

Міністерство освіти і науки

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**Methodical instructions**

**for independent work**

**from the discipline**

**“Methodology and organization of scientific researches”**

(for the students of speciality 073 «Management»)

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The manual for the study of discipline “Methods and organization of scientific researches” contains the compressed exposition of material, includes control questions and independent tasks on every section. It is intended for teachers, students, specialities of higher institutes, which study this object.

The manual is developed in accordance with curricula and can be used for engineering and economic universities, and also by the specialists of pertaining to national economy complex.

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**INTRODUCTION**

Purpose of manual is expansion and deepening of theoretical knowledge, acquiring skills for solution of practical tasks of methods and scientific researches organization of future master's degrees, students.

A modern specialist, master's degree, must solve in practice problem questions by scientific methods, conduct scientific researches, posess foundations of scientific cognitions.

A future research worker must know methodology of scientific researches, must be able to organize scientific research rationally and effectively, correctly formalize results of researches, know problems of their introduction into production.

Specialists, master's degrees, research workers, owning methodology of scientific researches, must be able to determine priority directions, industries, spheres of researches realization, to calculate research`s technical and economic effectiveness.

The purpose of discipline is armament of future master's degree, research worker with knowledges and skills of creative labour, independent idea development, skills and intellection development.

The tasks of discipline study come out of the goal and consist in the following:

- to show the place of scientific researches in society development;

- to expose the concept of scientific knowledge elements of theory scientific researches;

 - to consider the stages of scientific and technical researches and registration order of researches results;

- to learn to conduct specific calculations of scientific researches efficiency;

 - to expose maintenance and directions of public policy in the field of science.

**CHAPTER 1. BASIS OF SCIENTIFIC RESEARCHES**

***1.1 Object and task of discipline***

Science is a sphere of human activity, the function of which is production and systematization of objective knowledge about reality. Science is the system of knowledge about nature, society, thought, about objective laws and their centuries-old development. Actuality of scientific researches consists in the personal interest of humanity to study and use appropriate connections of the objective world.

Methodology of scientific researches is a doctrine about scientific research methods, is a division of theory cognition and based on certain philosophical conceptions. The postulates on which the methodology of scientific researches founded are:

1. the world is material.

2. the world is cognitive.

3. result of cognitive process is truth.

4. practice is a source, purpose and guideline of truth.

Only after long and comprehensive researches it is possible to get a scientific result. Therefore the main feature of methodology of scientific researches is aspiring to get authentic knowledge.

The process of becoming scientist consists in independent thought development and in production of mental activity habit. In addition young scientist must work out patience and self-control. These features are needed, since advanced study is related to experiments which are often long-termed. The state declared basic directions of science development and support of scientists in new version of Law of Ukraine "About scientific and scientific and technical activity" accepted on December 1, 1998.

Lets examine basic terms and definitions.

Considering the orientation and direct attitude toward practice it is accepted to divide science into **fundamental** and **applied**. The task of **fundamental sciences** is laws cognition, which manage proceeding and co-operation of basic nature structures, thought, and society. These laws are recognised independently of their possible use. Purpose of **applied sciences** is use of fundamental sciences results for the decision of social practical problems. On the whole science is divided into three groups which answer the corresponding areas of knowledge: **natural, public, technical**. All engineering sciences are applied.

Basic definition of innovations was given by Austrian economist Schumpeter in a book "Theory of economic development" (1912), where this term was named "new combination", meaning other quality of capital goods, which are achieved not by the shallow improvements of old equipment and present organizational chart, but discretely, along with them, through introduction of new means of production, systems of it`s organization. Innovation is not simply creation of something fundumetly new, but this is a new function of production.

A scientist L.S. Blyahman in the book " Economy, organization and planning of STP" (1991 year) writes: "Innovation is a progressive change of product, technique, technologies and organization of production, where scientific degree materializes ".

Scientific and technical progress is materialization of scientific knowledge in separate elements of productive forces (A.I. Anchishkin. Science – technology - economy. 2 publishing houses of - М: Economy, 1989).

V.P. Loginov determines scientific and technical progress as synthesis of intensification and efficiency (book "Acceleration STP and efficiency of production". - М: Science, 1988).

***1.2 Scientific potential and its logistical support.***

Basis of scientific potential of Ukraine is formed by establishments, organizations, enterprises and services of industry "science and scientific service", where scientists work (academicians, members-correspondents, doctors and candidates of sciences, research workers). Organizationally scientific potential functions in four sectors:

- academic;

- branch;

- higher institute;

- factory field.

A private sector develops for today, namely: small scientific enterprises, non-state scientific educational establishments.

75% of scientific establishments which conduct research works are concentrated in academic sector. Nearly 16% of all occupied in science and scientific service are engaged there.

Branch sector – the most meaningful considering amounts of employed.

State block consists of higher state educational establishments of III-IV accreditation level; higher educational establishments founded on the basis of private property (mainly establishments of III accreditation level) form non-state block.

Factory sector of science concentrates its activity on applied researches and experienced-designer works.

Small scientific enterprises conduct insignificant research works of local value, conduct design-engineering developments.

On the whole in the state science is coordinated by Ministry of education and science, National Academy of sciences of Ukraine, Academy of medical sciences, Academy of pedagogical, Academy of legal, Academy of agrarian sciences.

The characteristic feature of scientific potential development in Ukraine was development of research and design base. Practically all large enterprises owned research institutes, design offices. Main scientists suppose that potential of design offices must exceed institutes potential.

Development of material ground consists in:

1. Creation and development:

- the research fields;

- grounds;

- laboratories;

- archives, libraries.

2. Increasing of scientific establishments funds, because for now this index is at level of the year 1990.

3. financing of science according to the Law of Ukraine "About scientific and scientific and technical activity" from December 1, 1998, and that is 1,7 % of GDP.

*Control questions.*

1. Name a few determinations of science.

2. What is studied by "Methodology of scientific researches"?

3. Name postulates which methodology is based on. Describe them.

4. In what does actuality of scientific researches consist?

5. Give determination of fundamental and applied sciences. What is the difference between them?

6. Determine: innovation, scientific and technical progress.

7. Describe the legislative base of Ukraine in the sphere of science, in particular, law of Ukraine "On scientific and scientific and technical activity" from December, 1, 1998.

*Task to 1.2: Deepening the knowledge about scientific potential and logistical support of science.*

Form of realization: discussion of practical present situation in relation to scientific potential of Ukraine and him logistical support.

Practical study is suggested to conduct on such chart:

1. To define the scientific sectors, their structure.

2. To consider non-state sector development in science (private higher institutes, small private scientific enterprises).

3. To define academic branch, higher institute and non-state science sectors in the state.

4. To consider the logistical support of science in technical university.

**CHAPTER 2. BASIC CONCEPTS OF SCIENTIFIC COGNITIONS.**

***2.1 Concept of scientific knowledge.***

Knowledge is any kind of expression of summarizing presentations of appropriate connections of the objective world. Knowledge is a product of people`s public activity, which refers to reality transformation. The process of motion of human idea from ignorance to knowledge is named cognition in basis of which lies the reflection of objective reality in consciousness of man in the process of his activity. Cognition disaffiliates with practice and then directs at practical capture of reality.

True knowledge exists in the type of laws of science, theoretical positions and conclusions, studies which are confirmed by practice and exist objectively. Relative knowledge is knowledge, which represents reality, differs in some incomplete match of character with object. Absolute knowledge is a complete, comprehensive reproduction of summarizing views about object and it provides complete match of character with object. Absolute knowledge can not be denied or changed in future.

Cognition includes two levels: perceptible and rational. Perceptible cognition forms empiric knowledge, and rational - theoretical. Perceptible cognition provides direct connection between man and surrounding reality. The elements of this cognition are feeling, perception, and apprehension. Rational cognition complements and proceeds perceptible cognition, helps to realize the essence of processes, reveals regularity of development. The form of rational cognition is abstract thought. Thought is the mediated and generalized reflection of substantial properties, causal relations and appropriate connections between objects and phenomena in the brain of man.

A scientific idea is intuitive phenomena explanation without intermediate argumentation, without realization of all connections on the basis of which conclusion are made. It is based on available knowledge that reveals rules not observed in the past.

A theory (from lat. theoreo - examine) is the system of generalized knowledge, explanation of different sides of reality. It is based on results of cognitive activity and practice. It is generalized experience of consciousness of people. Initial positions of scientific theory are named postulates or axioms. In modern logic and science methodology a postulate and axiom is used as equivalent ones. The axiom is position which supposes as starting position, unproven in theory, which all suggestions hatch from.

Motion of idea from ignorance to knowledge directs by methodology. Methodology is a study about the methods of cognition and transformation of reality, application of principles of perception of the world in the process of cognition, creation and practice. Two connected functions show up in methodology:

1. Grounding of outlook appliance rules towards the process of cognition and world`s transformation.

2. Determination of approach to facts of reality.

First function is general, second - partial.

***2.2 Elements of scientific and technical creation theory***

Creation is higher form of thought, which outsteps beyond known, and also that is activity which generates fundamentally new cognition of outward things and aims to satisfact humans practical necessities. Scientific and technical creation is a search and decision of tasks in area of technique on the basis of achievements of science. Scientists refer logic and intuition to mechanisms of creation. "Through mediation of logic they prove, through mediation of intuition they inventt", - said А. Puancare. Specific act of creation - casual realization (insight) - is in realization of everything that arose out of depth of consciousness, in the scope of elements of situation in those connections and relations which guarantee the decision of task. Idea is the most essential type of thought for creation. Creative presentation, fantasy play decisive role in creation of new development of society.

Psychological inertia is opposite to creative presentation of thought, related to past experience and knowledge, with the use of standard methods.

Contradictions in the technical systems are extremely various. In the process of scientific and technical tasks solution consistently appear firstly external, and then internal contradictions. External contradictions forego scientific and technical task and create reasons for its detection and decision. Technical contradictions appear between system elements and its parts, between technical options and properties. For example, increasing of constructions streng can lead to unacceptable value of its mass; increasing nuclear power plant power can worsen ecological situation.

Heuristic receptions and methods of creative labour activation are main methodological assets of scientific and technical creation. Lets analyse some of them.

Method of crushing and amalgamation. For example, nut, bolted on the installed cartridge, which is enshrined in the corps can be screwed of it without removing the body of the unit; combining two tires in automobile wheel can increase the reliability and loading.

Method of taking (selection of necessary part). For example at a fluorography to protect many organs from x-rays on the way of radiation they put a leaden screen, leaving only necessary parts of thorax.

Method of inversion. For example, at the stand rolling of car, stand drums create counteraction to the wheels of car; in order to determinate aerodynamic resistance of cars baskets in a wind-channel on meeting to conditional motion of basket a blast is given. A car and basket remain in place in the first and in second example.

Method of universality (portfolio grip can serve simultaneously as espander).

Method of damage transformation into benefit can be realized, for example during buses forced engine braking.

The analysis of patent materials shows that inventions of high level, as a rule, based on the direct use of the physical phenomena, natural laws. Many research groups create funds of descriptions of physical and technical effects, banks of ideas and projects aiming to increase the amount of inventions, extend the areas of invention.

*Control questions:*

1. Explain difference between scientific knowledge and cognition.

2. Determine veritable, relative and absolute knowledge.

3. Give an example of some scientific ideas and theories.

4. What is studied by methodology of science?

5. Determine concept "scientific and technical creation".

6. Analyze development of scientific and technical activity in Ukraine for the last 5 years.

7. Name basic laws in Ukraine, which regulate technical innovation.

*Task to 2.1: To get practical skills in relation to concepts application of scientific knowledge.*

**Form of realization: Practical study.**

1. To give basic and profound definition of "knowledge" and "cognition".

2. Making examples about veritable knowledge (laws of Ohm, Boil-Mariott, free falling; theoretical positions: relativity Einstein theory, probability theory, theory of large and small economic vibrations cycles; studies Keynes, Schumpeter and others).

3. To give examples on absolute and relative knowledge (knowledge about planets is relative, flights theory is absolute knowledge).

4. A scientific idea discussion of transformation the economic system in Ukraine with the achievement purpose of concrete index increase and construction on this theory idea.

*Task to 2.2: to learn in practice how to use the theory elements of scientific and technical creation.*

**Form of realization: the productive situation.**

Practical realization - it is suggested to conduct on such chart: Consideration productive situation. In practice there are situations, when it is impossible to avoid the use theory elements of scientific and technical creation, for example:

1. At increasing engine power of internal combustion - its mass increases to the impermissible size (an engine is set on an airplane).

2. Nut, that involution a screw-bolt, which is envisaged in a corps it is possible to take off directly from a screw-bolt (if accessible place) and take off a corps from an asm, component part which is a corps, and later to screw together a nut.

On the basis of external contradictions:

1. In the first example analyze contradiction in the system engine-airplane, find a few variants in practice certain types establishment of engines: turbo-jet, reactive on concrete type’s airplanes: biplanes, monoplanes, turbojet, reactive and others like that.

2. In the second example name contradictions, to determine the heuristic receptions decision of problem consist in what, optimal decision way of similar task in practice. On a concrete example analyze contradiction in designer documentation, their decision in the process experimental production, experienced party, mass production.

Give an example, funds examples, descriptions physical and technical effects, banks ideas creation and projects inversion receptions.

**CHAPTER 3. METHODOLOGY OF SCIENTIFIC RESEARCH.**

***3.1 General theory of knowledge.***

Theory of knowledge is a study about mans cognition of the real world, about origin and development of cognitive process, about methods and forms it fulfils in, about truth and criteria of its authenticity. The process of mans reality cognition is carried out in empiric and rational form.

Cognition of objective truth folds three stages:

1. Direct observation of external features of the phenomena.

2. Abstracting and generalization.

3. Verification of theoretical conclusions by practice.

Direct observation of external features of the nature`s phenomena carried out by means of sense-organs. Process of cognition begins from feeling and perception. Conception is more mediated form of connection of consciousness with the outer world. That is a specific image of objects or phenomena which previously affected senses, that is a form of knowledge, which consists in association of evident characters. Presentation serves as a transitional degree from cognition to logical thought. Logical comparisons, trial experiments, appliance of technical means of observation are not eliminated during direct observation.

Abstracting is imaginary selection and personification one of object`s properties, one connection with other objects, and then discovery of dependence of indexes of the phenomena from basic factors with the help of analysis and synthesis of the phenomena. On this level cognition moves from the phenomenon to reality, from specifically perceptible factors to natural and social laws, from specific to abstract. Thus abstract concepts operation is not end in itself, but only a mean of raising to specific, that is to such knowledge which would remove concrete diversity of the world. Mathematical vehicle (mathematical analysis, mathematical statistics, theory of chances, theory of relativity) is widely used on this degree of cognition. Example. In the days of the ancient greek philosopher Aristotle (IV century B.C.) it became firmly established that heavy bodies fell quicker than the easy ones. Next generations held ideas that bodyweight which falls determines the rate of its movement. They assumed at the same time that speed of body is proportional to distance from the beginning of falling. Approximately after 2000 years Galileo denied these suggestions. He came to the conclusion that all bodies must fall with an identical acceleration (not taking into account air resistance). However, experience with free-fall bodies in emptiness was carried out by І. Newton in the end of XVII century.

Concerning connection between falling body speed and its co-ordinates by mentally-observant ideas Galileo came to the conclusion about absence and impossibility between their direct proportion. Nowadays it can be proved through mathematics. Lets assume that х - is a co-ordinate of falling body; a - permanent index; t - time. Assuming the presence of direct proportion between body speed and its co-ordinates, we will write down:

dx/dt=ax, or

dx/x=adt,

∫dx/x=∫adt

**lnx=at+lnc**, wherefrom

x=Ceat i

dx/dt=Caeat

it must satisfy two terms:

At t=0, x=0 i dx/dt=0

At first condition find С=0, then speed of dx/dt also will be equal to the zero and movement is not described by the equation. If С>0, then initial conditions are not executed. We came to absurdity.

2. We accept that the speed of falling body is directly proportional to fall time. Then we can write down :

**dx/dt=gt**,

where **g** is a free falling acceleration.

Integrating, we obtain:

dx=gtdt;

∫dx=∫gtdt;

x=gt2/2+C

Initial conditions **t=0**, **x=0**, **dx/dt=0**

Wherebfrom C=0; dx/dt=gt, dx/dt=, or replacing t=

The obtained result does not contradict formal representation of an observed phenomenon. In fact it is also fair, as it is verified experimentally for free falling bodies.

Verification of theoretical conclusions on any degree is closely related to practice. Basic maintenance of practice is productive activity of society, but scientific experiments and other types of material activity of man are also admitted. At the last stage of knowledge practice is a measure for theoretical conclusions and a measure of restriction on the use of open patterns.

For natural sciences and technique the third stage of cognition always consists of experienced verification of theoretical conclusions on a model or real object. Herewith match between experiment and phenomenon that is studied theoretically as well as the correct interpretation of results obtained practically is very important.

***3.2 Basic methods of scientific researches realization***

A method is an aggregate of receptions, operations of the practical or theoretical mastering of reality, inferior to the decision of concrete task. A difference between a method and theory carries functional character: formed in quality the theoretical result of previous research, a method comes forward as an initial point in future researches.

Comparison is an operation of thought, directly which classified, maintenance of reality is put in order and estimated. Comparison of objects is executed with the purpose of exposure their rejections, similar or different signs. For example, electric devices are compared for powers, but far not on setting, exactness class, defenses degree.

Measuring is an operation by means which attitude of one measuring is determined toward other. For exact sciences characteristic supervisions connection and experiments is with being values descriptions numerical investigated objects. On the utterance of D. І. Mendeleyev "science begins since begin to measure".

Induction is a type of generalization, related to the supervisions results and experiments basis on the conducted experiments. Essence of it consists in a transition from knowledge of separate facts, from less general knowledge to more general.

Deduction is an thought operation , which is built on new knowledge hatch, basis knowledge of more general character, got before by supervisions generalization, experiments, practical activity, id est by induction means.

Induction and deduction is closely constrained inter se and complement each other.

An analysis is curriculum procedure of object or phenomenon on component parts with the study purpose. An analysis is divided into two kinds: thought or division of unit is real to pieces, and study of general properties of objects and relations between them.

A synthesis is connection of different elements, parties of object in single unit, which is carried out both in practice and in cognition.

Any creation process of concepts is based on unity analysis and synthesis. An example is management CAS. It is needed clearly to present parameters and functions of component parts (analysis) and system requirement on the whole (synthesis).

A hypothesis is a scientific supposition ground about a beloved fact. In a difference from a hypothesis theory is a form possible but not reliable scientific knowledge. Hypotheses as well as ideas carry credible character. On their basis systematizes before the accumulated knowledge and the searches of new scientific results are carried out - on the whole essence and hypothesis setting as forms science development.

Abstraction is a scientific researches method, not based on the peculiar prolapsed, not basic signs object, phenomenon at their study. It allows simplifying the picture of the investigated phenomenon and examining it in a "clean" kind.

Generalization is a mean cognition scientific, which allows to destroy general principles, their laws from the phenomena class, standardize and to equate the great number things and events in one formula. The generalized knowledge presents wider reality spectrum, but also more poor.

A design is objects’ research of cognition on their models, construction and study models of really existent objects, phenomena. A model is character of any object; she recreates the most characteristic signs of the investigated object. In the process of cognition a man always builds the situations models of the near-by world and manages the conduct basis on the conclusions, got the study model.

Distinguish three types of design: abstract, analog and physical.

Approach systems is complex research of large and difficult objects, study them as single unit with co-operation functioning of all elements, parts. Going out this determination, it is necessary to study every element of the system in co-operating with other, to expose influence properties separate parts of the system, to set appearance new properties system and define optimal office hours.

Analysis the systems are an aggregate methods which allow realizing approach the systems at research of large and difficult objects. An analysis and synthesis, mathematical design behaves to such methods. For the high-quality analysis functioning the systems use the expert estimations method, "brainstorming", and others like that.

On the whole, at empiric level of scientific research use methods: comparison, measuring, induction, deduction, analysis, synthesis. For a theoretical level such methods are characteristic: hypothesis, abstraction, idealization, generalization, design, experiment, analysis.

***3.3 Laws and forms of thought***

Laws of thought are the most general logic acts , both formal and dialectical. The laws of thought come forward in form certain correlations of concepts and utterances.

A concept is a reflection result in consciousness of man general signs of objects or phenomena, what substantial and necessary for a selection group that is examined. A concept has maintenance and volume. The table contents concept is characteristic the aggregate signs which distinguish this concept from other. A volume concept is an aggregate objects, phenomena represented in a concept.

A scientific concept is a concept which represents scientific knowledge about an object or phenomenon. The aggregate scientific terms are used in the separate areas of SciTech forms terminology of industry. To define a concept is means to explain it with the help of other concepts. Example, a voltmeter is an electric instrumentation device, intended for measuring of tension. Here the volume concept «electric instrumentation device" folds a great number and volume concept "voltmeter" - great number В, thus В ⊂ А.

Judgment - is a idea form, in which by mediation concepts connection, anything becomes firmly established about a certain object. It can be true or erroneous (untruthful). The example of veritable judgment is a statement: "If a current passes on an explorer, then he is heated".

Boolean operations are most widespread above judgement: denial, disjunction, implication. Algebra is based on the division mathematical logic. The last, on determination by Leibniz, is science, "which teaches other sciences methods of inventions and leading to all consequences which go out the set Refs.s".

Completion of idea is a conclusion judgements from other judgements, which are named reference. The study of idea completion considerable part of mathematical logic is sacred to. Will give an example simple idea completion, so-called syllogism. Syllogism consists of two Refs.s and conclusion, which can have one of next forms.

Forms of the first reference:

1. All **А ∈ В** (A is the subset of В).

2. No **А ∉ В** (numbers A and B does not intersect).

3. Some **А ∈ В** ( numbers A and B intersect).

Form of the second reference:

All **В ∈ С**.

No В ∉ С.

Some **В ∈ С**.

Conclusion forms:

 All **А ∈ С**.

No А ∉ С.

Some **А ∈ С**.

Different connections from these judgements can be logically true or untruthful regardless judgements truth. Always, even in correctly built veritable conclusions, it is necessary to analyse initial Refs.s. For example, will consider syllogism.

First reference: "All students (А) are successful in studies (В)".

Second reference: "All successful in studies (В) study in the institute (С)".

Conclusion: "All students (А) study in the institute (С)".

In spite the fact that, conclusion is untruthful true, conclusions are true. Thus, from wrong Refs.s it is possible to get logically a correct way correct conclusions.

The laws of logic go out mathematical logic.

1. Law of identity: =А. It means that maintenance and volume concept remain unchanging. Strictly speaking, this requirement making default, because a research object depends on generous amount continuously variable factors.

2. Law of contradiction: А∩А=0. In other words, there cannot be that at one and the same time, at identical terms took place and at the same sign did not take place. This law, as well as previous, represents relative firmness nature. It is basis of proceeding in experiments.

3. Law of exception third А∪А=1. In other words, at two judgments, from which one asserts that the second casts aside, cannot be third. Or A is true, and then A erroneous, or vice versa. From a law a requirement swims out: if one judgment is cast aside, then it is necessary to accept opposite.

4. Law of sufficient foundation: an idea is true then and only after, when sufficient foundation which the true are understood under is, before the well-proven positions, data of experiments. This law is basis of leading to. If basis of reasoning are the experienced data, a conclusion will be credible. A conclusion is not cast aside with certain probability of Р, which approaches unit on the measure of that, how the aggregate of the experienced data approaches endlessness.

*Control questions:*

1. What is the basic difference of empiric research from theoretical?

2. Is the role of scientific research methodology in the decision of cognitive tasks?

3. Can a scientific law be expressed? In what form?

4. Explain basic scientific researches methods.

5. Explain general differences between operations and measuring? Give an example.

6. What is the role of scientific ideas and hypotheses in development of cognitive reality?

8. Name the abstraction examples and give an example of their using for researches realization.

9. Ground the necessity of the generalized knowledge.

10. To determine definition: design and models. Transfer the types design and area the use.

11. What is the caused approach necessity in the systems of research of difficult objects? With the help of what methods it can be realized?

12. Specify the place of syllogism in the theory of conclusions.

14. Formulate the formal logic laws.

*Task to 3.1: Deepening knowledge about the general cognition and verification theory of theoretical conclusions by practice.*

**Realization form: discussion of theoretical aspect of general theory of cognition. Verification conclusions about cognition theory in practice.**

**Practical employment it is suggested to conduct on such chart:**

1. To give determination the cognition theory.

2. To consider supervision essence of external signs the phenomena, abstracting and generalization.

3. On the example centuries-old research the free falling body to form a mathematical model.

4. To give an example the experienced theoretical conclusions verification on a model, or real object (relativity theory А. Einstein, having special purpose complex scientific programs: "Stabilizing of economy", "Development of untraditional energy", "Ukraine - 2010").

*A task is to 3.2: Fixing theoretical knowledge about the basic methods of realization researches.*

**Form of realization : Consideration methods scientific researches realization.**

**Practical employment is suggested to conduct on a chart: question-answer is a discussion.**

1. To give determination to the comparison and measuring terms, the practical application.

2. To give an example the use as in researches so, and in practice scientific methods: "induction" and "deduction".

3. At what scientific researches it is expedient to use an analysis and synthesis.

4. What is grounded by a hypothesis? To give an example hypotheses which was confirmed.

5. To give determination to the scientific research methods: "abstraction", "generalization".

6. When drawn on researches on models. What do distinguish the design types?

7. To ground expediency of the use approach the systems and analysis the systems at research large and difficult objects.

*A task is to 3.3: Deepening of knowledge about scientific researches methodology.*

**Form of realization: Discussion about laws and thought forms.**

**Practical employments is suggested to conduct on a chart:**

1. To give determination to. To define the thought laws place in scientific researches methodology.

2. To consider definition "scientific concept". In what his essence consists at researches.

3. To discuss such thought forms t as "judgments" and «conclusions". To give an example their use in practice.

4. To ground the laws of logic:

* it is a law of identity;
* it is a law of contradiction;
* it is a law of exception third;
* it is a law of sufficient foundation.
1. What are the intercommunications between laws of logic and mathematical logic?

**CHAPTER 4. ORGANIZATION AND STRUCTURE**

**OF SCIENTIFIC RESEARCH.**

***4.1 Stages of scientific and technical research.***

The process of scientific cognition begins from raising the problem as starting point the directed scientific activity. In our country the list scientific problems is determined by the complex scientific programs, which are formed by ministries (branch), Cabinet of Ministers of Ukraine (state), regions (regional, local), separate enterprises and establishments (programs of enterprises, establishments). The government programs become firmly established Verkhovna Rada of Ukraine. All other - by corresponding leaders with the concordance collective organs.

An initial document for realization of scientific and technical research is a requirement specification, which determines a purpose, maintenance, order of work, method of realization research results. A requirement specification is developed on the basis of scientific prognostication, analysis of front-rank achievements of SciTech in this area.

Distinguish the basic stages of scientific and technical research: informative search and stowage research methods; previous development research; preparation and realization experimental part of research; treatment and analysis data of experiment; introduction of complete developments.

On the first stage collection information is conducted on terms and methods decision tasks of this type. Results of such analysis are more comfortable to design everything as a card index. Card indexes are basis for writing abstract about the state of the investigated problem. If the purpose of researches is development method of receipt what be not, or creation certain device then the obligatory stage will be patent research.

The next stage is stowage previous research plan. At the plan stowage it is necessary to estimate the implementation term of every research stage. It can be realized on the basis network chart. In a plan there must be certain expenses on implementation of every stage and sourcing.

Results, that are in an abstract and got in the process of planning designed as methods, in which realization the methods are determined researches, given about the terms carrying out tests sizes ranges, limitation, and others like that.

On the stage of previous development researches a working hypothesis is grounded and formulated, carried out it informative and logical and mathematical development with the conclusions receipt, correlations, formulas. The informative (descriptive) model process, which after the choice of mathematical vehicle is translated into the mathematics language, is thus built. The stage ends with requirement delivery specification on planning of pilot plant, equipment, which further development project will be conducted on the base.

Preparation and realization of experimental research part can be conducted in three directions:

* it is introduction of the specially worked out setting;
* it is carrying out tests pilot-scale;
* it is an analysis of mathematical model which is well-proven on the stage of previous development.

The stage ends with registration results of experiments in form protocol.

An experiment ends with processing the got data by results presentation as tables, charts, formulas, by verbal description.

Graphic arts evidently show dependence results of experiment of Y on one, two, n of variables of Xn. If results depend on three or anymore variables, then better to present them as formula (s). Expression results experiment in a verbal form is considered ineffective. However on the initial stages, such form is simply irreplaceable. The stage ends with formulation of new facts and laws, theoretical and practical conclusions, explanations and scientific foresights.

***4.2 Registration of research results.***

Materials, got during scientific researchers realization must be worked out, are systematized and formed in a report. To the report are pulled out next requirements: clearness of construction, logical persuasiveness of argumentation, brevity and exactness of formulations, specification of exposition of job, leading to of conclusions performances and validity of recommendations. A report has a next structure:

1. Title page.

2. Castlist.

3. Abstract (annotation).

4. Table of contents.

5. List of conditional denotations, symbols, units, terms, and others like that.

6. Entry.

7. Basic maintenance.

8. Conclusion.

9. List of the used sources.

10. Additions.

The article lays out basic results, got on concrete question, which have scientific and practical values are certain. The articles are publicist and scientific.

A monograph is scientific labor which is dedicated to development of one theme or limited circle questions; it is belonged to one or a few authors which hold one point of view. The contents table of publication, form of exposition of material and his volume, substantially depends on the credible circle of readers and from the requirements of publishing house.

Dissertation is research what appears on the receipt scientific degrees (candidate, doctor of sciences) and in public is on the defensive a bread-winner on meeting of the specialized scientific advice. The structure work, mainly, answers the scientific structure and technical research. At dissertation exposition it is needed to specify the personal payment of search engine in development of the investigated scientific problem.

Opening can appear in the process of implementation of scientific researches.

Opening is acknowledge establishment of unknown before objectively existent conformities to law, properties, phenomena of the material world, which bring in drastic alternations in the level of knowledge.

Invention - it establishment of new, before the not known methods receipt products, materials, creation new essentially and which bring in mechanisms setting, charts, wares, substantial changes in knowledge and practice.

Introduction of complete results of research works includes for itself the transmission to the customers of scientific products.

The process of scientific products introduction in a production consists of two stages - experienced and serial introduction. Coming from the results of the experienced introduction, recommendations are developed on perfection of this standard, technical documentation is corrected. Only after it development is passed in a mass production. On the second stage of introduction research subdivisions can accompany development.

Distinguish the separate and complex introduction method. At first from them scientific and technical researches are executed by organization which folds suggestion on introduction. On the basis of it project-designer organization develops designer documentation on a pre-production model or experienced party. Making, editing, adjusting and introduction of pre-production model carried out by a customer. Here all stages from developments to introduction are executed separately.

Accelerating scientific introduction and technical developments is possible during complex organization of works. For this purpose research organizations unite with project, designer and productive subdivisions. New structures are created: experienced-designer-productive. In market conditions technical poles and technical parks work effectively, innovative will inculcate to the inculcating company.

*Control questions:*

1. Give examples of scientific problems which need decision on the modern stage.

2. Formulate the primary purpose of scientific and technical research.

3. In what the basic difference of searching researches consists from developments.

4. Transfer the basic stages of scientific and technical (economic) researches.

5. Is there what role of informative search during scientific researches realization?

6. Ground the previous necessity research development.

7. How is preparation conducted to realization of experimental part of research?

8. Is treatment of these experiments carried out for what purpose?

9. Describe the structure of scientific report, dissertation, article, monograph,

invention.

1. Specify the organizational introduction forms complete developments in industry.

*A task is to the 4.1: Use theoretical knowledge for practical aims.*

**Form of realization: Research realization on the scientific and technical topic.**

**Practical employment is suggested to conduct on a chart:**

1. To define a theme of scientific and technical research is determined. These sneak up on the subjects of research works, conducted by the research university sector for the last years.

2. A requirement specification which determines maintenance is formulated, sweep, order research work method realization research results.

3. The research stages are distinguished:

* it is an informative search;
* it is a stowage research methods;
* it is previous development research;
* it is preparation and realization of experimental research part;
* it is treatment and analysis data experiment;
* it is registration research results :
* it is introduction complete developments.

4. After every stage the group master's degrees (in dependence on an amount in academic group) are fastened.

5. Is research conducted in order the distinguished stages in п. 3, but near-term for further advancement will be "research methods"? The most erudite listeners sneak up on this stage.

6. The formed methods of scientific research on the chosen topic are circulated and are heard to all groups which work on the topic, investigating the envisaged stage.

7. Is coordination research conducted by a teacher?

8. Are research results designed in form the scientific article?

*A task is to the 4.2: Use theoretical knowledge for practical aims.*

**Form of realization: Practical registration of results of scientific researches.**

**Practical study is suggested to conduct on a chart:**

1. Divide the group of masters into two parts:

1.1 The first part designs, in form of scientific report results of scientific researches on the topic 5.

1.2 The second part designs a patent on an invention and annotation to the bulletin. For this purpose take a patent on an invention "Scraper conveyer of Root crops»:

1.2.1 Description to the patent includes:

* the name of invention;
* a class of International inventions classification;
* the last names of inventors (inventor);
* an enterprise;
* annotation;
* substantial difference from analogues;

The further is given:

* an area, application domain;
* a patent search - analogues, prototypes;
* lacks of the known analogues;
* it is the offered variant of technical decision;
* decision ways of the offered variant;
* invention structure, his picture, chart;
* description (process) work.

**CHAPTER 5. EFFICIENCY OF SCIENTIFIC RESEARCHES**

***5.1 Concept of efficiency of scientific researches***

Efficiency of scientific researches shows up in the increase of the labour productivity due to new machines creation , equipment, high-tech, improvement of the labor state and environment protection, in replacement of hand labor machines, on the whole - in the improvement standard of people life.

Fundamental theoretical researches which sometimes result in the ponderable opening it is difficult to measure any quantitative indexes. Their introduction, considerable results receipt, broadens on new industries, spheres and in time. The same, exactly they enrich science, extend knowledge horizons of humanity and sooner or later give perceptible results.

The applied scientific researches accustom in comparatively short space (1-3 years). Meaningful results, economic effect, give thus, also. In the market applying conditions in industry results of the applied researches brings to the firms the considerable winning in competitive activity. From it the scientific market, scientific and technical developments, innovations functions in the developed countries. Under this market a corresponding structure and infrastructure is created.

Efficiency of scientific researches separate research workers is estimated by the amount copyright certificates, patents, published scientific labours, their meaningfulness.

General formula for determination of economic efficiency of К looks like:

**К=Е/Z** (5.1)

Е - is an economic effect from introduction of scientific researches;

Z - are expenses on implementation and introduction.

If the results of scientific researchers are sold in other country, then economic efficiency is estimated by the coefficient of Ке

**Ке=D/ΣZ** (5.2)

where:

D - is a currency profit;

ΣZ - are the Total expenses on realization of scientific researches, registration and sale of licenses.

Depending on the state of scientific research distinguish the previous, expected and actual economic efficiency.

Previous efficiency settles accounts on large-sized reference indexes at the stowage plan (programs) researches.

The expected efficiency is determined during implementation researches after the study of the state of the investigated question and data about the program introduction research.

Actual economic efficiency is determined after applying scientific researches in industry, industry, and sphere.

The value economic effect settles accounts in a formula (5.1), as a difference expenses of З1, at old processes, construction or technology and new, scientifically reasonable З2, id est

**Е=Z1- Z2**  (5.3)

In turn expenses Z1 and Z2 is determined after a formula:

**Z1=S1+fnВ1**(5.4)

**Z2=S2+fnВ2**  (5.5)

Where S1 and S2 - is a prime price unit products;

 В1 and В2 - is capital charges on unit products in a year;

 fn - is a branch normative coefficient economic efficiency(fn≈0.06… 0.1).

***5.2 Determination of income from the use of industrial property objects***

Income which turns out from the use objects of industrial property reckons with a purpose:

* determining size of reward to the author (s);
* determining size of fee for an assistance to development ОIP, receipt of legal safeguard ОIP, his introduction and use (a fee is for an assistance);
* decision-making about applying in industry corresponding ОIP (choice of optimal variant);
* determination cost rights on the object industrial property for contributing to the regulation fund at creation joint ventures;
* decision-making about the conclusion of the licensed treaty on the use ОIP (acquisition or sale license);
* determining size of the licensed payments, if it is foreseen by a licensed contract;
* determination enterprise income, got from the use ОIP, which is shown in the state statistical accounting on the form № 4-nt;
* determining indemnification size to the proprietor protective document for the unauthorized use ОIP and others like that.

The calculation income, got from the use ОIP, becomes firmly established the leader enterprise.

Features determination increase income enterprise, ОIP got from the use.

1. An income, got from the use ОIP, as a rule, is determined by comparison results activity enterprise in base (the last period is to beginning the use ОIP) and calculation (after the beginning the use ОIP) periods.

2. Comparison results of activity enterprise in base and calculation periods is made a by bringing middle economic quantitative and cost indicators over base period to the middle economic quantitative and cost indicators calculation period.

3. Duration of calculation period is determined by the conditions agreement between parties and requirements accounting enterprise (month, quarter, half-year, year). In that case, when ОIP was used less than month the calculation income is conducted in times the actual use.

Duration of base period, as a rule, undertakes even to one year. In that case, when products without the use ОIP were made less than one year, duration base period can be set by even half-year, to the quarter, but not less than one month.

Order determination income got from use ОIP.

1. An income is a difference between profits and charges enterprise for a certain term

I=P-Ch (5.6)

where

 P - is a profit from realization of products, services works (farther are

products), hryvnyas;

 Ch- are charges f enterprise on making and realization products, hryvnyas.

2. A profit from realization products, works, services (farther is a profit) is determined after a formula

P=Z х A (5.7)

where

Z - is unit costs, hryvnyas;

 A - is a volume realization, natural units.

3. The charges enterprise on making and realization products (farther are charges) are determined after a formula

Ch=(P+Sp) х And (5.8)

where

P - is a prime price unit products, hryvnyas;

 Sp - is specific (on unit products) capital charges on creation ОIP hryvnyas;

 A - is a volume realization products, natural units.

4. Taking into account formulas (2, 3) a formula for determination income

acquires a kind

P=(Z-P-Sp)х A (5.9)

5. An income, got in a calculation period from realization products, made from the use ОIP, is determined after a formula

 Ii=Ic-Ib= (Uc-Pc-Sc) х of Vs-(Ub-Pb-Sb)х Vc=

[(Uc-Ub)+(Pb-Pc)+(Sb-Sc)] х Vc (5.10)

where

Ii - is an increase of income, got from realization in the calculation period of products, made with the use of ОIP, hryvnyas;

Ic - is an income, got from realization in the calculation period of products, made with the use of ОIP, hryvnyas;

Ib - is an income, got from realization in the base period Аn volume products, made without the use ОIP (income which must was be got in a calculation period from realization the same amount products, ОIP made without the use), hryvnyas;

Vc - is a volume products, realized in a calculation period, natural units;

Uc, Ub - are unit costs in calculation and base periods accordingly, hryvnyas;

Pc, Pb - is a prime price unit products in calculation and base periods accordingly, hryvnyas;

Sc, Sb - is specific charges on creation object in calculation and base periods accordingly, hryvnyas/ natural. odes to the products.

5.1. If the use ОIP causes the change prime price, and the cost products does not change here, then a formula (5) acquires such kind

Ii=[(Pc-Pb)+( Spb-Spc)] х Ан (5.11)

5.2. In the case when the use ОIP does not result in the change prime price, and the cost products changes, a formula (5) acquires such kind

Ii=[(Ub=Uc) + (Spb-Spc)] х А (5.12)

5.3. In the case when the use ОIP does not result in the change price and unit cost, a formula (5) acquires a kind

Ii=( (Spb-Spc) х А (5.13)

6. In the case creation new technologies, facilities mechanization and computer-aided manufacturing on a base ОIP the increase income in a calculation period is determined after a formula

Ii=[(Pb-Pn) of -Pr х (Spb-Sps)] х Nc (5.14)

where

Ii - is an increase income;

Pb, Pn - is a prime price unit of good at the use of base and new technical process;

Spb, Sps - is specific (on unit of good) capital investments;

Nc - is a normative coefficient efficiency capital investments (norm discount);

Pr - is the productivity new technical process in a calculation period, natural units (things, tons and others like that).

*Determination share of profits, which falls out on the stake ОIP in the increase income, got from the use object new technique*

 1. If products on the whole are embodiment one or a few protected in Ukraine ОIP, then all increase income, got in a calculation period from introduction to change of this products, confesses to even the income, got from the use this (these) ОIP

Iu= Ii (5.15)

where

 Iu - is an income, got from one use or a few ОIP hryvnyas;

 Is – is the increase income, got in a calculation period from introduction to change products which contain one or a few ОIP, hryvnyas.

2. If products only partly are embodiment one or a few protected in Ukraine ОIP, then the share profits which falls out on the stake concrete ОIP in the general increase income, got in a calculation period from introduction to change this products, is determined after a formula

Ifo = Ii х Cd (5.16)

 where

 Ifo - is an income which falls out on the stake ОIP, hryvnyas;

Is - the increase income got in a calculation period from introduction to change

 Cd - is a coefficient which determines the share of profits of і of ОIP in the

general increase of income.

i = 1,2,3,4 …n is an amount protected ОIP in products.

3. Coefficient Cd can be certain on the base productive-industrial index of products the method expert estimation and mixed method.

 Determination ocoefficient o Cd on the base of productive-industrial indexes is conducted after a formula

Cd = Vі/Е (5.17)

where

Vі - is a value index, invention related to all signs, useful model, industrial prototype, rationalization suggestion and others like that;

V - is a value index, related to the object on the whole.

Such indexes can be a prime price, price, mass, productivity, power and others like that.

*Control questions:*

1. What is an effect from introduction of research developments?

2. To determine the previous, expected and actual efficiency.

3. Give determination and interpretation of the "potential economic efficiency"?

4. Name the examples of fundamental scientific researches. How does efficiency settle accounts for them?

5. What criteria is for efficiency of collective research works?

6. How does economic efficiency account from applying in industry rationalization suggestions, inventions and patents?

7. What factors do promote scientific researches efficiency?

8. What methods for the calculations of economic efficiency of SED are used by research workers and producers in Ukraine?

9. Describe determination methodology of profits share, which falls out on the stake ОPI, in the income increase, got from the use of new technique.

*Task to 5.1: the Practical economic calculations.*

**Task.**

Expect the previous, expected and actual economic efficiency of development and introduction new technological line on making corps gear-box detail 170-37.00, for a tractor which is constructed first.

Data given: term of work of line of t=6 years; the annual program of making of corps of N=is 5000 things; cost (prime price) of corps of КПП of с=is 40 hrn.; expenses on research works fold Z= 150000 hrn.; additional expenses on adjustment odocumentation fold Za =30000 hrn.; expenses on applying line in industry fold Ze=100000 hrn.; expenses on adjusting line after adjustment documentation fold Zea=20000 hrn.; normative coefficient capital investments Кn=0.15.

Explain the order calculations during modernization line on products which are serially made.

*Task to 5.2: practical economic calculations.*

**Example 1.**

To define the increase annual income from application of one new machine by such data:

base period calculation period

Cost of machine, mln.grn 172 190

Concomitant capital charges, mln.grn 36 48

Running expenses, mln.grn./year 80 90

Annual capacity, thousands tons /year 20 25

Term use, years 20 25

Normative coefficient 0,15 0,15

Putting these data in a formula we will have:

Ii={172 x (25/20) x [(1/20+0.15)/(1/25+0.15)]+[(25/20) x 80- 90]/(1/20+0.15)+0.15 x [(25/20) x 36-48]/(1/20+0.15)-190} x 1=72,75 (mln.hrn.)

In the creation case on a base ОIP the new labour articles (materials, instruments and others like that) the increase income in a calculation period is determined after a formula:

Пр={Ub х Chb/Chn+[( Chb / Chn) х Rb-Rn]/ Chn +Еn х [(Chb / Chn) х Spb-Spb]/ Chn -Un} х Aр, (2)

where

 Ub, Un - a cost the base and new article labour on products unit, hryvnyas;

 Chb, Chn - charges the base and new article labour on making unit products, nat.un. (kg, m, мл and others like that);

 Rb, Rn - current outlays on making products unit in base and calculation periods accordingly, hryvnyas;

 Spb, Spn - capital charges are brought around to products unit in base and calculation periods accordingly, hryvnyas;

 Aр - an annual production the new labour article, kg and others like that.

**Example 2.**

To define an annual income from producing on a base ОIP of the new labour article (to material) by such data:

 base period calculation period

Cost of material, thousands grn./kg 18 20

Charges of material on

unit of products, kg/ton 30 25

Current outlays are on making

units of products, thousands grn./ton 190 200

Specific capital charges

on this products, thousands grn./ton 210 240

Normative coefficient of Еn 0,12 0,12

Material volume production, ton/year 380 380

Putting these data in (2) a formula, we will have:

Ii={18 x 30/25+[(30/25) x 190-200]/25+0.12 x [(30/25) x 210-240]/25-20} x 380=1055,488 (thousands hrn.).

**Example 3.**

In the process of production of vodka a new fluidizer mixing, protected by a patent on a useful model, is applied. In the total amount the vodka made with the use the new setting grew from 100 to 110декалітрів on a hour. Other ОIP on this operation (mixing) from the date setting introduction not used organizationally-productive measures, sent to the increase volume output products in a hour, also did not have been used.

At that rate:

Sp= 10:110=0, 09.

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