided for by these educational and professional programs, in the context of the formation of the worldview and civic qualities of students of higher education, their moral values and general cultural training, the formation of their methodological foundations for original thinking and research, critical reflection on problems in the industry and the verge of branches of knowledge.

Learning outcomes and competences the subject makes it possible to achieve:

The academic discipline, together with other educational components of each educational and professional program where it is taught, allows achieving program learning outcomes determined by the educational and professional program, previously correlated with the achievement of general competencies – universal competencies that do not depend on the subject area, but are important for a successful further professional and social activities of the applicant for higher education in various industries and his personal development.

Such general competencies, directly or indirectly related to the general competencies provided for by each educational and professional program, include, in particular, the most relevant general competencies for each specialty from the European Union (European Commission) Project "Tuning Educational Structures in Europe", indicated, in particular, in the order of the Ministry of Education and Science of Ukraine dated June 1, 2017 No. 600 (as amended in the Ministry of Education and Science of Ukraine order dated April 30, 2020 No. 584):

– ability for abstract and analytical thinking, and synthesis of ideas;

– capacity to learn and stay up-to-date with learning;

– ability to be critical and self-critical;

– ability to search for, process and analyse information from a variety of sources;

– ability to identify, pose and resolve problems;

– ability to plan and manage time;

– ability to adapt to and act in new situations;

– capacity to generate new ideas (creativity);

– ability to make reasoned decisions;

– ability to work in a team, to achieve consensus, and make joint decisions;

– ability for interpersonal relationships;

– ability to motivate people and move toward common goals;

– ability to communicate with representatives of different professional groups across varying social levels (with experts from other fields of knowledge/types of economic activity);

– appreciation of diversity and multiculturality;

– ability to work in an international context;

– ability to work autonomously;

– ability to design and manage projects, in particular in the domain of interdisciplinary scholarship;

– ability to take the initiative and to foster the spirit of entrepreneurship;

– ability to act on the basis of ethical reasoning;

– ability to determine and persist in mastery-approach goals and assigned duties;

– ability to act with social responsibility and civic awareness;

– ability to show awareness of equal opportunities and gender issues;

– ability to apply knowledge in practical situations;

– being able to draw the latest innovative technologies (nanotechnology, biotechnology, information technology, and cognitive science (NBIC)) in particular practical activities;

– ability to undertake research at an appropriate level;

– ability to coordinate philosophical, general scientific and specifically scientific methodological tools to solve problems and tasks.

Module 1. SCIENCE AS A PHENOMENON OF CIVILIZATION

THEME 1.1.
INFORMATION SOCIETY AS A KNOWLEDGE SOCIETY

Plan:

1. Criteria for defining the information society.
2. The role of information in the information society. Information and knowledge.
3. Basic theories of the information society.

***Key concepts**: agrarian society, industrial society, information, information society, informatization, knowledge, knowledge society, post-industrial society, science, wave theory.*

1. Revealing the criteria for defining the information society, a higher education student should focus on the content of the concepts of "information society", "post-industrial society", and "knowledge society" denoting the specifics of the transformation of modern society from different conceptual positions. The fundamental criterion of the information society is technological, determining social, economic, political, cultural, and other spheres. As for the concepts of "post-industrial society" and "knowledge society", they are also used to indicate the direction of changes in modern society. Their peculiarity lies in the fact that the concept of "post-industrial society" generally focuses on changes in the social system, and the "knowledge society" concept incorporates the economic aspect of innovative development. The main factor in the information society development is the production and use of scientific, technical, and other information, so the service sector, science, and education play a leading role in it.

2. Changing the way people live in the information society causes the emergence of new contradictions in the system of social relations. Because in the information society, information is the determining factor in the economy as a resource, service, product, source of surplus value, and the creation of new forms of employment, its production becomes decisive in economic activity. This leads to an avalanche-like accumulation of information that cannot be processed quickly. In addition, the proportion of false information is constantly growing in the information flow. In the information (post-industrial) society, structural changes acquire economic relations, the main purpose of which is the production of intangible products and services. The material products themselves become a shell for the existence and promotion of intangible intellectual products. This leads to de-industrialization and virtualization of the economy, and also reduces its functions to the production of speculative capital and then to the simulation of social development.

3. Outlining the role of information in the information society, a higher education student should pay attention to the fact that the production and consumption of information in such a society becomes a prerequisite for any social interaction. Around the production, accumulation, and use of information (the formation of the knowledge economy), the entire economy is being restructured. As a result of the growing technologization, science becomes the main productive force in this new society, and such concepts as “information”, “knowledge”, “information technologies”, and “information resources” acquire a decisive role.

4. The primacy of the development of information and communication technologies in modern society determined the conceptual direction of the development of information theory, which for the most part influenced the content of the concept of "information". The theoretical basis for the information study is the sections of applied mathematics, radio engineering (in the field of signal processing), cybernetics, and informatics. An important property of information is that it leads to a decrease in uncertainty in the knowledge and actions of the addressee. Under these conditions, the amount of information acts as the value of entropy, by which the total entropy of the system decreases as a result of receiving information from this system. Accordingly, when considering information, it should be correlated with the content and form of knowledge, that is, disclosed using an activity approach, including in an epistemological context. In the broadest sense, knowledge is fixed and conscious information, a practice-tested result of cognition of reality, which

with varying degrees of reliability and objectivity, reflects in the human mind the objective properties and patterns of the studied objects and phenomena of the surrounding world. In this context, knowledge is an adequate understanding of the world in the subjective and objective sense, a specific experience possession.

5. Revealing the main theories of the information society, one should turn to the theory of post-industrial society by Daniel Bell, then move on to the culturological theory of Alvin Toffler, the theory of the information society by Francis Fukuyama, and the social theory of network society structures by Manuel Castells, and also consider a critical analysis of modern Western theories of the information society by Frank Webster.

Check your knowledge

1. Is there any difference between the concept of post-industrial society and the information society?
2. What do you know about post-industrial and information society theories developed by Western philosophers, sociologists, and cultural scientists?
3. Name and describe the national concepts of the information society.

THEME 1.2.
THEORETICAL PROBLEMS OF SCIENCE

Plan:

1. Science and its Western origin.
2. Science as a system of knowledge, a sphere of social activity, and a social institution.
3. Sociocultural focus of science. The place of science in the system of culture.

Key concepts: *culture, social activity, social institution, system of knowledge.*

1. Describing science as a system of knowledge, a field of activity and a social institution, it should be noted that science is a complex, open, non-linear, non-equilibrium and self-organized constantly developing system of knowledge.

Science as a social institution is a system of norms, rules, principles, attitudes, behavior patterns, etc. that regulate relations between people in the field of scientific activity. The functioning of science as an integral social organism is ensured by an appropriate system of organization and management of scientific activity, which is a special social structure of society.

2. The backbone elements of science are: the concept and terms of science; methodological principles; scientific ways. Unlike everyday knowledge, scientific knowledge has the following features: it exists in a sign form; is based on rational forms of mastering the world - concepts, judgments, conclusions; logically substantiated and proven; open to criticism; authentic; objectively true; repeatedly confirmed by social practice; maximally capable of formalization; systemic.

3. Culture, of course, is much older and wider than science. By its origin, science is and should be a sociocultural organism or, more precisely, a kind of functional organ created by mankind in the course of its historical development. Initially, it functioned within the framework of mythology, religion, philosophy, art, labor activity, etc., that is, within the framework of culture in the broadest sense of the word. Then it became independent and began to acquire its own features and develop its own laws of development. Originality, independence of thought, and dissent are characteristics of scientific culture and therefore challenge established cultural values. The advances in science and the use of scientific knowledge have profoundly changed daily life, mainly in developed countries.

Check your knowledge

1. What is knowledge? How is scientific knowledge different from common "everyday" knowledge?

2. Demonstrate why science is a system of knowledge.

3. Why is science a field of social activity? Explain the innovative function of science in the information society.

4. Justify that science is a social institution. What is the purpose of science as a social institution? What does science include as a social institution?

5. Expand the socio-cultural functions of science in the context of informatization of society.

6. Why is the autonomy of science a value? Explain your answer with examples from history and the present time.

7. What are the functions of science in the system of culture?

THEME 1.3.
WESTERN AND NATIVE TRADITIONS IN METHODOLOGY OF SCIENCE

Plan:

1. The relationship between philosophy and science in the Modern Era.
2. The role of new European rationalism and empiricism in the emergence of the philosophy of science.
3. Western concepts of the philosophy of science in the XX and early XXI centuries.
4. Peculiarities of the national tradition in modern philosophy of science.

Key concepts: *empiricism, methodology, philosophy of science, positivism, post-positivism, rationalism, scientism, synergetics, theory of knowledge.*

1. In the XVI-XVII cc., there were radical changes in scientific thought, or a scientific revolution, which led to the formation of experimental mathematical science. During this period, the foundations of ancient and medieval physics and, in many respects, mathematics are also being revised, and the very concept of nature (developed in antiquity and preserved in the Middle Ages) is rethought. One of the methodologically important changes that occurred during this period is the transformation of mathematics.

The main task of scientific knowledge is empirical (experimental), practically oriented to the study of nature. The knowledge that does not bring useful practical fruits is, in Bacon's opinion, unnecessary. It is the very experimental knowledge that should be the basis of scientific knowledge. The founder of positivism, the French philosopher Auguste Comte, followed the tradition of empiricism in philosophy, which recognized the great value of sensual, experienced knowledge in comparison with rational knowledge. O. Comte's positivist ideas were supported by scholars and were developed in the following historical form of positivism – *Machism*, within which scientific knowledge turns out to be the main subject of philosophical research. The task of science is to describe the facts of sensory perception.

It should be noted that during that period a special idea of the subject of scientific knowledge was emerging. An "absolute", impassive researcher, relying only on accurate, objective data, free from personal addictions and beliefs is the moral ideal that a scientist should strive for. Only such a researcher is able to obtain objective, universal, and necessary knowledge about the world.

A new type of scientific thinking was gradually being formed and the natural-science ideal of knowledge was being formed, which included, as already noted above, not only theoretical, logical, and mathematical criteria of scientificness, but also experimental substantiation of the theory. This was connected with the concept of the practical use of the forces and energies of nature on the basis of the scientific knowledge of its "structure" and laws.

2. Outlining the role of new European rationalism and empiricism in the formation of classical science, it is necessary to show that these philosophical and worldview attitudes served as the conceptual foundations for classical philosophy and science formation in the period of the Modern

age. Revealing the content of the concepts of "rationalism" and "empiricism", it should be noted that initially, they acted as antinomic methodological means, due to different philosophical and worldview trends. Rationalism (R. Descartes) was based on the priority of thinking about feelings and the empirical sphere in general in the cognitive process. Its features are clarity; definition; undeniable logical self-evidence; use of deductive methodology; identification of logical and causal relationships (which meant the identity of the structures of thinking and being); mechanism and use of mathematics as a universal method of scientific knowledge; epistemological optimism, scientific determinism and belief in the infinity of reason. The methodological basis of rationalism is the fundamental principle of reason, which, on the subjective side, made reason the central point of analysis, and on the objective side, rationality and the logical order of things. Empiricism (F. Bacon), in contrast to rationalism, was based on the fact that sensory experience is the only source and criterion of probable knowledge. The strength of empiricism lies in its focus on a thorough analysis of sensibility and the justification of its role in cognition. Experience in empiricism is primarily considered as sensory knowledge that arises through the interaction of the senses with material objects. But most philosophers - supporters of empiricism - also recognize the importance of internal experience, that is, awareness of the mental states of the subject of knowledge in the introspection (reflection) act. Empiricism takes into account not only experience but also the relationship of the mind with the senses in the process of cognition because research and experimentation require a goal, that is, reasonable grounds. The characteristic features of empiricism are induction and materialism. Rationalism and empiricism opposed each other for a long time, but over time, in the course of the development of science and philosophy, their principles formed the methodological basis of classical science, defining its specific epistemological character.3. Consideration of Western concepts of the philosophy of science of the XX - early XXI centuries should begin with the philosophical doctrine and the direction in the methodology of science of positivism, which emerged in the 30s of the XIX century. Empirio-criticism at the end of the XIX - beginning of the XX century acted as a kind of continuation of positivism. The philosophical trends and schools associated with the solution of theoretical and methodological problems of science also include neo-Kantianism (the Freiburg school), pragmatism, conventionalism, and constructivism. A significant contribution to the philosophy of science was made by the studies of the Vienna Circle (neopositivism) by Moritz Schlick, Otto Neurath, Rudolf Carnap, Henrici G. Reichenbach, and others, the concept of Ludwig Wittgenstein. Subsequently, the philosophy of science went beyond positivism, which is represented in the critical rationalism of Karl Popper, the historicism of Thomas Kuhn and Imre Lakatos, in the scientific realism of Saul Kripke, Hilary Putnam, and other modern researchers. The phenomenological image of science, the assessment of science from the positions of the philosophy of existentialism, and the postmodern image of science remain outside the positivist constructions of the philosophy of science. In addition, during the twentieth century, such areas of philosophy as the philosophy of economics, the philosophy of ecology, the philosophy of biology, the philosophy of geography, etc., were formed. At the end of XX - beginning of XXI century, a postnonclassical view of science is being formed. It is based on non-linear thinking and the methodology of synergetics, which makes it possible to represent modern science as a complex self-organized non-linear multidimensional system.

4. Considering the features of the domestic tradition in the modern philosophy of science, it is worth noting its dialogism and polyphonic nature, which is associated with the formative principle of asserting the polyphony of meaning in the domestic scientific consciousness. In contrast to the features of dogmatism and relativism inherent in the classical and nonclassical scientific paradigms, the dialogical position allows us to comprehend the historicity of culture in the context of the formation of science. Thus, a unity of points of view is achieved. The latter emphasizes the historicity of spiritual life and fixes the invariance of the structures of consciousness. This leads to the understanding and substantiation of science as an integral process of culture in the unity and interdependence of historical and socio-cultural development. The cultural and historical image formation of domestic science is also associated with the tradition of cosmism. Cosmism is an idea of scientific knowledge and its place in a single system of worldview, directing the opinion to the

real sources of the synthesis of science and other forms of information about the Universe. It was in the philosophy of cosmism that the problem of the unity of the microcosm (man) and the macrocosm (the world), the cosmic origin of man and the influence of his creative activity not only on the fate of human civilization but also on cosmic processes arose in full.

Check your knowledge

1. What does the philosophy of science study, and what are the meanings of this concept?
2. What is the historical and philosophical evolution of the methodological problems of the Western philosophy of science?
3. What are the most famous names among Western philosophers of science? What are their main ideas?
4. Why did logical positivism come to self-negation? Why was it criticized?
5. What are the main types of scientific traditions? What role do traditions play in scientific knowledge?
6. Name representatives and their research studies of the Kyiv philosophical school.
7. What scientific works of Kyiv philosophical school are you personally familiar with?
8. Can it be argued that there is a spiritual continuity of the Kyiv School of Philosophy of the Soviet period with the traditions of Ukrainian philosophizing? Justify your answer.

THEME 1.4.
SPECIFICITY OF SCIENTIFIC KNOWLEDGE

Plan:

1. The relationship between the processes of cognition and mastering the world. Specifics of scientific mastering the world.
2. Specificity of subject-object relation in science.
3. The problem of the truth in science. Basic concepts of truth in the philosophy of science.

Key concepts: *mastering (developing), scientific knowledge, subject, object, truth, error, lies.*

1. As is known from philosophy, cognition is a complex process of acquiring knowledge by mankind. This is the movement of human thinking from ignorance to knowledge, from incomplete and inaccurate knowledge to ever more complete and accurate. The result of human cognitive activity is knowledge that constitutes the content of human consciousness. Its structural components include: sensory-emotional; motivational-volitional; abstract-logical (intelligence). In the process of *cognition*, the intellectual component of consciousness dominates, through which the formation of abstract knowledge takes place. However, the knowledge of the world is carried out by a person for the sake of its development, that is, the development of the ability to apply the acquired knowledge in the process of practical activity to transform the world in accordance with the needs and interests of people. Thus, people strive to make the world “their own”.

The main forms of mastering the world are: spiritually-theoretical mastering, spiritually-practical development, subject-practical development. They are formed in the process of establishing a relationship between the objective world (this is the objective world of nature and society), the subjective world (this is the ideal world of consciousness - knowledge, feelings, experiences, beliefs, dreams, beliefs, etc.) and the objective-subjective world (this the world of spiritual culture - moral, political, religious, aesthetic, legal, etc. values). The relation of the subjective world to the objective one forms the *spiritually-theoretical development of the human world*, which is a process of cognition. The result of this relationship is the knowledge that a person acquires. Here it embodies mainly the abstract-logical component of consciousness. The relation of the subjective world to the subjective-objective forms the spiritual and practical development of the world. Here, the predominantly sensual-emotional component of consciousness is embodied

because a person experiences the world of spiritual images that spiritual culture operates with. The relation of the subjective world to the objective and subjective-objective worlds simultaneously forms the subject-practical development of the world, which consists of the transformation of nature and culture, the creation of new objects from nature, and new values of spiritual culture. The motivational-volitional component of consciousness dominates here because a person must show will (mental readiness for action) to achieve a goal.

2. Scientific knowledge differs significantly from ordinary and other types of extra-scientific knowledge. Its features include the following: it is purposeful; the object and subject of cognitive activity are specially allocated; it is carried out by specially trained people - scientists; it is classified according to the objective reality: natural science, social science, and humanitarian knowledge. In particular, special means of cognitive activity are produced: methodological principles, methods, techniques, operations, procedures, methods, and technical means. A special language is also being developed: artificial languages, schemes, models, and other sign systems. Scientific knowledge is aimed at achieving the truth, it results in theoretical knowledge and is systemic. Scientific knowledge has a socially organized character and is based on reality construction through hypotheses as special forms of scientific knowledge that require substantiation or refutation. Scientific knowledge is carried out through specific forms of "scientific knowledge: a "scientific idea", "scientific problem", "scientific theory", and "scientific concept".

The researcher forms himself the object of scientific knowledge based on the application of logical procedures of abstraction and generalization. Therefore, the object of scientific research is idealized. Even when a scientist deals with real objects or phenomena, he is mentally distracted from characteristics and properties that are not essential for his research, focusing on those that need to be investigated. Often, the object of scientific knowledge is an ideal model - a formula, table, diagram, etc., which represents the properties to be studied.

Not every person who even has a higher education can become a subject of scientific knowledge. They can only be a talented person with the ability to create scientific research. Such a person should be prepared for scientific activity - to master the language of science; not only must know the existing methods and technical means used in scientific activities, but also be able to adequately use them; know the classification of sciences and scientific means to apply the scientific apparatus of related and interdisciplinary sciences; be able to formulate the goals and objectives of research activities; be able to engage in scientific communication in the scientific community. He must also have the skills to work in a research team, etc.

3. For the first time, the essence of truth was formulated by Aristotle in the IV century. BC e., noting that truth is the correspondence of our knowledge to reality. In the history of philosophy, the doctrine of truth has changed in connection with the development of science, especially the theoretical sciences - mathematics, theoretical physics, theoretical biology, social sciences, etc. Generally, a distinction is made between the classical (Aristotle) and coherent (A. Poincaré) conceptions of truth. Philosophy considers absolute and relative truths. At each particular stage of development, scientists deal only with relative truth. The relativity of our knowledge and its incompleteness does not mean that it has no objective content. Whatever approximately the scientific picture of the world, if it reproduces the real characteristics of this world, it is not arbitrary, and therefore, it is objective in its content. Absolute truth is complete, exhaustive knowledge of reality. Relative truth is the moment of absolute truth. There is exactly as much absolute, as there is objectively true in every scientific knowledge. Therefore, absolute truth, on the one hand, acts as an epistemological ideal towards which science strives. On the other hand, absolute truth is understood as actual knowledge about individual processes and phenomena, the validity of which is beyond doubt.

Truth is never abstract - it is always concrete. The requirement for the specificity of truth means, that an object or phenomenon should be considered in those conditions of place and time, in those connections and relations in which this object (or phenomenon) exists and develops. Truth and error are dialectically related opposites. In the real process of cognition, there is no truth in its pure form, entirely free from moments of untruth, that is, delusion. The latter arises as a result of the

absolutization of some relative truth. Ignorance of the limits of applicability and, as a consequence, the truth of a specific scientific position and its dogmatic application without taking into account definite conditions, the absolutization of its significance for science will inevitably lead to delusion.

Check your knowledge

1. What determines the knowledge boundaries? What is the difference between the positions of skepticism and agnosticism?
2. What are the features of understanding cognition as a reflection? What aspects of the cognition process does this concept not take into account?
3. What new ideas does I. Kant bring to understanding the essence of cognition?
4. What tendencies in cognition nature understanding are characteristic of modern epistemology?
5. Identify the main features of the sensualist and rationalist theories of cognition.
6. How does epistemology interpret the concept of "object" and "subject" of cognition?
7. What is the basis for the formation of different truth conceptions?
8. How is the problem of truth criterion solved in these concepts?

THEME 1.5.
UNITY OF EMPIRICAL AND THEORETICAL KNOWLEDGE IN SCIENTIFIC COGNITION

Plan:

1. The concept and essence of empirical and theoretical levels of scientific knowledge.
2. Empirical and theoretical knowledge structure.
3. Traditions and innovations in the process of empirical and theoretical research.
4. The role of intuition and creativity in scientific knowledge.

Key concepts: *empirical knowledge, innovation, intuition, scientific knowledge, theoretical knowledge, tradition, truth.*

1. Revealing the content of the concepts of "empirical level of scientific knowledge" and "theoretical level of scientific knowledge" it should be noted that these concepts refer to different types of research activities and are different ways of obtaining scientific knowledge.

The empirical level of scientific knowledge is based on the acquisition of knowledge through experiences and experiments. The patterns of functioning of the object under study are derived through conducting and summarizing the results of a significant number of experiments and, as a result, establishing stable, repetitive relationships between the properties of the object or between objects. Empirical knowledge is defined as a system of statements about abstract empirical objects, which are usually real objects, in the study of which scientists mentally abstract from their properties that are insignificant in the framework of a particular study.

The theoretical level of scientific knowledge is the process of obtaining new knowledge about the corresponding object based on already existing scientific knowledge (including empirical data) through deduction. At this level of scientific knowledge, there is no direct contact between the scientist and the object under study. The researcher does not deal with real objects or phenomena but with abstract theoretical objects (or idealized objects, theoretical constructs), which are special logical reconstructions of real objects and phenomena. Theoretical knowledge is of a general and necessary nature and contains information about the internal patterns of observed phenomena.

2. Describing the structure of empirical and theoretical knowledge, it should be noted that these levels of organization of scientific knowledge do not exist separately from each other. In a real scientific process, they are organically connected, mutually stipulate and complement each other. The structure of empirical knowledge is formed by a combination of the following elements: single

empirical expressions that fix the results of single observations or experiments; empirical facts - statements in which protocol statements are generalized; empirical laws are general statements that fix objective, essential, necessary, recurring connections and relationships between certain properties, events, facts, etc. The following components can be distinguished in the structure of theoretical knowledge: single theoretical models as the mental reconstruction of individual properties of an object and the establishment of relationships between them; fundamental theoretical laws - theoretical statements that characterize the relationship of ideal objects of theoretical models; scientific theories are detailed and developed systems of theoretical knowledge in which the corresponding fundamental laws are coordinated.

3. Revealing the role of tradition and innovation in the process of empirical and theoretical research, the student should pay attention to the fact that traditions in science play the role of a mechanism for accumulating, preserving, and transmitting scientific experience, storing and transferring methods and skills of activity (technologies), rules and values of science, patterns of setting and solving problems, norms of behavior, customs, forms of consciousness and worldview attitudes, models and principles of scientific communication, etc. Scientific tradition (from Latin traditio - transmission) is a way of being of science and reproduction of elements of its socio-cultural heritage, fixing the stability and continuity of the experience of generations, times, and eras.

Innovation, in a broad sense, is a set of technical, industrial, commercial, and other activities aimed at introducing the latest ideas and products in the field of labor organization and management, as well as in other areas of scientific and social activities, inventions, technologies, modernized products, production processes, equipment, etc., based on the use of the latest achievements of science and best practices, which provides a tangible economic effect, increases efficiency and contributes to obtaining competitive advantages for the enterprise. Innovative activity is a process, the stages of which are: the creation of an innovative product; its implementation; dissemination, and use of the results of innovation. In a simplified form, the innovation process can be represented as a process of the successful transformation of an idea into a new marketable product or service. It can be divided into two main stages: the first - is the actual innovative development, containing research and development work; the second is the life cycle of an innovative product, which involves the commercial use of innovation - the result of innovative development.

In the process of innovative development, the system integration of the results of scientific and technical activities obtained at different times by different teams is carried out. There is a debugging and refinement of individual subsystems and technologies in the context of the assigned technical task. At this stage, the work performers are teams of scientists and engineering and technical workers from universities, institutes, scientific and technical centers, etc. They are engaged in fundamental and applied research in the context of the tasks set and conduct experimental, empirical, theoretical, and search activities to produce new knowledge and apply it to achieve practical goals and solve specific problems, including those of commercial importance. Given the above, scientific traditions are an important element of innovative development because they serve as a methodological base and a source of knowledge for innovative development and also provide a moment of continuity, giving vitality to the process of change and updating reality.

4. Outlining the role of intuition and creativity in scientific knowledge, it should be noted that scientific rationality relies not only on logic but also on creativity, intuition, imagination, fantasy, and other unconscious acts of the human psyche, on the so-called "implicit personal knowledge" (Michael Polanyi), leading to flashes of consciousness, signifying discoveries, insights, insights, etc. Intuition is an implicit personal knowledge that exists as a certain given, as a premonition. It is based on a sudden insight, an unexpected guess. At the same time, intuition is based on rational forms of knowledge obtained in the learning process or scientific activity. Irrational moments of cognitive activity, which include intuition, contribute to the combination of sensory-visual and abstract-conceptual (logical). Intuition is closely related to another form of implicit personal knowledge - creativity. Creativity is a human activity through which something new is born and it was not there before. It aims to transform the natural and social world following

the goals and needs of people. Creative activity is unique and original - both in terms of the nature of its implementation and the result. Creativity is the ability of a person to make changes in reality based on imagination, fantasy, intuition, and reason, which allows thinking to move on, to expand the boundaries of the possible in the cognitive process. This is how new concepts, norms, principles, rules, and ideals of cognitive activity are formed.

Check your knowledge

1. Explain the meaning of the concepts "empirical level of scientific knowledge" and "theoretical level of scientific knowledge".
2. How are empirical and theoretical levels of scientific knowledge related?
3. Describe the structure of empirical and theoretical knowledge.
4. Reveal the role of tradition and innovation in the process of empirical research.
5. Reveal the role of tradition and innovation in the process of theoretical research.
6. What is, in your opinion, the ratio of internal and external factors in the development of science?
7. Give arguments to confirm the position according to which the development of science is determined by socio-cultural and personal factors (externalism)?

THEME 1.6.

NON-LINEAR MUTUAL INFLUENCE OF PHILOSOPHICAL AND SCIENTIFIC COGNITION IN THEIR HISTORICAL PROGRESS

Plan:

1. The relations between science and philosophy in historical context.
2. Ancient natural philosophy as a prototype of the mutual influence of philosophical and specifically scientific knowledge.
3. The world cosmism philosophy as a project for the integration of philosophical and scientific knowledge
4. Science and philosophical discussions on the anthropic principle.

Key concepts: *natural philosophy, noosphere, philosophy of cosmos*.

1. The history of science and the legacy of problems it has left for philosophy shows that these two kinds of intellectual knowledge have always been inextricably linked. And heritage can help us understand philosophy. One of the oddities of philosophy is that it seems to be a heterogeneous subject that lacks the unity that characterizes, say, economics or chemistry. Among its sub-disciplines are: logic – the study of valid forms of reasoning, epistemology - the study of the nature, extent, and justification of knowledge, ethics and political philosophy, which both deal with the foundations of moral value and justice, aesthetics – the study of the nature of beauty, as well as metaphysics, seeking to determine the fundamental types of things that exist.

What unites all these diverse questions in one discipline? We will give a working definition of philosophy by American philosopher Alex Rosenberg (PhD 1971, Johns Hopkins). He believes that what is commonplace in all subdisciplines is concentrated in two blocks of questions, that philosophy deals with:

1) questions that science – physical, biological, social, behavioral – cannot answer now and perhaps may never be able to answer.

2) questions about why science cannot answer the first set of questions.

Here we should remember the specifics of philosophy. Unlike scientific knowledge, philosophy is concerned with normative questions, questions of values – i.e. questions about what should be, what we should do, what is right and wrong, what is good and what is bad, and what is fair and unfair.

2. Revealing the connection between philosophy and science in the Modern age, it is necessary to show that during this period, thinkers have been forming a practical view of philosophy because it was believed that it, like other sciences, could be used for all possible applications, thereby becoming the masters of nature (R. Descartes). Philosophy in modern times was seen as a method of cognition and a way of mastering nature. Therefore, one should pay attention to the fact that the connection between philosophy and science at that time consisted in the interpenetration and mutual influence of their various elements, through which the content of both the philosophical and scientific conceptual and categorical apparatus is enriched, refined, and deepened.

3. Outlining the mutual influence of philosophical and scientific knowledge in the philosophy of cosmism, one must first note that in such philosophical and cultural trends, a view is formed of the Cosmos as a single process with mutual penetration and mutual influence of various manifestations of being. This, in particular, corresponds to the post-non-classical science of the late XX - early XXI centuries, where the formation and evolution of the Universe are considered a complex, non-linear, ambiguous, unpredictable process. You need to move on then to the consideration of cosmism, which acts as the unity of the individual and the Cosmos through the prism of Sophia. This approach determines the anthropological dimension in science, including natural science. In the philosophy of cosmism, humanity is also considered as part of the biosphere (V. I. Vernadsky) that actively influences it in the course of the practical development of nature and the development of science, which leads to the development of the biosphere into the noosphere, which becomes a special factor in the further evolution of the Cosmos.

4. In this question, one will trace the interaction of philosophy and science in the debate about the anthropic principle in cosmology (a branch of physics and astrophysics). The anthropic principle, also known as the "observation selection effect", is the hypothesis first introduced by the American physicist *Robert Dicke* in 1957 in response to English physicist *Paul Dirac*'s attempt in 1937 to explain some observed coincidences between the values of different constants of nature by proposing that the strength of gravity decreases as the universe ages. Dicke showed that these coincidences were equivalent to the requirement that humanity lives late enough in the universe's history for carbon to have formed in stars. So, the weak form of the anthropic principle, proposed by Robert Dicke, says that the universe must be found to possess those properties necessary for the existence of observers.

The anthropic principle has contributed to the development of many new scientific ideas on the existence of worlds other than the one we know, sometimes as a result of the opposition to the teleological interpretations that the principle suggests. The interaction between science and philosophy (and theology) in this case can be summarized in the following sequence. In the first place, several philosophically minded scientists have tried to solve problems regarding the basic features of the world, within the limits of the science of their time. Then other scientists used anthropic reasoning that eventually led to the formulation of the anthropic principle, always in a scientific context and trying to apply the principle to scientific problems. Then, also in the hands of other scientists, the issue exploded and merged with problems in teleology and theology. In its turn, this has provoked further speculation about other worlds and their origin. Also, the so-called fine-tuning of the universe has enlarged the perspectives for teleological reasoning.

Check your knowledge

1. What was the interaction between philosophy and science during their historical development?
2. What are the classic philosophical questions that science is still looking for answers to?
3. Why is an ancient natural philosophy considered a prototype of the mutual influence of philosophical and specifically scientific knowledge?
4. What is meant by the world philosophy of cosmism? Name the famous directions of this philosophy.
5. How is the philosophy of cosmism and modern postnonclassical science connected?

6. Name the Ukrainian representatives of the philosophy of cosmism and explore the essence of their cosmic concepts.

7. What is the anthropic principle in cosmology? What does it state?

8. Is the anthropic principle scientific? Is it testable or falsifiable?

9. How many forms of the anthropic principle are there?

THEME 1.7.

INTERDEPENDENCE OF PHILOSOPHICAL AND SCIENTIFIC KNOWLEDGE IN POSTMODERN EPOCH

Plan:

1. Modernity and Postmodernity in the civilizational progress of the Western World.
2. Modernism and postmodernism in philosophy and science of the XX century.
3. Postmodernist ideas in philosophy and science at the end of the XX - at the beginning of the XXI centuries

Key concepts: *Modern philosophy, Modernity, Postmodernity, modernism, postmodernism, postnonclassical science, relativism, epistemic relativism.*

1. Describing Modernity and Postmodernity in the civilizational movement of the Western world, it should be noted that Western and domestic philosophers define the terms "modernity" and "postmodernity" in different ways. They also highlight different features inherent in the historical stages in the development of culture, denoted by these terms, express a different attitude towards these historical eras. Therefore, it is necessary to establish the main disagreements in the philosophical concepts that divide cultural epochs into Modernity and Postmodernity. First, one should turn to classical philosophical literature, which deals with the era of Modernity, and then move on to describing the opposition "Modern - Postmodern" from the position of postmodernist philosophers. It is necessary to determine the main features of the culture of Modernity and Postmodernity to identify the specific scientific knowledge inherent in these cultural eras.

2. Revealing the specifics of modernism and postmodernism in the philosophy and science of the twentieth century, it should be noted the gradual transition that began in the second half of the XX century - from the cultural tradition of Modernity, in which science was based on the principles of a strictly rationalistic explanation of the Universe, emphasizing discreteness, - to postmodern culture, in which science is aimed at understanding the Universe as a single living organism. Postmodernism, as a cultural and spiritual phenomenon of our time, change the nature of science itself, which becomes more tolerant, and tolerant of other types of discourse: pre-scientific, para-scientific, mythological, religious, everyday etc.

3. Outlining postmodern ideas in philosophy and science in the late XX - early XXI centuries, it is necessary to point out the peculiarity of postmodern scientific consciousness, which is characterized by the coordination of rational and irrational, verbalized and non-verbalized means of understanding the world, developed in various fields: mythology, art, religion, para science, etc. Such a vision changes the attitude of scientists toward nature: instead of a monologue of scientists, a dialogue is formed between nature and its researchers. And nature itself no longer seems to be a stable, dynamically balanced system, which is unambiguously described by dynamic laws. Therefore, a new arsenal of scientific principles, approaches, theories, methods, etc., is emerging, constituting the content of modern postnonclassical science. In connection with the above, students shall reveal the main features of postnonclassical science, which forms new ideas about the unity of order and chaos, recurrence and irreversibility, and balance and disequilibrium.

Check your knowledge

1. What period in philosophy and science development is called "modern"?
2. Describe the features of modernism.
3. What period in the development of philosophy and science is called "postmodern"?

4. Is postmodernism an opposition or alternative to modernism?

5. Describe the features of postmodernism.

6. Which way is the estimation of the philosophy and science relations in the postmodern era changing?

THEME 1.8.
PHILOSOPHICAL GROUNDS OF SCIENCE

Plan:

1. Ontological foundations of scientific knowledge.
2. Epistemological principles of scientific knowledge.
3. Praxeological principles of scientific knowledge.
4. Axiological principles of scientific knowledge.

Key concepts: *axiology, value, epistemology, ontology, praxeology*.

1. Describing the ontological foundations of scientific knowledge, it should be noted that they are a set of ideas adopted in a certain field of science about their subject, the most general properties, patterns, and relationships of the objects studied by it, as well as the nature of their relationship and change. Thus, in science, an idea is formed about the picture of the world, and types of material objects - atoms, matter, field, forms of motion of matter, spatiotemporal characteristics of objects, etc. The ontological foundations of science differ significantly both for specific sciences (physics, history, biology, mathematics, etc.) and for its cultural and historical stages (classical, non-classical, post-non-classical sciences). The ontological basis for the differentiation of sciences is the inexhaustibility of matter, the infinity of various manifestations of reality - things, processes, their properties, and relationships. The dissimilarities, the specificity of the various material and spiritual reality spheres, and their inevitable delimitation from each other give rise to differences in science processes. They allow scientists to focus knowledge on individual specific objects of nature, society, and thinking, increasing the efficiency of scientific activity and creating opportunities for achieving success with less effort and material resources. However, the differentiation of sciences has its drawbacks. In particular, the horizons of scientists engaged in the study of one subject area are narrowing, and this gives rise to the danger of losing sight of some important areas that are on the border with other subject areas. Therefore, integration processes are no less important for the successful development of science. Moreover, the modern differentiation of sciences does not lead to sectoral delimitation but, on the contrary, to their unification. The problem of determining the object of scientific research is closely related to the above because the effectiveness of the scientific research itself depends on the correctness of this procedure. For any area of scientific knowledge, the accuracy of determining its subject component determines the adequacy of understanding the specifics of cognitive activity, expressed through the fixation of the ontological scheme of a particular subject area and its correspondence to disciplinary identity.

2. Revealing the epistemological foundations of scientific knowledge, it should be noted that its general initial principles are the following: objectivity (recognition of the objective existence of reality, which is the object of knowledge); reflection (recognition that the universality of reflection is a property of matter, due to the universal interaction of objects and phenomena); recognition (recognition of the fundamental ability of human knowledge to adequately reflect reality and form a true picture of the world); practice (recognition that knowledge is the result of practical (active) development of the world by man). In a general sense, the epistemological foundations of science include theoretical provisions on the nature of scientific knowledge, the relationship between the sensual and the rational in it, theory and practice, understanding of truth, the status of scientific concepts, etc.

3. Describing the logical procedures of substantiation and proof in science, it should be noted that the logical foundations of science are the rules of abstraction accepted in science, the formation

of initial and derived concepts and statements, the rules of proof, etc. In the broadest sense, "logic" means reasonableness (rationality), internal regularity, and consistency, explicitly (explicitly) or implicitly (implicitly, hiddenly) are inherent in objective things and ideal phenomena. The use of logic as a specific science to study the development of scientific knowledge (the logic of science) helps to identify the patterns of emergence and nature of the transformation of scientific concepts and terms, the principles of the development of scientific knowledge, the justification of the truth of scientific theories, etc. The logical operations used in science include: abstraction, generalization, analysis, synthesis, conjunction, disjunction, negation, etc. At the heart of logic itself is rationality. The basic tool of rational thinking is the logical considerations of a person, the structural elements of which are concepts, judgments, and conclusions. These elements are, at the same time, forms of logical reflection of reality.

4. Defining the praxeological and axiological foundations of scientific knowledge, it is necessary to show their interdependence because the axiological (value) foundations of science are the ideas accepted in science about the practical and theoretical significance of science and its specific parts (theories, etc.) for society, development spiritual and material, the idea of the goals and purpose of science, the connection between the development of science and social development, the moral and humanistic aspects of science, etc., and praxeological is the idea of a particular science about the nature and methods of its relationship with practical activities, forms of application of the results of scientific research, evaluation of the effectiveness of scientific research in the context of their application in the process of social practice, the relationship of science with the innovation system of society.

Check your knowledge

1. Characterize the ontological foundations of scientific knowledge and outline the problem of defining the object of scientific research.
2. Elaborate on the epistemological foundations of scientific knowledge.
3. Define the pragmatic and axiological foundations of scientific knowledge.
4. What is the cause of the interdependence of the pragmatic and axiological foundations of scientific knowledge?

Module 2. "Philosophical and Scientific Methodological Tools"

THEME 2.1.

LOGICAL FOUNDATIONS OF SCIENTIFIC KNOWLEDGE

Plan:

1. The concept of rationality and scientific rationality.
2. The main types of scientific rationality in the history of science.
3. Scientific rationality and its logical basics. Historical varieties of logic.

Key concepts: *classical rationality, nonclassical rationality, postnonclassical rationality, rationality, rational and reasonable rationality, scientific rationality, logical reasoning, traditional logic, classical logic, nonclassical logics.*

1. Characterizing logic as the basis of rationality, it should be noted that the logic here is understood in its broadest sense and means reasonableness (rationality). Revealing the content of the concept of "rationality" it is necessary to establish the difference between it and the concept of "rationalism". *Rationalism* is a philosophical trend that arose in the XVII-XVIII centuries and is based on the position that only reason (ratio) gives true knowledge. *Rationality* is a certain way of organizing knowledge, providing for reasonableness, generalization, orderliness, consistency, and the ability to transfer knowledge from one subject to another, from one generation to the next. The philosophical methodology considers different types of rationality. So, Georg Hegel distinguished between *rational rationality*, on which formal logic is based, and *reasonable rationality*, which is

reflexive, that is, based on critical rethinking, analysis of all existing norms, rules, principles, methods, etc. in new sociocultural conditions or the acquisition of new knowledge. As a rule, this kind of rationality is used in scientific knowledge. The modern Swiss philosopher of science Evandro Agazzi defined *theoretical rationality* as intending to explain the actual state of things and *practical rationality* associated with a person's choice of one of the possible alternatives for performing certain actions in the future.

2. Expanding the content of the concept of "scientific rationality", it should be noted that scientific rationality is a specific way of constructing and substantiating a scientific theory. It is based on the choice by scientists of the appropriate methodological foundations, scientific principles, methods, norms, and ideals of scientific character.

Based on the historical periodization of scientific knowledge, in the modern philosophy of science, three historical types of scientific rationality are distinguished: 1) *classical rationality* - associated with the formation of classical natural science (from the XVII century to the end of the XIX century), when the development of natural sciences (in particular, mechanics) took place) based on the use of mathematical apparatus. The ideal for such type of scientific rationality was an entirely true scientific picture of the world construction based on observations, experiments, and principles arising from the experience of empiricism. Space, time, object, and subject of cognition, by the mechanistic view of classical rationality on the world, were considered in isolation from each other, neglecting chance, the influence of the environment, etc.; 2) *nonclassical rationality* - was formed in the course of the development of nonclassical natural science (the end of the XIX century - the first half of the XX century). During this period, the subject orientation of science is replaced by a problem, its interdisciplinary directions are formed. The construction of a quantum-relativistic picture of the world becomes a scientific ideal: the world is considered not as a state but as a process; the principle of evidence is eliminated from the philosophical foundations of science; there is a formation of idealized objects, which are idealized constructions of human thinking; personal characteristics of the researcher are taken into account; new methodological principles of cognitive activity are being formed - the principle of relativity, the principle of complementarity, the principle of symmetry, etc. Contingency plays a significant role in the process of scientific knowledge. The phenomenon of contingency parameters is studied with the help of scientific methods, which gave a new mathematical discipline - the theory of probability; 3) *postnonclassical scientific rationality* - associated with the formation of post-non-classical science (from the last third of the twentieth century to the present). A specific feature of postnonclassical science is complex research programs based on using complex computer technology for processing, transmitting, and storing scientific information, in which specialists from different fields of knowledge are engaged. The scientific ideal of postnonclassical science is the construction of a synergetic picture of the world and its methodological principles are the principles of coherence (consistency), cooperativity, self-regulation, evolutionism, etc.

3. Comparison of the history of philosophy and the history of science allows us to state their inseparable connection and mutual influence, which lies primarily in the ambivalence of philosophical and concrete scientific knowledge throughout the entire time of their coexistence. Philosophy replenishes and deepens its ideas about the world in the process of generalizing the results of the entire complex of sciences, assimilating the main achievements of the latter in its conceptual categorical apparatus. It is important to understand that any type of scientific rationality is a specific system of rules, standards, and patterns defined for society in a given historical era. In the context of the historical interaction of philosophy and science, it is important to establish what factors determine the transition to a new type of rationality, to a change in the norms necessary to achieve goals that are significant from the point of view of society. Such reflection makes it possible to understand better the features of the modern scientific picture of the world.

Check your knowledge

1. Characterize logic as the basis of rationality.
2. Contrast the concepts of "rationality" and "scientific rationality."

3. What are the types of scientific rationality in the history of science?
4. Outline the peculiarities of classical rationality.
5. How do nonclassical and postnonclassical rationalities differ?
6. What types of logic do you know? Give a short characteristic of each type.

THEME 2.2.
SPECIFICITY OF SCIENTIFIC LANGUAGE

Plan:

1. Everyday language as a source of scientific language formation.
2. The ratio of natural and artificial languages in the development of science.
3. The phenomenon of "migration" of scientific concepts and terms in the process of scientific functioning.
4. Transformation of the scientific language under the influence of information use and communicative technologies.

Key concepts: *word, term, concept, speech, language, natural language, artificial language, scientific language, everyday language.*

1. Characterizing everyday speech as a source of the formation of the language of science, it is necessary to reveal the essence of everyday language and the specifics of the language of science, considering the process of their mutual influence in historical and cultural development. Analyzing the relationship between scientific and everyday language, Wilhelm von Humboldt wrote that the same words could be used in each of them, but this word usage will be different. Vyacheslav Stepin considered its objectivity to be the key feature of the scientific language. The scientist noted the differences between everyday and scientific languages. Science uses natural language but cannot describe and study its objects only on its basis since the concept of everyday language is unclear and meaningful. Their exact meaning most often appears only in the verbal communication context controlled by everyday experience. Consequently, science, using the words of everyday speech, introduces significant clarifications into their content and conquers completely different connections than are in ordinary language. Their original content is almost lost in scientific usage, especially, when an artificial language is formed based on ordinary words.

2. Revealing the relationship between natural and artificial languages in the development of science, it should be noted that science, unlike everyday knowledge, involves special tools and methods to obtain new knowledge. It is not limited to the use of natural language but forms its own artificial languages and harmonizes them with each other, applying the interpretation procedure. The current stage in the development of science gives rise to new types of artificial languages, but this does not devalue the importance of natural speech, which most often serves as a barrier to the penetration into science and everyday life of words that reduce the culture of speech. Natural languages are historically formed first sound (language) and then graphic (writing) information sign systems that arose to consolidate and transmit information in the communication process between people. They are the bearers of the cultural heritage of mankind and are distinguished by their broad expressive possibilities and universal coverage of various spheres of life. A feature of artificial (scientific) languages is that they are created to solve specific cognition problems. Artificial languages appeared as formalized languages of various sciences - mathematics, physics, chemistry, and programming. Consequently, artificial languages act as auxiliary sign systems based on natural languages or a previously built artificial language for scientific and another information-accurate transmission. Scientific languages are subject to normative principles: unambiguity, objectivity, and interchangeability.

3. To understand better the specifics of changing the content of concepts and terms transferred from one language of science to another in the functioning of the science process, it is necessary to identify the differences between the "term" and the "concept". The reasons for the "migration" of scientific concepts and terms lie in the changes in worldview and modern scientific knowledge

methodological guidelines. So, if in previous eras, science rejected everything that did not concern scientific rationality, then postnonclassical science not only does not exclude pre-scientific and extra-scientific knowledge but also demonstrates its continuity to them and has the intention to apply effectively nonscientific knowledge elements. In the era of the birth of science, its terms became words produced in already existing spheres of culture. Over time, science began to produce new terms for its own needs, as well as, extrapolate them to other areas of culture. An example - is the "migration" of the scientific term "information" in mathematics to all areas of culture. The interpenetration of concepts and terms of such kind, and their rather broad interpretation in various areas of use, allows us to explore not only existing objects but also contributes to the desire of science to look into the future. So, in restructuring the conceptual and terminological apparatus of science, an important role is played the clarification of its content and comparison with the realities of life.

4. The computerization of modern cognitive activity and the involvement of non-verbal components of knowledge in it led to the transformation of the language of sciences, which made it necessary to bring them into line with modern machine language. So, I. Alekseeva considers the concept - as a special kind of cognitive image, which has a developed verbal component containing information about some object characteristics (features). At the same time, she notes the opinion about the need for development, clarification, correlation, etc. of existing concepts by a particular situation in cognitive activity. Another feature of the scientist's approach to studying the nature of concepts is their correlation with frames, which are some data structures (images) that interpret the representation of knowledge as a representation of concepts. Concepts and frames are expressed through sign systems - texts. But if the text concept is built on the sentence of an ordinary language, then the text file has the form of a specific ordered sequence of signs of artificial languages and language.

Check your knowledge

1. Describe everyday language as a source of the formation of the scientific language.
2. Reveal the relationship between natural and artificial languages in the development of science.
3. What logical procedures underlie the formation of scientific concepts?
4. Is there any distinction between the "term" and the "concept"?
5. What is an inter-subjective feature of scientific concepts and terms?
6. How do neo-positivism and post-positivism positions differ in the formation of the concepts of science?
7. Show how the formation of concepts and terms is influenced by science computerization.
8. What is the knowledge representation frame?
9. Explain the "migration" phenomenon of scientific concepts and terms.

THEME 2.3.
PHILOSOPHICAL METHODOLOGY AS BASICS OF SCIENTIFIC COGNITION

Plan:

1. Concept of method in philosophy. Method and methodology in the structure of the philosophy of science
2. Relationship between philosophical and scientific methodology.
3. Science, non-science, and pseudoscience.

Key concepts: method, methodology, philosophical methodology, scientific methodology.

1. Revealing the relationship between philosophical and scientific methodology, it should be pointed out that the foundations of the methodological theory were laid by scientists - representatives of classical natural science Galileo Galilei, Francis Bacon, René Descartes, Isaac

Newton, Albert Einstein, Werner Heisenberg, Niels Bohr, Volodymyr Fock, Lev Landau, Ilya Prigogine, and others continued their methodological research.

I. Newton was the first to apply the methodological principle of combining theoretical knowledge with empirical one to create an integrated scientific picture of the world. This principle applies to modern science as well. Hegel's dialectical method helped to combine organically the elements of knowledge that different sciences received. Without replacing the methods of specific sciences, dialectics, with the help of its system of categories, contributes to the formation of new approaches, and research methods in different sciences, because it comprehensively reflects the general properties and connections inherent in all objects without exception. The problem of the relationship between philosophical and scientific methodology was considered both by philosophers and natural scientists, particularly the scientist Volodymyr Vernadsky. In the philosophy of science, for a long time was a certain opposition between the philosophical method of cognition to the formal-logical one, and also the methods of specific sciences. But later, it turned out that philosophical and specific scientific methods are an inseparable unity, complementing each other.

2. Describing the methodological foundations of the empirical and theoretical levels of organization of scientific knowledge, it should be noted that for the first time, the development of criteria for their difference was formulated by representatives of logical positivism (one of the currents in neopositivism) back in the 30s of the twentieth century, when, in the process of analyzing the language of science, significant differences in the meanings of empirical and theoretical terms. And the neopositivist approach breaks the dialectical unity of the sensual and the rational, which negatively results in the development of the scientific methodology. Subsequent studies have shown that the division of scientific knowledge into empirical and theoretical - is rather arbitrary, although these levels of scientific knowledge are characterized by different methodological approaches, methodological techniques, and means. The methodological foundations of empirical knowledge are based on the rational moment of cognition and guided by the direct study of phenomena through the senses or the use of instruments and experimental installations. It is characterized by the collection of facts, primary generalization, description of experimental data, as well as systematization and classification. Empirical research is a special type of scientific and practical activity during which empirical information is collected, the results of observations and experiments are comprehended, empirical laws are discovered, data arrays are formed, etc.

The methodological foundations of theoretical knowledge are related to the functioning of concepts, theoretical constructs, laws and principles, scientific generalizations, etc. Theoretical knowledge reflects the relations and properties of objects and phenomena of the objective world in the context of their internal universal and essential connections and patterns.

3. Expanding the concept of method in philosophy, it should be noted that, depending on the consideration, it acts simultaneously as a system of principles, rules, techniques, requirements, methods, and norms of cognition for the study of phenomena, properties and laws of nature, society and thinking; way, way to achieve certain results of knowledge; a set of interrelated specific research techniques, methods, operations of theoretical research or practical implementation of the cognitive activity results. Methods express the connection between the subject and the object of cognition and reveal the interaction system. It is through methods that the subject of any science realizes its characteristics and deeds. By their origin, scientific methods are derived from the subject of science, which they represent, and reflect the direction of its development. And yet they have relative independence compared to the subject that generates them, and therefore the same methods can be applied in various sciences.

4. From a philosophical position, methodology as a general theory of the construction of human activity is associated with the socio-historical development of the means of human activity and is dependent on the nature of the problems it faces. The methodology is the doctrine of the methods, methods, and forms of organization of scientific activity. It reveals the ways of construction, structure, and principles of knowledge substantiation; this is a specific area of knowledge about the general patterns and trends of scientific knowledge, which acts as a special

activity for the production of scientific knowledge, taken in their historical development and considered in a historically changing socio-cultural context. Methodology is a metatheory (theory of theory), organically woven into the body of specific scientific research.

Check your knowledge

1. Compare definitions of the scientific method in classical, nonclassical, and postnonclassical science.
2. What interpretations of methodology do you know? What is the essence of the methodological consciousness of scientists?
3. How do method and methodology correlate in a particular research work?
4. What are the main methodological strategies in Western and domestic philosophy of science?
5. What is the relationship between philosophical and scientific methodology?
6. Name the characteristics of scientific knowledge.

THEME 2.4.

CORRESPONDENCE OF PHILOSOPHICAL AND SCIENTIFIC METHODOLOGY

Plan:

1. Levels of methodology: philosophical, general scientific, and specific scientific.
2. Criteria for classification of scientific methods.
3. The concepts of methodological approach, methodological principle, and methodological tool in science.

Key concepts: philosophical level of methodology, general scientific level of methodology, specific scientific level of methodology, methodological approach, methodological principle, methodological tool.

1. Revealing the philosophical, general scientific, and concrete-scientific levels of methodology, it should be noted that they are a complex interconnected system within which the philosophical level acts as the substantive basis of any methodological knowledge. Philosophy determines the worldview approaches and principles of the process of cognition and transformation of reality. In modern science, the following levels of methodology are distinguished: the *philosophical* (highest) level, which contains the general principles of cognition and the categorical structure of science as a whole (structural components), as well as the entire system of philosophical knowledge (functional components); *general scientific* methodology, or the level of the methodology of general scientific principles of research, containing theoretical concepts used in all or most scientific disciplines; *specific scientific* methodology, which is a set of methods, principles of research and procedures used in a particular scientific discipline.

2. Describing the criteria for the classification of scientific methods, it should be noted that, according to the main stages and patterns of the cognitive process, two main groups are distinguished in the classification of methods: methods of empirical and methods of theoretical level of knowledge. However, their distinction is not absolute. Each of these levels performs a specific cognitive function carried out through a system of methods.

For the empirical level of cognition, it is important to single out the object of study and systematize knowledge about it. Methods for isolating and studying an empirical object include a) observation; b) description; d) measurement; e) experiment; e) modeling. Based on these research methods, relatively stable ideas about the world - facts are formulated. l research. The methods of constructing theoretical knowledge include a) deductive (axiomatic, hypothetical-deductive); b) historical (concrete-historical, abstract-historical); c) systemic. The classification of methods carried out is not exhaustive and not the only possible one.

3. Expanding the concepts of the methodological approach, methodological principle, and methodological means in science, it should be noted that the method differs from the method, means, and approach to cognition.

The "methodological approach" is the fundamental methodological orientation of the study, that is, it acts as a method in its undeveloped form in the process of its formation, while the "method" is a relatively complete and stable formation based on the general laws of the development of reality. Not every approach can turn into a method. That is, the scientific method is richer, fuller, and more meaningful than the approach to knowledge. Therefore, the method includes the approach in a "removed" form since it can rely simultaneously on several interconnected approaches.

Regarding the "methodological principle", it rather appears as the main idea, the cognitive attitude of the researcher, or the fundamental position of the scientific school (theory), reflecting the systemic, cumulative action of the objective laws of the development of nature, society, thinking, directing the cognitive activity of the subject in the chosen subject area. In this context, the methodological principle acts as a specific criterion for selecting a method, taking into account the relevance, admissibility, expediency, and adequacy of the last task. It should be noted that the methodological principle is deployed (concretized) in an integral methodological system and not in one specific method. Together with other principles, it systematizes and builds a hierarchical structure of the entire set of methods, techniques, means, etc. used in a particular science, theory, research, etc.

"Method" should be distinguished from method and technique, because it is a set of interrelated specific research techniques, methods, and operations. The method and technique can be identified since each of them is one cognitive tool used in the research process mostly automatically. However, the method, method, and technique have both distinctive features and something in common. What they have in common is primarily that they represent the process and direction of the development of scientific knowledge, and all of them are derived from the subject of study, determined by it.

Check your knowledge

1. What levels of methodology do you know?
2. Describe the levels of methodology: philosophical, general scientific, and specific scientific.
3. Name and characterize the criteria for the classification of scientific methods.
4. Explain the concepts of methodological approach, methodological principle, and methodological tool in science.
5. What role does a methodological principle play in the system of scientific cognition?

THEME 2.5.

PECULIARITIES OF METHODOLOGY OF NATURAL, SOCIAL, HUMANITIES AND TECHNICAL SCIENCES

Plan:

1. Dependence of the choice of scientific research methodology on the object.
2. The specifics of the relationship between the historical and the logical in the humanities, natural, technical, and social sciences.
3. The usage of hermeneutic procedures in the humanities, natural, technical, and social sciences.

Key concepts: *hermeneutics, methodology of scientific research, scientific method.*

1. Revealing the dependence of the choice of the methodology of scientific research on the object, it should be noted that it is through methods that the subject of any science realizes its

properties and relationships. On the one hand, scientific methods, in their origin, are derived from the scientific subject that they represent and reflect the direction of its development. On the other hand, they are interdependent with the object of study. The scientific method is determined by the content of the object being studied and, at the same time, it influences the knowledge content obtained about this object because the interpretation of certain scientific concepts also depends on the choice of methods of cognition. Thus, it is impossible to abstractly and arbitrarily choose one or another method for studying a particular object. Instead, the very procedure for determining the object of study is associated with the appropriate method choice.

2. Describing the specifics of the relationship between the historical and the logical in the natural, technical, social, and human sciences, it should be noted that our thinking has historical nature because it is the result of the practical development of the world. At the same time, history is logical, given its inherent determinism and causality. The historical development and differentiation of scientific knowledge led to the emergence of each science, in addition to general scientific and philosophical tools, of its own arsenal of scientific methods and cognitive means. Given that different sciences have different objects of knowledge, the study of the latter, and the identification of their properties and relationships are accompanied by an awareness of the scientific method or their combination. At the same time, one should also consider science inclusion in the relevant socio-cultural space, especially regarding the problem of choosing scientific methods in physics. The radical changes that occurred during the transition from classical to modern physics are associated with a change in the very object of physical research, the evidence of which has become problematic. Another reason for the change in the choice of methods of physical cognition is the significant development of modern mathematics, its methods allow, without resorting to measuring instruments, to study the objects of the macro- and microworld in sufficient depth.

Thanks to the development of the mathematical apparatus of science, theory acquires a procedural character and turns into instrumental knowledge, that is, the scientific method. Faster than other branches of science, natural and technical sciences, as well as interdisciplinary scientific trends based on the quantitative methods usage, react to changes in mathematical methods. The humanities are also used to a certain extent by quantitative research methods but with significant reservations. In particular, G. Gadamer believes that thanks to the “hermeneutic phenomenon” the humanities are approaching such methods of comprehension that lie outside science: with the experience of philosophy, art, and history itself. At the same time, in his opinion, the method itself here has rather vague contours. Such an idea of the scientific method in the social sciences and humanities contradicts the classical approach to the knowledge of spiritual phenomena. It laid the foundations for postnonclassical approaches to the application of scientific methods in the cognition of socio-cultural phenomena associated with a combination of previously unconnected formalized and descriptive, scientific and everyday, pre-scientific and para-scientific methods for obtaining various forms of knowledge, as well as “narrations” (Jean-François Lyotard).

3. Outlining the application of hermeneutic procedures in the natural, technical, social, and human sciences, it should be noted that in the broadest sense, hermeneutics is associated with the interpretation or interpretation (clarification) of the content, elements of one language in terms of another. In particular, this concerns the application of concepts, terms, signs, symbols, schemes, models of mathematics, and other deductive sciences to the description of objects of natural, technical, and social sciences that are subject to formalization, and in modern conditions - computerization and informatization. Or when there is a need to interpret one theory in the meaningful terms of another. Also, when constructing formal theories, especially in logic, mathematics, and partly in mathematical physics, interpretation is understood as the interpretation of a theory by identifying its objective content, the meaning of its terms, and the physical content of mathematical expressions. In an experimental study, interpretation is understood as the interpretation of certain physical, chemical, and other phenomena from a single, more general point of view, their explanation with the help of an already known theory or hypothesis. In the humanities, interpretation is understood as the interpretation of texts associated with the clarification of the meaning laid down in them by the authors. As a cognitive procedure, it is used in

linguistics to establish the meaning of speech actions. In philosophy, the problem of interpretation is considered a way of being of the subject himself, who is in a situation of understanding. That is why hermeneutics here is the theory of interpretation.

Check your knowledge

1. How does the object of research affect the choice of methodology?
2. Why is history logical and logic is historical?
3. Describe the specifics of the relationship between the historical and the logical in the natural, technical, social, and humanitarian sciences.
4. What is hermeneutics? Is there a difference between hermeneutics and interpretation?
5. Define the role of the hermeneutic procedure in scientific research.
6. What are the specifics of the application of hermeneutic procedures in the natural, technical, and social sciences?

THEME 2.6.

INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN THE STRUCTURE OF CONTEMPORARY SCIENTIFIC KNOWLEDGE

Plan: 1. The role of human-machine systems in humanities, natural, social and technical sciences.

2. The essence of information modeling in modern science.
3. The specifics of modeling complex nonlinear processes in natural, technical, and social-humanitarian sciences.

Key concepts: human-machine system, information modeling, computer interpretation, technics, technical sciences

1. Revealing the role of the human-machine system in the natural, social, humanitarian, and technical sciences, one should note the modern integration trends in science (the formation of interdisciplinary sciences). Their peculiarity is that they arise at the junctions of different subject branches that use the same cognitive means: methodological principles, methods, and techniques, as well as a general conceptual and terminological apparatus. Social sciences and the humanities are increasingly involved in these processes whereas, in the past, integration took place mainly in the natural science field, which primarily used mathematical means. An important role here has been played in the creation of the man-machine system, which is both an object and a means of modern scientific knowledge. In the conditions of computerization, technical sciences synthesize pieces of knowledge of mathematics, natural sciences, psychology, socionics, linguistics, etc.

2. Outlining the essence of information modeling in modern science, it should be noted that due to the widespread computerization of science and practice, the so-called computer interpretation has become one of the varieties of interpretation. Therefore, in modern science, the most significant role is given to the methods of information modulation and computer experiments. Since computer technology and information technology are based on formalized artificial language usage, the main problem is the search and construction of adequate models with the help of which the specific information processing is carried out, its interpretation in symbols and signs of the corresponding language.

3. Revealing the specifics of modeling complex nonlinear processes in the natural, technical, social, and humanitarian sciences, it should be pointed out that modern post-non-classical science deals mainly with complex, open, non-equilibrium, nonlinear systems, which are influenced by probabilistic factors, therefore it uses primarily stochastic mathematical models. Recently, stochastic models have become widespread, which, together with the information technology use, leads to new radical transformations in the structure of the scientific method. They qualitatively change the scientific knowledge appearance and internal structure and reveal new epistemological

and methodological problems of the relationship between traditional methods of obtaining new knowledge and modern ones using information technology. Under these conditions, such a traditional method of cognition as a thought experiment received new content, which, with the introduction of computers into scientific activity, turned into a mathematical (or machine) experiment based on the principles and ideas of mathematical modeling.

Check your knowledge

1. What is a human-machine system?
2. Reveal the role of the human-machine system in humanities, natural, social, and technical sciences.
3. Explain the role of the model in scientific knowledge.
4. Show the difference between natural, mental, and informational models.
5. What role does information modeling play in the development of modern science?
6. Can information modeling be used in any scientific research? Justify your answer.
7. Reveal the specifics of modeling complex nonlinear processes in natural, technical, and social sciences.

THEME 2.7.
CLASSIFICATION OF SCIENTIFIC KNOWLEDGE

Plan:

1. The concept of classification in science. Basic principles of the classification of sciences.
2. Scientific knowledge and its typology within the historical development.
3. Interdisciplinary sciences in the structure of modern scientific knowledge.

Key concepts: *applied sciences, fundamental sciences, humanities, natural sciences, sciences classification, social sciences, technical sciences, interdisciplinary sciences.*

1. Describing the concept and essence of classification in science, it should be noted that modern science is a single integrated system with certain connections with other areas of culture. Therefore, in the sociology and methodology of science, pre-scientific, scientific, non-scientific, and para-scientific are distinguished; everyday knowledge, and in science itself - theoretical and empirical; natural science, humanitarian and technical; verbalized and non-verbalized, etc. In the structure of any scientific knowledge, some elements are not included in the traditional concept of scientificness: it is characterized by both homogeneity (homogeneity) and heterogeneity (heterogeneity). Therefore, scientists, philosophers, methodologies, and sociologists of science seek to systematize the results of the cognitive process and demarcate between different types, types, and forms of knowledge according to specific criteria. This leads to the construction of a certain cognitive coordinates system, determined by the corresponding styles of thinking, paradigms, themes, research programs, and definite pictures of the world, which constitute the initial prerequisites for the formation of the specific content of scientific concepts, theories, explanatory schemes, etc.

2. Outlining the historical periodization of science: classics - non-classics - post-non-classics, it should be noted that these types of science differ not only in their subject content and disciplinary scope but also in their principles: ontological, epistemological, methodological, and social. In this regard, it is necessary to bring ontological, epistemological, methodological, and social foundations of classical, nonclassical, and postnonclassical sciences and then move on to a general description of each of these sciences.

3. Describing interdisciplinary sciences in the structure of modern scientific knowledge, it is necessary to show that the emergence of these sciences is associated with the processes of informatization and computerization, as well as the phenomenon of diversification, which means heterogeneous and at the same time parallel development of different in the subject of research, problem orientation, methods of scientific and cognitive activity often unrelated sciences. The

purpose of diversification as a methodological procedure is to identify differences in the style of thinking, the type of scientific rationality, research methods, and means of forming the conceptual and terminological apparatus in each science field. This contributes to the search for common scientific knowledge means, the mutual enrichment of sciences, and, ultimately, the accelerated development of science and the objectification of its results. The features of the modern diversification of scientific knowledge are caused primarily by the formation of interdisciplinary sciences that do not fall under existing classifications. These sciences arose at the intersection of varied sciences - natural, social, humanitarian, and technical - and solve common problems for them.

Check your knowledge

1. What does the procedure of science classification mean?
2. What historical period required the classification of sciences?
3. What traditional types of science classification do you know? What criteria are they classified by?
4. What are the functions of the classification of sciences in methodology? Show the value of the classification of science for the development of scientific knowledge.
5. What are the main characteristics of classical science?
6. What is the essence of Newton's scientific method?
7. What features are inherent in nonclassical science?
8. What are the features of postnonclassical science?
9. How do the object and subject correlate in classical, nonclassical, and postnonclassical science?
10. What stage of society's development are interdisciplinary sciences at? What is their originality?

THEME 2.8.
SCIENTIFIC COMMUNITY. ETHICS FOR SCIENTISTS

Plan:

1. Problems of forming a scientific community. The ethos of science
2. The concept of the moral responsibility of the scientist.
3. Features of scientific communication through social networks and digital platforms.

Key concepts: *ethics, ethos of science, scientific community, scientific communication.*

1. Revealing the problems of the scientific community formation, it should be noted that modern science has formed a view of knowledge as a sphere that avoids a moral dimension. At the same time, science as a social institution is embedded in the system of social relations. This means that it is based not only on the requirement of the truth of the acquired knowledge but also relies on the value-moral and socio-cultural dimension of the society that uses the heritage of science. Therefore, throughout the entire historical period of the functioning of science as a specific sphere of social activity, scientists themselves have developed a set of norms, rules, and principles of behavior, internal values accepted in the scientific community, having the status of moral norms. This set of the scientific community's internal values is called "scientific ethos" or "ethos of science" which includes the following regulators: universalism; collectivism; unselfishness; organized skepticism; rationalism; emotional neutrality; honesty, and scientific conscientiousness in the activities of scientists.

2. In postnonclassical science, an important role is assigned to the moral responsibility of scientists for the use of scientific discoveries. The internal ethics of science, stimulating the search for truth and orientation towards the increment of new knowledge, is constantly consistent with general humanistic principles and societal values. That scientific knowledge is considered in the context of specific social conditions and their social consequences and determined at each stage of its development by the general state of the culture. The ethical foundations of science are based on a

systematic, comprehensive, and not a utilitarian one-sided, and fragmentary assessment of activity, which provides an orientation towards an interdisciplinary synthesis of science. For example, when developing the issues of evaluating technology, a group of philosophers and engineers of the German Union of Engineers determined the primary values that objects of technology and technology should correspond to: personal development; public utility; human health and safety; economy and environmental friendliness; functional suitability.

3. Outlining the features of scientific communication through social networks and digital platforms, it should be noted that in the conditions of the information society formation, the information culture plays a significant role among all information users. For interpersonal communication in computerization conditions, the scientific community produces a system of norms and principles for conducting a dialogue, which also provides for moral responsibility for the truthfulness of the information provided, adherence to the rules of academic and scientific virtue, tolerance towards other ethnonational cultures, traditions of scientific schools, etc. This approach to scientific information culture formation helps to provide more flexible access to a significant part of the information concentrated on the Internet, researchers and scientists, as well as all interested parties.

Check your knowledge

1. Expand the problems of the formation of the scientific community.
2. Define the ethos of science.
3. Describe the concept of moral responsibility of a scientist.
4. What is techno-science?
5. Describe the features of Internet communication.
6. Determine the features of scientific communication through social networks and digital platforms.
7. They say, humanity must become stronger and smarter. Why, then, is the likelihood and scale of technological disasters growing? Is a crisis-free reality of earthly humanity possible in the near historical perspective, and was it in the past? What is the role of technological development in the emergence and overcoming of